Allwinner R16 User Manual

The Most Efficient Quad-Core IoT Solution

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Revision : 1.2

Release data : Jan 05, 2016

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Revision History

Revision	Date	Description
1.0	Dec.30, 2014	Initial release version
1.1	Feb.03, 2015	Modify CCU register description
1.2	Jan.05, 2016	1. Modify audio codec feature about the SNR of ADC and DAC 2. Modify clock and ADC conversion time of Thermal Sensor. 3. Modify CSI block diagram. 4. Modify the overview of TCON.

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Chapter 1 About This Document

This user manual of R16 processor is intended to be used by board-level product designers and product software developers. This manual assumes that the reader has a background in computer engineering and/or software engineering and understands concepts of digital system design, microprocessor architecture, Input / Output (I/O) devices, industry standard communication and device interface protocols.

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Chapter 2 Platform Introduction

This chapter provides a brief introduction of the quad-core R16 processor.

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2.1 Overview

The Allwinner R16 is designed to provide a scalability,low-power capabilities,high performance application processor solution for Internet-of-Things(IoT) applications,which outperforms competitors in the terms of its system performance,great flexibility and energy-efficiency. The processor perfectly supports various applications of mainstream operating systems such as Android,Linux,etc.

R16 packs four ARM Cortex™-A7 CPU cores and Mali400MP2 graphics architecture to support display and gaming effects.Video Engine is included to provide full motion playback of up to 1080p high-definition video encoding/decoding and supports MPEG1/2/4, WMV9/VC1, H.263,H.264, VP8 and JPEG/MJPEG video decoding standards with dedicated hardware.The integration of display subsystem enables high resolution and high color display.Also the CSI controller allows for taking photos, video input and streaming video.

The processor has optimized external memory interfaces to SDRAM, Nand Flash and SD/MMC.The SDRAM port can be configured to support DDR3 and DDR3L. In addition,to reduce total system cost and deliver better architecture scalability,Allwinner's R16 comes with many extensive connectivity and interfaces,including seven groups of GPIOs,five UARTs,one SPIs,four TWIs,4-lane MIPI DSI,RGB/LVDS LCD controller,USB OTG/HOST, I2S/PCM,RSB,and a lot more.

Allwinner also designed R16 to be extremely power-efficient to realize massive ubiquitous deployment.It achieves lower power consumption with a balanced combination of several features:the exceedingly power efficient Cortex™-A7 CPU cores,the advanced fabrication process,the battery-saving DVFS technology support,and the low power design architectures,etc.

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2.2 System Features

2.2.1 ARM CPU Architecture

The quad-core R16 platform is based on ARM's Cortex™-A7 CPU architecture.

- ARMv7 ISA standard instruction set
- Thumb-2
- NEON with SIMD and VFPv4 support
- Support hardware virtualization
- Support LPAE
- Integrated 32KB L1 instruction cache and 32KB L1 data cache for each CPU
- Shared 512KB L2 cache
- Support DVFS with independent power domain

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2.2.2 GPU

- ARM Mali400MP2
- Support OpenGL ES 2.0 / OpenVG 1.1 standard

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2.2.3 Memory Subsystem

This section includes:

- Boot ROM
- SDRAM
- NAND Flash
- SD/MMC interface

Boot ROM

- Support system boot from Raw NAND, eMMC, SPI Nor Flash, SD/TF card
- Support system code download through USB OTG

SDRAM

- Support 2GB address space
- Support 16-bit bus width
- Compatible with JEDEC standard DDR3/DDR3L SDRAM
- Support Memory Dynamic Frequency Scale
- Support two ranks
- Support 16 address signal lines and 3 bank signal lines

NAND Flash

- Comply to ONFI 2.3 and Toggle 1.0
- Support 64-bit ECC per 512 bytes or 1024 bytes
- 8-bit Raw NAND flash controller sharing pin with eMMC
- Support up to 2 CE and 2 RB signals
- Support SLC/MLC/TLC NAND and EF-NAND

SD/MMC

- Comply to eMMC standard specification V4.41, SD physical layer specification V2.0, SDIO card specification V2.0
- Support 1/4/8-bit bus width
- Support HS/DS bus mode
- Up to three SD/MMC controllers
- Support SDIO interrupt detection,CRC generation and error detection

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2.2.4 System Peripheral

This section includes：

- Timer
- High Speed Timer
- RTC
- GIC
- DMA
- CCU
- PWM

Timer

- Support two timers: clock source can be switched over 24MHz and 32768Hz
- Support two 33-bit AVS counters
- Support one 64-bit system counter from 24MHz
- Support watchdog to generate reset signal or interrupts

High Speed Timer

- One High Speed Timer
- Clock source is fixed to AHB, and the pre-scale ranges from 1 to 16
- Support 56-bit counter that can be separated to 24-bit Hi-register and 32-bit Low-register

RTC

- Timer,Calendar,Alarm
- Support full clock features: second/minute/hour/day/month/year
- Support 32768Hz clock fanout

GIC

- Support 16 SGIs, 16 PPIs and 128 SPIs
- Support ARM architecture security extensions
- Support ARM architecture virtualization extensions
- Support single processor and multiprocessor environments

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DMA

- 8-channel DMA
- Support data width of 8/16/32 bits
- Support linear and IO address modes
- Support data transfer types with memory-to-memory, memory-to-peripheral, peripheral-to-memory

CCU

- 11 PLLs
- One 24MHz oscillator, one 32768Hz oscillator and an on-chip RC oscillator
- Support clock gating control for individual components
- Clock generation, clock division, clock output

PWM

- 2 PWM outputs for CPUx
- Support cycle mode and pulse mode
- Supports output frequency from 0MHz to 24MHz
- 0% ~ 100% adjustable duty
- Minimum PWM resolution 1/65536

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2.2.5 Security System

Crypto Engine

- Support Symmetrical Algorithm: AES, DES, TDES(3DES)
- Support Hash Algorithm:SHA-1, MD5
- Support 160-bits hardware PRNG with 192-bits seed
- Support ECB, CBC, CTR modes for DES/3DES
- Support ECB, CBC, CTR, CTS modes for AES
- Support 128-bits, 192-bits and 256-bits key size for AES
- 32-words RX FIFO and 32-words TX FIFO for high speed application
- Support CPU mode and DMA mode

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2.2.6 Display Subsystem

This section includes:

- Display engine
- Video output

Display Engine(DE 1.0)

- Four movable layers, each layer size up to 2048x2048 pixels
- Ultra-Scaling engine
  -- 4-tap scale filter in horizontal and vertical
  --Support input size up to 2048 x 2048 resolution and output size up to 1280 x 1280 resolution
- Support multiple image input formats: 1/2/4/8-bpp mono/palette,16/24/32-bpp color, YUV444/420/422/411
- Support alpha blending
- Support Saturation Enhancement and Dynamic Range Control
- Support real time write back function

Video Output

- Support RGB/LVDS LCD interface up to 1280 x 800 resolution , CPU interface up to 800 x 480 resolution
- Integrated 4-lane MIPI DSI interface up to 1280 x 800 resolution
  -- Support MIPI DSI V1.01 and D-PHY V1.00
  -- Support command mode and video mode (non-burst mode with sync pulses, non-burst mode with sync event and burst mode)
- Dither function from RGB666/RGB565 to RGB888

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2.2.7 Video Engine

Video Decoding

- Support video playback up to 1920 x 1080@60ps
- Support multi-format video playback, including MPEG1/2, MPEG4 SP/ASP GMC, WMV9/VC1, H.263 including Sorenson Spark, H.264 BP/MP/HP, VP8, JPEG/MJPEG, etc

Video Encoding

- Support H.264 HP video encoding up to 1920 x 1080@60fps
- JPEG baseline: picture size up to 4080 x 4080
- Support Alpha blending
- Support thumb generation
- 4x2 scaling ratio: from 1/16 to 64 arbitrary non-integer ratio

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2.2.8 Video Input

CSI

- Support 8bit yuv422 CMOS sensor interface
- Support CCIR656 protocol for NTSC and PAL
- Maximum still capture resolution to 5M
- Maximum video capture resolution to 1080p@30fps

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2.2.9 Audio Subsystem

Analog Audio Codec

- Support stereo audio DAC
  --Up to 100±3dB SNR
  -- 8KHz to 192KHz DAC sample rate
- Support stereo audio ADC
  --Up to 93±3dB SNR
  -- 8KHz to 48KHz ADC sample rate
- Support four analog audio inputs
  -- Two microphone differential inputs for main mic and headphone mic
  -- One differential phone input from modem
  -- One stereo line-in input for FM
- Support two analog audio outputs
  -- One stereo or differential capless headphone output
  -- One differential earpiece output to modem
- Support Dynamic Range Controller(DRC) adjusting the DAC playback output
- Support Automatic Gain Control(AGC) adjusting the ADC recording output
- Two PCM interface connected with BB and BT

Digital Audio

- Support two I2S/PCM compliant digital audio interfaces for modem and BT
- I2S or PCM configured by software
- Support 3 I2S Data formats: Standard I2S,Left Justified and Right Justified
- I2S supports 2 channels output and 2 channels input
- PCM supports linear sample(8-bit or 16-bit), 8-bit u-law and A-law companded sample
- Sample rate from 8KHz to 192KHz
- Support 16,20,24bits audio data resolutions
- One 128x24-bits FIFO for data transmit, one 64x24-bits FIFO for data receive

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2.2.10 External Peripherals

This section includes:

- USB 2.0 OTG
- USB HOST
- KEYADC
- UART
- SPI
- Open-drain TWI
- RSB™

USB 2.0 OTG

- Support High-Speed (HS, 480-Mbps), Full-Speed (FS, 12-Mbps), and Low-Speed (LS, 1.5-Mbps) in Host mode
- Support High-Speed (HS, 480-Mbps) and Full-Speed (FS, 12-Mbps) in Device mode
- Support up to 10 user-configurable endpoints for Bulk, Isochronous, Control and Interrupt
- Support the embedded DMA

USB Host

- EHCI/OHCI-compliant hosts
- USB2.0 PHY and HSIC
- Support High-Speed(HS,480Mbps),Full-Speed(FS,12Mbps),and Low-Speed(LS,1.5Mbps) Device
- An internal DMA Controller for data transfer with memory

KEYADC

- 6-bit resolution
- Support hold key and continuous key
- Support single key, normal key and continuous key

UART

- Five UART controllers
- Compliant with industry-standard 16550 UARTs
- FIFO size up to 64 bytes
- Support speed up to 3MHz
- Support Infrared Data Association(IrDA) 1.0 SIR

SPI

- One SPI controllers
- Master/Slave configurable

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- Full-duplex synchronous serial interface
- Two 64-Bytes FIFO for SPI-TX and SPI-RX operation
- DMA-based or interrupt-based operation
- Polarity and phase of the chip select(SPI_SS) and SPI_Clock(SPI_SCLK) are configurable

TWI

- Up to four TWIs(Two Wire Interface) controllers
- Support Standard mode(up to 100Kbps) and Fast mode(up to 400Kbps)
- Master/Slave configurable
- Allow 10-bits addressing transactions
- One dedicated TWI for CSI

RSB™(Reduced Serial Bus)

- Speed up to 20MHz with lower power consumption
- Support Push-Pull bus
- Support Host mode
- Support multiple devices
- Programmable output delay of CD signal
- Parity check for address and data transmission

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2.2.11 Power Management

- Support DVFS for CPU frequency and voltage adjustment
- Support super standby mode for power efficiency
- Support talking standby mode for energy efficiency during voice call applications

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2.2.12 Package

- FBGA 282 balls,0.80mm ball pitch, 14 x 14 x 1.4-mm

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2.3 Block Diagram

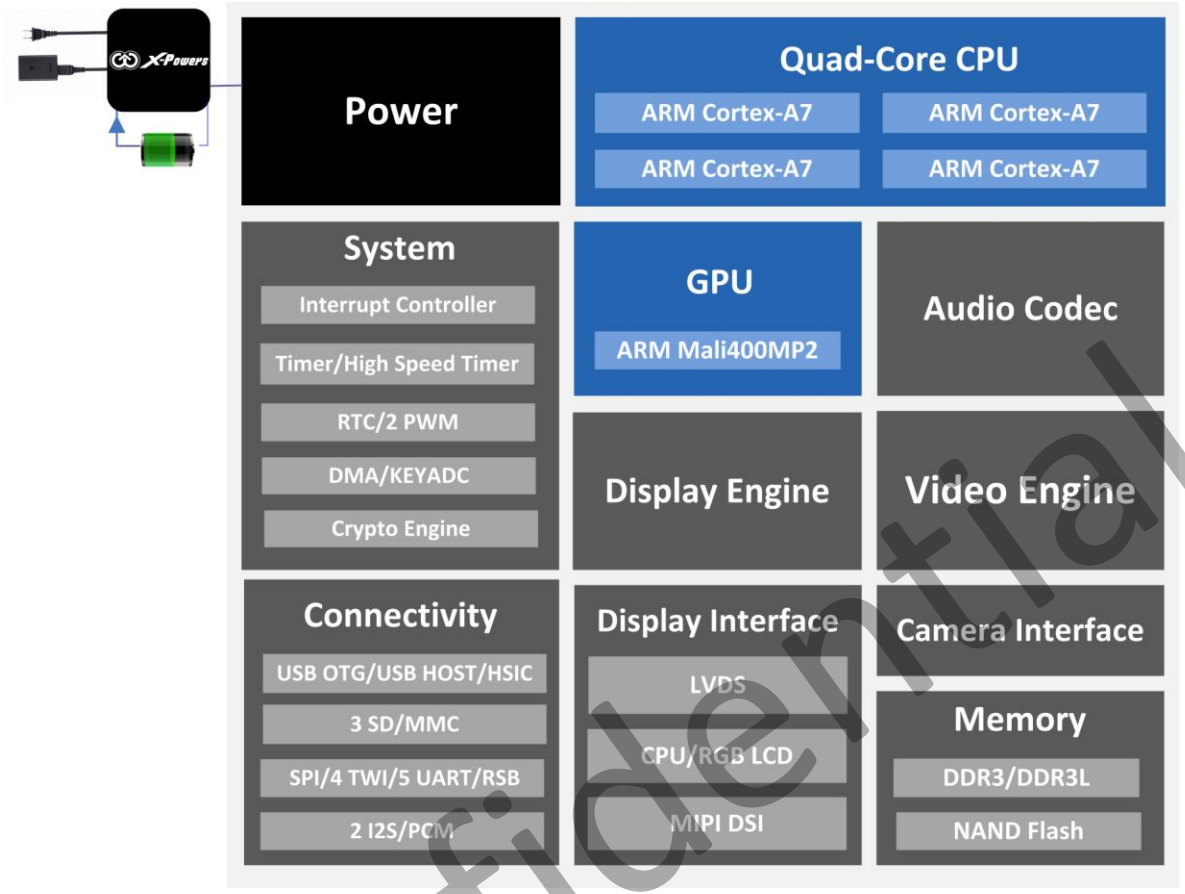

Figure 2.3-1 R16 Block Diagram

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Chapter 3 System

This chapter introduces the R16 system architecture from several perspectives, including memory mapping, boot system, clock control unit (CCU), CPU configuration, timer, PWM, high-speed timer, DMA, GIC, RTC, system control, audio CODEC, KEYADC, thermal sensor controller, port configuration, etc.

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3.1 Memory Map

Module	CPUx Address	Size(Bytes)
SRAM A1	0x0000 0000---0x0000 7FFF	32K
SRAM A2	0x0004 4000---0x0005 3FFF 0x40100,0x40200,0x40300,0x40400,0x40500, 0x40600,0x40700,0x40800,0x40900,0x40a00, 0x40b00,0x40c00,0x40d00,0x40e00	64K
SRAM Controller	0x01C0 0000---0x01C0 0FFF	4K
DMA	0x01C0 2000---0x01C0 2FFF	4K
NDFC	0x01C0 3000---0x01C0 3FFF	4K
LCD	0x01C0 C000---0x01C0 CFFF	4K
VE	0x01C0 E000---0x01C0 EFFF	4K
SD/MMC 0	0x01C0 F000---0x01C0 FFFF	4K
SD/MMC 1	0x01C1 0000---0x01C1 0FFF	4K
SD/MMC 2	0x01C1 1000---0x01C1 1FFF	4K
/	0x01C1 2000---0x01C1 2FFF	4K
CE	0x01C1 5000---0x01C1 5FFF	4K
/	0x01C1 7000---0x01C1 7FFF	/
/	0x01C1 8000---0x01C1 8FFF	/
USB OTG	0x01C1 9000---0x01C1 9FFF	4K
USB EHCI0/OHCI0	0x01C1 A000---0x01C1 AFFF	4K
/	0x01C1 C000---0x01C1 CFFF	4K
CCU	0x01C2 0000---0x01C2 03FF	1K
/	0x01C2 0400---0x01C2 07FF	1K
PIO	0x01C2 0800---0x01C2 0BFF	1K
TIMER	0x01C2 0C00---0x01C2 0FFF	1K
PWM	0x01C2 1400---0x01C2 17FF	1K
DAUDIO-0	0x01C2 2000---0x01C2 23FF	1K
DAUDIO-1	0x01C2 2400---0x01C2 27FF	1K
KEYADC	0x01C2 2800---0x01C2 2BFF	1K
AUDIO CODEC	0x01C2 2C00---0x01C2 33FF	2K
SID	0x01C2 3800---0x01C2 3BFF	1K
THERMAL SENSOR	0x01C2 5000---0x01C2 53FF	1K
UART 0	0x01C2 8000---0x01C2 83FF	1K
UART 1	0x01C2 8400---0x01C2 87FF	1K
UART 2	0x01C2 8800---0x01C2 8BFF	1K
UART 3	0x01C2 8C00---0x01C2 8FFF	1K
/	0x01C2 9000---0x01C2 93FF	1K
/	0x01C2 9400---0x01C2 97FF	1K
TWI 0	0x01C2 AC00---0x01C2 AFFF	1K
TWI 1	0x01C2 B000---0x01C2 B3FF	1K

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TWI 2	0x01C2 B400---0x01C2 B7FF	1K
/	0x01C2 B800---0x01C2 BBFF	1K
GPU	0x01C4 0000---0x01C4 FFFF	64K
HSTMR	0x01C6 0000---0x01C6 0FFF	4K
/	0x01C6 1000---0x01C6 1FFF	4K
DRAMCOM	0x01C6 2000---0x01C6 2FFF	4K
DRAMCTL	0x01C6 3000---0x01C6 3FFF	4K
DRAMPHY	0x01C6 5000---0x01C6 5FFF	4K
/	0x01C6 7000---0x01C6 7FFF	/
SPI0	0x01C6 8000---0x01C6 8FFF	4K
/	0x01C6 9000---0x01C6 9FFF	4K
/	0x01C6 A000---0x01C6 AFFF	4K
/	0x01C6 B000---0x01C6 BFFF	4K
SCU REGISTERS	0x01C8 0000	/
MIPI DSI	0x01CA 0000---0x01CA 0FFF	4K
/	0x01CA 1000---0x01CA 1FFF	4K
CSI	0x01CB 0000---0x01CB 0FFF	4K
DEFE	0x01E0 0000---0x01E1 FFFF	128K
DEBE	0x01E6 0000---0x01E6 FFFF	64K
DRC	0x01E7 0000---0x01E7 FFFF	64K
SAT	0x01E8 0000---0x01E8 0FFF	4K
RTC	0x01F0 0000---0x01F0 03FF	1K
/	0x01F0 0400---0x01F0 07FF	1K
R_TIMER	0x01F0 0800---0x01F0 0BFF	1K
R_INTC	0x01F0 0C00---0x01F0 0FFF	1K
R_WDOG	0x01F0 1000---0x01F0 13FF	1K
R_PRCM	0x01F0 1400---0x01F0 17FF	1K
R_CPUCFG	0x01F0 1C00---0x01F0 1FFF	1K
R_TWI	0x01F0 2400---0x01F0 27FF	1K
R_UART	0x01F0 2800---0x01F0 2BFF	1K
R_PIO	0x01F0 2C00---0x01F0 2FFF	1K
R_RSB	0x01F0 3400---0x01F0 37FF	1K
R_PWM	0x01F0 3800---0x01F0 3BFF	1K
CoreSight Debug Module	0x3F50 0000---0x3F51 FFFF	128K
TSGEN RO	0x3F50 6000---0x3F50 6FFF	4K
TSGEN CTRL	0x3F50 7000---0x3F50 7FFF	4K
DDR	0x4000 0000---0xBFFF FFFF	2G
BROM	0xFFFF 0000—0xFFFF 7FFF	32K

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3.2 Boot System

3.2.1 Overview

The quad-core R16 processor supports system boot from five devices: it can boot sequentially from NAND Flash, eMMC NAND, SPI Nor Flash, SD card (SDC 0/2) and USB.

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3.2.2 Boot Diagram

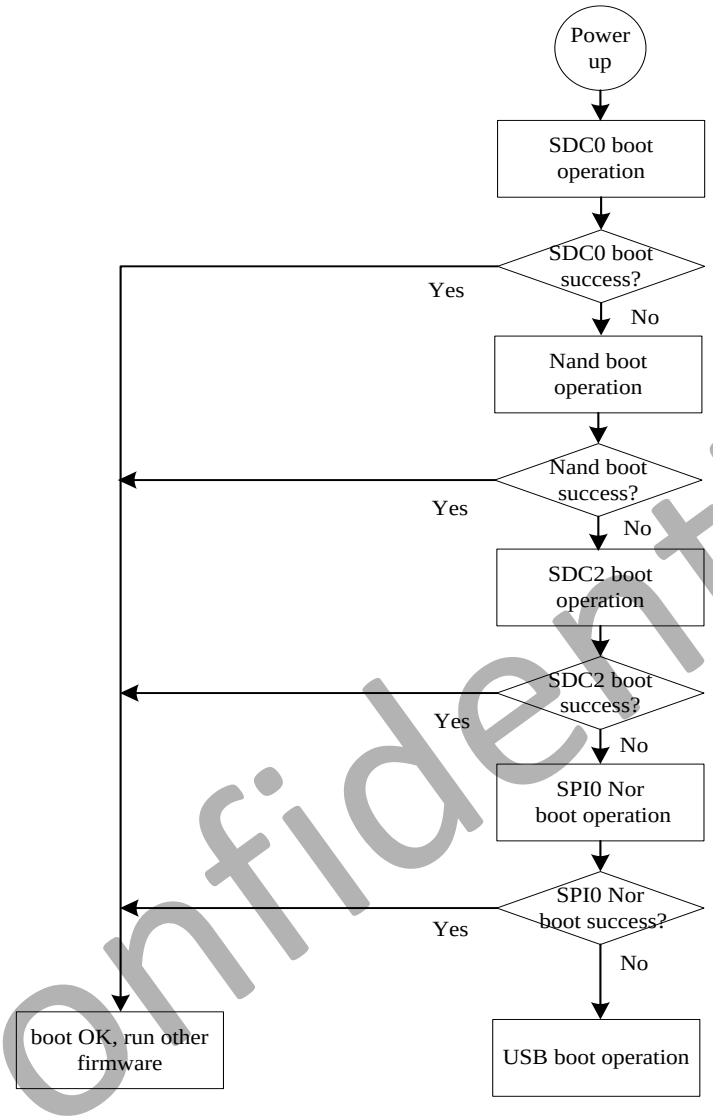

Figure 3.2-1 Boot Diagram

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3.3 CCU

3.3.1 Overview

The CCU provides the registers to program the PLLs and the controls most of the clock generation, division, distribution, synchronization and gating. CCU input signals include the external clock for the reference frequency (24MHz). The outputs from CCU are mostly clocks to the other blocks in the system.

3.3.2 Features

The CCU includes the following features:

- 11 PLLs, independent PLL for CPU
- Bus Source and Divisions
- Clock Output Control
- PLLs Bias Control
- PLLs Tunning Control
- PLLs Pattern Control
- Configuring Modules Clock
- Bus Clock Gating
- Bus Software Reset

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3.3.3 Functionalities Description

Bus Clock Tree

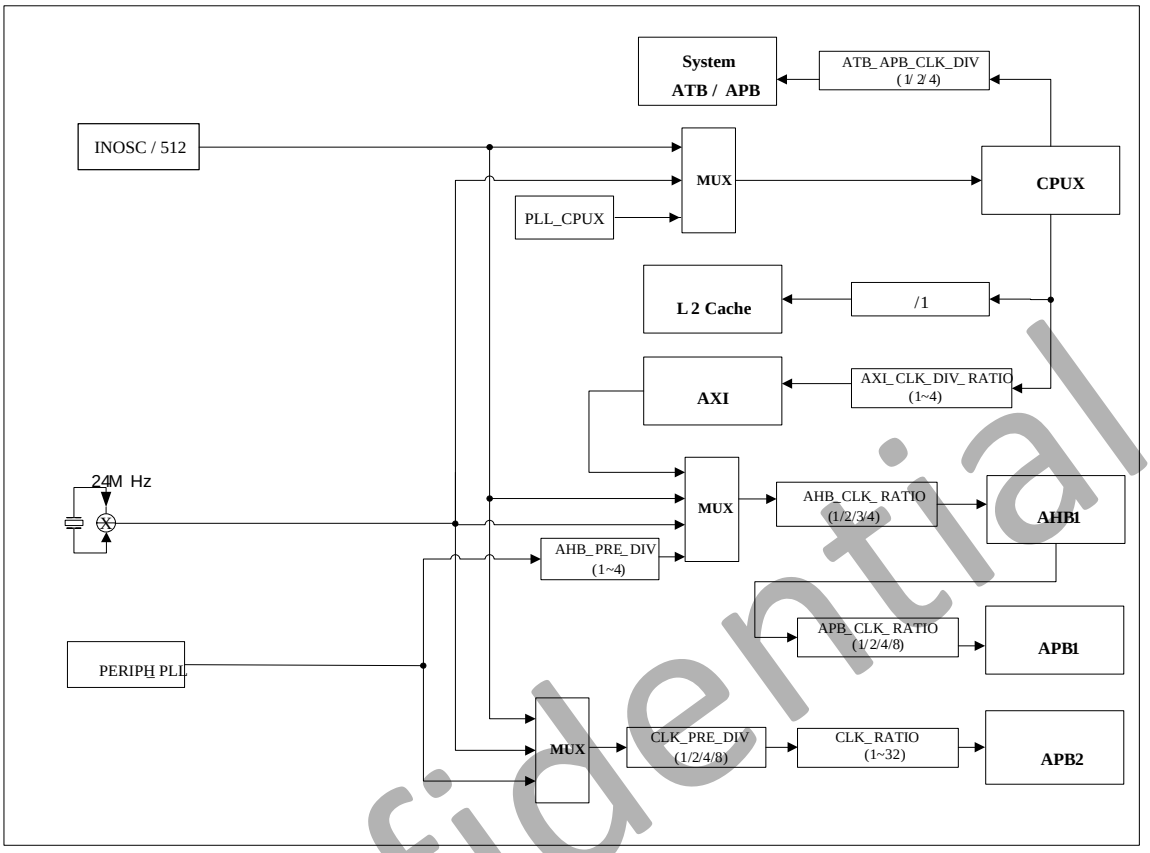

Figure3.3-1 BUS Clock Diagram

CCU Typical Applications

PLL Applications: use the available clock sources to generate clock roots to various parts of the chip. In practical application, other PLLs doesn't support dynamic frequency scaling except for **PLL_CPUX** and **PLL_DDR1**.

PLLs	Typical Applications	Dynamic Frequency Scaling(DFS)
PLL_CPUX	CPU	Support
PLL_AUDIO	I2S/PCM0,I2S/PCM1,Audio Codec	Not Support
PLL_VIDEO	DEBE,DEFE,TCON,CSI,MIPI_DSI,DRC	Not Support
PLL_VE	VE,CSI	Not Support
PLL_DDR0	MBUS,DRAM	Not Support
PLL_DDR1	MBUS,DRAM	Support
PLL_PERIPH	AHB1,APB1,APB2,MBUS,NAND,SD/MMC0, SD/MMC1,SD/MMC2,CE,SPI0,SPI1,DEBE, DEFE,MIPI_DSI,DRC,ATS,CPUS	Not Support
PLL_GPU	DEBE,DEFE,DRC	Not Support
PLL_MIPI	TCON,CSI	Not Support
PLL_HSIC	USBPHY	Not Support
PLL_DE	DEBE,DEFE,CSI,DRC	Not Support

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The module clock do not support DFS unless other noted, because the module clock source is switched or the divider is adjusted, it will be generated burr or transient instability, which could cause the module controller hung up.

Make sure that the reset signal is released before the release of module clock gating.

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3.3.4 Register List

Module Name	Base Address
CCU	0x01C20000

PLL_CPUX_CTRL_REG	0x0000	PLL_CPUX Control Register
PLL_AUDIO_CTRL_REG	0x0008	PLL_AUDIO Control Register
PLL_VIDEO_CTRL_REG	0x0010	PLL_VIDEO Control Register
PLL_VE_CTRL_REG	0x0018	PLL_VE Control Register
PLL_DDR0_CTRL_REG	0x0020	PLL_DDR0 Control Register
PLL_PERIPH_CTRL_REG	0x0028	PLL_PERIPH Control Register
PLL_GPU_CTRL_REG	0x0038	PLL_GPU Control Register
PLL_MIPI_CTRL_REG	0x0040	PLL_MIPI Control Register
PLL_HSIC_CTRL_REG	0x0044	PLL_HSIC Control Register
PLL_DE_CTRL_REG	0x0048	PLL_DE Control Register
PLL_DDR1_CTRL_REG	0x004C	PLL_DDR1 Control Register
CPU_AXI_CFG_REG	0x0050	CPUX/AXI Configuration Register
AHB1_APB 1_CFG_REG	0x0054	AHB1/APB1 Configuration Register
APB2 _CFG_REG	0x0058	APB2 Configuration Register
BUS_CLK_GATING_REG0	0x0060	Bus Clock Gating Register 0
BUS_CLK_GATING_REG1	0x0064	Bus Clock Gating Register 1
BUS_CLK_GATING_REG2	0x0068	Bus Clock Gating Register 2
BUS_CLK_GATING_REG3	0x006C	Bus Clock Gating Register 3
NAND_CLK_REG	0x0080	NAND Clock Register
SDMMC0_CLK_REG	0x0088	SDMMC0 Clock Register
SDMMC1_CLK_REG	0x008C	SDMMC1 Clock Register
SDMMC2_CLK_REG	0x0090	SDMMC2 Clock Register
CE_CLK_REG	0x009C	Crypto Engine Clock Register
SPI0_CLK_REG	0x00A0	SPI0 Clock Register
/	0x00A4	/
DAUDIO0_CLK_REG	0x00B0	DAUDIO0 Clock Register
DAUDIO1_CLK_REG	0x00B4	DAUDIO1 Clock Register
USBPHY_CFG_REG	0x00CC	USBPHY Configuration Register
DRAM_CFG_REG	0x00F4	DRAM CFG Register
PLL_DDR_CFG_REG	0x00F8	PLL_DDR Configuration Register
MBUS_RST_REG	0x00FC	MBUS Reset Register
DRAM_CLK_GATING_REG	0x0100	DRAM Clock Gating Register
BE_CLK_REG	0x0104	BE Clock Register
FE_CLK_REG	0x010C	FE Clock Register
LCD_CH0_CLK_REG	0x0118	LCD Channel0 Clock Register
LCD_CH1_CLK_REG	0x012C	LCD Channel1 Clock Register

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CSI_CLK_REG	0x0134	CSI Clock Register
VE_CLK_REG	0x013C	VE Clock Register
AC_DIG_CLK_REG	0x0140	Audio Codec Digital Clock Register
AVS_CLK_REG	0x0144	AVS Clock Register
MBUS_CLK_REG	0x015C	MBUS Clock Register
MIPI_DSI_CLK_REG	0x0168	MIPI_DSI Clock Register
DRC_CLK_REG	0x0180	DRC Clock Register
GPU_CLK_REG	0x01A0	GPU Clock Register
ATS_CLK_REG	0x01B0	ATS Clock Register
PLL_STABLE_TIME_REG0	0x0200	PLL Stable Time Register0
PLL_STABLE_TIME_REG1	0x0204	PLL Stable Time Register1
PLL_CPUX_BIAS_REG	0x0220	PLL_CPUX Bias Register
PLL_AUDIO_BIAS_REG	0x0224	PLL_AUDIO Bias Register
PLL_VIDEO_BIAS_REG	0x0228	PLL_VIDEO Bias Register
PLL_VE_BIAS_REG	0x022C	PLL_VE Bias Register
PLL_DDR0_BIAS_REG	0x0230	PLL_DDR0 Bias Register
PLL_PERIPH_BIAS_REG	0x0234	PLL_PERIPH Bias Register
PLL_GPU_BIAS_REG	0x023C	PLL_GPU Bias Register
PLL_MIPI_BIAS_REG	0x0240	PLL_MIPI Bias Register
PLL_HSIC_BIAS_REG	0x0244	PLL_HSIC Bias Register
PLL_DE_BIAS_REG	0x0248	PLL_DE Bias Register
PLL_DDR1_BIAS_REG	0x024C	PLL_DDR1 Bias Register
PLL_CPUX_TUN_REG	0x0250	PLL_CPUX Tuning Register
PLL_DDR0_TUN_REG	0x0260	PLL_DDR0 Tuning Register
PLL_MIPI_TUN_REG	0x0270	PLL_MIPI Tuning Register
PLL_CPUX_PAT_CTRL_REG	0x0280	PLL_CPUX Pattern Control Register
PLL_AUDIO_PAT_CTRL_REG	0x0284	PLL_AUDIO Pattern Control Register
PLL_VIDEO_PAT_CTRL_REG	0x0288	PLL_VIDEO Pattern Control Register
PLL_VE_PAT_CTRL_REG	0x028C	PLL_VE Pattern Control Register
PLL_DDR0_PAT_CTRL_REG	0x0290	PLL_DDR0 Pattern Control Register
PLL_GPU_PAT_CTRL_REG	0x029C	PLL_GPU Pattern Control Register
PLL_MIPI_PAT_CTRL_REG	0x02A0	PLL_MIPI Pattern Control Register
PLL_HSIC_PAT_CTRL_REG	0x02A4	PLL_HSIC Pattern Control Register
PLL_DE_PAT_CTRL_REG	0x02A8	PLL_DE Pattern Control Register
PLL_DDR1_PAT_CTRL_REG0	0x02AC	PLL_DDR1 Pattern Control Register0
PLL_DDR1_PAT_CTRL_REG1	0x02B0	PLL_DDR1 Pattern Control Register1
BUS_SOFT_RST_REG0	0x02C0	Bus Software Reset Register 0
BUS_SOFT_RST_REG1	0x02C4	Bus Software Reset Register 1
BUS_SOFT_RST_REG2	0x02C8	Bus Software Reset Register 2
BUS_SOFT_RST_REG3	0x02D0	Bus Software Reset Register 3
BUS_SOFT_RST_REG4	0x02D8	Bus Software Reset Register 4

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3.3.5 Register Description

PLL_CPUX Control Register (Default: 0x00001000)

Offset: 0x0000			Register Name: PLL_CPUX_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	PLL_ENABLE. 0: Disable 1: Enable. The PLL Output= (24MHz*N*K)/(M*P). The PLL output is for the CPUX Clock. Note: The PLL output clock must be in the range of 200MHz~2.6GHz. Its default is 408MHz.
30:29	/	/	/
28	R	0x0	LOCK 0: Unlocked 1: Locked (It indicates that the PLL has been stable.)
27:25	/	/	/
24	R/W	0x0	CPUX_SDM_EN. 0: Disable 1: Enable.
23:18	/	/	/
17:16	R/W	0x0	PLL_OUT_EXT_DIV_P PLL Output External Divider P 00: /1 01: /2 10: /4 11: /.
15:13	/	/	/
12:8	R/W	0x10	PLL_FACTOR_N PLL Factor N. Factor=0, N=1 Factor=1, N=2 Factor=2, N=3 …… Factor=31,N=32.
7:6	/	/	/
5:4	R/W	0x0	PLL_FACTOR_K. PLL Factor K.(K=Factor + 1) The range is from 1 to 4.
3:2	/	/	/
1:0	R/W	0x0	PLL_FACTOR_M. PLL Factor M. (M=Factor + 1) The range is from 1 to 4.

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PLL_AUDIO Control Register (Default: 0x00035514)

Offset: 0x0008			Register Name: PLL_AUDIO_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	PLL_ENABLE. 0: Disable 1: Enable. The PLL is for Audio. The PLL_AUDIO Output= (24MHz*N)/(M*P). Note: In the Clock Control Module, The PLL_AUDIO(8X) Output = (24MHz*N*2)/M. The PLL output clock must be in the range of 20MHz~200MHz. Its default is 24.571MHz.
30:29	/	/	/
28	R	0x0	LOCK. 0: Unlocked 1: Locked (It indicates that the PLL has been stable.)
27:25	/	/	/
24	R/W	0x0	PLL_SDM_EN. 0: Disable 1: Enable. In this case, the PLL_FACTOR_N only low 4 bits are valid (N: The range is from 1 to 16).
23:20	/	/	/
19:16	R/W	0x3	PLL_POSTDIV_P. Post-div factor (P= Factor+1) The range is from 1 to 16.
14:8	R/W	0x55	PLL_FACTOR_N. PLL Factor N. Factor=0, N=1 Factor=1, N=2 …… Factor=127, N=128.
7:5	/	/	/
4:0	R/W	0x14	PLL_PREDIV_M. PLL Pre-div Factor(M = Factor+1). The range is from 1 to 32.

PLL_VIDEO Control Register (Default: 0x03006207)

Offset: 0x0010			Register Name: PLL_VIDEO_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	PLL_ENABLE. 0: Disable

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			1: Enable. In the integer mode,the PLL Output = (24MHz*N)/M. In the fractional mode, the PLL Output is select by bit 25. Note: In the Clock Control Module, PLL(1X) Output=PLL while PLL(2X) Output=PLL * 2. The PLL output clock must be in the range of 30MHz~600MHz. Its default is 297MHz.
30	R/W	0x0	PLL_MODE. 0: Manual Mode 1: Auto Mode (Controlled by DE).
29	/	/	/
28	R	0x0	LOCK. 0: Unlocked 1: Locked (It indicates that the PLL has been stable.)
27:26	/	/	/
25	R/W	0x1	FRAC_CLK_OUT. PLL clock output when PLL_MODE_SEL=0(PLL_PREDIV_M factor must be set to 0); No meaning when PLL_MODE_SEL =1. 0: PLL Output=270MHz 1: PLL Output =297MHz.
24	R/W	0x1	PLL_MODE_SEL. 0: Fractional Mode 1: Integer Mode. Note: When in Fractional mode, the Per Divider M should be set to 0.
23:21	/	/	/
20	R/W	0x0	PLL_SDM_EN. 0: Disable 1: Enable.
19:15	/	/	/
14:8	R/W	0x62	PLL_FACTOR_N. PLL Factor N. Factor=0, N=1 Factor=1, N=2 Factor=2, N=3 …… Factor=127,N=128.
7:4	/	/	/
3:0	R/W	0x7	PLL_PREDIV_M. PLL Pre-div Factor(M = Factor+1). The range is from 1 to 16.

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PLL_VE Control Register (Default: 0x03006207)

Offset: 0x0018			Register Name: PLL_VE_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	PLL_ENABLE. 0: Disable 1: Enable. In the integer mode, The PLL Output = (24MHz*N)/M. In the fractional mode, the PLL Output is select by bit 25. Note: The PLL output clock must be in the range of 30MHz~600MHz. Its default is 297MHz.
30:29	/	/	/
28	R	0x0	LOCK 0: Unlocked 1: Locked (It indicates that the PLL has been stable.)
27:26	/	/	/
25	R/W	0x1	FRAC_CLK_OUT. PLL clock output when PLL_MODE_SEL=0(PLL_PREDIV_M factor must be set to 0); No meaning when PLL_MODE_SEL =1. 0: PLL Output=270MHz 1: PLL Output =297MHz.
24	R/W	0x1	PLL_MODE_SEL. 0: Fractional Mode 1: Integer Mode. Note: When in Fractional mode, the Per Divider M should be set to 0.
23:21	/	/	/
20	R/W	0x0	PLL_SDM_EN. 0: Disable 1: Enable.
19:15	/	/	/
14:8	R/W	0x62	PLL_FACTOR_N. PLL Factor N. Factor=0, N=1 Factor=1, N=2 Factor=2, N=3 …… Factor=31,N=32 … Factor=127,N=128.
7:4	/	/	/
3:0	R/W	0x7	PLL_PREDIV_M. PLL Pre Divider (M = Factor+1). The range is from 1 to 16.

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PLL_DDR0 Control Register (Default: 0x00001000)

Offset: 0x0020			Register Name: PLL_DDR0_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	PLL_ENABLE. 0: Disable 1: Enable. This PLL is for MBUS. Set bit20 to validate the PLL after this bit is set to 1. The PLL Output = (24MHz*N*K)/M. Note: the PLL output clock must be in the range of 200MHz~2.6GHz. Its default is 408MHz.
30:29	/	/	/
28	R	0x0	LOCK 0: Unlocked 1: Locked (It indicates that the PLL has been stable.)
27:25	/	/	/
24	R/W	0x0	PLL_SDM_EN. 0: Disable 1: Enable. In this case, the PLL_FACTOR_N only low 4 bits are valid (N: The range is from 1 to 16).
23:21	/	/	/
20	R/W	0x0	PLL_DDR0_CFG_UPDATE. PLL_DDR0 Configuration Update. When PLL_DDR0 has been changed, this bit should be set to 1 to validate the PLL, otherwise the change would be invalid. And this bit would be cleared automatically after the PLL change is valid. 0: No effect 1: Validating the PLL_DDR0.
19:13	/	/	/
12:8	R/W	0x10	PLL_FACTOR_N. PLL Factor N. Factor=0, N=1 Factor=1, N=2 Factor=2, N=3 …… Factor=31,N=32.
7:6	/	/	/
5:4	R/W	0x0	PLL_FACTOR_K. PLL Factor K.(K=Factor + 1) The range is from 1 to 4.
3:2	/	/	/

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1:0	R/W	0x0	PLL_FACTOR_M. PLL Factor M.(M = Factor + 1) The range is from 1 to 4.

PLL_PERIPH Control Register (Default: 0x00041811)

Offset: 0x0028			Register Name: PLL_PERIPH_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	PLL_ENABLE. 0: Disable 1: Enable. The PLL Output = 24MHz*N*K/2. Note: The PLL Output should be fixed to 600MHz, it is not recommended to vary this value arbitrarily. In the Clock Control Module, PLL(2X) output= PLL*2 = 24MHz*N*K. The PLL output clock must be in the range of 200MHz~1.8GHz. Its default is 600MHz.
30:29	/	/	/
28	R	0x0	LOCK. 0: Unlocked 1: Locked (It indicates that the PLL has been stable.)
27:26	/	/	/
25	R/W	0x0	PLL_BYPASS_EN. PLL Output Bypass Enable. 0: Disable 1: Enable. If the bypass is enabled, the PLL output is 24MHz.
24	R/W	0x0	PLL_CLK_OUT_EN. PLL clock output enable.(Just for the SATA Phy) 0: Disable 1: Enable.
23:19	/	/	/
18	R/W	0x1	PLL_24M_OUT_EN. PLL 24MHz Output Enable. 0: Disable 1: Enable. When 25MHz crystal used, this PLL can output 24MHz.
17:16	R/W	0x0	PLL_24M_POST_DIV. PLL 24M Output Clock Post Divider (When 25MHz crystal used). 1/2/3/4.
15:13	/	/	/
12:8	R/W	0x18	PLL_FACTOR_N. PLL Factor N.

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			Factor=0, N=1 Factor=1, N=2 Factor=2, N=3 …… Factor=31,N=32.
7:6	/	/	/
5:4	R/W	0x1	PLL_FACTOR_K. PLL Factor K.(K=Factor + 1) The range is from 1 to 4.
3:2	/	/	/
1:0	R/W	0x1	PLL_FACTOR_M. PLL Factor M (M = Factor + 1) is only valid in plltest debug. The PLL_PERIPH back door clock output =24MHz*N*K/M. The range is from 1 to 4.

PLL_GPU Control Register (Default: 0x03006207)

Offset: 0x0038			Register Name: PLL_GPU_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	PLL_ENABLE. 0: Disable 1: Enable. In the integer mode, The PLL_GPU Output= (24MHz*N)/M. In the fractional mode, the PLL_GPU Output is select by bit 25. Note: The PLL output clock must be in the range of 30MHz~600MHz. Its default is 297MHz.
30:29	/	/	/
28	R	0x0	LOCK. 0: Unlocked 1: Locked (It indicates that the PLL has been stable.)
27:26	/	/	/
25	R/W	0x1	FRAC_CLK_OUT. PLL clock output when PLL_MODE_SEL=0(PLL_PREDIV_M factor must be set to 0); no meaning when PLL_MODE_SEL =1. 0: PLL Output=270MHz 1: PLL Output=297MHz.
24	R/W	0x1	PLL_MODE_SEL. 0: Fractional Mode. 1: Integer Mode. Note: When in Fractional mode, the Per Divider M should be set to 0.
23:21	/	/	/

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20	R/W	0x0	PLL_SDM_EN. 0: Disable 1: Enable.
19:15	/	/	/
14:8	R/W	0x62	PLL_FACTOR_N PLL Factor N. Factor=0, N=1 Factor=1, N=2 Factor=2, N=3 …… Factor=127,N=128.
7:4	/	/	/
3:0	R/W	0x7	PLL_PRE_DIV_M. PLL Pre Divider (M = Factor+1). The range is from 1 to 16.

PLL_MIPI Control Register (Default: 0x00000502)

Offset: 0x0040			Register Name: PLL_MIPI_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	PLL_ENABLE. 0: Disable 1: Enable. The PLL Output= (PLL_VIDEO*N*K)/M when VFB_SEL=0 (MIPI mode). When VFB_SEL=1, the PLL Output is depend on these bits: sint_frac,sdiv2, s6p25_7p5 , pll_feedback_div.
30:29	/	/	/
28	R	0x0	LOCK. 0: Unlocked 1: Locked (It indicates that the PLL has been stable.)
27	R/W	0x0	SINT_FRAC. When VFB_SEL=1, PLL mode control, otherwise no meaning. 0: Integer Mode 1: Fractional Mode.
26	R/W	0x0	SDIV2. PLL clock output when VFB_SEL=1; no meaning when VFB_SEL =0 0: PLL Output 1: PLL Output X2.
25	R/W	0x0	S6P25_7P5. PLL Output is selected by this bit when VFB_SEL=1 and SINT_FRAC=1, otherwise no meaning. 0: PLL Output=PLL Input*6.25 1: PLL Outpu= PLL Input *7.5.

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24	/	/	/
23	R/W	0	LDO1_EN. On-chip LDO1 Enable.
22	R/W	0	LDO2_EN. On-chip LDO2 Enable.
21	R/W	0	PLL_SRC. PLL Source Select. 0: VIDEO PLL 1: /.
20	R/W	0x0	PLL_SDM_EN. 0: Disable 1: Enable.
19:18	/	/	/
17	R/W	0x0	PLL_FEEDBACK_DIV. PLL feed-back divider control. PLL clock output when VFB_SEL=1; no meaning when VFB_SEL =0 0:Divided by 5 1:Divided by 7.
16	R/W	0x0	VFB_SEL. 0: MIPI Mode(N, K, M valid) 1:HDMI Mode(sint_frac,sdiv2,s6p25_7p5 , pll_feedback_div valid)
15:12	/	/	/
11:8	R/W	0x5	PLL_FACTOR_N PLL Factor N. Factor=0, N=1 Factor=1, N=2 …… Factor=15,N=16;
7:6	/	/	/
5:4	R/W	0x0	PLL_FACTOR_K. PLL Factor K.(K=Factor + 1) The range is from 1 to 4.
3:0	R/W	0x2	PLL_PRE_DIV_M. PLL Pre Divider (M = Factor+1). The range is from 1 to 16.

PLL_HSIC Control Register (Default: 0x03001300)

Offset: 0x0044			Register Name: PLL_HSIC_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	PLL_ENABLE. 0: Disable 1: Enable. In the integer mode, the PLL Output= (24MHz*N)/M. In the fractional mode, the PLL Output is select by bit 25.

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			Note: The PLL output clock must be in the range of 30MHz~600MHz. Its default is 480MHz.
30:29	/	/	/
28	R	0x0	LOCK 0: Unlocked 1: Locked (It indicates that the PLL has been stable.)
27:26	/	/	/
25	R/W	0x1	FRAC_CLK_OUT. PLL clock output when PLL_MODE_SEL=0(PLL_PREDIV_M factor must be set to 0); no meaning when PLL_MODE_SEL =1. 0: PLL Output=270MHz 1: PLL Output=297MHz.
24	R/W	0x1	PLL_MODE_SEL. 0: Fractional Mode 1: Integer Mode. Note: When in Fractional mode, the Per Divider M should be set to 0.
23:21	/	/	/
20	R/W	0x0	PLL_SDM_EN. 0: Disable 1: Enable.
19:15	/	/	/
14:8	R/W	0x13	PLL_FACTOR_N PLL Factor N. Factor=0, N=1 Factor=1, N=2 Factor=2, N=3 …… Factor=0x7F,N=128.
7:4	/	/	/
3:0	R/W	0x0	PLL_PRE_DIV_M. PLL Per Divider (M = Factor+1). The range is from 1 to 16.

PLL_DE Control Register (Default: 0x03006207)

Offset: 0x0048			Register Name: PLL_DE_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	PLL_ENABLE. 0: Disable 1: Enable In the integer mode, The PLL Output= (24MHz*N)/M. In the fractional mode, the PLL Output is select by bit 25. Note: The PLL output clock must be in the range of

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			30MHz~600MHz. Its default is 297MHz.
30:29	/	/	/
28	R	0x0	LOCK 0: Unlocked 1: Locked (It indicates that the PLL has been stable.)
27:26	/	/	/
25	R/W	0x1	FRAC_CLK_OUT. PLL clock output when PLL_MODE_SEL=0(PLL_PREDIV_M factor must be set to 0); no meaning when PLL_MODE_SEL =1. 0: PLL Output=270MHz 1: PLL Output =297MHz.
24	R/W	0x1	PLL_MODE_SEL. 0: Fractional Mode 1: Integer Mode. Note: When in Fractional mode, the Pre Divider M should be set to 0.
23:21	/	/	/
20	R/W	0x0	PLL_SDM_EN. 0: Disable 1: Enable.
19:15	/	/	/
14:8	R/W	0x62	PLL_FACTOR_N PLL Factor N. Factor=0, N=1 Factor=1, N=2 Factor=2, N=3 …… Factor=0x7F,N=128.
7:4	/	/	/
3:0	R/W	0x7	PLL_PRE_DIV_M. PLL Per Divider (M = Factor+1). The range is from 1 to 16.

PLL_DDR1 Control Register (Default: 0x00001800)

Offset: 0x004C			Register Name: PLL_DDR1_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	PLL_ENABLE. 0: Disable 1: Enable. This PLL is for the MBUS. The PLL Output = 24MHz*N. Its default is 600 MHz.
30	R/W	0x0	SDRPLL_UPD.

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			SDRPLL Configuration Update. Note: When PLL_DDR1 has changed, this bit should be set to 1 to validate the PLL, otherwise the change is invalid. It will be auto cleared after the PLL is valid. 0: No effect 1: To validate the PLL_DDR1.
29	/	/	/
28	R	0x0	LOCK 0:Unlocked 1: Locked (It indicates that the PLL has been stable.)
27:25	/	/	/
24	R/W	0x0	PLL_SDM_EN. 0: Disable 1: Enable.
23:14	/	/	/
13:8	R/W	0x18	PLL_FACTOR_N. PLL Factor N. The range is from 0 to 255 (In application, Factor N should be no less than 12)
7:0	/	/	/

CPUX/AXI Configuration Register (Default: 0x00010000)

Offset: 0x0050			Register Name: CPU_AXI_CFG_REG
Bit	Read/Write	Default/Hex	Description
31:18	/	/	/
17:16	R/W	0x1	CPUX_CLK_SRC_SEL. CPUX Clock Source Select. CPUX Clock = Clock Source 00: LOSC 01: OSC24M 1X: PLL_CPU . If the clock source is changed, at most to wait for 8 present running clock cycles.
15:10	/	/	/
9:8	R/W	0x0	CPU_APB_CLK_DIV. 00: /1 01: /2 1x: /4. Note: System APB clock source is CPU clock source.
7:2	/	/	/
1:0	R/W	0x0	AXI_CLK_DIV_RATIO. AXI Clock Divide Ratio. AXI Clock source is CPU clock source. 00: /1 01: /2

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			10: /3 11: /4.

AHB1/APB1 Configuration Register (Default: 0x00001010)

Offset: 0x0054			Register Name: AHB1_APB 1_CFG_REG
Bit	Read/Write	Default/Hex	Description
31:14	/	/	/
13:12	R/W	0x1	AHB1_CLK_SRC_SEL. 00: LOSC 01: OSC24M 10: AXI 11: PLL_PERIPH/ AHB1_PRE_DIV.
11:10	/	/	/
9:8	R/W	0x0	APB1_CLK_RATIO. APB1 Clock Divide Ratio. APB1 clock source is AHB1 clock. 00: /2 01: /2 10: /4 11: /8.
7:6	R/W	0x0	AHB1_PRE_DIV AHB1 Clock Pre Divide Ratio 00: /1 01: /2 10: /3 11: /4.
5:4	R/W	0x1	AHB1_CLK_DIV_RATIO. AHB1 Clock Divide Ratio. 00: /1 01: /2 10: /4 11: /8.
3:0	/	/	/

APB2 Configuration Register (Default: 0x01000000)

Offset: 0x0058			Register Name: APB2 _CFG_REG
Bit	Read/Write	Default/Hex	Description
31:26	/	/	/
25:24	R/W	0x1	APB2_CLK_SRC_SEL. APB2 Clock Source Select 00: LOSC 01: OSC24M 1X: PLL_PERIPH. This clock is used for some special module apbclk(UART、TWI). Because these modules need special clock rate even if the apb1clk changed.

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23:18	/	/	/
17:16	R/W	0x0	CLK_RAT_N Clock Per Divide Ratio (n) 00: /1 01: /2 10: /4 11:/8.
15:5	/	/	/
4:0	R/W	0x0	CLK_RAT_M. Clock Divide Ratio (m) The pre-divided clock is divided by (m+1). The divider is from 1 to 32.

Bus Clock Gating Register 0 (Default: 0x00000000)

Offset: 0x0060			Register Name: BUS_CLK_GATING_REG0
Bit	Read/Write	Default/Hex	Description
31:30	/	/	/
29	R/W	0x0	USBOHCI_GATING. Gating Clock for USB OHCI 0: Mask 1: Pass.
27:28	/	/	/
26	R/W	0x0	USBEHCI_GATING. Gating Clock For USB EHCI 0: Mask 1: Pass.
25	/	/	/
24	R/W	0x0	USBOTG_GATING. Gating Clock For USB OTG 0: Mask 1: Pass.
23:22	/	/	/
21	R/W	0x0	/
20	R/W	0x0	SPI0_GATING. Gating Clock For SPI0 0: Mask 1: Pass.
19	R/W	0x0	HSTMR_GATING. Gating Clock For High Speed Timer 0: Mask 1: Pass.
18:15	/	/	/
14	R/W	0x0	DRAM_GATING. Gating Clock For DRAM 0: Mask

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			1: Pass.
13	R/W	0x0	NAND_GATING. Gating Clock For NAND 0: Mask 1: Pass.
12:11	/	/	/
10	R/W	0x0	MMC2_GATING. Gating Clock For MMC2 0: Mask 1: Pass.
9	R/W	0x0	MMC1_GATING. Gating Clock For MMC1 0: Mask 1: Pass.
8	R/W	0x0	MMC0_GATING. Gating Clock For MMC0 0: Mask 1: Pass.
7	/	/	/
6	R/W	0x0	DMA_GATING. Gating Clock For DMA 0: Mask 1: Pass.
5	R/W	0x0	CE_GATING. Gating Clock For Crypto Engine 0: Mask 1: Pass.
4:2	/	/	/
1	R/W	0x0	MIPIDSI_GATING. Gating Clock For MIPI DSI 0: Mask 1: Pass.
0	/	/	/

Bus Clock Gating Register 1 (Default: 0x00000000)

Offset: 0x0064			Register Name: BUS_CLK_GATING_REG1
Bit	Read/Write	Default/Hex	Description
31:25	/	/	/
26	R/W	0x0	SAT_GATING. Gating Clock For SAT 0: Mask 1: Pass.
25	R/W	0x0	DRC_GATING. Gating Clock For DRC 0: Mask

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			1: Pass.
24:23	/	/	/
22	R/W	0x0	SPINLOCK_GATING. Gating Clock For SPINLOCK 0: Mask 1: Pass.
21	R/W	0x0	MSGBOX_GATING. Gating Clock For MSGBOX 0: Mask 1: Pass.
20	R/W	0x0	GPU_GATING. Gating Clock For GPU 0: Mask 1: Pass.
19:15	/	/	/
14	R/W	0x0	FE_GATING. Gating Clock For DE-FE 0: Mask 1: Pass.
13			
12	R/W	0x0	BE_GATING. Gating Clock For DE-BE 0: Mask 1: Pass.
11:9	/	/	/
8	R/W	0x0	CSI_GATING. Gating Clock For CSI 0: Mask 1: Pass.
7:5	/	/	/
4	R/W	0x0	LCD_GATING. Gating Clock For LCD 0: Mask 1: Pass.
3:1	/	/	/
0	R/W	0x0	VE_GATING. Gating Clock For VE 0: Mask 1: Pass.

Bus Clock Gating Register 2 (Default: 0x00000000)

Offset: 0x0068			Register Name: BUS_CLK_GATING_REG2
Bit	Read/Write	Default/Hex	Description
31:14	/	/	/
13	R/W	0x0	DAUDIO1_GATING.

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			Gating Clock For DAUDIO 1 0: Mask 1: Pass.
12	R/W	0x0	DAUDIO0_GATING. Gating Clock For DAUDIO 0 0: Mask 1: Pass.
11:6	/	/	/
5	R/W	0x0	PIO_GATING. Gating Clock For PIO 0: Mask 1: Pass.
4:1	/	/	/
0	R/W	0x0	AC_GATING. Gating Clock For Audio Codec 0: Mask 1: Pass.

Bus Clock Gating Register 3 (Default: 0x00000000)

Offset: 0x006C			Register Name: BUS_CLK_GATING_REG3
Bit	Read/Write	Default/Hex	Description
31:21	/	/	/.
20	R/W	0x0	/
19	R/W	0x0	UART3_GATING. Gating Clock For UART3 0: Mask 1: Pass.
18	R/W	0x0	UART2_GATING. Gating Clock For UART2 0: Mask 1: Pass.
17	R/W	0x0	UART1_GATING. Gating Clock For UART1 0: Mask 1: Pass.
16	R/W	0x0	UART0_GATING. Gating Clock For UART0 0: Mask 1: Pass.
15:3	/	/	/
2	R/W	0x0	TWI2_GATING. Gating Clock For TWI2 0: Mask 1: Pass.
1	R/W	0x0	TWI1_GATING.

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			Gating Clock For TWI1 0: Mask 1: Pass.
0	R/W	0x0	TWI0_GATING. Gating Clock For TWI0 0: Mask 1: Pass.

NAND Clock Register (Default: 0x00000000)

Offset: 0x0080			Register Name: NAND_CLK_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SCLK_GATING. Gating Special Clock(Max Clock = 200MHz) 0: Clock is OFF 1: Clock is ON. SCLK = Clock Source/Divider N/Divider M.
30:26	/	/	/
25:24	R/W	0x0	CLK_SRC_SEL. Clock Source Select 00: OSC24M 01: PLL_PERIPH 1X: /.
23:18	/	/	/
17:16	R/W	0x0	CLK_DIV_RATIO_N. Clock Pre Divide Ratio (n) 00: /1 01: /2 10: /4 11: /8.
15:4	/	/	/
3:0	R/W	0x0	CLK_DIV_RATIO_M Clock Divide Ratio (m) The pre-divided clock is divided by (m+1). The divider M is from 1 to 16.

SDMMC0 Clock Register (Default: 0x00000000)

Offset: 0x0088			Register Name: SDMMC0_CLK_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SCLK_GATING. Gating Special Clock(Max Clock = 200MHz) 0: Clock is OFF 1: Clock is ON. SCLK = Clock Source/Divider N/Divider M.
30:26	/	/	/
25:24	R/W	0x0	CLK_SRC_SEL.

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			Clock Source Select 00: OSC24M 01: PLL_PERIPH 1X: /.
23	/	/	/
22:20	R/W	0x0	SAMPLE_CLK_PHASE_CTR. Sample Clock Phase Control. The sample clock phase delay is based on the number of source clock that is from 0 to 7.
19:18	/	/	/
17:16	R/W	0x0	CLK_DIV_RATIO_N. Clock Pre Divide Ratio (n) 00: /1 01: /2 10: /4 11: /8.
15:11	/	/	/
10:8	R/W	0x0	OUTPUT_CLK_PHASE_CTR. Output Clock Phase Control. The output clock phase delay is based on the number of source clock that is from 0 to 7.
7:4	/	/	/
3:0	R/W	0x0	CLK_DIV_RATIO_M. Clock Divide Ratio (m) The pre-divided clock is divided by (m+1). The divider is from 1 to 16.

SDMMC1 Clock Register (Default: 0x00000000)

Offset: 0x008C			Register Name: SDMMC1_CLK_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SCLK_GATING. Gating Special Clock(Max Clock = 200MHz) 0: Clock is OFF 1: Clock is ON. SCLK= Clock Source/Divider N/Divider M.
30:26	/	/	/
25:24	R/W	0x0	CLK_SRC_SEL. Clock Source Select 00: OSC24M 01: PLL_PERIPH 1X: /.
23	/	/	/
22:20	R/W	0x0	SAMPLE_CLK_PHASE_CTR. Sample Clock Phase Control. The sample clock phase delay is based on the number of

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			source clock that is from 0 to 7.
19:18	/	/	/
17:16	R/W	0x0	CLK_DIV_RATIO_N. Clock Pre-Divide Ratio (n) 00: /1 01: /2 10: /4 11: /8.
15:11	/	/	/
10:8	R/W	0x0	OUTPUT_CLK_PHASE_CTR. Output Clock Phase Control. The output clock phase delay is based on the number of source clock that is from 0 to 7.
7:4	/	/	/
3:0	R/W	0x0	CLK_DIV_RATIO_M. Clock Divide Ratio (m) The pre-divided clock is divided by (m+1). The divider is from 1 to 16.

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SDMMC2 Clock Register (Default: 0x00000000)

Offset: 0x0090			Register Name: SDMMC2_CLK_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SCLK_GATING. Gating Special Clock(Max Clock = 200MHz) 0: Clock is OFF 1: Clock is ON. If SDMMC2 is in old mode, SCLK = Clock Source/Divider N/Divider M. If SDMMC2 is in new mode, SCLK= Clock Source/Divider N/Divider M/2.
30	R/W	0x0	MMC2_MODE_SELECT. 0: Old Mode 1: New Mode.
29:26	/	/	/
25:24	R/W	0x0	CLK_SRC_SEL. Clock Source Select 00: OSC24M 01: PLL_PERIPH 1X: /.
23	/	/	/
22:20	R/W	0x0	CLK_PHASE_CTR. Sample Clock Phase Control. The sample clock phase delay is based on the number of source clock that is from 0 to 7.
19:18	/	/	/
17:16	R/W	0x0	CLK_DIV_RATIO_N. Clock Pre Divide Ratio (n) 00: /1 01: /2 10: /4 11: /8.
15:11	/	/	/
10:8	R/W	0x0	OUTPUT_CLK_PHASE_CTR. Output Clock Phase Control. The output clock phase delay is based on the number of source clock that is from 0 to 7.
7:4	/	/	/
3:0	R/W	0x0	CLK_DIV_RATIO_M. Clock Divide Ratio (m) The pre-divided clock is divided by (m+1). The divider is from 1 to 16.

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CE Clock Register (Default: 0x00000000)

Offset: 0x009C			Register Name: CE_CLK_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SCLK_GATING. Gating Special Clock(Max Clock = 200MHz) 0: Clock is OFF 1: Clock is ON. SCLK = Clock Source/Divider N/Divider M.
30:26	/	/	/
25:24	R/W	0x0	CLK_SRC_SEL. Clock Source Select 00: OSC24M 01: PLL_PERIPH 1X: /.
23:18	/	/	/
17:16	R/W	0x0	CLK_DIV_RATIO_N. Clock Pre Divide Ratio (n) 00: /1 01: /2 10: /4 11: /8.
15:4	/	/	/
3:0	R/W	0x0	CLK_DIV_RATIO_M. Clock divide ratio (m) The pre-divided clock is divided by (m+1). The divider is from 1 to 16.

SPI0 Clock Register (Default: 0x00000000)

Offset: 0x00A0			Register Name: SPI0_CLK_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SCLK_GATING. Gating Special Clock(Max Clock = 200MHz) 0: Clock is OFF 1: Clock is ON. SCLK = Clock Source/Divider N/Divider M.
30:26	/	/	/
25:24	R/W	0x0	CLK_SRC_SEL. Clock Source Select 00: OSC24M 01: PLL_PERIPH 1X: /.
23:18	/	/	/
17:16	R/W	0x0	CLK_DIV_RATIO_N. Clock Pre Divide Ratio (n) 00: /1

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			01: /2 10: /4 11: /8.
15:4	/	/	/
3:0	R/W	0x0	CLK_DIV_RATIO_M. Clock Divide Ratio (m) The pre-divided clock is divided by (m+1). The divider is from 1 to 16.

DAUDIO0 Clock Register (Default: 0x00000000)

Offset: 0x00B0			Register Name: DAUDIO0_CLK_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SCLK_GATING. Gating Special Clock(Max Clock = 200MHz) 0: Clock is OFF 1: Clock is ON.
30:18	/	/	/
17:16	R/W	0x0	CLK_SRC_SEL. 00: PLL_AUDIO (8X) 01: PLL_AUDIO(8X)/2 10: PLL_AUDIO(8X)/4 11: PLL_AUDIO.
15:0	/	/	/.

DAUDIO1 Clock Register (Default: 0x00000000)

Offset: 0x00B4			Register Name: DAUDIO1_CLK_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SCLK_GATING. Gating Special Clock(Max Clock = 200MHz) 0: Clock is OFF 1: Clock is ON.
30:18	/	/	/
17:16	R/W	0x0	CLK_SRC_SEL. 00: PLL_AUDIO (8X) 01: PLL_AUDIO(8X)/2 10: PLL_AUDIO(8X)/4 11: PLL_AUDIO.
15:0	/	/	/

USBPHY Configuration Register (Default: 0x00000000)

Offset: 0x00CC			Register Name: USBPHY_CFG_REG
Bit	Read/Write	Default/Hex	Description
31:18	/	/	/
17	/	/	/
16	R/W	0x0	SCLK_GATING_OHCI.

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			Gating Special Clock For OHCI 0: Clock is OFF 1: Clock is ON.
15:12	/	/	/
11	R/W	0	SCLK_GATING_12M Gating Special 12M Clock For HSIC 0: Clock is OFF 1: Clock is ON. The special 12M clock = OSC24M/2.
10	R/W	0	SCLK_GATING_HSIC Gating Special Clock For HSIC 0: Clock is OFF 1: Clock is ON. The special clock is from PLL_HSIC.
9	R/W	0x0	SCLK_GATING_USBPHY1. Gating Special Clock For USB PHY1(EHCI0,OHCI0) 0: Clock is OFF 1: Clock is ON.
8	R/W	0x0	SCLK_GATING_USBPHY0. Gating Special Clock For USB PHY0(USB OTG) 0: Clock is OFF 1: Clock is ON.
7:3	/	/	/
2	R/W	0	USBHSIC_RST USB HSIC Reset Control 0: Assert 1: De-assert.
1	R/W	0x0	USBPHY1_RST. USB PHY1 Reset Control 0: Assert 1: De-assert.
0	R/W	0x0	USBPHY0_RST. USB PHY0 Reset Control 0: Assert 1: De-assert.

DRAM Configuration Register (Default: 0x00000001)

Offset: 0X00F4			Register Name: DRAM_CFG_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	DRAM_CTR_RST. DRAM Controller Reset For S_CLK Domain. 0: Assert 1: De-assert.
30:15	/	/	/
16	R/W	0x0	SDRCLK_UPD.

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			SDRCLK Configuration 0 update. 0:Invalid 1:Valid. Note: Set this bit will validate Configuration 0. It will be auto cleared after the Configuration 0 is valid. The DRAMCLK Source is from PLL_DDR.
15:4	/	/	/
3:0	R/W	0x1	DRAM_DIV_M. DRAMCLK Divider of Configuration. The clock is divided by (m+1). The divider should be from 2 to 16.

PLL_DDR Configuration Register (Default: 0x00000030)

Offset: 0X00F8			Register Name: PLL_DDR_CFG_REG
Bit	Read/Write	Default/Hex	Description
31:17	/	/	/
16	R/W	0x0	PLL_DDR_SRC_SELECT. 0: PLL_DDR0 1: PLL_DDR1.
15:13	/	/	/
12	R/W	0x0	PLL_DDR1_MODE. 0: Normal Mode 1: Continuously Frequency Scale.
11:7	/	/	/
6:4	R/W	0x3	PLL_DDR1_PHASE_COMPENSATE. The value of bit[6:4] is based on 24M clock, then the default PLL_DDR phase compensate is (3/24000000) s.
3:0	R/W	0x0	PLL_DDR1_STEP. 0000: 0.004MHz/us (576/2^17) 0001: 0.008MHz/us (576/2^16) 0010: 0.016MHz/us (576/2^15) 0011: 0.032MHz/us (576/2^14) 0100: 0.064MHz/us (576/2^13) 0101: 0.128MHz/us (576/2^12) 0110: 0.256MHz/us (576/2^11) 0111: 0.512MHz/us (576/2^10) 1000: 1.024MHz/us (576/2^9) 1001: 2.048MHz/us (576/2^8) Others: 0.004MHz/us (576/2^17).

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MBUS Reset Register (Default: 0x80000000)

Offset: 0X00FC			Register Name: MBUS_RST_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x1	MBUS_RESET. 0: Reset Mbus Domain 1: Assert Mbus Domain.
30:0	/	/	/

DRAM Clock Gating Register (Default: 0x00000000)

Offset: 0x0100			Register Name: DRAM_CLK_GATING_REG
Bit	Read/Write	Default/Hex	Description
31:27	/	/	/
26	R/W	0x0	BE_DCLK_GATING. Gating DRAM Clock For DE_BE 0: Mask 1: Pass.
25	/	/	/
24	R/W	0x0	FE_DCLK_GATING. Gating DRAM Clock For DE_FE 0: Mask 1: Pass.
23:17	/	/	/.
16	R/W	0x0	DRC_DCLK_GATING. Gating DRAM Clock For IEP DRC 0: Mask 1: Pass.
15:2	/	/	/
1	R/W	0x0	CSI_DCLK_GATING. Gating DRAM Clock For CSI 0: Mask 1: Pass.
0	R/W	0x0	VE_DCLK_GATING. Gating DRAM Clock For VE 0: Mask 1: Pass.

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BE Clock Register (Default: 0x00000000)

Offset: 0X0104			Register Name: BE_CLK_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SCLK_GATING. Gating Special Clock 0: Clock is OFF 1: Clock is ON. This special clock = Clock Source/Divider M.
30:27	/	/	/
26:24	R/W	0x0	CLK_SRC_SEL. Clock Source Select 000: PLL_VIDEO 001: / 010: PLL_PERIPH(2X) 011: PLL_GPU 100:/ 101:PLL_DE 110/111:/.
23:4	/	/	/
3:0	R/W	0x0	CLK_DIV_RATIO_M. Clock Divide Ratio (m) The pre-divided clock is divided by (m+1). The divider is from 1 to 16.

FE Clock Register (Default: 0x00000000)

Offset: 0X010C			Register Name: FE_CLK_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SCLK_GATING. Gating Special Clock 0: Clock is OFF 1: Clock is ON. SCLK = Clock Source/Divider M.
30:27	/	/	/
26:24	R/W	0x0	CLK_SRC_SEL. Clock Source Select 000: PLL_VIDEO 001: / 010: PLL_PERIPH(2X) 011: PLL_GPU 100:/ 101:PLL_DE 110/111:/.
23:4	/	/	/
3:0	R/W	0x0	CLK_DIV_RATIO_M.

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			Clock Divide Ratio (m) The pre-divided clock is divided by (m+1). The divider is from 1 to 16.

LCD Channel0 Clock Register (Default: 0x00000000)

Offset: 0X0118			Register Name: LCD_CH0_CLK_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SCLK_GATING. Gating Special Clock 0: Clock is OFF 1: Clock is ON.
30:27	/	/	/
26:24	R/W	0x0	CLK_SRC_SEL. Clock Source Select 000: PLL_VIDEO(1X) 001: / 010: PLL_VIDEO(2X) 011: / 100: PLL_MIPI 101~111: /.
23:0	/	/	/

LCD Channel1 Clock Register (Default: 0x00000000)

Offset: 0X012C			Register Name: LCD_CH1_CLK_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SCLK_GATING. Gating Special Clock 0: Clock is OFF 1: Clock is ON. SCLK = Clock Source/ Divider M.
30:26	/	/	/
25:24	R/W	0x0	SCLK_SEL. Special Clock Source Select 00: PLL_VIDEO(1X) 01: / 10: PLL_VIDEO(2X) 11: /.
23:4	/	/	/
3:0	R/W	0x0	CLK_DIV_RATIO_M. Clock divide ratio (m) The pre-divided clock is divided by (m+1). The divider is from 1 to 16.

CSI Clock Register (Default: 0x00000000)

Offset: 0x0134	Register Name: CSI_CLK_REG

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Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	CSI_SCLK_GATING. Gating Special Clock 0: Clock is OFF 1: Clock is ON. SCLK = Special Clock Source/CSI_SCLK_DIV_M.
30:27	/	/	/
26:24	R/W	0x0	SCLK_SRC_SEL. Special Clock Source Select 000: PLL_VIDEO(1X) 001: / 010: / 011: PLL_DE 100: PLL_MIPI 101: PLL_VE 110~111:/.
23:20	/	/	/
19:16	R/W	0x0	CSI_SCLK_DIV_M. CSI Clock Divide Ratio (m) The pre-divided clock is divided by (m+1). The divider is from 1 to 16.
15	R/W	0x0	CSI_MCLK_GATING. Gating Master Clock 0: Clock is OFF 1: Clock is ON. SCLK =Master Clock Source/ CSI_MCLK_DIV_M.
14:11	/	/	/
10:8	R/W	0x0	MCLK_SRC_SEL. Master Clock Source Select 000: PLL_VIDEO(1X) 001: / 010: / 011: PLL_DE 100: / 101: OSC24M 110~111:/.
7:5	/	/	/
4:0	R/W	0x0	CSI_MCLK_DIV_M. CSI Master Clock Divide Ratio (m) The pre-divided clock is divided by (m+1). The divider is from 1 to 32.

VE Clock Register (Default: 0x00000000)

Offset: 0X013C			Register Name: VE_CLK_REG
Bit	Read/Write	Default/Hex	Description

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31	R/W	0x0	VE_SCLK_GATING. Gating Special Clock 0: Clock is OFF 1: Clock is ON. SCLK = PLL_VE /Divider N.
30:19	/	/	/.
18:16	R/W	0x0	CLK_DIV_RATIO_N. Clock Pre Divide Ratio (N) The select clock source is pre-divided by n+1. The divider is from 1 to 8.
15:0	/	/	/

Audio Codec Digital Clock Register (Default: 0x00000000)

Offset: 0X0140			Register Name: AC_DIG_CLK_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SCLK_1X_GATING. Gating Special Clock 0: Clock is OFF 1: Clock is ON. SCLK = PLL_AUDIO Output.
30	R/W	0x0	SCLK_4X_GATING. Gating Special Clock 0: Clock is OFF 1: Clock is ON. SCLK= PLL_AUDIO Output.
29:0	/	/	/

AVS Clock Register (Default: 0x00000000)

Offset: 0X0144			Register Name: AVS_CLK_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SCLK_GATING. Gating Special Clock 0: Clock is OFF 1: Clock is ON. SCLK= OSC24M.
30:0	/	/	/

MBUS Clock Register (Default: 0x00000000)

Offset: 0X015C			Register Name: MBUS_CLK_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	MBUS_SCLK_GATING. Gating Clock For MBUS 0: Clock is OFF 1: Clock is ON. MBUS_CLOCK = Clock Source/Divider M

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30:26	/	/	/
25:24	R/W	0x0	MBUS_SCLK_SRC Clock Source Select 00: OSC24M 01: PLL_PERIPH(2X) 10: PLL_DDR0 11: PLL_DDR1.
23:3	/	/	/
2:0	R/W	0x0	MBUS_SCLK_RATIO_M Clock Divide Ratio (M) The divided clock is divided by (M+1). The divider is from 1 to 8. The divide ratio must be changed smoothly. Note: If the clock has been changed ,it must wait for at least 16 cycles.

MIPI_DSI Clock Register (Default: 0x00000000)

Offset: 0x0168			Register Name: MIPI_DSI_CLK_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	DSI_SCLK_GATING. Gating DSI Special Clock 0: Clock is OFF 1: Clock is ON. DSI Special clock(test clock) = Clock Source/DSI_SCLK_DIV_M.
30:26	/	/	/
25:24	R/W	0x0	DSI_SCLK_SRC_SEL. DSI Special Clock Source Select 00: PLL_VIDEO(1X) 01: / 10: PLL_VIDEO(2X). 11: /.
23:20	/	/	/
19:16	R/W	0x0	DSI_SCLK_DIV_M. DSI Special Clock Divide Ratio (m) The pre-divided clock is divided by (m+1). The divider is from 1 to 16.
15	R/W	0x0	DSI_DPHY_GATING. Gating DSI DPHY Clock 0: Clock is OFF 1: Clock is ON. This DSI DPHY clock =Clock Source/ DPHY_CLK_DIV_M.
14:10	/	/	/
9:8	R/W	0x0	DSI_DPHY_SRC_SEL. DSI DPHY Clock Source Select.

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			00: PLL_VIDEO(1X) 01: / 10: PLL_PERIPH 11: /.
7:4	/	/	/.
3:0	R/W	0x0	DPHY_CLK_DIV_M. DSI DPHY Clock divide ratio (m) The pre-divided clock is divided by (m+1). The divider is from 1 to 16.

DRC Clock Register (Default: 0x00000000)

Offset: 0X0180			Register Name: DRC_CLK_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SCLK_GATING. Gating Special Clock 0: Clock is OFF 1: Clock is ON. SCLK = Clock Source/Divider M.
30:27	/	/	/
26:24	R/W	0x0	CLK_SRC_SEL. Clock Source Select 000: PLL_VIDEO(1X) 001: / 010: PLL_PERIPH(2X) 011: PLL_GPU 100:/ 101:PLL_DE 110/111:/.
23:4	/	/	/
3:0	R/W	0x0	CLK_DIV_RATIO_M. Clock divide ratio (m) The pre-divided clock is divided by (m+1). The divider is from 1 to 16.

GPU Clock Register (Default: 0x00000000)

Offset: 0x01A0			Register Name: GPU_CLK_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SCLK_GATING. 0: Clock is OFF 1: Clock is ON. SCLK= PLL-GPU/Divider N.
30:3	/	/	/.
2:0	R/W	0x0	CLK_DIV_RATIO_N. Clock pre-divide ratio (N) The select clock source is pre-divided by(n+1). The

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			divider is from 1 to 8.

ATS Clock Register (Default: 0x80000000)

Offset: 0X01B0			Register Name: ATS_CLK_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x1	SCLK_GATING. Gating Special Clock(Max Clock = 200MHz) 0: Clock is OFF 1: Clock is ON. SCLK = Clock Source /Divider M.
30:26	/	/	/
25:24	R/W	0x0	CLK_SRC_SEL. Clock Source Select 00: OSC24M 01: PLL_PERIPH 1X: /.
23:3	/	/	/
2:0	R/W	0x0	CLK_DIV_RATIO_M. Clock Divide Ratio (m) The pre-divided clock is divided by (m+1). The divider is from 1 to 8.

PLL Stable Time Register0 (Default: 0x000000FF)

Offset: 0x0200			Register Name: PLL_STABLE_TIME_REG0
Bit	Read/Write	Default/Hex	Description
31:16	/	/	/
15:0	R/W	0x00FF	PLL_LOCK_TIME PLL Lock Time (Unit: us). Note: When any PLL (except PLL_CPU) is enabled or changed, the corresponding PLL lock bit will be set after the PLL Lock Time.

PLL Stable Time Register 1 (Default: 0x000000FF)

Offset: 0x0204			Register Name: PLL_STABLE_TIME_REG1
Bit	Read/Write	Default/Hex	Description
31:16	/	/	/
15:0	R/W	0x00FF	PLL_CPU_LOCK_TIME PLL_CPU Lock Time (Unit: us). Note: When PLL_CPU is enabled or changed, the PLL_CPU lock bit will be set after the PLL_CPU Lock Time.

PLL_CPUX Bias Register (Default: 0x08100200)

Offset: 0x0220			**Register Name: PLL_CPUX_BIAS_REG**
Bit	**Read/Write**	**Default/Hex**	**Description**
31	R/W	0x0	VCO_RST.

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			VCO reset in.
30:29	/	/	/
28	R/W	0x0	EXG_MODE. Exchange Mode. Note: CPU PLL source will select PLL_PERIPH instead of PLL_CPU
27:24	R/W	0x8	PLL_VCO_BIAS_CTRL. PLL VCO Bias Control[3:0].
23:21	/	/	/
20:16	R/W	0x10	PLL_BIAS_CUR_CTRL. PLL Bias Current Control[4:0].
15:11	/	/	/
10:8	R/W	0x2	PLL_LOCK_CTRL. PLL Lock Time Control[2:0].
7:4	/	/	/
3:0	R/W	0x0	PLL_DAMP_FACT_CTRL. PLL Damping Factor Control[3:0].

PLL_AUDIO Bias Register (Default: 0x10100000)

Offset: 0x0224			Register Name: PLL_AUDIO_BIAS_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:24	R/W	0x10	PLL_VCO_BIAS. PLL VCO Bias Current[4:0].
23:21	/	/	/
20:16	R/W	0x10	PLL_BIAS_CUR. PLL Bias Current[4:0].
15:0	/	/	/

PLL_VIDEO Bias Register (Default: 0x10100000)

Offset: 0x0228			Register Name: PLL_VIDEO_BIAS_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:24	R/W	0x10	PLL_VCO_BIAS_CTRL. PLL VCO Bias Control[4:0].
23:21	/	/	/
20:16	R/W	0x10	PLL_BIAS_CTRL. PLL Bias Control[4:0].
15:3	/	/	/
2:0	R/W	0x0	PLL_DAMP_FACTOR_CTRL. PLL Damping Factor Control[2:0].

PLL_VE Bias Register (Default: 0x10100000)

Offset: 0x022C			Register Name: PLL_VE_BIAS_REG
Bit	Read/Write	Default/Hex	Description

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31:29	/	/	/
28:24	R/W	0x10	PLL_VCO_BIAS_CTRL. PLL VCO Bias Control[4:0].
23:21	/	/	/
20:16	R/W	0x10	PLL_BIAS_CTRL. PLL Bias Control[4:0].
15:3	/	/	/
2:0	R/W	0x0	PLL_DAMP_FACTOR_CTRL. PLL Damping Factor Control[2:0].

PLL_DDR0 Bias Register (Default: 0x81104000)

Offset: 0x0230			Register Name: PLL_DDR0_BIAS_REG
Bit	Read/Write	Default/Hex	Description
31:28	R/W	0x8	PLL_VCO_BIAS. PLL VCO Bias[3:0].
27:26	/	/	/.
25	R/W	0x0	PLL_VCO_GAIN_CTRL_EN. PLL VCO Gain Control Enable. 0: Disable 1: Enable.
24	R/W	0x1	PLL_BANDW_CTRL. PLL Band Width Control. 0: Narrow 1: Wide.
23:21	/	/	/
20:16	R/W	0x10	PLL_BIAS_CUR_CTRL. PLL Bias Current Control.
15	/	/	/
14:12	R/W	0x4	PLL_VCO_GAIN_CTRL. PLL VCO Gain Control Bit[2:0].
11:4	/	/	/
3:0	R/W	0x0	PLL_DAMP_FACTOR_CTRL. PLL Damping Factor Control[3:0].

PLL_PERIPH Bias Register (Default: 0x10100010)

Offset: 0x0234			Register Name: PLL_PERIPH_BIAS_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:24	R/W	0x10	PLL_VCO_BIAS. PLL VCO Bias[4:0].
23:21	/	/	/
20:16	R/W	0x10	PLL_BIAS_CUR_CTRL. PLL Bias Current Control.
15:5	/	/	/
4	R/W	0x1	PLL_BANDW_CTRL.

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			PLL Band Width Control. 0: Narrow 1: Wide.
3:2	/	/	/
1:0	R/W	0x0	PLL_DAMP_FACTOR_CTRL. PLL Damping Factor Control[1:0].

PLL_GPU Bias Register (Default: 0x10100000)

Offset: 0x023C			Register Name: PLL_GPU_BIAS_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/.
28:24	R/W	0x10	PLL_VCO_BIAS_CTRL. PLL VCO Bias Control[4:0].
23:21	/	/	/.
20:16	R/W	0x10	PLL_BIAS_CTRL. PLL Bias Control[4:0].
15:3	/	/	/.
2:0	R/W	0x0	PLL_DAMP_FACTOR_CTRL. PLL Damping Factor Control[2:0].

PLL_MIPI Bias Register (Default: 0xA8100400)

Offset: 0x0240			Register Name: PLL_MIPI_BIAS_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x1	VCO_RST. VCO Reset In.
30:28	R/W	0x2	PLLVDD_LDO_OUT_CTRL. PLLVDD LDO Output Control. 000:1.10v 001:1.15v 010:1.20v 011:1.25v 100: 1.30v 101:1.35v 110:1.40v 111:1.45v
27:24	R/W	0x8	PLL_VCO_BIAS_CTRL. PLL VCO Bias Control [3:0].
23:21	/	/	/
20:16	R/W	0x10	PLL_BIAS_CUR_CTRL. PLL Bias Current Control[4:0].
15:11	/	/	/
10:8	R/W	0x4	PLL_LOCK_CTRL. PLL Lock Time Control[2:0].
7:1	/	/	/
0	R/W	0x0	PLL_DAMP_FACT_CTRL.

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			PLL Damping Factor Control.

PLL_HSIC Bias Register (Default: 0x10100000)

Offset: 0x0244			Register Name: PLL_HSIC_BIAS_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/.
28:24	R/W	0x10	PLL_VCO_BIAS_CTRL. PLL VCO Bias Control[4:0].
23:21	/	/	/.
20:16	R/W	0x10	PLL_BIAS_CTRL. PLL Bias Control[4:0].
15:3	/	/	/.
2:0	R/W	0x0	PLL_DAMP_FACTOR_CTRL. PLL Damping Factor Control[2:0].

PLL_DE Bias Register (Default: 0x10100000)

Offset: 0x0248			Register Name: PLL_DE_BIAS_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/.
28:24	R/W	0x10	PLL_VCO_BIAS_CTRL. PLL VCO Bias Control[4:0].
23:21	/	/	/.
20:16	R/W	0x10	PLL_BIAS_CTRL. PLL Bias Control[4:0].
15:3	/	/	/.
2:0	R/W	0x0	PLL_DAMP_FACTOR_CTRL. PLL Damping Factor Control[2:0].

PLL_DDR1 Bias Register (Default: 0x10010000)

Offset: 0x024C			Register Name: PLL_DDR1_BIAS_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:24	R/W	0x10	PLL_VCO_BIAS_CTRL. PLL VCO Bias Control[4:0].
23:21	/	/	/
20:16	R/W	0x01	PLL_BIAS_CUR_CTRL. PLL Bias Current Control[4:0].
15:0	/	/	/

PLL_CPUX Tuning Register (Default: 0x0A101000)

Offset: 0x0250			Register Name: PLL_CPUX_TUN_REG
Bit	Read/Write	Default/Hex	Description
31:28	/	/	/
27	R/W	0x1	PLL_BAND_WID_CTRL. PLL Band Width Control.

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			0: Narrow 1: Wide.
26	R/W	0x0	VCO_GAIN_CTRL_EN. VCO Gain Control Enable. 0: Disable 1: Enable.
25:23	R/W	0x4	VCO_GAIN_CTRL. VCO Gain Control Bits[2:0].
22:16	R/W	0x10	PLL_INIT_FREQ_CTRL. PLL Initial Frequency Control[6:0].
15	R/W	0x0	C_OD. C-Reg-Od For Verify.
14:8	R/W	0x10	C_B_IN. C-B-In[6:0] For Verify.
7	R/W	0x0	C_OD1. C-Reg-Od1 For Verify.
6:0	R	0x0	C_B_OUT. C-B-Out[6:0] For Verify.

PLL_DDR0 Tuning Register (Default: 0x14880000)

Offset: 0x0260			Register Name: PLL_DDR0_TUN_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28	R/W	0x1	VREG1_OUT_EN. Vreg1 Out Enable. 0: Disable 1: Enable.
27	/	/	/
26:24	R/W	0x4	PLL_LTIME_CTRL. PLL Lock Time Control[2:0].
23	R/W	0x0	VCO_RST. VCO Reset In.
22:16	R/W	0x10	PLL_INIT_FREQ_CTRL. PLL Initial Frequency Control[6:0].
15	R/W	0x0	OD1. Reg-Od1 For Verify.
14:8	R/W	0x10	B_IN. B-In[6:0] For Verify.
7	R/W	0x0	OD. Reg-Od For Verify.
6:0	R	0x0	B_OUT. B-Out[6:0] For Verify.

PLL_MIPI Tuning Register (Default: 0x8A002000)

Offset: 0x0270	Register Name: PLL_MIPI_TUN_REG

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Bit	Read/Write	Default/Hex	Description
31	R/W	0x1	PLL_INPUT_POWER_SEL. 0:2.5V 1:3.3V.
30	/	/	/
29:28	R/W	0x0	VREG_OUT_EN. For Verify
27	R/W	0x1	PLL_BAND_WID_CTRL. PLL Band Width Control. 0: Narrow 1: Wide.
26	R/W	0x0	VCO_GAIN_CTRL_EN. VCO Gain Control Enable. 0: Disable 1: Enable.
25:23	R/W	0x4	VCO_GAIN_CTRL. VCO Gain Control Bits[2:0].
22	/	/	/
21:16	R/W	0x0	CNT_INT. For Verify[5:0].
15	R/W	0x0	C_OD. C-Reg-Od For Verify
14	/	/	/
13:8	R/W	0x20	C_B_IN. C-B-In[5:0] For Verify
7	R/W	0x0	C_OD1. C-Reg-Od1 For Verify
6	/	/	/
5:0	R	0x0	C_B_OUT. C-B-Out[5:0] For Verify

PLL_CPUX Pattern Control Register (Default: 0x00000000)

Offset: 0x0280			Register Name: PLL_CPUX_PAT_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SIG_DELT_PAT_EN. Sigma-Delta Pattern Enable.
30:29	R/W	0x0	SPR_FREQ_MODE. Spread Frequency Mode. 00: DC=0 01: DC=1 1X: Triangular.
28:20	R/W	0x0	WAVE_STEP. Wave Step.
19	/	/	/
18:17	R/W	0x0	FREQ.

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			Frequency. 00: 31.5KHz 01: 32KHz 10: 32.5KHz 11: 33KHz.
16:0	R/W	0x0	WAVE_BOT. Wave Bottom.

PLL_AUDIO Pattern Control Register (Default: 0x00000000)

Offset: 0x0284			Register Name: PLL_AUDIO_PAT_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SIG_DELT_PAT_EN. Sigma-Delta Pattern Enable.
30:29	R/W	0x0	SPR_FREQ_MODE. Spread Frequency Mode. 00: DC=0 01: DC=1 1X: Triangular.
28:20	R/W	0x0	WAVE_STEP. Wave Step.
19	/	/	/
18:17	R/W	0x0	FREQ. Frequency. 00: 31.5KHz 01: 32KHz 10: 32.5KHz 11: 33KHz.
16:0	R/W	0x0	WAVE_BOT. Wave Bottom.

PLL_VIDEO Pattern Control Register (Default: 0x00000000)

Offset: 0x0288			Register Name: PLL_VIDEO_PAT_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SIG_DELT_PAT_EN. Sigma-Delta Pattern Enable.
30:29	R/W	0x0	SPR_FREQ_MODE. Spread Frequency Mode. 00: DC=0 01: DC=1 1X: Triangular.
28:20	R/W	0x0	WAVE_STEP. Wave Step.
19	/	/	/
18:17	R/W	0x0	FREQ. Frequency.

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			00: 31.5KHz 01: 32KHz 10: 32.5KHz 11: 33KHz.
16:0	R/W	0x0	WAVE_BOT. Wave Bottom.

PLL_VE Pattern Control Register (Default: 0x00000000)

Offset: 0x028C			Register Name: PLL_VE_PAT_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SIG_DELT_PAT_EN. Sigma-Delta Pattern Enable.
30:29	R/W	0x0	SPR_FREQ_MODE. Spread Frequency Mode. 00: DC=0 01: DC=1 1X: Triangular.
28:20	R/W	0x0	WAVE_STEP. Wave Step.
19	/	/	/
18:17	R/W	0x0	FREQ. Frequency. 00: 31.5KHz 01: 32KHz 10: 32.5KHz 11: 33KHz.
16:0	R/W	0x0	WAVE_BOT. Wave Bottom.

PLL_DDR0 Pattern Control Register (Default: 0x00000000)

Offset: 0x0290			Register Name: PLL_DDR0_PAT_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SIG_DELT_PAT_EN. Sigma-Delta Pattern Enable.
30:29	R/W	0x0	SPR_FREQ_MODE. Spread Frequency Mode. 00: DC=0 01: DC=1 1X: Triangular.
28:20	R/W	0x0	WAVE_STEP. Wave Step.
19	/	/	/
18:17	R/W	0x0	FREQ. Frequency. 00: 31.5KHz

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			01: 32KHz 10: 32.5KHz 11: 33KHz.
16:0	R/W	0x0	WAVE_BOT. Wave Bottom.

PLL_GPU Pattern Control Register (Default: 0x00000000)

Offset: 0x029C			Register Name: PLL_GPU_PAT_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SIG_DELT_PAT_EN. Sigma-Delta Pattern Enable.
30:29	R/W	0x0	SPR_FREQ_MODE. Spread Frequency Mode. 00: DC=0 01: DC=1 1X: Triangular.
28:20	R/W	0x0	WAVE_STEP. Wave Step.
19	/	/	/
18:17	R/W	0x0	FREQ. Frequency. 00: 31.5KHz 01: 32KHz 10: 32.5KHz 11: 33KHz.
16:0	R/W	0x0	WAVE_BOT. Wave Bottom.

PLL_MIPI Pattern Control Register (Default: 0x00000000)

Offset: 0x02A0			Register Name: PLL_MIPI_PAT_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SIG_DELT_PAT_EN. Sigma-Delta Pattern Enable.
30:29	R/W	0x0	SPR_FREQ_MODE. Spread Frequency Mode. 00: DC=0 01: DC=1 1X: Triangular.
28:20	R/W	0x0	WAVE_STEP. Wave Step.
19	/	/	/
18:17	R/W	0x0	FREQ. Frequency. 00: 31.5KHz 01: 32KHz

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			10: 32.5KHz 11: 33KHz.
16:0	R/W	0x0	WAVE_BOT. Wave Bottom.

PLL_HSIC Pattern Control Register (Default: 0x00000000)

Offset: 0x02A4			Register Name: PLL_HSIC_PAT_CTRL_REG
Bit	**Read/Write**	**Default/Hex**	**Description**
31	R/W	0x0	SIG_DELT_PAT_EN. Sigma-Delta Pattern Enable.
30:29	R/W	0x0	SPR_FREQ_MODE. Spread Frequency Mode. 00: DC=0 01: DC=1 1X: Triangular.
28:20	R/W	0x0	WAVE_STEP. Wave Step.
19	/	/	/
18:17	R/W	0x0	FREQ. Frequency. 00: 31.5KHz 01: 32KHz 10: 32.5KHz 11: 33KHz.
16:0	R/W	0x0	WAVE_BOT. Wave Bottom.

PLL_DE Pattern Control Register (Default: 0x00000000)

Offset: 0x02A8			Register Name: PLL_DE_PAT_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SIG_DELT_PAT_EN. Sigma-Delta Pattern Enable.
30:29	R/W	0x0	SPR_FREQ_MODE. Spread Frequency Mode. 00: DC=0 01: DC=1 1X: Triangular.
28:20	R/W	0x0	WAVE_STEP. Wave Step.
19	/	/	/
18:17	R/W	0x0	FREQ. Frequency. 00: 31.5KHz 01: 32KHz 10: 32.5KHz

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			11: 33KHz.
16:0	R/W	0x0	WAVE_BOT. Wave Bottom.

PLL_DDR1 Pattern Control Register 0 (Default: 0x00000000)

Offset: 0x02AC			Register Name: PLL_DDR1_PAT_CTRL_REG0
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	SIG_DELT_PAT_EN. Sigma-Delta Pattern Enable.
30:29	R/W	0x0	SPR_FREQ_MODE. Spread Frequency Mode. 00: DC=0 01: DC=1 10: / 11: Triangular.
28:20	R/W	0x0	WAVE_STEP. Wave Step.
19	/	/	/
18:17	R/W	0x0	FREQ. Frequency. 00: 31.5KHz 01: 32KHz 10: 32.5KHz 11: 33KHz.
16:0	R/W	0x0	WAVE_BOT. Wave Bottom.

PLL_DDR1 Pattern Control Register 1(Default: 0x00000000)

Offset: 0x02B0			Register Name: PLL_DDR1_PAT_CTRL_REG1
Bit	Read/Write	Default/Hex	Description
30:25	/	/	/
24	R/W	0x0	DITHER_EN.
23:21	/	/	/
20	R/W	0x0	FRAC_EN.
19:17	/	/	/
16:0	R/W	0x0	FRAC_IN.

Bus Software Reset Register 0 (Default: 0x00000000)

Offset: 0x02C0			Register Name: BUS_SOFT_RST_REG0
Bit	Read/Write	Default/Hex	Description
31:30	/	/	/
29	R/W	0x0	USBOHCI_RST. USB OHCI Reset Control 0: Assert 1: De-assert.

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27	/	/	/
26	R/W	0x0	USBEHCI_RST. USB EHCI Reset Control 0: Assert 1: De-assert.
25	/	/	/
24	R/W	0x0	USBOTG_RST. USB OTG Reset Control 0: Assert 1: De-assert.
23:22	/	/	/
21	R/W	0x0	/
20	R/W	0x0	SPI0_RST. SPI0 Reset. 0: Assert 1: De-assert.
19	R/W	0x0	HSTMR_RST. HSTMR Reset. 0: Assert 1: De-assert.
18:15	/	/	/
14	R/W	0x0	SDRAM_RST. SDRAM AHB Reset. 0: Assert 1: De-assert.
13	R/W	0x0	NAND_RST. NAND Reset. 0: Assert 1: De-assert.
12:11	/	/	/
10	R/W	0x0	SD2_RST. SD/MMC2 Reset. 0: Assert 1: De-assert.
9	R/W	0x0	SD1_RST. SD/MMC1 Reset. 0: Assert 1: De-assert.
8	R/W	0x0	SD0_RST. SD/MMC0 Reset. 0: Assert 1: De-assert.
7	/	/	/
6	R/W	0x0	DMA_RST. DMA Reset.

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			0: Assert 1: De-assert.
5	R/W	0x0	CE_RST. CE Reset. 0: Assert 1: De-assert.
4:2	/	/	/
1	R/W	0x0	MIPI_DSI_RST. MIPI DSI Reset. 0: Assert 1: De-assert.
0	/	/	/

Bus Software Reset Register 1 (Default: 0x00000000)

Offset: 0x02C4			Register Name: BUS_SOFT_RST_REG1
Bit	Read/Write	Default/Hex	Description
31:27	/	/	/
26	R/W	0x0	SAT_RST. SAT Reset. 0: Assert 1: De-assert.
25	R/W	0x0	DRC_RST. DRC Reset. 0: Assert 1: De-assert.
24:23	/	/	/
22	R/W	0x0	SPINLOCK_RST. SPINLOCK Reset. 0: Assert 1: De-assert.
21	R/W	0x0	MSGBOX_RST. MSGBOX Reset. 0: Assert 1: De-assert.
20	R/W	0x0	GPU_RST. GPU Reset. 0: Assert 1: De-assert.
19:15	/	/	/
14	R/W	0x0	FE_RST. DE-FE Reset. 0: Assert 1: De-assert.
13	/	/	/
12	R/W	0x0	BE_RST.

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			DE-BE Reset. 0: Assert 1: De-assert.
11:9	/	/	/
8	R/W	0x0	CSI_RST. CSI Reset. 0: Assert 1: De-assert.
7:5	/	/	
4	R/W	0x0	LCD_RST. LCD Reset. 0: Assert 1: De-assert.
3:1	/	/	/
0	R/W	0x0	VE_RST. VE Reset. 0: Assert 1: De-assert.

Bus Software Reset Register 2 (Default: 0x00000000)

Offset: 0x02C8			Register Name: BUS_SOFT_RST_REG2
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/
0	R/W	0x0	LVDS_RST. LVDS Reset. 0: Assert 1: De-assert.

Bus Software Reset Register 3 (Default: 0x00000000)

Offset: 0x02D0			Register Name: BUS_SOFT_RST_REG3
Bit	Read/Write	Default/Hex	Description
31:14	/	/	/.
13	R/W	0x0	DAUDIO1_RST. DAUDIO1 Reset. 0: Assert 1: De-assert.
12	R/W	0x0	DAUDIO0_RST. DAUDIO0 Reset. 0: Assert 1: De-assert.
11:1	/	/	/
0	R/W	0x0	AC_RST. Audio Codec Reset. 0: Assert 1: De-assert.

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Bus Software Reset Register 4 (Default: 0x00000000)

Offset: 0x02D8			Register Name: BUS_SOFT_RST_REG4
Bit	Read/Write	Default/Hex	Description
31:21	/	/	/
20	R/W	0x0	/
19	R/W	0x0	UART3_RST. UART3 Reset. 0: Assert 1: De-assert.
18	R/W	0x0	UART2_RST. UART2 Reset. 0: Assert 1: De-assert.
17	R/W	0x0	UART1_RST. UART1 Reset. 0: Assert 1: De-assert.
16	R/W	0x0	UART0_RST. UART0 Reset. 0: Assert 1: De-assert.
15:3	/	/	/
2	R/W	0x0	TWI2_RST. TWI2 Reset. 0: Assert 1: De-assert.
1	R/W	0x0	TWI1_RST. TWI1 Reset. 0: Assert 1: De-assert.
0	R/W	0x0	TWI0_RST. TWI0 Reset. 0: Assert 1: De-assert.

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3.4 CPU CFG

3.4.1 Overview

The CPU configuration module features:

- Support software reset control for each CPU core
- Support CPU configuration for each CPU core
- Support a 64-bit common counter

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3.4.2 CPUCFG Register List

Module Name	Base Address
CPUCFG	0x01F01C00

Register Name	Offset	Description
/	0x0000	/
/	0x000C	/
/	0x0010	/
/	0x0014	/
/	0x0018	/
/	0x001C	/
/	0x0020	/
/	0x0024	/
/	0x0028	/
/	0x002C	/
CPU0_RST_CTRL	0x0040	CPU0 Reset Control
CPU0_CTRL_REG	0x0044	CPU0 Control Register
CPU0_STATUS_REG	0x0048	CPU0 Status Register
CPU1_RST_CTRL	0x0080	CPU1 Reset Control
CPU1_CTRL_REG	0x0084	CPU1 Control Register
CPU1_STATUS_REG	0x0088	CPU1 Status Register
CPU2_RST_CTRL	0x00C0	CPU2 Reset Control
CPU2_CTRL_REG	0x00C4	CPU2 Control Register
CPU2_STATUS_REG	0x00C8	CPU2 Status Register
CPU3_RST_CTRL	0x0100	CPU3 Reset Control
CPU3_CTRL_REG	0x0104	CPU3 Control Register
CPU3_STATUS_REG	0x0108	CPU3 Status Register
CPU_SYS_RST_REG	0x0140	CPU System Reset Register
GENER_CTRL_REG	0x0184	General Control Register
EVENT_IN	0x0190	Event Input Register
SUP_STAN_FLAG_REG	0x01A0	Super Standby Flag Register
PRIVATE_REG0	0x01A4	Private Register0
PRIVATE_REG1	0x01A8	Private Register1
CNT64_CTRL_REG	0x0280	64-Bit Counter Control Register
CNT64_LOW_REG	0x0284	64-Bit Counter Low Register
CNT64_HIGH_REG	0x0288	64-Bit Counter High Register

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3.4.3 CPUCFG Register Description

CPU0 Reset Control (Default: 0x00000003)

Offset: 0x40			Register Name: CPU0_RST_CTRL
Bit	Read/Write	Default/Hex	Description
31:2	/	/	/.
1	R/W	0x1	CPU0_CORE_REST. These are the primary reset signals which initialize the processor logic in the processor power domains, not including the debug, breakpoint and watchpoint logic. 0: assert 1: de-assert.
0	R/W	0x1	CPU0_RESET. CPU0 Reset Assert. These power-on reset signals initialize all the processor logic, including CPU Debug, and breakpoint and watch point logic in the processor power domains. They do not reset debug logic in the debug power domain. 0: assert 1: de-assert.

CPU0 Control Register (Default: 0x00000000)

Offset: 0x44			Register Name: CPU0_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/
0	R/W	0x0	CPU0_CP15_WRITE_DISABLE. Disable write access to certain CP15 registers. 0: enable 1: disable

CPU0 Status Register (Default: 0x00000000)

Offset: 0x48			Register Name: CPU0_ STATUS
Bit	Read/Write	Default/Hex	Description
31:3	/	/	/.
2	R	0x0	STANDBYWFI. Indicates if the processor is in WFI standby mode: 0: Processor not in WFI standby mode. 1: Processor in WFI standby mode
1	R	0x0	STANDBYWFE. Indicates if the processor is in the WFE standby mode: 0: Processor not in WFE standby mode 1: Processor in WFE standby mode
0	R	0x0	SMP_AMP 0: AMP mode

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			1: SMP mode

CPU1 Reset Control (Default: 0x00000001)

Offset: 0x80			Register Name: CPU1_RST_CTRL
Bit	Read/Write	Default/Hex	Description
31:2	/	/	/.
1	R/W	0x0	CPU1_CORE_REST. These are the primary reset signals which initialize the processor logic in the processor power domains, not including the debug, breakpoint and watchpoint logic. 0: assert 1: de-assert.
0	R/W	0x1	CPU1_RESET. CPU1 Reset Assert. These power-on reset signals initialize all the processor logic, including CPU Debug, and breakpoint and watch point logic in the processor power domains. They do not reset debug logic in the debug power domain. 0: assert 1: de-assert.

CPU1 Control Register (Default: 0x00000000)

Offset: 0x84			Register Name: CPU1_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/
0	R/W	0x0	CPU1_CP15_WRITE_DISABLE. Disable write access to certain CP15 registers. 0: enable 1: disable

CPU1 Status Register (Default: 0x00000000)

Offset: 0x88			Register Name: CPU1_ STATUS
Bit	Read/Write	Default/Hex	Description
31:3	/	/	/.
2	R	0x0	STANDBYWFI. Indicates if the processor is in WFI standby mode: 0: Processor not in WFI standby mode. 1: Processor in WFI standby mode
1	R	0x0	STANDBYWFE. Indicates if the processor is in the WFE standby mode: 0: Processor not in WFE standby mode 1: Processor in WFE standby mode
0	R	0x0	SMP_AMP 0: AMP mode 1: SMP mode

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CPU2 Reset Control (Default: 0x00000001)

Offset: 0xC0			Register Name: CPU2_RST_CTRL
Bit	Read/Write	Default/Hex	Description
31:2	/	/	/.
1	R/W	0x0	CPU2_CORE_REST. These are the primary reset signals which initialize the processor logic in the processor power domains, not including the debug, breakpoint and watchpoint logic. 0: assert 1: de-assert.
0	R/W	0x1	CPU2_RESET. CPU2 Reset Assert. These power-on reset signals initialize all the processor logic, including CPU Debug, and breakpoint and watch point logic in the processor power domains. They do not reset debug logic in the debug power domain. 0: assert 1: de-assert.

CPU2 Control Register (Default: 0x00000000)

Offset: 0xC4			Register Name: CPU2_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/
0	R/W	0x0	CPU2_CP15_WRITE_DISABLE. Disable write access to certain CP15 registers. 0: enable 1: disable

CPU2 Status Register (Default: 0x00000000)

Offset: 0xC8			Register Name: CPU2_ STATUS
Bit	Read/Write	Default/Hex	Description
31:3	/	/	/.
2	R	0x0	STANDBYWFI. Indicates if the processor is in WFI standby mode: 0: Processor not in WFI standby mode. 1: Processor in WFI standby mode
1	R	0x0	STANDBYWFE. Indicates if the processor is in the WFE standby mode: 0: Processor not in WFE standby mode 1: Processor in WFE standby mode
0	R	0x0	SMP_AMP 0: AMP mode 1: SMP mode

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CPU3 Reset Control (Default: 0x00000001)

Offset: 0x100			Register Name: CPU3_RST_CTRL
Bit	Read/Write	Default/Hex	Description
31:2	/	/	/.
1	R/W	0x0	CPU3_CORE_REST. These are the primary reset signals which initialize the processor logic in the processor power domains, not including the debug, breakpoint and watchpoint logic. 0: assert 1: de-assert.
0	R/W	0x1	CPU3_RESET. CPU3 Reset Assert. These power-on reset signals initialize all the processor logic, including CPU Debug, and breakpoint and watch point logic in the processor power domains. They do not reset debug logic in the debug power domain. 0: assert 1: de-assert.

CPU3 Control Register (Default: 0x00000000)

Offset: 0x104			Register Name: CPU3_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/
0	R/W	0x0	CPU3_CP15_WRITE_DISABLE. Disable write access to certain CP15 registers. 0: enable 1: disable

CPU3 Status Register (Default: 0x00000000)

Offset: 0x108			Register Name: CPU3_ STATUS
Bit	Read/Write	Default/Hex	Description
31:3	/	/	/.
2	R	0x0	STANDBYWFI. Indicates if the processor is in WFI standby mode: 0: Processor not in WFI standby mode. 1: Processor in WFI standby mode
1	R	0x0	STANDBYWFE. Indicates if the processor is in the WFE standby mode: 0: Processor not in WFE standby mode 1: Processor in WFE standby mode
0	R	0x0	SMP_AMP 0: AMP mode 1: SMP mode

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CPU System Reset Control Register (Default: 0x00000001)

Offset: 0x140			Register Name: CPU_SYS_RST_REG
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/
0	R/W	0x1	CPU System Reset Control. 0: assert 1: de-assert.

General Control Register (Default: 0x00000020)

Offset: 0x184			Register Name: GENER_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31:9	/	/	/.
8	R/W	0x0	CFGSDISABLE. Disables write access to some secure GIC registers.
7	/	/	/
6	R/W	0x0	ACINACTM. Snoop interface is inactive and no longer accepting requests.
5	R/W	0x1	L2_RST. L2 Reset.(SCU global reset) 0: Apply reset to shared L2 memory system controller. 1: Do not apply reset to shared L2 memory system controller.
4	R/W	0x0	L2_RST_DISABLE. Disable automatic L2 cache invalidate at reset: 0: L2 cache is reset by hardware. 1: L2 cache is not reset by haredware.
3:2	/	/	/
1:0	R/W	0x0	L1_RST_DISABLE. L1 Reset Disable[1:0]. 0: L1 cache is reset by hardware. 1: L1 cache is not reset by hardware.

Event Input Register (Default: 0x00000000)

Offset: 0x190			Register Name: EVENT_IN
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/.
0	R/W	0x0	EVENT_IN. Event input that can wake-up CPU0/1/2/3 from WFE standby mode.

Super Standby Flag Register (Default: 0x00000000)

Offset: 0x1A0			Register Name: SUP_STAN_FLAG_REG
Bit	Read/Write	Default/Hex	Description
31:16	R/W	0x0	SUP_STANDBY_FLAG.

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			Key Field. Any value can be written and read back in the key field, but if the values are not appropriate, the lower 16 bits will not change in this register. Only fellow the appropriate process, the super standby flag can be written in the lower 16 bits. Refer to Description and Diagram.
15:0	R/W	0x0	SUP_STANBY_FLAG_DATA. Refer to Description and Diagram

Note: When system is turned on, the value in the Super Standby Flag Register low 16 bits should be 0x0. If software programmer wants to write correct super standby flag ID in low 16 bits, the high 16 bits should be written 0x16AA at first. Then, software programmer must write 0xAA16XXXX in the Super Standby Flag Register, the 'XXXX' means the correct super standby flag ID. Referring to the Diagram section (Diagram 1.1) in detail.

Private Register0 (Default: 0x00000000)

Offset: 0x1A4			Register Name: PRIVATE_REG0
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0x0	/

Private Register1 (Default: 0x00000000)

Offset: 0x1A8			Register Name: PRIVATE_REG1
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0x0	/

64-bit Counter Control Register (Default: 0x00000000)

Offset: 0x280			Register Name: CNT64_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31:3	/	/	/.
2	R/W	0x0	CNT64_CLK_SRC_SEL. 64-bit Counter Clock Source Select. 0: OSC24M 1: /
1	R/W	0x0	CNT64_RL_EN. 64-bit Counter Read Latch Enable. 0: no effect, 1: to latch the 64-bit Counter to the Low/Hi registers and it will change to zero after the registers are latched.
0	R/W	0x0	CNT64_CLR_EN. 64-bit Counter Clear Enable. 0: no effect, 1: to clear the 64-bit Counter Low/Hi registers and it will change to zero after the registers are cleared. Note: It is not recommended to clear this counter arbitrarily.

Note: This 64-bit counter will start to count as soon as the System Power On finished.

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64-bit Counter Low Register (Default: 0x00000000)

Offset: 0x284			Register Name: CNT64_LOW_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0x0	CNT64_LO. 64-bit Counter [31:0].

64-bit Counter High Register (Default: 0x00000000)

Offset: 0x288			Register Name: CNT64_HIGH_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0x0	CNT64_HI. 64-bit Counter [63:32].

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3.5 Timer

3.5.1 Overview

The R16 provides two timers, a watch dog and two AVS counters.

Timer 0/1 can take their inputs from internal RC oscillator, external 32768Hz crystal or OSC24M. They provide the operating system's scheduler interrupt. It is designed to offer maximum accuracy and efficient management, even for systems with long or short response time. They provide 24-bit programmable overflow counter and work in auto-reload mode or no-reload mode. When the current value in *Current Value Register* is counting down to zero, the timer will generate interrupt if set interrupt enable bit.

The watchdog is used to resume the controller operation when it had been disturbed by malfunctions such as noise and system errors. It features a down counter that allows a watch dog period of up to 16 seconds (512000 cycles). It can generate a general reset or interrupt request.

AVS counter is used to synchronize video and audio in the player.

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3.5.2 Block Diagram

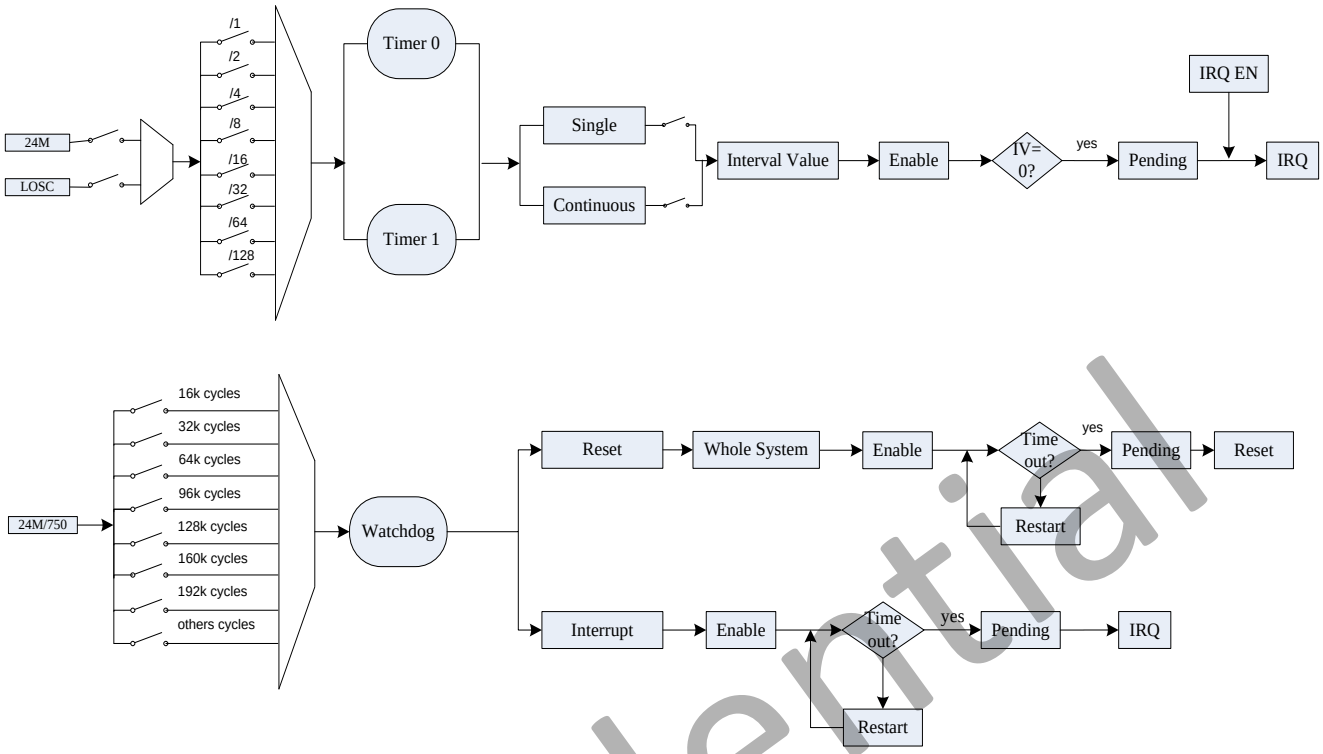

Figure3.5-1 Timer Block Diagram

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3.5.3 Timer Register List

Module Name	Base Address
Timer	0x01C20C00

Register Name	Offset	Description
TMR_IRQ_EN_REG	0x0	Timer IRQ Enable Register
TMR_IRQ_STA_REG	0x4	Timer Status Register
TMR0_CTRL_REG	0x10	Timer 0 Control
TMR0_INTV_VALUE_REG	0x14	Timer 0 Interval Value Register
TMR0_CUR_VALUE_REG	0x18	Timer 0 Current Value Register
TMR1_CTRL_REG	0x20	Timer 1 Control Register
TMR1_INTV_VALUE_REG	0x24	Timer 1 Interval Value Register
TMR1_CUR_VALUE_REG	0x28	Timer 1 Current Value Register
AVS_CNT_CTL_REG	0x80	AVS Control Register
AVS_CNT0_REG	0x84	AVS Counter 0 Register
AVS_CNT1_REG	0x88	AVS Counter 1 Register
AVS_CNT_DIV_REG	0x8C	AVS Divisor
WDOG0_IRQ_EN_REG	0xA0	Watchdog 0 IRQ Enable Register
WDOG0_IRQ_STA_REG	0xA4	Watchdog 0 Status Register
WDOG0_CTRL_REG	0xB0	Watchdog 0 Control Register
WDOG0_CFG_REG	0xB4	Watchdog 0 Configuration Register
WDOG0_MODE_REG	0xB8	Watchdog 0 Mode Register

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3.5.4 Timer Programmable Register

Timer IRQ Enable Register (Default: 0x00000000)

Offset:0x0			Register Name: TMR_IRQ_EN_REG
Bit	Read/Write	Default/Hex	Description
31:2	/	/	/
1	R/W	0x0	TMR1_IRQ_EN. Timer 1 Interrupt Enable. 0: No effect; 1: Timer 1 Interval Value reached interrupt enable.
0	R/W	0x0	TMR0_IRQ_EN. Timer 0 Interrupt Enable. 0: No effect; 1: Timer 0 Interval Value reached interrupt enable.

Timer IRQ Status Register (Default: 0x00000000)

Offset:0x04			Register Name: TMR_IRQ_STA_REG
Bit	Read/Write	Default/Hex	Description
31:2	/	/	/
1	R/W	0x0	TMR1_IRQ_PEND. Timer 1 IRQ Pending. Set 1 to the bit will clear it. 0: No effect; 1: Pending, timer 1 interval value is reached.
0	R/W	0x0	TMR0_IRQ_PEND. Timer 0 IRQ Pending. Set 1 to the bit will clear it. 0: No effect; 1: Pending, timer 0 interval value is reached.

Timer 0 Control Register (Default: 0x00000004)

Offset:0x10			Register Name: TMR0_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7	R/W	0x0	TMR0_MODE. Timer 0 mode. 0: Continuous mode. When interval value reached, the timer will not disable automatically. 1: Single mode. When interval value reached, the timer will disable automatically.
6:4	R/W	0x0	TMR0_CLK_PRES. Select the pre-scale of timer 0 clock source. 000: /1 001: /2 010: /4 011: /8

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			100: /16 101: /32 110: /64 111: /128
3:2	R/W	0x1	TMR0_CLK_SRC. Timer 0 Clock Source. 'N' is the value of Internal OSC Clock Prescalar register. 00: InternalOSC / N 01: OSC24M. 10: / 11: /
1	R/W	0x0	TMR0_RELOAD. Timer 0 Reload. 0: No effect, 1: Reload timer 0 Interval value. After the bit is set, it can not be written again before it's cleared automatically.
0	R/W	0x0	TMR0_EN. Timer 0 Enable. 0: Stop/Pause, 1: Start. If the timer is started, it will reload the interval value to internal register, and the current counter will count from interval value to 0. If the current counter does not reach the zero, the timer enable bit is set to "0", the current value counter will pause. At least wait for 2 cycles, the start bit can be set to 1. In timer pause state, the interval value register can be modified. If the timer is started again, and the Software hope the current value register to down-count from the new interval value, the reload bit and the enable bit should be set to 1 at the same time.

Timer 0 Interval Value Register

Offset:0x14			Register Name: TMR0_INTV_VALUE_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0x0	TMR0_INTV_VALUE. Timer 0 Interval Value.

Note: the value setting should consider the system clock and the timer clock source.

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Timer 0 Current Value Register

Offset:0x18			Register Name: TMR0_CUR_VALUE_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0x0	TMR0_CUR_VALUE. Timer 0 Current Value.

Note: Timer 0 current value is a 32-bit down-counter (from interval value to 0).

Timer 1 Control Register (Default: 0x00000004)

Offset:0x20			Register Name: TMR1_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7	R/W	0x0	TMR1_MODE. Timer 1 mode. 0: Continuous mode. When interval value reached, the timer will not disable automatically. 1: Single mode. When interval value reached, the timer will disable automatically.
6:4	R/W	0x0	TMR1_CLK_PRES. Select the pre-scale of timer 1 clock source. 000: /1 001: /2 010: /4 011: /8 100: /16 101: /32 110: /64 111: /128
3:2	R/W	0x1	TMR1_CLK_SRC. Timer 1 Clock Source. 'N' is the value of Internal OSC Clock Prescalar register. 00: InternalOSC / N 01: OSC24M. 10: / 11: /.
1	R/W	0x0	TMR1_RELOAD. Timer 1 Reload. 0: No effect, 1: Reload timer 1 Interval value. After the bit is set, it can not be written again before it's cleared automatically.
0	R/W	0x0	TMR1_EN. Timer 1 Enable. 0: Stop/Pause, 1: Start. If the timer is started, it will reload the interval value to internal register, and the current counter will count from

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			interval value to 0. If the current counter does not reach the zero, the timer enable bit is set to "0", the current value counter will pause. At least wait for 2 cycles, the start bit can be set to 1. In timer pause state, the interval value register can be modified. If the timer is started again, and the Software hope the current value register to down-count from the new interval value, the reload bit and the enable bit should be set to 1 at the same time.

Timer 1 Interval Value Register

Offset:0x24			Register Name: TMR1_INTV_VALUE_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0x0	TMR1_INTV_VALUE. Timer 1 Interval Value.

Note: the value setting should consider the system clock and the timer clock source.

Timer 1 Current Value Register

Offset:0x28			Register Name: TMR1_CUR_VALUE_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0x0	TMR1_CUR_VALUE. Timer 1 Current Value.

Note: Timer 1 current value is a 32-bit down-counter (from interval value to 0).

AVS Counter Control Register (Default: 0x00000000)

Offset:0x80			Register Name: AVS_CNT_CTL_REG
Bit	Read/Write	Default/Hex	Description
31:10	/	/	/
9	R/W	0x0	AVS_CNT1_PS. Audio/Video Sync Counter 1 Pause Control 0: Not pause 1: Pause Counter 1
8	R/W	0x0	AVS_CNT0_PS. Audio/Video Sync Counter 0 Pause Control 0: Not pause 1: Pause Counter 0
7:2	/	/	/
1	R/W	0x0	AVS_CNT1_EN. Audio/Video Sync Counter 1 Enable/ Disable. The counter source is OSC24M. 0: Disable 1: Enable
0	R/W	0x0	AVS_CNT0_EN. Audio/Video Sync Counter 1 Enable/ Disable. The counter

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			source is OSC24M. 0: Disable 1: Enable

AVS Counter 0 Register (Default: 0x00000000)

Offset:0x84			Register Name: AVS_CNT0_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0x0	AVS_CNT0. Counter 0 for Audio/ Video Sync Application The high 32 bits of the internal 33-bits counter register. The initial value of the internal 33-bits counter register can be set by software. The LSB bit of the 33-bits counter register should be zero when the initial value is updated. It will count from the initial value. The initial value can be updated at any time. It can also be paused by setting AVS_CNT0_PS to '1'. When it is paused, the counter won't increase.

AVS Counter 1 Register (Default: 0x00000000)

Offset:0x88			Register Name: AVS_CNT1_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0x0	AVS_CNT1. Counter 1 for Audio/ Video Sync Application The high 32 bits of the internal 33-bits counter register. The initial value of the internal 33-bits counter register can be set by software. The LSB bit of the 33-bits counter register should be zero when the initial value is updated. It will count from the initial value. The initial value can be updated at any time. It can also be paused by setting AVS_CNT1_PS to '1'. When it is paused, the counter won't increase.

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AVS Counter Divisor Register (Default: 0x05DB05DB)

Offset:0x8C			Register Name: AVS_CNT_DIV_REG
Bit	Read/Write	Default/Hex	Description
31:28	/	/	/
27:16	R/W	0x5DB	AVS_CNT1_D. Divisor N for AVS Counter 1 AVS CN1 CLK=24MHz/Divisor_N1. Divisor N1 = Bit [27:16] + 1. The number N is from 1 to 0x7ff. The zero value is reserved. The internal 33-bits counter engine will maintain another 12-bits counter. The 12-bits counter is used for counting the cycle number of one 24Mhz clock. When the 12-bits counter reaches (>= N) the divisor value, the internal 33-bits counter register will increase 1 and the 12-bits counter will reset to zero and restart again. **Note**: It can be configured by software at any time.
15:12	/	/	/
11:0	R/W	0x5DB	AVS_CNT0_D. Divisor N for AVS Counter 0 AVS CN0 CLK=24MHz/Divisor_N0. Divisor N0 = Bit [11:0] + 1 The number N is from 1 to 0x7ff. The zero value is reserved. The internal 33-bits counter engine will maintain another 12-bits counter. The 12-bits counter is used for counting the cycle number of one 24Mhz clock. When the 12-bits counter reaches (>= N) the divisor value, the internal 33-bits counter register will increase 1 and the 12-bits counter will reset to zero and restart again. **Note**: It can be configured by software at any time.

Watchdog 0 IRQ Enable Register (Default: 0x00000000)

Offset:0xA0			Register Name: WDOG0_IRQ_EN_REG
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/
0	R/W	0x0	WDOG0_IRQ_EN. Watchdog 0 Interrupt Enable. 0: No effect, 1: Watchdog 0 interrupt enable.

Watchdog 0 Status Register (Default: 0x00000000)

Offset:0xA4			Register Name: WDOG0_IRQ_STA_REG
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/
0	R/W	0x0	WDOG0_IRQ _PEND. Watchdog 0 IRQ Pending. Set 1 to the bit will clear it.

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			0: No effect, 1: Pending, Watchdog 0 interval value is reached.

Watchdog 0 Control Register (Default: 0x00000000)

Offset:0xB0			Register Name: WDOG0_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:1	R/W	0x0	/
0	R/W	0x0	WDOG0_RSTART. Watchdog 0 Restart. 0: No effect, 1: Restart the Watchdog 0.

Watchdog 0 Configuration Register (Default: 0x00000000)

Offset:0xB4			Register Name: WDOG0_CFG_REG
Bit	Read/Write	Default/Hex	Description
31:2	/	/	/
1:0	R/W	0x1	WDOG0_CONFIG. 00: / 01: to whole system 10: only interrupt 11: /

Watchdog 0 Mode Register (Default: 0x00000000)

Offset:0xB8			Register Name: WDOG0_MODE_REG
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7:4	R/W	0x0	WDOG0_INTV_VALUE. Watchdog 0 Interval Value. Watchdog 0 clock source is *OSC24M / 750*. If the clock source is turned off, Watchdog 0 will not work. 0000: 16000 cycles (0.5s) 0001: 32000 cycles (1s) 0010: 64000 cycles (2s) 0011: 96000 cycles (3s) 0100: 128000 cycles (4s) 0101: 160000 cycles (5s) 0110: 192000 cycles (6s) 0111: 256000 cycles (8s) 1000: 320000 cycles (10s) 1001: 384000 cycles (12s) 1010: 448000 cycles (14s) 1011: 512000 cycles (16s) others: /
3:1	/	/	/
0	R/W	0x0	WDOG0_EN.

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			Watchdog 0 Enable. 0: No effect; 1: Enable the Watchdog 0.

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3.6 PWM

3.6.1 Overview

The output of the PWM is a toggling signal whose frequency and duty cycle can be modulated by its programmable registers. Each channel has a dedicated internal 16-bit up-counter. If the counter reaches the value stored in the channel period register, it resets. At the beginning of a count period cycle, the PWMOUT is set to active state and count from 0x0000.

The PWM divider divides the clock(24MHz) by 1~4096 according to the pre-scalar bits in the PWM control register.

In PWM cycle mode, the output will be a square waveform, the frequency is set to the period register. In PWM pulse mode, the output will be a positive pulse or a negative pulse.

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3.6.2 Block Diagram

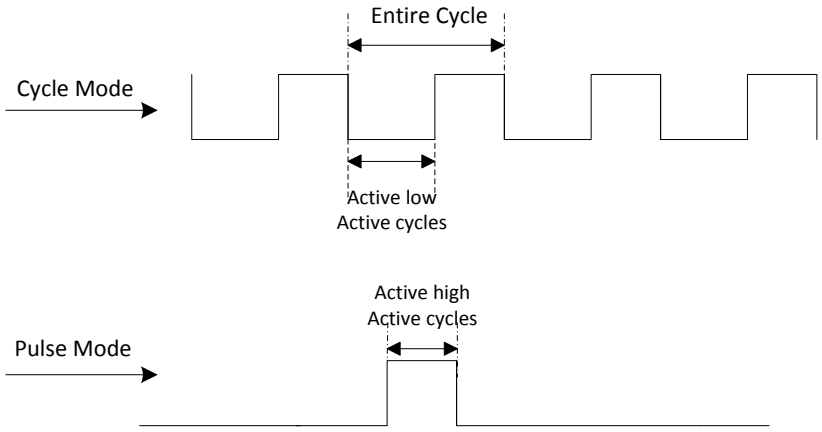

Figure3.6-1 PWM Block Diagram

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3.6.3 PWM Register List

Module Name	Base Address
PWM	0x01C21400

Register Name	Offset	Description
PWM_CTRL_REG	0x0	PWM Control Register
PWM_CH0_PERIOD	0x4	PWM Channel 0 Period Register
PWM_CH1_PERIOD	0x8	PWM Channel 1 Period Register

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3.6.4 PWM Register Description

PWM Control Register (Default: 0x00000000)

Offset: 0x0			Register Name: PWM_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31:30	/	/	/.
29	RO	0x0	PWM1_RDY. PWM1 period register ready. 0: PWM1 period register is ready to write, 1: PWM1 period register is busy.
28	RO	0x0	PWM0_RDY. PWM0 period register ready. 0: PWM0 period register is ready to write, 1: PWM0 period register is busy.
27:25	/	/	/
24	R/W	0x0	PWM1_BYPASS. PWM CH1 bypass enable. If the bit is set to 1, PWM1's output is OSC24MHz. 0: disable 1: enable
23	R/W	0x0	PWM_CH1_PULSE_OUT_START. PWM Channel 1 pulse output start. 0: no effect, 1: output 1 pulse. The pulse width should be according to the period 1 register[15:0],and the pulse state should be according to the active state. After the pulse is finished, the bit will be cleared automatically.
22	R/W	0x0	PWM_CH1_MODE. PWM Channel 1 mode. 0: cycle mode, 1: pulse mode.
21	R/W	0x0	PWM_CH1_CLK_GATING Gating the Special Clock for PWM1(0: mask, 1: pass).
20	R/W	0x0	PWM_CH1_ACT_STATE. PWM Channel 1 Active State. 0: Low Level, 1: High Level.
19	R/W	0x0	PWM_CH1_EN. PWM Channel 1 Enable. 0: Disable, 1: Enable.
18:15	R/W	0x0	PWM_CH1_PRESCAL. PWM Channel 1 Prescalar. These bits should be setting before the PWM Channel 1 clock gate on. 0000: /120

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			0001: /180 0010: /240 0011: /360 0100: /480 0101: / 0110: / 0111: / 1000: /12k 1001: /24k 1010: /36k 1011: /48k 1100: /72k 1101: / 1110: / 1111: /1
14:10	/	/	/
9	R/W	0x0	PWM0_BYPASS. PWM CH0 bypass enable. If the bit is set to 1, PWM0's output is OSC24MHz. 0: disable, 1: enable.
8	R/W	0x0	PWM_CH0_PUL_START. PWM Channel 0 pulse output start. 0: no effect, 1: output 1 pulse. The pulse width should be according to the period 0 register[15:0],and the pulse state should be according to the active state. After the pulse is finished, the bit will be cleared automatically.
7	R/W	0x0	PWM_CHANNEL0_MODE. 0: cycle mode, 1: pulse mode.
6	R/W	0x0	SCLK_CH0_GATING. Gating the Special Clock for PWM0(0: mask, 1: pass).
5	R/W	0x0	PWM_CH0_ACT_STA. PWM Channel 0 Active State. 0: Low Level, 1: High Level.
4	R/W	0x0	PWM_CH0_EN. PWM Channel 0 Enable. 0: Disable, 1: Enable.
3:0	R/W	0x0	PWM_CH0_PRESCAL. PWM Channel 0 Prescalar. These bits should be setting before the PWM Channel 0 clock gate on. 0000: /120 0001: /180

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			0010: /240 0011: /360 0100: /480 0101: / 0110: / 0111: / 1000: /12k 1001: /24k 1010: /36k 1011: /48k 1100: /72k 1101: / 1110: / 1111: /1

PWM Channel 0 Period Register

Offset: 0x4			Register Name: PWM_CH0_PERIOD
Bit	Read/Write	Default/Hex	Description
31:16	R/W	x	PWM_CH0_ENTIRE_CYS Number of the entire cycles in the PWM clock. 0 = 1 cycle 1 = 2 cycles …… N = N+1 cycles If the register need to be modified dynamically, the PCLK should be faster than the PWM CLK(PWM CLK = 24MHz/pre-scale).
15:0	R/W	x	PWM_CH0_ENTIRE_ACT_CYS Number of the active cycles in the PWM clock. 0 = 0 cycle 1 = 1 cycles …… N = N cycles

Note*:* the active cycles should be no larger than the period cycles.

PWM Channel 1 Period Register

Offset: 0x8			Register Name: PWM_CH1_PERIOD
Bit	Read/Write	Default/Hex	Description
31:16	R/W	x	PWM_CH1_ENTIRE_CYS Number of the entire cycles in the PWM clock. 0 = 1 cycle 1 = 2 cycles …… N = N+1 If the register need to be modified dynamically, the

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			PCLK should be faster than the PWM CLK(PWM CLK = 24MHz/pre-scale).
15:0	R/W	x	PWM_CH1_ENTIRE_CYS Number of the active cycles in the PWM clock. 0 = 0 cycle 1 = 1 cycles …… N = N cycles

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3.7 High Speed Timer

3.7.1 Overview

High Speed Timer clock source is fixed to AHBCLK, which is much higher than OSC24M. Compared with other timers, High Speed Timer clock source is synchronized with AHB clock, and when the relevant bit in the control register is set to 1, timer goes into the test mode, which is used to System Simulation. When the current value in both LO and HI Current Value Register are counting down to zero, the timer will generate interrupt if set interrupt enable bit.

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3.7.2 High Speed Timer Register List

Module Name	Base Address
High Speed Timer	0x01C60000

Register Name	Offset	Description
HS_TMR_IRQ_EN_REG	0x0	HS Timer IRQ Enable Register
HS_TMR_IRQ_STAS_REG	0x4	HS Timer Status Register
HS_TMR0_CTRL_REG	0x10	HS Timer Control Register
HS_TMR0_INTV_LO_REG	0x14	HS Timer Interval Value Low Register
HS_TMR0_INTV_HI_REG	0x18	HS Timer Interval Value High Register
HS_TMR0_CURNT_LO_REG	0x1C	HS Timer Current Value Low Register
HS_TMR0_CURNT_HI_REG	0x20	HS Timer Current Value High Register

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3.7.3 High Speed Timer Register Description

HS Timer IRQ Enable Register (Default: 0x00000000)

Offset:0x0			Register Name: HS_TMR_IRQ_EN_REG
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/
0	R/W	0x0	HS_TMR_INT_EN. High Speed Timer Interrupt Enable. 0: No effect; 1: High Speed Timer Interval Value reached interrupt enable.

HS Timer IRQ Status Register (Default: 0x00000000)

Offset:0x4			Register Name: HS_TMR_IRQ_STAS_REG
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/
0	R/W	0x0	HS_TMR_IRQ_PEND. High Speed Timer IRQ Pending. Set 1 to the bit will clear it. 0: No effect; 1: Pending, High speed timer interval value is reached.

HS Timer Control Register (Default: 0x00000000)

Offset:0x10			Register Name: HS_TMR0_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	HS_TMR_TEST. High speed timer test mode. In test mode, the low register should be set to 0x1, the high register will down counter. The counter needs to be reloaded. 0: normal mode; 1: test mode.
30:8	/	/	/
7	R/W	0x0	HS_TMR_MODE. High Speed Timer mode. 0: Continuous mode. When interval value reached, the timer will not disable automatically. 1: Single mode. When interval value reached, the timer will disable automatically.
6:4	R/W	0x0	HS_TMR_CLK Select the pre-scale of the high speed timer clock sources. 000: /1 001: /2 010: /4 011: /8 100: /16

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			101: / 110: / 111: /
3:2	/	/	/
1	R/W	0x0	HS_TMR_RELOAD. High Speed Timer Reload. 0: No effect, 1: Reload High Speed Timer Interval Value.
0	R/W	0x0	HS_TMR_EN. High Speed Timer Enable. 0: Stop/Pause, 1: Start. If the timer is started, it will reload the interval value to internal register, and the current counter will count from interval value to 0. If the current counter does not reach the zero, the timer enable bit is set to "0", the current value counter will pause. At least wait for 2 cycles, the start bit can be set to 1. In timer pause state, the interval value register can be modified. If the timer is started again, and the Software hope the current value register to down-count from the new interval value, the reload bit and the enable bit should be set to 1 at the same time.

HS Timer Interval Value Lo Register

Offset:0x14			Register Name: HS_TMR_INTV_LO_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	x	HS_TMR_INTV_VALUE_LO. High Speed Timer Interval Value [31:0].

HS Timer Interval Value Hi Register

Offset:0x18			Register Name: HS_TMR_INTV_HI_REG
Bit	Read/Write	Default/Hex	Description
31:24	/	/	/
23:0	R/W	x	HS_TMR_INTV_VALUE_HI. High Speed Timer Interval Value [55:32].

Note: the interval value register is a 56-bit register. When read or write the interval value, the Lo register should be read or write first. And the Hi register should be written after the Lo register.

HS Timer Current Value Lo Register

Offset:0x1C			Register Name: HS_TMR_CURNT_LO_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	x	HS_TMR_CUR_VALUE_LO. High Speed Timer Current Value [31:0].

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HS Timer Current Value Hi Register

Offset:0x20			Register Name: HS_TMR_CURNT_HI_REG
Bit	Read/Write	Default/Hex	Description
31:24	/	/	/
23:0	R/W	x	HS_TMR_CUR_VALUE_HI. High Speed Timer Current Value [55:32].

Note: HS timer current value is a 56-bit down-counter (from interval value to 0).

The current value register is a 56-bit register. When read or write the current value, the Lo register should be read or written first.

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3.8 DMA

3.8.1 Overview

The R16 supports 8-channel DMA. Each DMA channel can generate interrupts, and each referenced DMA channel can generate interrupts according to different pending status, and the configuration information of every DMA channel will be stored in the DDR or SRAM. After a DMA transfer starts, the address information in the DDR or SRAM will be described in *DMA Channel Descriptor Address Register*.

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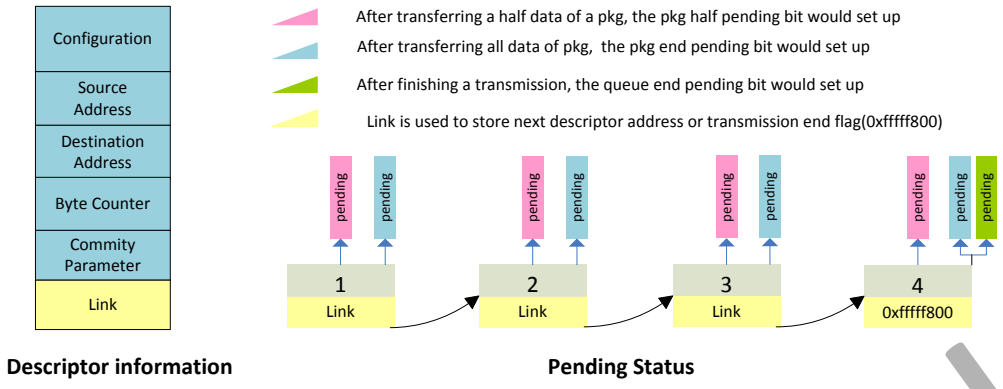
3.8.2 Block Diagram



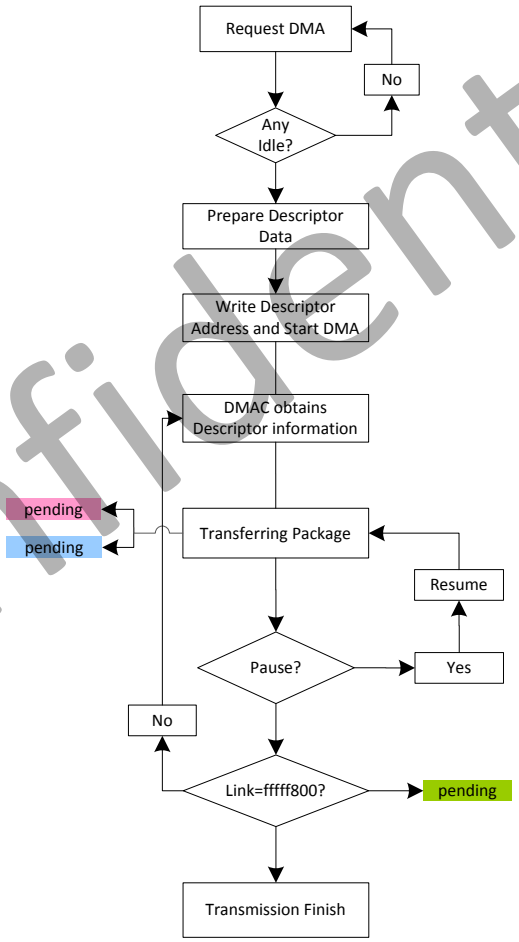


Figure3.8-1 DMA Block Diagram

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3.8.3 DRQ Type and Port Corresponding Relation

Source DRQ Type		Destination DRQ Type	
port0	SRAM	port0	SRAM
port1	SDRAM	port1	SDRAM
port2	/	port2	/
port3	DAUDIO_0-RX	port3	DAUDIO_0-TX
port4	DAUDIO_1-RX	port4	DAUDIO_1-TX
port5	NAND	port5	NAND
port6	UART0-RX	port6	UART0-TX
port7	UART1-RX	port7	UART1-TX
port8	UART2-RX	port8	UART2-TX
port9	UART3-RX	port9	UART3-TX
port10	/	port10	/
port11	/	port11	/
port12	/	port12	TCON_0
port13	/	port13	/
port14	/	port14	/
port15	Audio Codec-RX	port15	Audio Codec-TX
port16	CE-RX	port16	CE-TX
port17	USB OTG_EP1-RX	port17	USB OTG_EP1-TX
port18	USB OTG_EP2-RX	port18	USB OTG_EP2-TX
port19	USB OTG_EP3-RX	port19	USB OTG_EP3-TX
port20	USB OTG_EP4-RX	port20	USB OTG_EP4-TX
port21	USB OTG_EP5-RX	port21	USB OTG_EP5-TX
port22	/	port22	/
port23	SPI_0-RX	port23	SPI_0-TX
port24	/	port24	/
port25	/	port25	/
port26	/	port26	/
port27	/	port27	/
port28	/	port28	/
port29	/	port29	/
Port30	/	Port30	/

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3.8.4 DMA Description

In this section, the DMA descriptor registers will be introduced in detail.

When starting a DMA transmission, the module data are transferred as packages, which have the link data information. And, by reading the DMA Status Register, the status of a DMA channel could be known. Reading back the descriptor address register, the value is the link data in the transferring package. If only the value is equal to 0xfffff800, then it can be regarded as NULL, which means the package is the last package in this DMA transmission. Otherwise, the value means the start address of the next package. And, the Descriptor Address Register can be changed during a package transferring.

When transferring the half of a package, the relevant pending bit will be set up automatically, and if the corresponding interrupt is enabled, DMA generates an interrupt to the system. The similar thing would occur when transferring a package completely. Meanwhile, if DMA have transferred the last package in the data, the relevant pending bit would be set up, and generates an interrupt if the corresponding interrupt is enabled. The flow-process diagram is shown in Block Diagram section.

During a DMA transmission, the configuration could be obtained via the Configuration Register. And, behind the address of the configuration register in DDR or SRAM, there are some registers including other information of a DMA transmission. The structure chart is shown in Block Diagram section. Also, other information of a transferring data can be obtained by reading the Current Source Address Register, Current Destination Address Register and Byte Counter Left Register. The configuration must be word-aligning.

The transferring data would be paused when setting up the relevant Pause Register, if coming up emergency. And the pausing data could be presumable when set 0 to the same bit in Pause Register.

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3.8.5 DMA Register List

Module Name	Base Address
DMA	0x01C02000

Register Name	Offset	Description
DMA_IRQ_EN_REG	0x0	DMA IRQ Enable Register
DMA_IRQ_PEND_REG	0x10	DMA IRQ Pending Register
DMA_STA_REG	0x30	DMA Status Register
DMA_EN_REG	0x100+N*0x40	DMA Channel Enable Register (N=0~7)
DMA_PAU_REG	0x100+N*0x40+0x4	DMA Channel Pause Register (N=0~7)
DMA_DESC_ADDR_REG	0x100+N*0x40+0x8	DMA Channel Start Address Register (N=0~7)
DMA_CFG_REG	0x100+N*0x40+0xC	DMA Channel Configuration Register (N=0~7)
DMA_CUR_SRC_REG	0x100+N*0x40+0x10	DMA Channel Current Source Register (N=0~7)
DMA_CUR_DEST_REG	0x100+N*0x40+0x14	DMA Channel Current Destination Register (N=0~7)
DMA_BCNT_LEFT_REG	0x100+N*0x40+0x18	DMA Channel Byte Counter Left Register (N=0~7)
DMA_PARA_REG	0x100+N*0x40+0x1C	DMA Channel Parameter Register (N=0~7)

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3.8.6 DMA Register Description

DMA IRQ Enable Register (Default: 0x00000000)

Offset:0x0			Register Name: DMA_IRQ_EN_REG
Bit	Read/Write	Default/Hex	Description
31	/	/	/
30	R/W	0x0	DMA7_QUEUE_IRQ_EN DMA 7 Queue End Transfer Interrupt Enable. 0: Disable, 1: Enable.
29	R/W	0x0	DMA7_PKG_IRQ_EN DMA 7 Package End Transfer Interrupt Enable. 0: Disable, 1: Enable.
28	R/W	0x0	DMA7_HLAF_IRQ_EN DMA 7 Half Package Transfer Interrupt Enable. 0: Disable, 1: Enable.
27	/	/	/
26	R/W	0x0	DMA6_QUEUE_IRQ_EN DMA 6 Queue End Transfer Interrupt Enable. 0: Disable, 1: Enable.
25	R/W	0x0	DMA6_PKG_IRQ_EN DMA 6 Package End Transfer Interrupt Enable. 0: Disable, 1: Enable.
24	R/W	0x0	DMA6_HLAF_IRQ_EN DMA 6 Half Package Transfer Interrupt Enable. 0: Disable, 1: Enable.
23	/	/	/
22	R/W	0x0	DMA5_QUEUE_IRQ_EN DMA 5 Queue End Transfer Interrupt Enable. 0: Disable, 1: Enable.
21	R/W	0x0	DMA5_PKG_IRQ_EN DMA 5 Package End Transfer Interrupt Enable. 0: Disable, 1: Enable.
20	R/W	0x0	DMA5_HLAF_IRQ_EN DMA 5 Half package Transfer Interrupt Enable. 0: Disable, 1: Enable.
19	/	/	/
18	R/W	0x0	DMA4_QUEUE_IRQ_EN DMA 4 Queue End Transfer Interrupt Enable. 0: Disable, 1: Enable.
17	R/W	0x0	DMA4_PKG_IRQ_EN DMA 4 Package End Transfer Interrupt Enable. 0: Disable, 1: Enable.
16	R/W	0x0	DMA4_HLAF_IRQ_EN DMA 4 Half Package Transfer Interrupt Enable.

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			0: Disable, 1: Enable.
15	/	/	/
14	R/W	0x0	DMA3_QUEUE_IRQ_EN DMA 3 Queue End Transfer Interrupt Enable. 0: Disable, 1: Enable.
13	R/W	0x0	DMA3_PKG_IRQ_EN DMA 3 Package End Transfer Interrupt Enable. 0: Disable, 1: Enable.
12	R/W	0x0	DMA3_HLAF_IRQ_EN DMA 3 Half Package Transfer Interrupt Enable. 0: Disable, 1: Enable.
11	/	/	/
10	R/W	0x0	DMA2_QUEUE_IRQ_EN DMA 2 Queue End Transfer Interrupt Enable. 0: Disable, 1: Enable.
9	R/W	0x0	DMA2_PKG_IRQ_EN DMA 2 Package End Transfer Interrupt Enable. 0: Disable, 1: Enable.
8	R/W	0x0	DMA2_HLAF_IRQ_EN DMA 2 Half Package Transfer Interrupt Enable. 0: Disable, 1: Enable.
7	/	/	/
6	R/W	0x0	DMA1_QUEUE_IRQ_EN DMA 1 Queue End Transfer Interrupt Enable. 0: Disable, 1: Enable.
5	R/W	0x0	DMA1_PKG_IRQ_EN DMA 1 Package End Transfer Interrupt Enable. 0: Disable, 1: Enable.
4	R/W	0x0	DMA1_HLAF_IRQ_EN DMA 1 Half Package Transfer Interrupt Enable. 0: Disable, 1: Enable.
3	/	/	/
2	R/W	0x0	DMA0_QUEUE_IRQ_EN DMA 0 Queue End Transfer Interrupt Enable. 0: Disable, 1: Enable.
1	R/W	0x0	DMA0_PKG_IRQ_EN DMA 0 Package End Transfer Interrupt Enable. 0: Disable, 1: Enable.
0	R/W	0x0	DMA0_HLAF_IRQ_EN DMA 0 Half Package Transfer Interrupt Enable. 0: Disable, 1: Enable

DMA IRQ Pending Status Register (Default: 0x00000000)

Offset:0x10			Register Name: DMA_IRQ_PEND_REG
Bit	Read/Write	Default/Hex	Description

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31	/	/	/
30	R/W	0x0	DMA7_QUEUE_IRQ_PEND. DMA 7 Queue End Transfer Interrupt Pending. Set 1 to the bit will clear it. 0: No effect, 1: Pending.
29	R/W	0x0	DMA7_PKG_IRQ_ PEND DMA 7 Package End Transfer Interrupt Pending. Set 1 to the bit will clear it. 0: No effect, 1: Pending.
28	R/W	0x0	DMA7_HLAF_IRQ_PEND. DMA 7 Half Package Transfer Interrupt Pending. Set 1 to the bit will clear it. 0: No effect, 1: Pending.
27	/	/	/
26	R/W	0x0	DMA6_QUEUE_IRQ_PEND. DMA 6 Queue End Transfer Interrupt Pending. Set 1 to the bit will clear it. 0: No effect, 1: Pending.
25	R/W	0x0	DMA6_PKG_IRQ_ PEND DMA 6 Package End Transfer Interrupt Pending. Set 1 to the bit will clear it. 0: No effect, 1: Pending.
24	R/W	0x0	DMA6_HLAF_IRQ_PEND. DMA 6 Half Package Transfer Interrupt Pending. Set 1 to the bit will clear it. 0: No effect, 1: Pending.
23	/	/	/
22	R/W	0x0	DMA5_QUEUE_IRQ_PEND. DMA 5 Queue End Transfer Interrupt Pending. Set 1 to the bit will clear it. 0: No effect, 1: Pending.
21	R/W	0x0	DMA5_PKG_IRQ_ PEND DMA 5 Package End Transfer Interrupt Pending. Set 1 to the bit will clear it. 0: No effect, 1: Pending.
20	R/W	0x0	DMA5_HLAF_IRQ_PEND. DMA 5 Half Package Transfer Interrupt Pending. Set 1 to the bit will clear it. 0: No effect, 1: Pending.
19	/	/	/
18	R/W	0x0	DMA4_QUEUE_IRQ_PEND. DMA 4 Queue End Transfer Interrupt Pending. Set 1 to the bit will clear it. 0: No effect, 1: Pending.
17	R/W	0x0	DMA4_PKG_IRQ_ PEND

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			DMA 4 Package End Transfer Interrupt Pending. Set 1 to the bit will clear it. 0: No effect, 1: Pending.
16	R/W	0x0	DMA4_HLAF_IRQ_PEND. DMA 4 Half Package Transfer Interrupt Pending. Set 1 to the bit will clear it. 0: No effect, 1: Pending.
15	/	/	/
14	R/W	0x0	DMA3_QUEUE_IRQ_PEND. DMA 3 Queue End Transfer Interrupt Pending. Set 1 to the bit will clear it. 0: No effect, 1: Pending.
13	R/W	0x0	DMA3_PKG_IRQ_ PEND DMA 3 Package End Transfer Interrupt Pending. Set 1 to the bit will clear it. 0: No effect, 1: Pending.
12	R/W	0x0	DMA3_HLAF_IRQ_PEND. DMA 3 Half Package Transfer Interrupt Pending. Set 1 to the bit will clear it. 0: No effect, 1: Pending.
11	/	/	/
10	R/W	0x0	DMA2_QUEUE_IRQ_PEND. DMA 2 Queue End Transfer Interrupt Pending. Set 1 to the bit will clear it. 0: No effect, 1: Pending.
9	R/W	0x0	DMA2_PKG_IRQ_ PEND DMA 2 Package End Transfer Interrupt Pending. Set 1 to the bit will clear it. 0: No effect, 1: Pending.
8	R/W	0x0	DMA2_HLAF_IRQ_PEND. DMA 2 Half Package Transfer Interrupt Pending. Set 1 to the bit will clear it. 0: No effect, 1: Pending.
7	/	/	/
6	R/W	0x0	DMA1_QUEUE_IRQ_PEND. DMA 1 Queue End Transfer Interrupt Pending. Set 1 to the bit will clear it. 0: No effect, 1: Pending.
5	R/W	0x0	DMA1_PKG_IRQ_ PEND DMA 1 Package End Transfer Interrupt Pending. Set 1 to the bit will clear it. 0: No effect, 1: Pending.
4	R/W	0x0	DMA1_HLAF_IRQ_PEND. DMA 1 Half Package Transfer Interrupt Pending. Set 1 to the bit will clear it.

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			0: No effect, 1: Pending.
3	/	/	/
2	R/W	0x0	DMA0_QUEUE_IRQ_PEND. DMA 0 Queue End Transfer Interrupt Pending. Set 1 to the bit will clear it. 0: No effect, 1: Pending.
1	R/W	0x0	DMA0_PKG_IRQ_ PEND DMA 0 Package End Transfer Interrupt Pending. Set 1 to the bit will clear it. 0: No effect, 1: Pending.
0	R/W	0x0	DMA0_HLAF_IRQ_PEND. DMA 0 Half Package Transfer Interrupt Pending. Set 1 to the bit will clear it. 0: No effect, 1: Pending.

DMA Auto Gating Register (Default: 0x00000000)

Offset:0x020			Register Name: DMA_AUTO_GATE_REG
Bit	Read/Write	Default/Hex	Description
31:3	/	/	/
2	R/W	0x0	DMA_MCLK_CIRCUIT. DMA MCLK interface circuit auto gating bit. 0: Auto gating enable 1: Auto gating disable.
1	R/W	0x0	DMA_COMMON_CIRCUIT. DMA common circuit auto gating bit. 0: Auto gating enable 1: Auto gating disable.
0	R/W	0x0	DMA_CHAN_CIRCUIT. DMA channel circuit auto gating bit. 0: Auto gating enable 1: Auto gating disable.

Note: When initializing DMA Controller, bit-2 should be set up.

DMA Status Register (Default: 0x00000000)

Offset:0x30			Register Name: DMA_STA_REG
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7	RO	0x0	DMA7_STATUS DMA Channel 7 Status. 0: Idle, 1: Busy.
6	RO	0x0	DMA6_STATUS DMA Channel 6 Status. 0: Idle, 1: Busy.
5	RO	0x0	DMA5_STATUS DMA Channel 5 Status.

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			0: Idle, 1: Busy.
4	RO	0x0	DMA4_STATUS DMA Channel 4 Status. 0: Idle, 1: Busy.
3	RO	0x0	DMA3_STATUS DMA Channel 3 Status. 0: Idle, 1: Busy.
2	RO	0x0	DMA2_STATUS DMA Channel 2 Status. 0: Idle, 1: Busy.
1	RO	0x0	DMA1_STATUS DMA Channel 1 Status. 0: Idle, 1: Busy.
0	RO	0x0	DMA0_STATUS DMA Channel 0 Status. 0: Idle, 1: Busy.

DMA Channel Enable Register (Default: 0x00000000)

Offset:0x100+N*0x40+0x0 (N=0~7)			Register Name: DMA0_EN_REG
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/
0	R/W	0x0	DMA_EN. DMA Channel Enable 0: Disable, 1: Enable.

DMA Channel Pause Register (Default: 0x00000000)

Offset:0x100+N*0x40+0x4 (N=0~7)			Register Name: DMA_PAU_REG
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/
0	R/W	0x0	DMA_PAUSE. Pausing DMA Channel Transfer Data. 0: Resume Transferring, 1: Pause Transferring.

DMA Channel Descriptor Address Register

Offset:0x100+N*0x40+0x8 (N=0~7)			Register Name: DMA_DESC_ADDR_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	x	DMA_DESC_ADDR DMA Channel Descriptor Address.

DMA Channel Configuration Register (Default: 0x00000000)

Offset:0x100+N*0x40+0xC (N=0~7)	Register Name: DMA_CFG_REG

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Bit	Read/Write	Default/Hex	Description
31:27	/	/	/
26:25	RO	0x0	DMA_DEST_DATA_WIDTH. DMA Destination Data Width. 00: 8-bit 01: 16-bit 10: 32-bit 11: /
24:23	RO	0x0	DMA_DEST_BST_LEN. DMA Destination Burst Length. 00: 1 01: / 10: 8 11: /
22:21	RO	0x0	DMA_ADDR_MODE. DMA Destination Address Mode 0x0: Linear Mode 0x1: IO Mode 0x2: / 0x3: /
20:16	RO	0x0	DMA_DEST_DRQ_TYPE. DMA Destination DRQ Type The details in DRQ Type and Port Corresponding Relation.
15:11	/	/	/
10:9	RO	0x0	DMA_SRC_DATA_WIDTH. DMA Source Data Width. 00: 8-bit 01: 16-bit 10: 32-bit 11: /
8:7	RO	0x0	DMA_SRC_BST_LEN. DMA Source Burst Length. 00: 1 01: / 10: 8 11: /
6:5	RO	0x0	DMA_SRC_ADDR_MODE. DMA Source Address Mode 0x0: Linear Mode 0x1: IO Mode 0x2: / 0x3: /
4:0	RO	0x0	DMA_SRC_DRQ_TYPE. DMA Source DRQ Type The details in DRQ Type and Port Corresponding Relation.

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Note: If the DRQ type is dram, then, the corresponding burst length will be fixed, and the options will be invalid. The address of the *DMA Channel Configuration Register* must be word-aligned.

DMA Channel Current Source Address Register

Offset:0x100+N*0x40+0x10 (N=0~7)			Register Name: DMA_CUR_SRC_REG
Bit	Read/Write	Default/Hex	Description
31:0	RO	0x0	DMA_CUR_SRC DMA Channel Current Source Address, read only.

Note: The address of the DMA Channel Current Source Address Register must be word-aligned.

DMA Channel Current Destination Address Register

Offset:0x100+N*0x40+0x14 (N=0~7)			Register Name: DMA_CUR_DEST_REG
Bit	Read/Write	Default/Hex	Description
31:0	RO	0x0	DMA_CUR_DEST DMA Channel Current Destination Address, read only.

Note: The address of the DMA Channel Current Destination Address Register must be word-aligned.

DMA Channel Byte Counter Left Register

Offset:0x100+N*0x40+0x18 (N=0~7)			Register Name: DMA_BCNT_LEFT_REG
Bit	Read/Write	Default/Hex	Description
31:25	/	/	/
24:0	RO	0x0	DMA_BCNT_LEFT DMA Channel Byte Counter Left, read only.

Note: The address of the DMA Channel Byte Counter Left Register must be word-aligned.

DMA Channel Parameter Register

Offset:0x100+N*0x40+0x1C (N=0~7)			Register Name: DMA_PARA_REG
Bit	Read/Write	Default/Hex	Description
31:16	/	/	/
15:8	RO	0x0	DATA_BLK_SIZE Data Block Size ***N***.
7:0	RO	0x0	WAIT_CYC Wait Clock Cycles ***n***.

Note: The number of data block size usually depends on the capacity of the device's FIFO in the practical application.

The data block size must be multiple of ***burst*width*** (byte). For example: if burst is 4 and the width is 32-bit, so the data block size must be ***m*16***(byte), i.e. ***N = m * 16.***

When DMA controller has completed transferring ***N*** bytes data, and waiting ***n*** clock cycles to check the DRQ signal.

This register is only effective to devices, and the *Data Block Size* ***N*** should be **0** if it is less than **32**.

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3.9 GIC

For details about GIC, please refer to the GIC PL400 technical reference manual and ARM GIC Architecture Specification V2.0.

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3.9.1 Interrupt Source

Interrupt Source	SRC	Vector	FIQ	Description
SGI 0	0	0x0000		SGI 0 interrupt
SGI 1	1	0x0004		SGI 1 interrupt
SGI 2	2	0x0008		SGI 2 interrupt
SGI 3	3	0x000C		SGI 3 interrupt
SGI 4	4	0x0010		SGI 4 interrupt
SGI 5	5	0x0014		SGI 5 interrupt
SGI 6	6	0x0018		SGI 6 interrupt
SGI 7	7	0x001C		SGI 7 interrupt
SGI 8	8	0x0020		SGI 8 interrupt
SGI 9	9	0x0024		SGI 9 interrupt
SGI 10	10	0x0028		SGI 10 interrupt
SGI 11	11	0x002C		SGI 11 interrupt
SGI 12	12	0x0030		SGI 12 interrupt
SGI 13	13	0x0034		SGI 13 interrupt
SGI 14	14	0x0038		SGI 14 interrupt
SGI 15	15	0x003C		SGI 15 interrupt
PPI 0	16	0x0040		PPI 0 interrupt
PPI 1	17	0x0044		PPI 1 interrupt
PPI 2	18	0x0048		PPI 2 interrupt
PPI 3	19	0x004C		PPI 3 interrupt
PPI 4	20	0x0050		PPI 4 interrupt
PPI 5	21	0x0054		PPI 5 interrupt
PPI 6	22	0x0058		PPI 6 interrupt
PPI 7	23	0x005C		PPI 7 interrupt
PPI 8	24	0x0060		PPI 8 interrupt
PPI 9	25	0x0064		PPI 9 interrupt
PPI 10	26	0x0068		PPI 10 interrupt
PPI 11	27	0x006C		PPI 11 interrupt
PPI 12	28	0x0070		PPI 12 interrupt
PPI 13	29	0x0074		PPI 13 interrupt
PPI 14	30	0x0078		PPI 14 interrupt
PPI 15	31	0x007C		PPI 15 interrupt
UART 0	32	0x0080		UART 0 interrupt
UART 1	33	0x0084		UART 1 interrupt
UART 2	34	0x0088		UART 2 interrupt
UART 3	35	0x008C		UART 3 interrupt
UART 4	36	0x0090		UART 4 interrupt
/	37	0x0094		/
TWI 0	38	0x0098		TWI 0 interrupt

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Interrupt Source	SRC	Vector	FIQ	Description
TWI 1	39	0x009C		TWI 1 interrupt
TWI 2	40	0x00A0		TWI 2 interrupt
/	41	0x00A4		/
/	42	0x00A8		/
PA_EINT	43	0x00AC		PA_EINT interrupt
/	44	0x00B0		/
DAUDIO-0	45	0x00B4		DAUDIO-0 interrupt
DAUDIO-1	46	0x00B8		DAUDIO-1 interrupt
PB_EINT	47	0x00BC		PB_EINT interrupt
/	48	0x00C0		/
PG_EINT	49	0x00C4		PG_EINT interrupt
Timer 0	50	0x00C8		Timer 0 interrupt
Timer 1	51	0x00CC		Timer 1 interrupt
/	52	0x00D0		/
/	53	0x00D4		/
/	54	0x00D8		/
/	55	0x00DC		/
/	56	0x00E0		/
Watchdog	57	0x00E4		Watchdog interrupt
/	58	0x00E8		/
/	59	0x00EC		/
/	60	0x00F0		/
Audio Codec	61	0x00F4		Analogy Audio Codec interrupt
KEYADC	62	0x00F8		KEYADC interrupt
Thermal Sensor	63	0x00FC		Thermal Sensor interrupt
External NMI	64	0x100		External Non-Mask Interrupt
R_timer 0	65	0x104		R_timer 0 interrupt
R_timer 1	66	0x108		R_timer 1 interrupt
/	67	0x010C		/
R_watchdog	68	0x0110		R_watchdog interrupt
/	69	0x0114		/
R_UART	70	0x0118		R_UART interrupt
R_RSB	71	0x011C		R_RSB interrupt
R_Alarm 0	72	0x0120		R_Alarm 0 interrupt
R_Alarm 1	73	0x0124		R_Alarm 1 interrupt
/	74	0x0128		/
/	75	0x012C		/
R_TWI	76	0x0130		R_TWI interrupt
R_PL_LINT	77	0x0134		R_PL_LINT interrupt
HMIC	78	0x0138		HMIC interrupt
/	79	0x013C		/
/	80	0x0140		/

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Interrupt Source	SRC	Vector	FIQ	Description
M-box	81	0x0144		M-box interrupt
DMA	82	0x0148		DMA channel interrupt
HS Timer	83	0x014C		HS Timer interrupt
/	84	0x0150		/
/	85	0x0154		/
/	86	0x0158		/
/	87	0x015C		/
/	88	0x0160		/
/	89	0x0164		/
VE	90	0x0168		VE interrupt
/	91	0x016C		/
SD/MMC 0	92	0x0170		SD/MMC Host Controller 0 interrupt
SD/MMC 1	93	0x0174		SD/MMC Host Controller 1 interrupt
SD/MMC 2	94	0x0178		SD/MMC Host Controller 2 interrupt
/	95	0x017C		/
/	96	0x0180		/
SPI 0	97	0x0184		SPI 0 interrupt
SPI 1	98	0x0188		SPI 1 interrupt
/	99	0x018C		/
/	100	0x0190		/
/	101	0x0194		/
NAND	102	0x0198		NAND Flash Controller interrupt
USB-OTG	103	0x019C		USB-OTG interrupt
USB-EHCI0	104	0x01A0		USB-EHCI0 interrupt
USB-OHCI0	105	0x01A4		USB-OHCI0 interrupt
/	106	0x01A8		/
/	107	0x01AC		/
/	108	0x01B0		/
/	109	0x01B4		/
/	110	0x01B8		/
/	111	0x01BC		/
CE	112	0x01C0		CE interrupt
/	113	0x01C4		/
/	114	0x01C8		/
/	115	0x01CC		/
CSI	116	0x01D0		CSI interrupt
CSI_CCI	117	0x01D4		CSI_CCI interrupt
LCD	118	0x01D8		LCD Controller interrupt
/	119	0x01DC		/
/	120	0x01E0		/
MIPI DSI	121	0x01E4		MIPI DSI interrupt
/	122	0x01E8		/

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Interrupt Source	SRC	Vector	FIQ	Description
DRC 0/1	123	0x01EC		DRC 0/1 interrupt
/	124	0x01F0		/
DE_FE	125	0x01F4		DE_FE interrupt
/	126	0x01F8		/
DE_BE	127	0x01FC		DE_BE interrupt
/	128	0x0200		/
GPU-GP	129	0x0204		GPU-GP interrupt
GPU-GPMMU	130	0x0208		GPU-GPMMU interrupt
GPU-PP0	131	0x020C		GPU-PP0 interrupt
GPU-PPMMU0	132	0x0210		GPU-PPMMU0 interrupt
GPU-PMU	133	0x0214		GPU-PMU interrupt
GPU-PP1	134	0x0218		GPU-PP1 interrupt
GPU-PPMMU1	135	0x021C		GPU-PPMMU1 interrupt
/	136	0x0220		/
/	137	0x0224		/
/	138	0x0228		/
/	139	0x022C		/
CTI0	140	0x0230		CTI0 interrupt
CTI1	141	0x0234		CTI1 interrupt
CTI2	142	0x0238		CTI2 interrupt
CTI3	143	0x023C		CTI3 interrupt
COMMTX0	144	0x0240		COMMTX0 interrupt
COMMTX1	145	0x0244		COMMTX1 interrupt
COMMTX2	146	0x0248		COMMTX2 interrupt
COMMTX3	147	0x024C		COMMTX3 interrupt
COMMRX0	148	0x0250		COMMRX0 interrupt
COMMRX1	149	0x0254		COMMRX1 interrupt
COMMRX2	150	0x0258		COMMRX2 interrupt
COMMRX3	151	0x025C		COMMRX3 interrupt
PMU0	152	0x0260		PMU0 interrupt
PMU1	153	0x0264		PMU1 interrupt
PMU2	154	0x0268		PMU2 interrupt
PMU3	155	0x026C		PMU3 interrupt
AXI_ERROR	156	0x0270		AXI_ERROR interrupt

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3.10 RTC

3.10.1 Overview

The real time clock (RTC) is for calendar usage. It is built around a 30-bit counter and used to count elapsed time in YY-MM-DD and HH-MM-SS. The unit can be operated by the backup battery while the system power is off. It has a built-in leap year generator and a independent power pin (RTC_VIO).

The alarm generates an alarm signal at a specified time in the power-off mode or normal operation mode. In normal operation mode, both the alarm interrupt and the power management wakeup are activated. In power-off mode, the power management wakeup signal is activated. Two kinds of alarm are supported here: Alarm 0 is a general alarm whose counter is based on seconds, while Alarm 1 is a weekly alarm whose counter is based on the real time.

The 32768Hz oscillator is used only to provide a low power, accurate reference for the RTC.

General Purpose Register can be flag register, and it will save the value all the time when the VDD_RTC is not power off.

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3.10.2 RTC Register List

Module Name	Base Address
RTC	0x01F00000

Register Name	Offset	Description
LOSC_CTRL_REG	0x0	Low Oscillator Control Register l
LOSC_AUTO_SWT_STA_REG	0x4	LOSC Auto Switch Status Register
INTOSC_CLK_PRESCAL_REG	0x8	Internal OSC Clock Prescalar Register
RTC_YY_MM_DD_REG	0x10	RTC Year-Month-Day Register
RTC_HH_MM_SS_REG	0x14	RTC Hour-Minute-Second Register
ALARM0_COUNTER_REG	0x20	Alarm 0 Counter Register
ALARM0_CUR_VLU_REG	0x24	Alarm 0 Counter Current Value Register
ALARM0_ENABLE_REG	0x28	Alarm 0 Enable Register
ALARM0_IRQ_EN	0x2C	Alarm 0 IRQ Enable Register
ALARM0_IRQ_STA_REG	0x30	Alarm 0 IRQ Status Register
ALARM1_WK_HH_MM-SS	0x40	Alarm 1 Week HMS Register
ALARM1_ENABLE_REG	0x44	Alarm 1 Enable Register
ALARM1_IRQ_EN	0x48	Alarm 1 IRQ Enable Register
ALARM1_IRQ_STA_REG	0x4C	Alarm 1 IRQ Status Register
ALARM_CONFIG_REG	0x50	Alarm Configuration Register
LOSC_OUT_GATING_REG	0x60	LOSC output gating register
GP_DATA_REG	0x100 + N*0x4	General Purpose Register (N=0~3)
GPL_HOLD_OUTPUT_REG	0x180	GPL Hold Output Register
VDD_RTC_REG	0x190	VDD RTC Regulate Register
IC_CHARA_REG	0x1F0	IC Characteristic Register

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3.10.3 RTC Register Description

LOSC Control (Default: 0x00004000)

Offset:0x0			Register Name: LOSC_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31:16	W	0x0	/
15	/	/	/
14	R/W	0x1	LOSC_AUTO_SWT_EN. LOSC auto switch enable. 0: Disable, 1: Enable.
13:10	/	/	/
9	R/W	0x0	ALM_DDHHMMSS_ACCE. ALARM DD-HH-MM-SS access. After writing the ALARM DD-HH-MM-SS register, this bit is set and it will be cleared until the real writing operation is finished.
8	R/W	0x0	RTC_HHMMSS_ACCE. RTC HH-MM-SS access. After writing the RTC HH-MM-SS register, this bit is set and it will be cleared until the real writing operation is finished. After writing the RTC YY-MM-DD register, the YY-MM-DD register will be refreshed for at most one second.
7	R/W	0x0	RTC_YYMMDD_ACCE. RTC YY-MM-DD access. After writing the RTC YY-MM-DD register, this bit is set and it will be cleared until the real writing operation is finished. After writing the RTC YY-MM-DD register, the YY-MM-DD register will be refreshed for at most one second.
6:4	/	/	/
3:2	R/W	0x0	EXT_LOSC_GSM. External 32768Hz Crystal GSM. 00 low 01 10 11 high
1	/	/	/
0	R/W	0x0	LOSC_SRC_SEL. LOSC Clock source Select. 'N' is the value of Internal OSC Clock Prescalar register. 0: InternalOSC / N, 1: External 32.768KHz OSC.

Note:

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(1) Any bit of [9:7] is set, the RTC HH-MM-SS, YY-MM-DD and ALARM DD-HH-MM-SS register can't be written.

(2) Internal OSC is about 600KHz ~ 700KHz.

LOSC Auto Switch Status Register (Default: 0x00000000)

Offset:0x4			Register Name: LOSC_AUTO_SWT_STA_REG
Bit	Read/Write	Default/Hex	Description
31:2	/	/	/
1	R/W	0x0	LOSC_AUTO_SWT_PEND. LOSC auto switch pending. 0: no effect; 1: auto switches pending. Set 1 to this bit will clear it.
0	RO	0x0	LOSC_SRC_SEL_STA. Checking LOSC Clock Source Status. 'N' is the value of Internal OSC Clock Prescalar register. 0: InternalOSC / N; 1: External 32.768KHz OSC.

Internal OSC Clock Prescalar Register (Default: 0x00000014)

Offset:0x8			Register Name: INTOSC_CLK_PRESCAL_REG
Bit	Read/Write	Default/Hex	Description
31:5	/	/	/
4:0	R/W	0x14	INTOSC_CLK_PRESCAL. Internal OSC Clock Prescalar value N. 00000: 1 00001: 2 00010: 3 ..... 11111: 32

RTC YY-MM-DD Register

Offset:0x10			Register Name: RTC_YY_MM_DD_REG
Bit	Read/Write	Default/Hex	Description
31:23	/	/	/
22	R/W	0x0	LEAP. Leap Year. 0: not, 1: Leap year. This bit cannot set by hardware. It should be set or clear by software.
21:16	R/W	x	YEAR. Year. Range from 0~63.
15:12	/	/	/
11:8	R/W	x	MONTH. Month.

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			Range from 1~12.
7:5	/	/	/
4:0	R/W	x	DAY. Day. Range from 1~31.

Note:

If the written value is not from 1 to 31 in Day Area, it turns into 31 automatically. Month Area and Year Area are similar to Day Area.

The number of days in different month may be different.

RTC HH-MM-SS Register

Offset:0x14			Register Name: RTC_HH_MM_SS_REG
Bit	Read/Write	Default/Hex	Description
31:29	R/W	0x0	WK_NO. Week number. 000: Monday 001: Tuesday 010: Wednesday 011: Thursday 100: Friday 101: Saturday 110: Sunday 111: /
28:21	/	/	/
20:16	R/W	x	HOUR. Range from 0~23
15:14	/	/	/
13:8	R/W	x	MINUTE. Range from 0~59
7:6	/	/	/
5:0	R/W	x	SECOND. Range from 0~59

Note: If the written value is not from 0 to 59 in Second Area, it turns into 59 automatically. Minute Area and Hour Area are similar to Second Area.

Alarm 0 Counter Register (Default: 0x00000000)

Offset:0x20			Register Name: ALARM0_COUNTER_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0x0	ALARM0_COUNTER. Alarm 0 Counter is Based on Second.

Note: If the second is set to 0, it will be 1 second in fact.

Alarm 0 Current Value Register

Offset:0x24			Register Name: ALARM0_CUR_VLU_REG
Bit	Read/Write	Default/Hex	Description

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31:0	RO	x	ALARM0_CUR_VLU. Check Alarm 0 Counter Current Values.

Note: If the second is set to 0, it will be 1 second in fact.

Alarm 0 Enable Register (Default: 0x00000000)

Offset:0x28			Register Name: ALARM0_ENABLE_REG
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/
0	R/W	0x0	ALM_0_EN Alarm 0 Enable. If this bit is set to “1”, the Alarm 0 Counter register’s valid bits will down count to zero, and the alarm pending bit will be set to “1”. 0: disable, 1: enable.

Alarm 0 IRQ Enable Register (Default: 0x00000000)

Offset:0x2C			Register Name: ALARM0_IRQ_EN
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/
0	R/W	0x0	ALARM0_IRQ_EN. Alarm 0 IRQ Enable. 0: disable; 1: enable.

Alarm 0 IRQ Status Register (Default: 0x00000000)

Offset:0x30			Register Name: ALARM0_IRQ_STA_REG
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/
0	R/W	0x0	ALARM0_IRQ_PEND. Alarm 0 IRQ Pending bit. 0: No effect; 1: Pending, alarm 0 counter value is reached. If alarm 0 irq enable is set to 1, the pending bit will be sent to the interrupt controller.

Alarm 1 Week HH-MM-SS Register (Default: 0x00000000)

Offset:0x40			Register Name: ALARM1_WK_HH_MM-SS
Bit	Read/Write	Default/Hex	Description
31:21	/	/	/
20:16	R/W	x	HOUR. Range from 0~23.
15:14	/	/	/
13:8	R/W	x	MINUTE. Range from 0~59.

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7:6	/	/	/.
5:0	R/W	x	SECOND. Range from 0~59.

Note: If the written value is not from 0 to 59 in Second Area, it turns into 59 automatically. Minute Area and Hour Area are similar to Second Area.

Alarm 1 Enable Register (Default: 0x00000000)

Offset:0x44			Register Name: ALARM1_EN_REG
Bit	Read/Write	Default/Hex	Description
31:7	/	/	/
6	R/W	0x0	WK6_ALM1_EN. Week 6 (Sunday) Alarm 1 Enable. 0: Disable; 1: Enable. If this bit is set to "1", only when the Alarm 1 Week HH-MM-SS register valid bits is equal to RTC HH-MM-SS register and the register RTC HH-MM-SS bit [31:29] is 6, the week 6 alarm irq pending bit will be set to "1".
5	R/W	0x0	WK5_ALM1_EN. Week 5 (Saturday) Alarm 1 Enable. 0: Disable; 1: Enable. If this bit is set to "1", only when the Alarm 1 Week HH-MM-SS register valid bits is equal to RTC HH-MM-SS register and the register RTC HH-MM-SS bit [31:29] is 5, the week 5 alarm irq pending bit will be set to "1".
4	R/W	0x0	WK4_ALM1_EN. Week 4 (Friday) Alarm 1 Enable. 0: Disable, 1: Enable. If this bit is set to "1", only when the Alarm 1 Week HH-MM-SS register valid bits is equal to RTC HH-MM-SS register and the register RTC HH-MM-SS bit [31:29] is 4, the week 4 alarm irq pending bit will be set to "1".
3	R/W	0x0	WK3_ALM1_EN. Week 3 (Thursday) Alarm 1 Enable. 0: Disable; 1: Enable. If this bit is set to "1", only when the Alarm 1 Week HH-MM-SS register valid bits is equal to RTC HH-MM-SS register and the register RTC HH-MM-SS bit [31:29] is 3, the week 3 alarm irq pending bit will be set to "1".
2	R/W	0x0	WK2_ALM1_EN. Week 2 (Wednesday) Alarm 1 Enable. 0: Disable; 1: Enable.

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			If this bit is set to “1”, only when the Alarm 1 Week HH-MM-SS register valid bits is equal to RTC HH-MM-SS register and the register RTC HH-MM-SS bit [31:29] is 2, the week 2 alarm irq pending bit will be set to “1”.
1	R/W	0x0	WK1_ALM1_EN. Week 1 (Tuesday) Alarm 1 Enable. 0: Disable; 1: Enable. If this bit is set to “1”, only when the Alarm 1 Week HH-MM-SS register valid bits is equal to RTC HH-MM-SS register and the register RTC HH-MM-SS bit [31:29] is 1, the week 1 alarm irq pending bit will be set to “1”.
0	R/W	0x0	WK0_ALM1_EN. Week 0 (Monday) Alarm 1 Enable. 0: Disable; 1: Enable. If this bit is set to “1”, only when the Alarm 1 Week HH-MM-SS register valid bits is equal to RTC HH-MM-SS register and the register RTC HH-MM-SS bit [31:29] is 0, the week 0 alarm irq pending bit will be set to “1”.

Alarm 1 IRQ Enable Register (Default: 0x00000000)

Offset:0x48			Register Name: ALARM1_IRQ_EN
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/
0	R/W	0x0	ALARM1_IRQ_EN. Alarm 1 IRQ Enable. 0: disable; 1: enable.

Alarm 1 IRQ Status Register (Default: 0x00000000)

Offset:0x4C			Register Name: ALARM1_IRQ_STA_REG
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/
0	R/W	0x0	ALARM1_WEEK_IRQ_PEND. Alarm 1 Week (0/1/2/3/4/5/6) IRQ Pending. 0: No effect; 1: Pending, week counter value is reached. If alarm 1 week irq enable is set to 1, the pending bit will be sent to the interrupt controller.

Alarm Config Register (Default: 0x00000000)

Offset:0x50			Register Name: ALARM_CONFIG_REG
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/

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0	R/W	0x0	ALARM_WAKEUP. Configuration of alarm wake up output. 0: disable alarm wake up output; 1: enable alarm wake up output.

LOSC Output Gating Register (Default: 0x00000000)

Offset:0x60			Register Name: LOSC_OUT_GATING_REG
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/
0	R/W	0x0	LOSC_OUT_GATING. Configuration of LOSC output, and no LOSC output by default. 0: Enable LOSC output gating; 1: Disable LOSC output gating.

General Purpose Register (Default: 0x00000000))

Offset:0x100+N *0x4 (N=0~3)			Register Name: GP_DATA_REGn
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0x0	GP_DATA. Data [31:0].

Note: general purpose register 0/1/2/3 value can be stored if the VDD_RTC is larger than 1.0v.

GPL Hold Output Register (Default: 0x00000000)

Offset:0x180			Register Name: GPL_HOLD_OUTPUT_REG
Bit	Read/Write	Default/Hex	Description
31:12	/	/	/
11	R/W	0x0	GPL11_HOLD_OUTPUT. Hold the output of GPIOL11 when system's power is changing. The output must be low level (0) or high level (1) or High-Z; any other outputs may not hold on. 0: Hold disable 1: Hold enable
10	R/W	0x0	GPL10_HOLD_OUTPUT. Hold the output of GPIOL10 when system's power is changing. The output must be low level (0) or high level (1) or High-Z; any other outputs may not hold on. 0: Hold disable 1: Hold enable
9	R/W	0x0	GPL9_HOLD_OUTPUT. Hold the output of GPIOL9 when system's power is changing. The output must be low level (0) or high level (1) or High-Z; any other outputs may not hold on. 0: Hold disable 1: Hold enable

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8	R/W	0x0	GPL8_HOLD_OUTPUT. Hold the output of GPIOL8 when system's power is changing. The output must be low level (0) or high level (1) or High-Z; any other outputs may not hold on. 0: Hold disable 1: Hold enable
7	R/W	0x0	GPL7_HOLD_OUTPUT. Hold the output of GPIOL7 when system's power is changing. The output must be low level (0) or high level (1) or High-Z; any other outputs may not hold on. 0: Hold disable 1: Hold enable
6	R/W	0x0	GPL6_HOLD_OUTPUT. Hold the output of GPIOL6 when system's power is changing. The output must be low level (0) or high level (1) or High-Z; any other outputs may not hold on. 0: Hold disable 1: Hold enable
5	R/W	0x0	GPL5_HOLD_OUTPUT. Hold the output of GPIOL5 when system's power is changing. The output must be low level (0) or high level (1) or High-Z; any other outputs may not hold on. 0: Hold disable 1: Hold enable
4	R/W	0x0	GPL4_HOLD_OUTPUT. Hold the output of GPIOL4 when system's power is changing. The outputs must be low level (0) or high level (1) or High-Z; any other output may not hold on. 0: Hold disable 1: Hold enable
3	R/W	0x0	GPL3_HOLD_OUTPUT. Hold the output of GPIOL3 when system's power is changing. The output must be low level (0) or high level (1) or High-Z; any other outputs may not hold on. 0: Hold disable 1: Hold enable
2	R/W	0x0	GPL2_HOLD_OUTPUT. Hold the output of GPIOL2 when system's power is changing. The output must be low level (0) or high level (1) or High-Z; any other outputs may not hold on. 0: Hold disable 1: Hold enable
1	R/W	0x0	GPL1_HOLD_OUTPUT. Hold the output of GPIOL1 when system's power is changing. The output must be low level (0) or high level (1)

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			or High-Z; any other outputs may not hold on. 0: Hold disable 1: Hold enable
0	R/W	0x0	GPL0_HOLD_OUTPUT. Hold the output of GPIOL0 when system's power is changing. The output must be low level (0) or high level (1) or High-Z; any other outputs may not hold on. 0: Hold disable 1: Hold enable

VDD RTC Regulation Register (Default: 0x00000004)

Offset:0x190			Register Name: VDD_RTC_REG
Bit	Read/Write	Default/Hex	Description
31:3	/	/	/
2:0	R/W	0x100	VDD_RTC_REGU. These bits are useful for regulating the RTC_VIO from 0.7v to 1.4v, and the regulation step is 0.1v. 000: 0.7v 001: 0.8v 010: 0.9v 011: 1.0v 100: 1.1v 101: 1.2v 110: 1.3v 111: 1.4v

IC Characteristic Register (Default: 0x00000000)

Offset:0x1F0			Register Name: IC_CHARA_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0x0	/

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3.11 R_Timer

3.11.1 Overview

The R16 supports two general timers: R_timer 0 and R_timer 1, which use the LOSC or OSC24M as clock source.

R_timer 0 and R_timer 1 share a programmable 3-bit pre-scale that provides the division of the clock source. They can work in auto-reload mode or no-reload mode. When the current value in *Current Value Register* is counting down to zero, the timer will generate interrupt if interrupt enable bit is set.

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3.12 R_INTC

3.12.1 Overview

The interrupt controller has the following features:

- Controls the nIRQ processor
- Support thirty-one individually maskable interrupt sources
- One external NMI interrupt source
- 4-Level priority controller
- Six external sources of edge-sensitive or level-sensitive
- Support fast forcing

It provides handling of up to thirty-two interrupt sources. The 4-level Priority Controller allows the user to define the priority for each interrupt source, thus permitting higher priority interrupts to be serviced even if a lower priority interrupt is being treated. The fast forcing feature redirects any internal or external source to provide a fast interrupt rather than a normal interrupt.

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3.13 R_PWM

3.13.1 Overview

The output of the R_PWM is a toggling signal whose frequency and duty cycle can be modulated by its programmable registers. Each channel has a dedicated internal 16-bit up counter. If the counter reaches the value stored in the channel period register, it resets. At the beginning of a count period cycle, the PWMOUT is set to active state and count from 0.

The R_PWM divider divides the clock (24MHz) by 1~4096 according to the pre-scalar bits in the R_PWM control register.

In R_PWM cycle mode, the output will be a square waveform, the frequency is set to the period register. In R_PWM pulse mode, the output will be a positive pulse or a negative pulse.

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3.14 R_Watchdog

3.14.1 Overview

The R_watchdog is used to resume the controller operation when it had been disturbed by malfunctions such as noise and system errors. It features a down counter that allows a watchdog period of up to 16 seconds. It can generate a general reset or interrupt request. The watchdog generates the reset signal to reset CPUS or the whole system.

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3.15 System Control

3.15.1 Overview

Area	Address	Size(Bytes)
A1	0x00000000--0x00007FFF	32K
A2	0x00044000--0x00053FFF	64K
CPU0 I-Cache		32K
CPU0 D-Cache		32K
CPU1 I-Cache		32K
CPU1 D-Cache		32K
CPU2 I-Cache		32K
CPU2 D-Cache		32K
CPU3 I-Cache		32K
CPU3 D-Cache		32K
CPU L2 Cache		512K
Total		864K

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3.15.2 System Control Register List

Module Name	Base Address
SRAM	0x01C00000

Register Name	Offset	Description
SRAM_CTRL_REG0	0x0	SRAM Control Register 0
SRAM_CTRL_REG1	0x4	SRAM Control Register 1

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3.15.3 System Control Register Description

SRAM Control Register 0 (Default: 0x7FFFFFFF)

Offset:0x0			Register Name: SRAM_CTRL_REG0
Bit	Read/Write	Default/Hex	Description
31	/	/	/
30:0	R/W	0x7fffffff	SRAM_C1_MAP. SRAM Area C1 50K Bytes Configuration by AHB. 0: map to CPU/DMA 1: map to VE

SRAM Control Register 1 (Default: 0x00001300)

Offset:0x4			Register Name: SRAM_CTRL_REG1
Bit	Read/Write	Default/Hex	Description
31	R/W	0x0	BIST_DMA_CTRL_SEL. Bist and DMA control select. 0: DMA, 1: Bist.
30:0	/	/	/.

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3.16 Audio Codec

3.16.1 Overview

The embedded audio codec is a high-quality stereo audio codec with headphone amplifier and is designed for mobile computing and communications. It provides a stereo DAC for playback and stereo ADC for recording.

It includes the following features:

- Two audio digital to analog(DAC) channels
  - Stereo capless headphone drivers
  - Up to 100±3dB SNR
  - Supports DAC sample rates from 8KHz to 192KHz
- Two audio analog-to-digital(ADC) channels
  - Up to 93±3dB SNR
  - Supports ADC sample rates from 8KHz to 48KHz
- Supports analog/digital volume control
- Differential earpiece driver
- Accessory button press detection
- Supports four audio inputs
  - Two differential microphone inputs
  - One stereo line-in input
  - One differential phone input
- Supports two audio outputs
  - One stereo or differential capless headphone output
  - One differential phone output to modem

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3.16.2 Signal Description

Signal Name	Type	Description
HBIAS	O	Headset microphone bias supply
MBIAS	O	Main analog microphone bias supply
PHONEOUTP	O	Phone positive output
PHONEOUTN	O	Phone negative output
MICIN1P	I	First microphone positive input
MICIN1N	I	First microphone negative input
MICIN2P	I	Second microphone positive input
MICIN2N	I	Second microphone negative input
PHONEINP	I	Phone positive input
PHONEINN	I	Phone negative input
LINEINL	I	Line in left input
LINEINR	I	Line in right input
HPCOMFB	I	Headphone common reference feedback
HPCOM	O	Headphone common reference
HPOUTL	O	Headphone Left output
HPOUTR	O	Headphone Right output

Power Description:

VRA1	O	Reference
VRA2	O	Reference
VRP	O	Reference
AVCC	I	Analog Power
HPVCCIN	I	Headphone Amplifier Power Supply
HPVCCBP	O	Headphone Amplifier Power Bypass
AGND	GND	Analog Ground

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3.16.3 Block Diagram

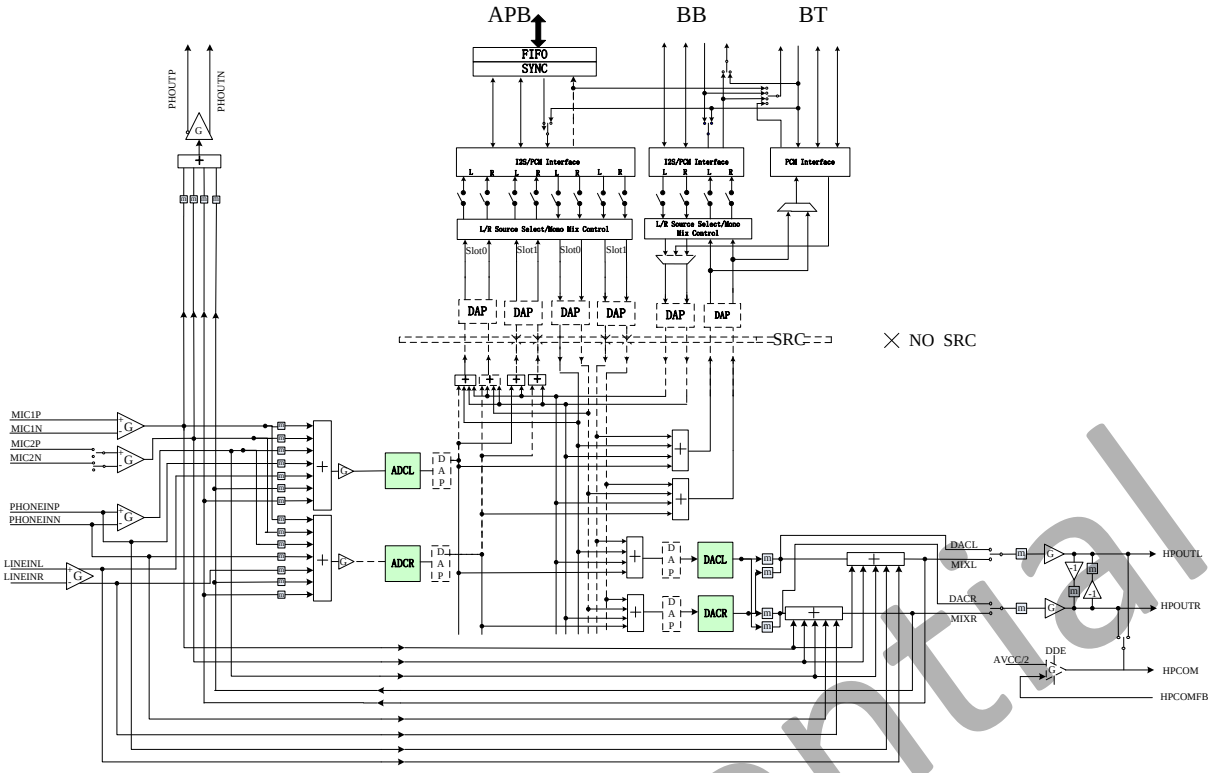

Figure 3.16-1 Audio Codec Block Diagram

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3.16.4 Audio Codec Register List

Module Name	Base Address
Audio Codec	0x01C22C00

Register Name	Offset	Description
DA_CTL	0x000	Digital Audio Control Register
DA_FAT0	0x004	Digital Audio Format Register 0
DA_FAT1	0x008	Digital Audio Format Register 1
DA_TXFIFO	0x00C	Digital Audio TX FIFO Register
DA_RXFIFO	0x010	Digital Audio RX FIFO Register
DA_FCTL	0x014	Digital Audio FIFO Control Register
DA_FSTA	0x018	Digital Audio FIFO Status Register
DA_INT	0x01C	Digital Audio Interrupt Control Register
DA_ISTA	0x020	Digital Audio Interrupt Status Register
DA_CLKD	0x024	Digital Audio Clock Divide Register
DA_TXCNT	0x028	Digital Audio RX Sample Counter Register
DA_RXCNT	0x02C	Digital Audio TX Sample Counter Register
DA_TXCHSEL	0x030	Digital Audio TX Channel Select register
DA_TXCHMAP	0x034	Digital Audio TX Channel Mapping Register
DA_RXCHSEL	0x038	Digital Audio RX Channel Select register
DA_RXCHMAP	0x03C	Digital Audio RX Channel Mapping Register
CHIP_AUDIO_RST	0x200	Chip Soft Reset Register
SYSCLK_CTL	0x20C	System Clock Control Register
MOD_CLK_ENA	0x210	Module Clock Control Register
MOD_RST_CTL	0x214	Module Reset Control Register
SYS_SR_CTRL	0x218	System Sample rate & SRC Configuration Register
SYS_SRC_CLK	0x21C	System SRC Clock Source Select Register
SYS_DVC_MOD	0x220	System DVC Mode Select Register
AIF1CLK_CTRL	0x240	AIF1 BCLK/LRCK Control Register
AIF1_ADCDAT_CTRL	0x244	AIF1 ADCDAT Control Register
AIF1_DACDAT_CTRL	0x248	AIF1 DACDAT Control Register
AIF1_MXR_SRC	0x24C	AIF1 Digital Mixer Source Select Register
AIF1_VOL_CTRL1	0x250	AIF1 Volume Control 1 Register
AIF1_VOL_CTRL2	0x254	AIF1 Volume Control 2 Register
AIF1_VOL_CTRL3	0x258	AIF1 Volume Control 3 Register
AIF1_VOL_CTRL4	0x25C	AIF1 Volume Control 4 Register
AIF1_MXR_GAIN	0x260	AIF1 Digital Mixer Gain Control Register
AIF1_RXD_CTRL	0x264	AIF1 Receiver Data Discarding Control Register
AIF2_CLK_CTRL	0x280	AIF2 BCLK/LRCK Control Register
AIF2_ADCDAT_CTRL	0x284	AIF2 ADCDAT Control Register
AIF2_DACDAT_CTRL	0x288	AIF2 DACDAT Control Register
AIF2_MXR_SRC	0x28C	AIF2 Digital Mixer Source Select Register

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AIF2_VOL_CTRL1	0x290	AIF2 Volume Control 1 Register
AIF2_VOL_CTRL2	0x298	AIF2 Volume Control 2 Register
AIF2_MXR_GAIN	0x2A0	AIF2 Digital Mixer Gain Control Register
AIF2_RXD_CTRL	0x2A4	AIF2 Receiver Data Discarding Control Register
AIF3_CLK_CTRL	0x2C0	AIF3 BCLK/LRCK Control Register
AIF3_ADCDAT_CTRL	0x2C4	AIF3 ADCDAT Control Register
AIF3_DACDAT_CTRL	0x2C8	AIF3 DACDAT Control Register
AIF3_SGP_CTRL	0x2CC	AIF3 Signal Path Control Register
AIF3_RXD_CTRL	0x2E4	AIF3 Receiver Data Discarding Control Register
ADC_DIG_CTRL	0x300	ADC Digital Control Register
ADC_VOL_CTRL	0x304	ADC Volume Control Register
ADC_DBG_CTRL	0x308	ADC Debug Control Register
DAC_DIG_CTRL	0x320	DAC Digital Control Register
DAC_VOL_CTRL	0x324	DAC Volume Control Register
DAC_DBG_CTRL	0x328	DAC Debug Control Register
DAC_MXR_SRC	0x330	DAC Digital Mixer Source Select Register
DAC_MXR_GAIN	0x334	DAC Digital Mixer Gain Control Register
AC_ADC_DAPLSTA	0x400	ADC DAP Left Status Register
AC_ADC_DAPRSTA	0x404	ADC DAP Right Status Register
AC_ADC_DAPLCTRL	0x408	ADC DAP Left Channel Control Register
AC_ADC_DAPRCTRL	0x40C	ADC DAP Right Channel Control Register
AC_ADC_DAPLTL	0x410	ADC DAP Left Target Level Register
AC_ADC_DAPRTL	0x414	ADC DAP Right Target Level Register
AC_ADC_DAPLHAC	0x418	ADC DAP Left High Average Coef Register
AC_ADC_DAPLLAC	0x41C	ADC DAP Left Low Average Coef Register
AC_ADC_DAPRHAC	0x420	ADC DAP Right High Average Coef Register
AC_ADC_DAPRLAC	0x424	ADC DAP Right Low Average Coef Register
AC_ADC_DAPLDT	0x428	ADC DAP Left Decay Time Register
AC_ADC_DAPLAT	0x42C	ADC DAP Left Attack Time Register
AC_ADC_DAPRDT	0x430	ADC DAP Right Decay Time Register
AC_ADC_DAPRAT	0x434	ADC DAP Right Attack Time Register
AC_ADC_DAPNTH	0x438	ADC DAP Noise Threshold Register
AC_ADC_DAPLHNAC	0x43C	ADC DAP Left Input Signal High Average Coef Register
AC_ADC_DAPLLNAC	0x440	ADC DAP Left Input Signal Low Average Coef Register
AC_ADC_DAPRHNAC	0x444	ADC DAP Right Input Signal High Average Coef Register
AC_ADC_DAPRLNAC	0x448	ADC DAP Right Input Signal Low Average Coef Register
AC_DAPHHPFC	0x44C	ADC DAP High HPF Coef Register
AC_DAPLHPFC	0x450	ADC DAP Low HPF Coef Register
AC_DAPOPT	0x454	ADC DAP Optimum Register
AC_DAC_DAPCTRL	0x480	DAC DAP Control Register
AC_DAC_DAPHHPFC	0x484	DAC DAP High HPF Coef Register
AC_DAC_DAPLHPFC	0x488	DAC DAP Low HPF Coef Register
AC_DAC_DAPLHAVC	0x48C	DAC DAP Left High Energy Average Coef Register
AC_DAC_DAPLLAVC	0x490	DAC DAP Left Low Energy Average Coef Register

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AC_DAC_DAPRHAVC	0x494	DAC DAP Right High Energy Average Coef Register
AC_DAC_DAPRLAVC	0x498	DAC DAP Right Low Energy Average Coef Register
AC_DAC_DAPHGDEC	0x49C	DAC DAP High Gain Decay Time Coef Register
AC_DAC_DAPLGDEC	0x4A0	DAC DAP Low Gain Decay Time Coef Register
AC_DAC_DAPHGATC	0x4A4	DAC DAP High Gain Attack Time Coef Register
AC_DAC_DAPLGATC	0x4A8	DAC DAP Low Gain Decay Time Coef Register
AC_DAC_DAPHETHD	0x4AC	DAC DAP High Energy Threshold Register
AC_DAC_DAPLETHD	0x4B0	DAC DAP Low Energy Threshold Register
AC_DAC_DAPHGKPA	0x4B4	DAC DAP High Gain K Parameter Register
AC_DAC_DAPLGKPA	0x4B8	DAC DAP Low Gain K Parameter Register
AC_DAC_DAPHGOPA	0x4BC	DAC DAP High Gain Offset Parameter Register
AC_DAC_DAPLGOPA	0x4C0	DAC DAP Low Gain Offset Parameter Register
AC_DAC_DAPOPT	0x4C4	DAC DAP Optimum Register
AGC_ENA	0x4D0	AGC Enable Register
DRC_ENA	0x4D4	DRC Enable Register
SRC1_CTRL1	0x4E0	SRC1 Control 1 Register
SRC1_CTRL2	0x4E4	SRC1 Control 2 Register
SRC1_CTRL3	0x4E8	SRC1 Control 3 Register
SRC1_CTRL4	0x4EC	SRC1 Control 4 Register
SRC2_CTRL1	0x4F0	SRC2 Control 1 Register
SRC2_CTRL2	0x4F4	SRC2 Control 2 Register
SRC2_CTRL3	0x4F8	SRC2 Control 3 Register
SRC2_CTRL4	0x4FC	SRC2 Control 4 Register

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3.16.5 Audio Codec Register Description

I2S_AP Control Register

Offset: 0x000			Register Name: DA_CTL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:9	/	/	/
8	R/W	0	SDO_EN 0: Disable 1: Enable
7	/	/	/
6	R/W	0	ASS Audio sample select when TX FIFO under run 0: Sending zero 1: Sending last audio sample
5	R/W	0	MS Master Slave Select 0: Master 1: Slave
4	R/W	0	PCM 0: I2S Interface 1: PCM Interface
3	R/W	0	LOOP Loop back test 0: Normal mode 1: Loop back test When set '1', connecting the SDO with the SDI in Master mode.
2	R/W	0	TXEN Transmitter Block Enable 0: Disable 1: Enable
1	R/W	0	RXEN Receiver Block Enable 0: Disable 1: Enable
0	R/W	0	GEN Globe Enable A disable on this bit overrides any other block or channel enables and flushes all FIFOs. 0: Disable 1: Enable

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I2S_AP Format Register 1

Offset: 0x004			Register Name: DA_FAT0 Default Value: 0x0000_000C
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7	R/W	0	LRCP Left/ Right Clock Parity 0: Normal 1: Inverted In DSP/ PCM mode 0: MSB is available on 2nd BCLK rising edge after LRC rising edge 1: MSB is available on 1st BCLK rising edge after LRC rising edge
6	R/W	0	BCP BCLK Parity 0: Normal 1: Inverted
5:4	R/W	0	SR Sample Resolution 00: 16-bits 01: 20-bits 10: 24-bits 11: Reserved
3:2	R/W	0x3	WSS Word Select Size 00: 16 BCLK 01: 20 BCLK 10: 24 BCLK 11: 32 BCLK
1:0	R/W	0	FMT Serial Data Format 00: Standard I2S Format 01: Left Justified Format 10: Right Justified Format 11: Reserved

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I2S_AP Format Register 1

Offset: 0x008			Register Name: DA_FAT1 Default Value: 0x0000_4020
Bit	Read/Write	Default/Hex	Description
31:15	/	/	/
14:12	R/W	0x4	PCM_SYNC_PERIOD PCM SYNC Period Clock Number 000: 16 BCLK period 001: 32 BCLK period 010: 64 BCLK period 011: 128 BCLK period 100: 256 BCLK period Others : Reserved
11	R/W	0	PCM_SYNC_OUT PCM Sync Out 0: Enable PCM_SYNC output in Master mode 1: Suppress PCM_SYNC whilst keeping PCM_CLK running. Some Codec utilize this to enter a low power state.
10	R/W	0	PCM Out Mute Write 1 force PCM_OUT to 0
9	R/W	0	MLS MSB / LSB First Select 0: MSB First 1: LSB First
8	R/W	0	SEXT Sign Extend (only for 16 bits slot) 0: Zeros or audio gain padding at LSB position 1: Sign extension at MSB position When writing the bit is 0, the unused bits are audio gain for 13-bit linear sample and zeros padding for 8-bit companding sample. When writing the bit is 1, the unused bits are both sign extension.
7:6	R/W	0	SI Slot Index 00: the 1st slot 01: the 2nd slot 10: the 3rd slot 11: the 4th slot
5	R/W	1	SW Slot Width 0: 8 clocks width 1: 16 clocks width Notes: For A-law or u-law PCM sample, if this bit is set to 1,

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			eight zero bits are following with PCM sample.
4	R/W	0	SSYNC Short Sync Select 0: Long Frame Sync 1: Short Frame Sync It should be set '1' for 8 clocks width slot.
3:2	R/W	0	RX_PDM PCM Data Mode 00: 16-bits Linear PCM 01: 8-bits Linear PCM 10: 8-bits u-law 11: 8-bits A-law
1:0	R/W	0	TX_PDM PCM Data Mode 00: 16-bits Linear PCM 01: 8-bits Linear PCM 10: 8-bits u-law 11: 8-bits A-law

I2S_AP TX FIFO register

Offset: 0x00C			Register Name: DA_TXFIFO Default Value: 0x0000_0000
Bit	Default/Hex	Default/Hex	Description
31:0	W	0	TX_DATA TX Sample Transmitting left, right channel sample data should be written this register one by one. The left channel sample data is first and then the right channel sample.

I2S_AP RX FIFO register

Offset: 0x010			Register Name: DA_RXFIFO Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:0	R	0	RX_DATA RX Sample Host can get one sample by reading this register. The left channel sample data is first and then the right channel sample.

I2S_AP FIFO Control Register

Offset: 0x014			Register Name: DA_FCTL Default Value: 0x0004_00F0
Bit	Read/Write	Default/Hex	Description
31	R/W	0	FIFOSRC TX FIFO source select

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			0: APB bus 1: Reserved
30:26	/	/	/
25	R/W	0	FTX Write ‘1’ to flush TX FIFO, self clear to ‘0’.
24	R/W	0	FRX Write ‘1’ to flush RX FIFO, self clear to ‘0’.
23:19	/	/	/
18:12	R/W	0x40	TXTL TX FIFO Empty Trigger Level Interrupt and DMA request trigger level for TXFIFO normal condition Trigger Level = TXTL
11:10	/	/	/
9:4	R/W	0xF	RXTL RX FIFO Trigger Level Interrupt and DMA request trigger level for RXFIFO normal condition Trigger Level = RXTL + 1
3	/	/	/
2	R/W	0	TXIM TX FIFO Input Mode (Mode 0, 1) 0: Valid data at the MSB of TXFIFO register 1: Valid data at the LSB of TXFIFO register Example for 20-bits transmitted audio sample: Mode 0: FIFO_I[23:0] = {4’h0, TXFIFO[31:12]} Mode 1: FIFO_I[23:0] = {4’h0, TXFIFO[19:0]}
1:0	R/W	0	RXOM RX FIFO Output Mode (Mode 0, 1, 2, 3) 00: Expanding ‘0’ at LSB of DA_RXFIFO register. 01: Expanding received sample sign bit at MSB of DA_RXFIFO register. 10: Truncating received samples at high half-word of DA_RXFIFO register and low half-word of DA_RXFIFO register is filled by ‘0’. 11: Truncating received samples at low half-word of DA_RXFIFO register and high half-word of DA_RXFIFO register is expanded by its sign bit. Example for 20-bits received audio sample: Mode 0: RXFIFO[31:0] = {FIFO_O[19:0], 12’h0} Mode 1: RXFIFO[31:0] = {12{FIFO_O[19]}, FIFO_O[19:0]} Mode 2: RXFIFO[31:0] = {FIFO_O[19:4], 16’h0} Mode 3: RXFIFO[31:0] = {16{FIFO_O[19], FIFO_O[19:4]}

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I2S_AP FIFO Status Register

Offset: 0x018			Register Name: DA_FSTA Default Value: 0x1080_0000
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28	R	1	TXE TX FIFO Empty 0: No room for new sample in TX FIFO 1: More than one room for new sample in TX FIFO (>= 1 word)
27:24	/	/	/
23:16	R	0x80	TXE_CNT TX FIFO Empty Space Word Counter
15:9	/	/	/
8	R	0	RXA RX FIFO Available 0: No available data in RX FIFO 1: More than one sample in RX FIFO (>= 1 word)
7	/	/	/
6:0	R	0	RXA_CNT RX FIFO Available Sample Word Counter

I2S_AP DMA & Interrupt Control Register

Offset: 0x01C			Register Name: DA_INT Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7	R/W	0	TX_DRQ TX FIFO Empty DRQ Enable 0: Disable 1: Enable
6	R/W	0	TXUI_EN TX FIFO Under run Interrupt Enable 0: Disable 1: Enable
5	R/W	0	TXOI_EN TX FIFO Overrun Interrupt Enable 0: Disable 1: Enable When set to '1', an interrupt happens when writing new audio data if TX FIFO is full.
4	R/W	0	TXEI_EN TX FIFO Empty Interrupt Enable 0: Disable 1: Enable

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3	R/W	0	RX_DRQ RX FIFO Data Available DRQ Enable 0: Disable 1: Enable When set to '1', RXFIFO DMA Request line is asserted if Data is available in RX FIFO.
2	R/W	0	RXUI_EN RX FIFO Under run Interrupt Enable 0: Disable 1: Enable
1	R/W	0	RXOI_EN RX FIFO Overrun Interrupt Enable 0: Disable 1: Enable
0	R/W	0	RXAI_EN RX FIFO Data Available Interrupt Enable 0: Disable 1: Enable

I2S_AP Interrupt Status Register

Offset: 0x020			Register Name: DA_ISTA Default Value: 0x0000_0010
Bit	Read/Write	Default/Hex	Description
31:7	/	/	/
6	R/W	0	TXU_INT TX FIFO Under run Pending Interrupt 0: No Pending Interrupt 1: FIFO Under run Pending Interrupt
5	R/W	0	TXO_INT TX FIFO Overrun Pending Interrupt 0: No Pending Interrupt 1: FIFO Overrun Pending Interrupt Write '1' to clear this interrupt
4	R/W	1	TXE_INT TX FIFO Empty Pending Interrupt 0: No Pending IRQ 1: FIFO Empty Pending Interrupt Write '1' to clear this interrupt or automatic clear if interrupt condition fails.
3:2	/	/	/
2	R/W	0	RXU_INT RX FIFO Under run Pending Interrupt 0: No Pending Interrupt 1:FIFO Under run Pending Interrupt Write 1 to clear this interrupt

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1	R/W	0	RXO_INT RX FIFO Overrun Pending Interrupt 0: No Pending IRQ 1: FIFO Overrun Pending IRQ Write '1' to clear this interrupt
0	R/W	0	RXA_INT RX FIFO Data Available Pending Interrupt 0: No Pending IRQ 1: Data Available Pending IRQ Write '1' to clear this interrupt or automatic clear if interrupt condition fails.

I2S_AP Clock Divide Register

Offset: 0x024			Register Name: DA_CLKD Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7	R/W	0	MCLKO_EN 0: Disable MCLK Output 1: Enable MCLK Output Notes: Whether in Slave or Master mode, when this bit is set to 1, MCLK should be output.
6:4	R/W	0	BCLKDIV BCLK Divide Ratio from MCLK 000: Divide by 2 (BCLK = MCLK/2) 001: Divide by 4 010: Divide by 6 011: Divide by 8 100: Divide by 12 101: Divide by 16 110: Divide by 32 111: Divide by 64
3:0	R/W	0	MCLKDIV MCLK Divide Ratio from Audio PLL Output 0000: Divide by 1 0001: Divide by 2 0010: Divide by 4 0011: Divide by 6 0100: Divide by 8 0101: Divide by 12 0110: Divide by 16 0111: Divide by 24 1000: Divide by 32 1001: Divide by 48 1010: Divide by 64

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			Others : Reserved

I2S_AP TX Counter register

Offset: 0x028			Register Name: DA_TXCNT Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0	TX_CNT TX Sample Counter The audio sample number of sending into TXFIFO. When one sample is put into TXFIFO by DMA or by host IO, the TX sample counter register increases by one. The TX sample counter register can be set to any initial valve at any time. After been updated by the initial value, the counter register should count on base of this initial value.

I2S_AP RX Counter register

Offset: 0x02C			Register Name: DA_RXCNT Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0	RX_CNT RX Sample Counter The audio sample number of writing into RXFIFO. When one sample is written by I2S_AP Engine, the RX sample counter register increases by one. The RX sample counter register can be set to any initial valve at any time. After been updated by the initial value, the counter register should count on base of this initial value.

I2S_AP TX Channel Select register

Offset: 0x030			Register Name: DA_TXCHSEL Default Value: 0x0000_0001
Bit	Read/Write	Default/Hex	Description
31:3	/	/	/
2:0	R/W	1	TX_CHSEL TX Channel Select 0: 1-ch 1: 2-ch 2: 3-ch 3: 4-ch

I2S_AP TX Channel Mapping Register

Offset: 0x034			Register Name: DA_TXCHMAP Default Value: 0x7654_3210
Bit	Read/Write	Default/Hex	Description
31:15	/	/	/

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14:12	R/W	3	TX_CH3_MAP TX Channel3 Mapping 000: 1st sample 001: 2nd sample 010: 3rd sample 011: 4th sample 1xx: Reserved
11	/	/	/
10:8	R/W	2	TX_CH2_MAP TX Channel2 Mapping 000: 1st sample 001: 2nd sample 010: 3rd sample 011: 4th sample 1xx: Reserved
7	/	/	/
6:4	R/W	1	TX_CH1_MAP TX Channel1 Mapping 000: 1st sample 001: 2nd sample 010: 3rd sample 011: 4th sample 1xx: Reserved
3	/	/	/
2:0	R/W	0	TX_CH0_MAP TX Channel0 Mapping 000: 1st sample 001: 2nd sample 010: 3rd sample 011: 4th sample 1xx: Reserved

I2S_AP RX Channel Select register

Offset: 0x038			Register Name: DA_RXCHSEL Default Value: 0x0000_0001
Bit	Read/Write	Default/Hex	Description
31:3	/	/	/
2:0	R/W	1	RX_CHSEL RX Channel Select 0: 1-ch 1: 2-ch

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			2: 3-ch 3: 4-ch Others: Reserved

I2S_AP RX Channel Mapping Register

Offset: 0x03C			Register Name: DA_RXCHMAP Default Value: 0x0000_3210
Bit	Read/Write	Default/Hex	Description
31:15	/	/	/
14:12	R/W	3	RX_CH3_MAP RX Channel3 Mapping 000: 1st sample 001: 2nd sample 010: 3rd sample 011: 4th sample Others: Reserved
11	/	/	/
10:8	R/W	2	RX_CH2_MAP RX Channel2 Mapping 000: 1st sample 001: 2nd sample 010: 3rd sample 011: 4th sample Others: Reserved
7	/	/	/
6:4	R/W	1	RX_CH1_MAP RX Channel1 Mapping 000: 1st sample 001: 2nd sample 010: 3rd sample 011: 4th sample Others: Reserved
3	/	/	/
2:0	R/W	0	RX_CH0_MAP RX Channel0 Mapping 000: 1st sample 001: 2nd sample 010: 3rd sample 011: 4th sample Others: Reserved

Chip Soft Reset Register

Offset: 0x200			Register Name: CHIP_AUDIO_RST Default Value: 0x0000_0101
Bit	Read/Write	Default/Hex	Description

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31:16	/	/	/
15:0	R/W	/	Reserved

System Clock Control Register

Offset: 0x20C			Register Name: SYSCLK_CTL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:12	/	/	/
11	R/W	0x0	AIF1CLK_ENA AIF1CLK Enable 0: Disable 1: Enable
10	R/W	0x0	Reserved
9:8	R/W	0x0	AIF1CLK_SRC AIF1CLK Source Select 00: MLCK1 01: Reserved 1X: pll2_1x
7	R/W	0x0	AIF2CLK_ENA AIF2CLK Enable 0: Disable 1: Enable
6	R/W	0x0	Reserved
5:4	R/W	0x0	AIF2CLK_SRC AIF2CLK Source Select 00: MLCK1 01: Reserved 1X: pll2_1x
3	R/W	0x0	SYSCLK_ENA SYSCLK Enable 0: Disable 1: Enable
2:1	R/W	0x0	Reserved
0	R/W	0x0	SYSCLK_SRC System Clock Source Select 0: AIF1CLK 1: AIF2CLK

Module Clock Control Register

Offset: 0x210			Register Name: MOD_CLK_ENA Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:16	R/W	0x0	Reserved
15:0	R/W	0x0000	Module clock enable control 0-Clock disable

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			1-Clock enable BIT15-AIF1 BIT14-AIF2 BIT13-AIF3 BIT12-Reserved BIT11-SRC1 BIT10-SRC2 BIT9-Reserved BIT8-Reserved BIT7-HPF & AGC BIT6-HPF & DRC BIT5-Reserved BIT4-Reserved BIT3-ADC Digital BIT2-DAC Digital BIT1-Reserved BIT0-Reserved

Module Reset Control Register

Offset: 0x214			Register Name: MOD_RST_CTL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:16	R/W	0x0	Reserved
15:0	R/W	0x0	Module reset control 0-Reset asserted 1-Reset de-asserted BIT15-AIF1 BIT14-AIF2 BIT13-AIF3 BIT12-Reserved BIT11-SRC1 BIT10-SRC2 BIT9-Reserved BIT8-Reserved BIT7-HPF & AGC BIT6-HPF & DRC BIT5-Reserved BIT4-Reserved BIT3-ADC Digital BIT2-DAC Digital BIT1-Reserved BIT0-Reserved

System Sample rate & SRC Configuration Register

Offset: 0x218	Register Name: SYS_SR_CTRL

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			Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:16	/	/	/
15:12	R/W	0x0	AIF1_FS AIF1 Sample Rate 0000: 8KHz 0001: 11.025KHz 0010: 12KHz 0011: 16KHz 0100: 22.05KHz 0101: 24KHz 0110: 32KHz 0111: 44.1KHz 1000: 48KHz 1001: 96KHz 1010: 192KHz Other: Reserved
11:8	R/W	0x0	AIF2_FS AIF2 Sample Rate 0000: 8KHz 0001: 11.025KHz 0010: 12KHz 0011: 16KHz 0100: 22.05KHz 0101: 24KHz 0110: 32KHz 0111: 44.1KHz 1000: 48KHz 1001: 96KHz 1010: 192KHz Other: Reserved
3	R/W	0x0	SRC1_ENA SRC1 Enable. SRC1 Performs sample rate conversion of digital audio input to the AW1653. 0: Disable 1: Enable
2	R/W	0x0	SRC1_SRC From which the input data will come. 0: AIF1 DAC Timeslot 0 1: AIF2 DAC
1	R/W	0x0	SRC2_ENA SRC2 Enable. SRC2 Performs sample rate conversion of digital audio output from the AW1653. 0: Disable 1: Enable

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0	R/W	0x0	SRC2_SRC To which the converted data will be output. 0: AIF1 ADC Timeslot 0 1: AIF2 ADC

System SRC Clock Source Select Register

Offset: 0x21C			Register Name: SYS_SRC_CLK Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:2	/	/	/
1:0	R/W	0x0	SRC_CLK_SLT System SRC module output clock source select 00: normal mode 01: src1 output sample rate select DAC clk 10: src2 input sample rate select ADC clk 11: reserved

AIF1 BCLK/LRCK Control Register

Offset: 0x240			Register Name: AIF1CLK_CTRL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15	R/W	0x0	AIF1_MSTR_MOD AIF1 Audio Interface mode select 0 = Master mode 1 = Slave mode
14	R/W	0x0	AIF1_BCLK_INV AIF1 BCLK Polarity 0: Normal 1: Inverted
13	R/W	0x0	AIF1_LRCK_INV AIF1 LRCK Polarity 0: Normal 1: Inverted
12:9	R/W	0x0	AIF1_BCLK_DIV Select the AIF1CLK/BCLK1 ratio 0000: AIF1CLK/1 0001: AIF1CLK/2 0010: AIF1CLK/4 0011: AIF1CLK/6 0100: AIF1CLK/8 0101: AIF1CLK/12 0110: AIF1CLK/16 0111: AIF1CLK/24 1000: AIF1CLK/32 1001: AIF1CLK/48

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			1010: AIF1CLK/64 1011: AIF1CLK/96 1100: AIF1CLK/128 1101: AIF1CLK/192 1110: Reserved 1111: Reserved
8:6	R/W	0x0	AIF1_LRCK_DIV Select the BCLK1/LRCK ratio 000: 16 001: 32 010: 64 011: 128 100: 256 1xx: Reserved
5:4	R/W	0x0	AIF1_WORD_SIZ AIF1 digital interface word size 00: 8bit 01: 16bit 10: 20bit 11: 24bit
3:2	R/W	0x0	AIF1_DATA_FMT AIF digital interface data format 00: I2S mode 01: Left mode 10: Right mode 11: DSP mode
1	R/W	0x0	DSP_MONO_PCM DSP Mono mode select 0: Stereo mode select 1: Mono mode select
0	R/W	0x0	AIF1_TDMM_ENA AIF1 TDM Mode enable 0: Disable 1: Enable

AIF1 ADCDAT Control Register

Offset: 0x244			Register Name: AIF1_ADCDAT_CTRL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15	R/W	0x0	AIF1_AD0L_ENA AIF1 ADC Timeslot 0 left channel enable 0: Disable 1: Enable
14	R/W	0x0	AIF1_AD0R_ENA AIF1 ADC Timeslot 0 right channel enable

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			0: Disable 1: Enable
13	R/W	0x0	AIF1_AD1L_ENA AIF1 ADC Timeslot 1 left channel enable 0: Disable 1: Enable
12	R/W	0x0	AIF1_AD1R_ENA AIF1 ADC Timeslot 1 right channel enable 0: Disable 1: Enable
11:10	R/W	0x0	AIF1_AD0L_SRC AIF1 ADC Timeslot 0 left channel data source select 00: AIF1 AD0L 01: AIF1 AD0R 10: (AIF1 AD0L+AIF1 AD0R) 11: (AIF1 AD0L+AIF1 AD0R)/2
9:8	R/W	0x0	AIF1_AD0R_SRC AIF1 ADC Timeslot 0 right channel data source select 00: AIF1 AD0R 01: AIF1 AD0L 10: (AIF1 AD0L+AIF1 AD0R) 11: (AIF1 AD0L+AIF1 AD0R)/2
7:6	R/W	0x0	AIF1_AD1L_SRC AIF1 ADC Timeslot 1 left channel data source select 00: AIF1 ADC1L 01: AIF1 ADC1R 10: (AIF1 ADC1L+AIF1 ADC1R) 11: (AIF1 ADC1L+AIF1 ADC1R)/2
5:4	R/W	0x0	AIF1_AD1R_SRC AIF1 ADC Timeslot 1 right channel data source select 00: AIF1 ADC1R 01: AIF1 ADC1L 10: (AIF1 ADC1L+AIF1 ADC1R) 11: (AIF1 ADC1L+AIF1 ADC1R)/2
3	R/W	0x0	AIF1_ADCP_ENA AIF1 ADC Companding enable(8-bit mode only) 0: Disable 1: Enable
2	R/W	0x0	AIF1_ADUL_ENA AIF1ADC Companding mode select 0: A-law 1: u-law
1:0	R/W	0x0	AIF1_SLOT_SIZ Select the slot size(only in TDM mode) 00: 8

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			01: 16 10: 32 11: Reserved

AIF1 DACDAT Control Register

Offset: 0x248			Register Name: AIF1_DACDAT_CTRL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15	R/W	0x0	AIF1_DA0L_ENA AIF1 DAC Timeslot 0 left channel enable 0: Disable 1: Enable
14	R/W	0x0	AIF1_DA0R_ENA AIF1 DAC Timeslot 0 right channel enable 0: Disable 1: Enable
13	R/W	0x0	AIF1_DA1L_ENA AIF1 DAC Timeslot 1 left channel enable 0: Disable 1: Enable
12	R/W	0x0	AIF1_DA1R_ENA AIF1 DAC Timeslot 1 right channel enable 0: Disable 1: Enable
11:10	R/W	0x0	AIF1_DA0L_SRC AIF1 DAC Timeslot 0 left channel data source select 00: AIF1 DA0L 01: AIF1 DA0R 10: (AIF1 DA0L+AIF1 DA0R) 11: (AIF1 DA0L+AIF1 DA0R)/2
9:8	R/W	0x0	AIF1_DA0R_SRC AIF1 DAC Timeslot 0 right channel data source select 00: AIF1 DA0R 01: AIF1 DA0L 10: (AIF1 DA0L+AIF1 DA0R) 11: (AIF1 DA0L+AIF1 DA0R)/2
7:6	R/W	0x0	AIF1_DA1L_SRC AIF1 DAC Timeslot 1 left channel data source select 00: AIF1 DA1L 01: AIF1 DA1R 10: (AIF1 DA1L+AIF1 DA1R) 11: (AIF1 DA1L+AIF1 DA1R)/2
5:4	R/W	0x0	AIF1_DA1R_SRC AIF1 DAC Timeslot 1 right channel data source select 00: AIF1 DA1R

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			01: AIF1 DA1L 10: (AIF1 DA1L+AIF1 DA1R) 11: (AIF1 DA1L+AIF1 DA1R)/2
3	R/W	0x0	AIF1_DACP_ENA AIF1 DAC Companding enable(8-bit mode only) 00: Disable 01: Enable
2	R/W	0x0	AIF1_DAUL_ENA AIF1 DAC Companding mode select 0: A-law 1: u-law
1	R/W	0x0	Reserved
0	R/W	0x0	AIF1_LOOP_ENA AIF1 loopback enable 0: No loopback 1: Loopback(ADCDAT1 data output to DACDAT1 data input)

AIF1 Digital Mixer Source Select Register

Offset: 0x24C			Register Name: AIF1_MXR_SRC Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:12	R/W	0x0	AIF1_AD0L_MXL_SRC AIF1 ADC Timeslot 0 left channel mixer source select 0: Disable 1: Enable Bit15: AIF1 DA0L data Bit14: AIF2 DACL data Bit13: ADCL data Bit12: AIF2 DACR data
11:8	R/W	0x0	AIF1_AD0R_MXR_SRC AIF1 ADC Timeslot 0 right channel mixer source select 0: Disable 1: Enable Bit11: AIF1 DA0R data Bit10: AIF2 DACR data Bit9: ADCR data Bit8: AIF2 DACL data
7:6	R/W	0x0	AIF1_AD1L_MXR_SRC AIF1 ADC Timeslot 1 left channel mixer source select 0: Disable 1: Enable Bit7: AIF2 DACL data Bit6: ADCL data
5:4	R/W	0x0	Reserved
3:2	R/W	0x0	AIF1_AD1R_MXR_SRC AIF1 ADC Timeslot 1 right channel mixer source select 0: Disable 1: Enable Bit3: AIF2 DACR data

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			Bit2: ADCR data
1:0	R/W	0x0	Reserved

AIF1 Volume Control 1 Register

Offset: 0x250			Register Name: AIF1_VOL_CTRL1 Default Value: 0x0000_A0A0
Bit	Read/Write	Default/Hex	Description
15:8	R/W	0xA0	AIF1_AD0L_VOL AIF1 ADC Timeslot 0 left channel volume (-119.25dB To 71.25dB, 0.75dB/Step) 0x00: Mute 0x01: -119.25dB …… 0x9F = -0.75dB 0xA0 = 0dB 0xA1 = 0.75dB …… 0xFF = 71.25dB
7:0	R/W	0xA0	AIF1_AD0R_VOL AIF1 ADC Timeslot 0 right channel volume (-119.25dB To 71.25dB, 0.75dB/Step) 0x00: Mute 0x01: -119.25dB …… 0x9F = -0.75dB 0xA0 = 0dB 0xA1 = 0.75dB …… 0xFF = 71.25dB

AIF1 Volume Control 2 Register

Offset: 0x254			Register Name: AIF1_VOL_CTRL2 Default Value: 0x0000_A0A0
Bit	Read/Write	Default/Hex	Description
15:8	R/W	0xA0	AIF1_AD1L_VOL AIF1 ADC Timeslot 1 left channel volume (-119.25dB To 71.25dB, 0.75dB/Step) 0x00: Mute 0x01: -119.25dB …… 0x9F = -0.75dB 0xA0 = 0dB 0xA1 = 0.75dB …… 0xFF = 71.25dB

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7:0	R/W	0xA0	AIF1_AD1R_VOL AIF1 ADC Timeslot 1 right channel volume (-119.25dB To 71.25dB, 0.75dB/Step) 0x00: Mute 0x01: -119.25dB …… 0x9F = -0.75dB 0xA0 = 0dB 0xA1 = 0.75dB …… 0xFF = 71.25dB

AIF1 Volume Control 3 Register

Offset: 0x258			Register Name: AIF1_VOL_CTRL3 Default Value: 0x0000_A0A0
Bit	Read/Write	Default/Hex	Description
15:8	R/W	0xA0	AIF1_DA0L_VOL AIF1 DAC Timeslot 0 left channel volume (-119.25dB To 71.25dB, 0.75dB/Step) 0x00: Mute 0x01: -119.25dB …… 0x9F = -0.75dB 0xA0 = 0dB 0xA1 = 0.75dB …… 0xFF = 71.25dB
7:0	R/W	0xA0	AIF1_DA0R_VOL AIF1 DAC Timeslot 0 right channel volume (-119.25dB To 71.25dB, 0.75dB/Step) 0x00: Mute 0x01: -119.25dB …… 0x9F = -0.75dB 0xA0 = 0dB 0xA1 = 0.75dB …… 0xFF = 71.25dB

AIF1 Volume Control 4 Register

Offset: 0x25C			Register Name: AIF1_VOL_CTRL4 Default Value: 0x0000_A0A0
Bit	Read/Write	Default/Hex	Description
15:8	R/W	0xA0	AIF1_DA1L_VOL AIF1 DAC Timeslot 1 left channel volume

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			(-119.25dB To 71.25dB, 0.75dB/Step) 0x00: Mute 0x01: -119.25dB …… 0x9F = -0.75dB 0xA0 = 0dB 0xA1 = 0.75dB …… 0xFF = 71.25dB
7:0	R/W	0xA0	AIF1_DA1R_VOL AIF1 DAC Timeslot 1 right channel volume (-119.25dB To 71.25dB, 0.75dB/Step) 0x00: Mute 0x01: -119.25dB …… 0x9F = -0.75dB 0xA0 = 0dB 0xA1 = 0.75dB …… 0xFF = 71.25dB

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AIF1 Digital Mixer Gain Control Register

Offset: 0x260			Register Name: AIF1_MXR_GAIN Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:12	R/W	0x0	AIF1_AD0L_MXR_GAIN AIF1 ADC Timeslot 0 left channel mixer gain control 0: 0dB 1: -6dB Bit15: AIF1 DA0L data Bit14: AIF2 DACL data Bit13: ADCL data Bit12: AIF2 DACR data
11:8	R/W	0x0	AIF1_AD0R_MXR_GAIN AIF1 ADC Timeslot 0 right channel mixer gain control 0: 0dB 1: -6dB Bit11: AIF1 DA0R data Bit10: AIF2 DACR data Bit9: ADCR data Bit8: AIF2 DACL data
7:6	R/W	0x0	AIF1_AD1L_MXR_GAIN AIF1 ADC Timeslot 1 left channel mixer gain control 0: 0dB 1: -6dB Bit7: AIF2 DACL data Bit6: ADCL data
5:4	R/W	0x0	Reserved
3:2	R/W	0x0	AIF1_AD1R_MXR_GAIN AIF1 ADC Timeslot 1 right channel mixer gain control 0: 0dB 1: -6dB Bit3: AIF2 DACR data Bit2: ADCR data
1:0	R/W	0x0	Reserved

AIF1 Receiver Data Discarding Control Register

Offset: 0x264			Register Name: AIF1_RXD_CTRL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:8	R/W	0x0	After data receiving progress begins, the first N-data will be discarded. N defined as follows: 0x00: None discarded 0x01: 1-data discarded ... 0xFF: 255-data discarded
7:0	R/W	0x0	Reserved

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AIF2 BCLK/LRCK Control Register

Offset: 0x280			Register Name: AIF2_CLK_CTRL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15	R/W	0x0	AIF2_MSTR_MOD AIF2 Audio Interface mode select 0 = Master mode 1 = Slave mode
14	R/W	0x0	AIF2_BCLK_INV AIF2 BCLK Polarity 0: Normal 1: Inverted
13	R/W	0x0	AIF2_LRCK_INV AIF2 LRCK Polarity 0: Normal 1: Inverted
12:9	R/W	0x0	AIF2_BCLK_DIV Select the AIF2CLK/BCLK2 ratio 0000: AIF2CLK/1 0001: AIF2CLK/2 0010: AIF2CLK/4 0011: AIF2CLK/6 0100: AIF2CLK/8 0101: AIF2CLK/12 0110: AIF2CLK/16 0111: AIF2CLK/24 1000: AIF2CLK/32 1001: AIF2CLK/48 1010: AIF2CLK/64 1011: AIF2CLK/96 1100: AIF2CLK/128 1101: AIF2CLK/192 1110: Reserved 1111: Reserved
8:6	R/W	0x0	AIF2_LRCK_DIV Select the BCLK2/LRCK2 ratio 000: 16 001: 32 010: 64 011: 128 100: 256 1xx: Reserved
5:4	R/W	0x0	AIF2_WORD_SIZ AIF2 digital interface world length 00: 8bit

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			01: 16bit 10: 20bit 11: 24bit
3:2	R/W	0x0	AIF2_DATA_FMT AIF digital interface data format 00: I2S mode 01: Left mode 10: Right mode 11: DSP mode
1	R/W	0x0	AIF2_MONO_PCM AIF2 Mono PCM mode select 0: Stereo mode select 1: Mono mode select
0	R/W	0x0	Reserved

AIF2 ADCDAT Control Register

Offset: 0x284			Register Name: AIF2_ADCDAT_CTRL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15	R/W	0x0	AIF2_ADCL_EN AIF2 ADC left channel enable 0: Disable 1: Enable
14	R/W	0x0	AIF2_ADCR_EN AIF2 ADC right channel enable 0: Disable 1: Enable
13:12	R/W	0x0	Reserved
11:10	R/W	0x0	AIF2_ADCL_SRC AIF2 ADC left channel data source select 00: AIF2 ADCL 01: AIF2 ADCR 10: (AIF2 ADCL+AIF2 ADCR) 11: (AIF2 ADCL+AIF2 ADCR)/2
9:8	R/W	0x0	AIF2_ADCR_SRC AIF2 ADC right channel data source select 00: AIF2 ADCR 01: AIF2 ADCL 10: (AIF2 ADCL+AIF2 ADCR) 11: (AIF2 ADCL+AIF2 ADCR)/2
7:4	R/W	0x0	Reserved
3	R/W	0x0	AIF2_ADCP_ENA AIF2 ADC Companding enable(8-bit mode only) 00: Disable 01: Enable

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2	R/W	0x0	AIF2_ADUL_ENA AIF2 ADC Companding mode select 0: A-law 1: u-law
1	/	/	/
0	R/W	0x0	AIF2_LOOP_EN AIF2 loopback enable 0: No loopback 1: Loopback(ADCDAT2 data output to DACDAT2 data input)

AIF2 DACDAT Control Register

Offset: 0x288			Register Name: AIF2_DACDAT_CTRL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15	R/W	0x0	AIF2_DACL_ENA AIF2 DAC left channel enable 0: Disable 1: Enable
14	R/W	0x0	AIF2_DACR_ENA AIF2 DAC right channel enable 0: Disable 1: Enable
13:12	R/W	0x0	Reserved
11:10	R/W	0x0	AIF2_DACL_SRC AIF2 DAC left channel data source select 00: AIF2 DACL 01: AIF2 DACR 10: (AIF2 DACL+AIF2 DACR) 11: (AIF2 DACL+AIF2 DACR)/2
9:8	R/W	0x0	AIF2_DACR_SRC AIF2 DAC right channel data source select 00: AIF2 DACR 01: AIF2 DACL 10: (AIF2 DACL+AIF2 DACR) 11: (AIF2 DACL+AIF2 DACR)/2
7:4	R/W	0x0	Reserved
3	R/W	0x0	AIF2_DACP_ENA AIF2 DAC Companding enable(8-bit mode only) 00: Disable 01: Enable
2	R/W	0x0	AIF2_DAUL_ENA AIF2 DAC Companding mode select 0: A-law 1: u-law
1	R/W	0x0	Reserved

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0	R/W	0x0	/

AIF2 Digital Mixer Source Select Register

Offset: 0x28C			Register Name: AIF2_MXR_SRC Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:12	R/W	0x0	AIF2_ADCL_MXR_SRC AIF2 ADC left channel mixer source select 0: Disable 1:Enable Bit15: AIF1 DA0L data Bit14: AIF1 DA1L data Bit13: AIF2 DACR data Bit12: ADCL data
11:8	R/W	0x0	AIF2_ADCR_MXR_SRC AIF2 ADC right channel mixer source select 0: Disable 1:Enable Bit11: AIF1 DA0R data Bit10: AIF1 DA1R data Bit9: AIF2 DACL data Bit8: ADCR data
7:0	R/W	0x0	Reserved

AIF2 Volume Control 1 Register

Offset: 0x290			Register Name: AIF2_VOL_CTRL1 Default Value: 0x0000_A0A0
Bit	Read/Write	Default/Hex	Description
15:8	R/W	0xA0	AIF2_ADCL_VOL AIF2 ADC left channel volume (-119.25dB To 71.25dB, 0.75dB/Step) 0x00: Mute 0x01: -119.25dB …… 0x9F = -0.75dB 0xA0 = 0dB 0xA1 = 0.75dB …… 0xFF = 71.25dB
7:0	R/W	0xA0	AIF2_ADCR_VOL AIF2 ADC right channel volume (-119.25dB To 71.25dB, 0.75dB/Step) 0x00: Mute 0x01: -119.25dB …… 0x9F = -0.75dB 0xA0 = 0dB

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			0xA1 = 0.75dB …… 0xFF = 71.25dB

AIF2 Volume Control 2 Register

Offset: 0x298			Register Name: AIF2_VOL_CTRL2 Default Value: 0x0000_A0A0
Bit	Read/Write	Default/Hex	Description
15:8	R/W	0xA0	AIF2_DACL_VOL AIF2 DAC left channel volume (-119.25dB To 71.25dB, 0.75dB/Step) 0x00: Mute 0x01: -119.25dB …… 0x9F = -0.75dB 0xA0 = 0dB 0xA1 = 0.75dB …… 0xFF = 71.25dB
7:0	R/W	0xA0	AIF2_DACR_VOL AIF2 DAC right channel volume (-119.25dB To 71.25dB, 0.75dB/Step) 0x00: Mute 0x01: -119.25dB …… 0x9F = -0.75dB 0xA0 = 0dB 0xA1 = 0.75dB …… 0xFF = 71.25dB

AIF2 Digital Mixer Gain Control Register

Offset: 0x2A0			Register Name: AIF2_MXR_GAIN Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:12	R/W	0x0	AIF2_ADCL_MXR_GAIN AIF2 ADC left channel mixer gain control 0: 0dB 1: -6dB Bit15: AIF1 DA0L data Bit14: AIF1 DA1L data Bit13: AIF2 DACR data Bit12: ADCL data
11:8	R/W	0x0	AIF2_ADCR_MXR_GAIN AIF2 ADC right channel mixer gain control 0: 0dB 1: -6dB

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			Bit11: AIF1 DA0R data Bit10: AIF1 DA1R data Bit9: AIF2 DACL data Bit8: ADCR data
7:0	R/W	0x0	Reserved

AIF2 Receiver Data Discarding Control Register

Offset: 0x2A4			Register Name: AIF2_RXD_CTRL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:8	R/W	0x0	After data receiving progress begins, the first N-data will be discarded. N defined as follows: 0x00: None discarded 0x01: 1-data discarded ... 0xFF: 255-data discarded
7:0	R/W	0x0	Reserved

AIF3 BCLK/LRCK Control Register

Offset: 0x2C0			Register Name: AIF3_CLK_CTRL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15	R/W	0x0	Reserved
14	R/W	0x0	AIF3_BCLK_INV AIF3 BCLK Polarity 0: Normal 1: Inverted
13	R/W	0x0	AIF3_LRCK_INV AIF3 LRCK Polarity 0: Normal 1: Inverted
12:6	R/W	0x0	Reserved
5:4	R/W	0x0	AIF3_WORD_SIZ AIF3 digital interface world length 00: 8bit 01: 16bit 10: 20bit 11: 24bit
3:2	R/W	0x0	Reserved
1:0	R/W	0x0	AIF3_CLOC_SRC AIF3 BCLK/LRCK source control 0: BCLK/LRCK Come from AIF1 1: BCLK/LRCK Come from AIF2 2: BCLK/LRCK is generated by AIF3, and the source clock is AIF1CLK

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			3: Reserved

AIF3 ADCDAT Control Register

Offset: 0x2C4			Register Name: AIF3_ADCDAT_CTRL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:4	R/W	0x0	Reserved
3	R/W	0x0	AIF3_ADCP_ENA AIF3 ADC Companding enable 00: Disable 01: Enable
2	R/W	0x0	AIF3_ADUL_ENA AIF3 ADC Companding mode select 0: A-law 1: u-law
1:0	R/W	0x0	Reserved

AIF3 DACDAT Control Register

Offset: 0x2C8			Register Name: AIF3_DACDAT_CTRL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:4	R/W	0x0	Reserved
3	R/W	0x0	AIF3_DACP_ENA AIF3 DAC Companding enable(8-bit mode only) 00: Disable 01: Enable
2	R/W	0x0	AIF3_DAUL_ENA AIF3 DAC Companding mode select 00: u-law 01: A-law
1	R/W	0x0	Reserved
0	R/W	0x0	AIF3_LOOP_ENA AIF3 loopback enable 0: No loopback 1: Loopback(ADCDAT3 data output to DACDAT3 data input)

AIF3 Signal Path Control Register

Offset: 0x2CC			Register Name: AIF3_SGP_CTRL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:12	R/W	0x0	Reserved
11:10	R/W	0x0	AIF3_ADC_SRC AIF3 PCM output source select 00: None

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			01: AIF2 ADC left channel 10: AIF2 ADC right channel 11: Reserved
9:8	R/W	0x0	AIF2_DAC_SRC AIF2 DAC input source select 00: Left and right inputs from AIF2 01: Left input from AIF3; Right input from AIF2 10: Left input from AIF2; Right input from AIF3 11: Reserved
7	R/W	0x0	AIF3_PINS_TRI AIF3 Pins Tri-state Control 0 = AIF3 pins operate normally 1 = Tri-state all AIF3 interface pins
6:4	R/W	0x0	AIF3_ADCDAT_SRC AIF3 ADCDAT Source select 0xx = AIF3 Mono PCM output 100 = AIF1 ADCDAT1 101 = AIF1 DACDAT1 110 = AIF2 ADCDAT2 111 = AIF2 DACDAT2
3	R/W	0x0	AIF2_ADCDAT_SRC AIF2 ADCDAT2 Source select 0: AIF2 ADCDAT2 1: AIF3 DACDAT3
2	R/W	0x0	AIF2_DACDAT_SRC AIF2 DACDAT2 Source select 0 = AIF2 DACDAT2 1 = AIF3 DACDAT3
1	R/W	0x0	AIF1_ADCDAT_SRC AIF1 ADCDAT1 Source select 0 = AIF1 ADCDAT1 1 = AIF3 DACDAT3
0	R/W	0x0	AIF1_DACDAT_SRC AIF1 DACDAT1 Source select 0 = AIF1 DACDAT1 1 = AIF3 DACDAT3

AIF3 Receiver Data Discarding Control Register

Offset: 0x2E4			Register Name: AIF3_RXD_CTRL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:8	R/W	0x0	After data receiving progress begins, the first N-data will be discarded. N defined as follows: 0x00: None discarded 0x01: 1-data discarded

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			... 0xFF: 255-data discarded
7:0	R/W	0x0	Reserved

ADC Digital Control Register

Offset: 0x300			Register Name: ADC_DIG_CTRL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15	R/W	0x0	ENAD ADC Digital part enable 0: Disable 1: Enable
14	R/W	0x0	ENDM Digital microphone enable 0: Analog ADC mode 1:Reserved
13	R/W	0x0	ADFIR32 Enable 32-tap FIR filter 0: 64-tap 1: 32-tap
12:4	R/W	0x0	Reserved
3:2	R/W	0x0	ADOUT_DTS ADC Delay Time For transmitting data after ENAD 00:5ms 01:10ms 10:20ms 11:30ms
1	R/W	0x0	ADOUT_DLY ADC Delay Function enable for transmitting data after ENAD 0: Disable 1: Enable
0	R/W	0x0	Reserved

ADC Volume Control Register

Offset: 0x304			Register Name: ADC_VOL_CTRL Default Value: 0x0000_A0A0
Bit	Read/Write	Default/Hex	Description
15:8	R/W	0xA0	ADC_VOL_L ADC left channel volume (-119.25dB To 71.25dB, 0.75dB/Step) 0x00: Mute 0x01: -119.25dB …… 0x9F = -0.75dB

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			0xA0 = 0dB 0xA1 = 0.75dB …… 0xFF = 71.25dB
7:0	R/W	0xA0	ADC_VOL_R ADC left channel volume (-119.25dB To 71.25dB, 0.75dB/Step) 0x00: Mute 0x01: -119.25dB …… 0x9F = -0.75dB 0xA0 = 0dB 0xA1 = 0.75dB …… 0xFF = 71.25dB

DAC Digital Control Register

Offset: 0x320			Register Name: DAC_DIG_CTRL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15	R/W	0x0	ENDA. DAC Digital Part Enable 0: Disabe 1: Enable
14	R/W	0x0	ENHPF HPF Function Enable 0: Enable 1: Disable
13	R/W	0x0	DAFIR32 Enable 32-tap FIR filter 0: 64-tap 1: 32-tap
12	R/W	0x0	Reserved
11:8	R/W	0x0	MODQU Internal DAC Quantization Levels Levels=[7*(21+MODQU[3:0])]/128 Default levels=7*21/128=1.15
7:0	R/W	0x0	Reserved

DAC Volume Control Register

Offset: 0x324			Register Name: DAC_VOL_CTRL Default Value: 0x0000_A0A0
Bit	Read/Write	Default/Hex	Description
15:8	R/W	0xA0	DAC_VOL_L DAC left channel volume

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			(-119.25dB To 71.25dB, 0.75dB/Step) 0x00: Mute 0x01: -119.25dB …… 0x9F = -0.75dB 0xA0 = 0dB 0xA1 = 0.75dB …… 0xFF = 71.25dB
7:0	R/W	0xA0	DAC_VOL_R DAC right channel volume (-119.25dB To 71.25dB, 0.75dB/Step) 0x00: Mute 0x01: -119.25dB …… 0x9F = -0.75dB 0xA0 = 0dB 0xA1 = 0.75dB …… 0xFF = 71.25dB

DAC Debug Control Register

Offset: 0x328			Register Name: DAC_DBG_CTRL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15	R/W	0x0	DASW DAC output channel swap enable 0:Disable 1:Enable
14	R/W	0x0	ENDWA_N DWA Function Disable 0: Enable 1: Disable
13	R/W	0x0	DAC_MOD_DBG DAC Modulator Debug 0: DAC Modulator Normal Mode 1: DAC Modulator Debug Mode
12:8	R/W	0x0	Reserved
7:6	R/W	0x0	DAC_PTN_SEL DAC Pattern Select 00: Normal(Audio sample from DAC mixer) 01: -6 dB sin wave 10: -60 dB sin wave 11: zero data
5:0	R/W	0x0	DVC Digital volume control, ATT=DVC[5:0]*(-1.16dB)

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			64 steps, -1.16dB/step

DAC Digital Mixer Source Select Register

Offset: 0x330			Register Name: DAC_MXR_SRC Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:12	R/W	0x0	DACL_MXR_SRC DAC left channel mixer source select 0: Disable 1:Enable Bit15: AIF1 DA0L Bit14: AIF1 DA1L Bit13: AIF2 DACL Bit12: ADCL
11:8	R/W	0x0	DACR_MXR_SRC DAC right channel mixer source select 0: Disable 1:Enable Bit11: AIF1 DA0R Bit10: AIF1 DA1R Bit9: AIF2 DACR Bit8: ADCR
7:0	R/W	0x0	Reserved

DAC Digital Mixer Gain Control Register

Offset: 0x334			Register Name: DAC_MXR_GAIN Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:12	R/W	0x0	DACL_MXR_GAIN DAC left channel mixer gain control 0: 0dB 1: -6dB Bit15: AIF1 DA0L Bit14: AIF1 DA1L Bit13: AIF2 DACL Bit12: ADCL
11:8	R/W	0x0	DACR_MXR_GAIN DAC right channel mixer gain control 0: 0dB 1: -6dB Bit11: AIF1 DA0R Bit10: AIF1 DA1R Bit9: AIF2 DACR Bit8: ADCR
7:0	R/W	0x0	Reserved

ADC DAP Left Status Register

Offset: 0x400	Register Name: AC_ADC_DAPLSTA Default Value: 0x0000_0000

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Bit	Read/Write	Default/Hex	Description
15:10	R	0x0	Reserved
9	R	0x0	Left AGC saturation flag
8	R	0x0	Left AGC noise-threshold flag
7:0	R	0x0	Left Gain applied by AGC (7.1 format 2s complement(-20dB – 40dB), 0.5B/ step) 0x50: 40dB 0x4F: 39.5dB ---------- 0x00: 00dB 0xFF: -0.5dB

ADC DAP Right Status Register

Offset: 0x404			Register Name: AC_ADC_DAPRSTA Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
11:10	R	0x0	Reserved
9	R	0x0	Right AGC saturation flag
8	R	0x0	Right AGC noise-threshold flag
7:0	R	0x0	Right Gain applied by AGC (7.1 format 2s complement(-20dB – 40dB), 0.5dB /step) 0x50: 40dB 0x4F: 39.5dB ---------- 0x00: 00dB 0xFF: -0.5dB

ADC DAP Left Channel Control Register

Offset: 0x408			Register Name: AC_ADC_DAPLCTRL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15	R/W	0x0	Reserved
14	R/W	0x0	Left AGC enable 0: disable 1: enable
13	R/W	0x0	Left HPF enable 0: disable 1: enable
12	R/W	0x0	Left Noise detect enable 0: disable 1: enable
11:10	R/W	0x0	Reserved
9:8	R/W	0x0	Left Hysteresis setting 00: 1dB 01: 2dB 10: 4dB 11: disable;
7:4	R/W	0x0	Left Noise debounce time

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			0000: disable 0001: 4/fs 0010: 8/fs ---------- 1111: 16*4096/fs T=2(N+1)/fs, except N=0
3:0	R/W	0x0	Left Signal debounce time 0000: disable 0001: 4/fs 0010: 8/fs ---------- 1111: 16*4096/fs T=2(N+1)/fs, except N=0

ADC DAP Right Channel Control Register

Offset: 0x40C			Register Name: AC_ADC_DAPRCTRL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15	R/W	0x0	Reserved
14	R/W	0x0	Right AGC enable 0: disable 1: enable
13	R/W	0x0	Right HPF enable 0: disable 1: enable
12	R/W	0x0	Right Noise detect enable 0: disable 1: enable
11:10	R/W	0x0	Reserved
9: 8	R/W	0x0	Right Hysteresis setting 00: 1dB 01: 2dB 10: 4dB 11: disable
7: 4	R/W	0x0	Right Noise debounce time 0000: disable 0001: 4/fs 0010: 8/fs ---------- 1111: 16*4096/fs T=2(N+1)/fs ,except N=0
3: 0	R/W	0x0	Right Signal debounce time 0000: disable 0001: 4/fs 0010: 8/fs ---------- 1111: 16*4096/fs T=2(N+1)/fs, except N=0

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ADC DAP Left Target Level Register

Offset: 0x410			Register Name: AC_ADC_DAPLTL Default Value: 0x0000_2C28
Bit	Read/Write	Default/Hex	Description
15:14	/	/	/
13:8	R/W	0x2C (-20dB)	Left channel target level setting(-1dB -- -30dB).(6.0format 2s complement)
7:0	R/W	0x28 (20dB)	Left channel max gain setting(0-40dB).(7.1format 2s complement)

ADC DAP Right Target Level Register

Offset: 0x414			Register Name: AC_ADC_DAPRTL Default Value: 0x0000_2C28
Bit	Read/Write	Default/Hex	Description
15:14	/	/	/
13:8	R/W	0x2C(-20dB)	Right channel target level setting(-1dB -- -30dB).(6.0format 2s complement)
7:0	R/W	0x28(20dB)	Right channel max gain setting (0-40dB). (7.1format 2s complement)

ADC DAP Left High Average Coef Register

Offset: 0x418			Register Name: AC_ADC_DAPLHAC Default Value: 0x0000_0005
Bit	Read/Write	Default/Hex	Description
15:11	/	/	/
10:0	R/W	0x0005	Left channel output signal average level coefficient setting(the coefficient [reg06[10:0],reg07] is 3.24 format 2s complement)

ADC DAP Left Low Average Coef Register

Offset: 0x41C			Register Name: AC_ADC_DAPLLAC Default Value: 0x0000_1EB8
Bit	Read/Write	Default/Hex	Description
15:0	R/W	0x1EB8	Left channel output signal average level coefficient setting(the coefficient [reg07[10:0],reg08] is 3.24 format 2s complement)

ADC DAP Right High Average Coef Register

Offset: 0x420			Register Name: AC_ADC_DAPRHAC Default Value: 0x0000_0005
Bit	Read/Write	Default/Hex	Description
15:11	/	/	/
10:0	R/W	0x0005	Right channel output signal average level coefficient setting(the coefficient [reg08[10:0],reg09] is 3.24 format

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			2s complement)

ADC DAP Right Low Average Coef Register

Offset: 0x424			Register Name: AC_ADC_DAPRLAC Default Value: 0x0000_1EB8
Bit	Read/Write	Default/Hex	Description
15:0	R/W	0x1EB8	Right channel output signal average level coefficient setting(the coefficient [reg08[10:0],reg09] is 3.24 format 2s complement)

ADC DAP Left Decay Time Register

Offset: 0x428			Register Name: AC_ADC_DAPLDT Default Value: 0x0000_001F
Bit	Read/Write	Default/Hex	Description
15	/	/	/
14:0	R/W	0x001F (32x32fs)	Left decay time coefficient setting 0000: 1x32/fs 0001: 2x32/fs ---------- 7FFF: 215 x32/fs T=(n+1)*32/fs When the gain increases, the actual gain will increase 0.5dB at every decay time.

ADC DAP Left Attack Time Register

Offset: 0x42C			Register Name: AC_ADC_DAPLAT Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15	/	/	/
14:0	R/W	0x0000	Left attack time coefficient setting 0000: 1x32/fs 0001: 2x32/fs ---------- 7FFF: 215 x32/fs T=(n+1)*32/fs When the gain decreases, the actual gain will decrease 0.5dB at every attack time.

ADC DAP Right Decay Time Register

Offset: 0x430			Register Name: AC_ADC_DAPRDT Default Value: 0x0000_001F
Bit	Read/Write	Default/Hex	Description
15	/	/	/
14:0	R/W	0x001F (32x32fs)	Right decay time coefficient setting 0000: 1x32/fs

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			0001: 2x32/fs ---------- 7FFF: 215 x32/fs T=(n+1)*32/fs When the gain increases, the actual gain will increase 0.5dB at every decay time.

ADC DAP Right Attack Time Register

Offset: 0x434			Register Name: AC_ADC_DAPRAT Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15	/	/	/
14:0	R/W	0x0000	Right attack time coefficient setting 0000: 1x32/fs 0001: 2x32/fs ---------- 7FFF: 215 x32/fs T=(n+1)*32/fs When the gain decreases, the actual gain will decrease 0.5dB at every attack time.

ADC DAP Noise Threshold Register

Offset: 0x438			Register Name:AC_ADC_DAPNTH Default Value: 0x0000_1E1E
Bit	Read/Write	Default/Hex	Description
15:13	/	/	/
12:8	R/W	0x1E (-90dB)	Left channel noise threshold setting. 0x00: -30dB 0x01: -32dB 0x02: -34dB ---------- 0x1D: -88dB 0x1E: -90dB 0x1F: -90dB(the same as 0x1E)
7:5	/	/	/
4:0	R/W	0x1E(-90dB)	Right channel noise threshold setting(-90 -- -30dB). 0x00: -30dB 0x01: -32dB 0x02: -34dB ---------- 0x1D: -88dB 0x1E: -90dB 0x1F: -90dB(the same as 0x1E

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ADC DAP Left Input Signal High Average Coef Register

Offset: 0x43C			Register Name: AC_ADC_DAPLHNAC Default Value: 0x0000_0005
Bit	Read/Write	Default/Hex	Description
15:11	/	/	/
10:0	R/W	0x0005	Left input signal average filter coefficient to check noise or not(the coefficient [reg0f[10:0],reg10] is 3.24 format 2s complement), always the same as the left output signal average filter's.

ADC DAP Left Input Signal Low Average Coef Register

Offset: 0x440			Register Name: AC_ADC_DAPLLNAC Default Value: 0x0000_1EB8
Bit	Read/Write	Default/Hex	Description
15:0	R/W	0x1EB8	Left input signal average filter coefficient to check noise or not(the coefficient [reg0f[10:0],reg10] is 3.24 format 2s complement) always the same as the left output signal average filter's

ADC DAP Right Input Signal High Average Coef Register

Offset: 0x444			Register Name: AC_ADC_DAPRHNAC Default Value: 0x0000_0005
Bit	Read/Write	Default/Hex	Description
15:11	/	/	/
10:0	R/W	0x0005	Right input signal average filter coefficient to check noise or not(the coefficient [reg11[10:0],reg12] is 3.24 format 2s complement), always the same as the right output signal average filter's

ADC DAP Right Input Signal Low Average Coef Register

Offset: 0x448			Register Name: AC_ADC_DAPRLNAC Default Value: 0x0000_1EB8
Bit	Read/Write	Default/Hex	Description
15:0	R/W	0x1EB8	Right input signal average filter coefficient to check noise or not(the coefficient [reg11[10:0],reg12] is 3.24 format 2s complement), always the same as the right output signal average filter's

ADC DAP High HPF Coef Register

Offset: 0x44C			Register Name: AC_DAPHHPFC Default Value: 0x0000_00FF
Bit	Read/Write	Default/Hex	Description
15:11	/	/	/
10:0	R/W	0x00FF	HPF coefficient setting(the coefficient [reg13[10:0],reg14] is 3.24 format 2s complement)

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ADC DAP Low HPF Coef Register

Offset: 0x450			Register Name: AC_DAPLHPFC Default Value: 0x0000_FAC1
Bit	Read/Write	Default/Hex	Description
15:0	R/W	0xFAC1	HPF coefficient setting(the coefficient [reg13[10:0],reg14] is 3.24 format 2s complement)

ADC DAP Optimum Register

Offset: 0x454			Register Name: AC_DAPOPT Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:11	/	/	/
10	R/W	0	Left energy default value setting(include the input and output) 0: min 1: max
9:8	R/W	00	Left channel gain hystersis setting. The different between target level and the signal level must larger than the hystersis when the gain change. 00: 0.4375db 01: 0.9375db 10: 1.9375db 11: 3db
7:6	/	/	/
5	R/W	0	The input signal average filter coefficient setting 0: is the [reg0f[10:0], reg10] and [reg11[1:0], reg12]; 1: is the [reg06[10:0], reg07] and [reg08[1:0], reg09];
4	R/W	0	AGC output when the channel in noise state 0: output is zero 1: output is the input data
3	/	/	/
2	R/W	0	Right energy default value setting(include the input and output) 0: min 1: max
1:0	R/W	0	Right channel gain hystersis setting. The different between target level and the signal level must larger than the hystersis when the gain change. 00: 0.4375db 01: 0.9375db 10: 1.9375db 11: 3db

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DAC DAP Control Register

Offset: 0x480			Register Name: AC_DAC_DAPCTRL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:3	/	/	/
2	R/W	0	DRC enable control 0: disable 1: enable
1	R/W	0	Left channel HPF enable control 0: disable 1: enable
0	R/W	0	Right channel HPF enable control 0: disable 1: enable

DAC DAP High HPF Coef Register

Offset: 0x484			Register Name: AC_DAC_DAPHHPFC Default Value: 0x0000_00FF
Bit	Read/Write	Default/Hex	Description
15:11	/	/	/
10:0	R/W	0xFF	HPF coefficient setting(the coefficient [reg01[10:0], reg02] is 3.24 format 2s complement)

DAC DAP Low HPF Coef Register

Offset: 0x488			Register Name: AC_DAC_DAPLHPFC Default Value: 0x0000_FAC1
Bit	Read/Write	Default/Hex	Description
15:0	R/W	0xFAC1	HPF coefficient setting(the coefficient [reg01[10:0], reg02] is 3.24 format 2s complement)

DAC DAP Left High Energy Average Coef Register

Offset: 0x48C			Register Name: AC_DAC_DAPLHAVC Default Value: 0x0000_0100
Bit	Read/Write	Default/Hex	Description
15:11	/	/	/
10:0	R/W	0x0100	Left channel energy average filter coefficient setting(the coefficient [reg03[10:0], reg04] is 3.24 format 2s complement)

DAC DAP Left Low Energy Average Coef Register

Offset: 0x490			Register Name: AC_DAC_DAPLLAVC Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:0	R/W	0x0000	Left channel energy average filter coefficient setting(the coefficient [reg03[10:0],reg04] is 3.24 format 2s complement)

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DAC DAP Right High Energy Average Coef Register

Offset: 0x494			Register Name: AC_DAC_DAPRHAVC Default Value: 0x0000_0100
Bit	Read/Write	Default/Hex	Description
15:11	/	/	/
10:0	R/W	0x0100	Right channel energy average filter coefficient setting(the coefficient [reg05[10:0], reg06] is 3.24 format 2s complement)

DAC DAP Right Low Energy Average Coef Register

Offset: 0x498			Register Name: AC_DAC_DAPRLAVC Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:0	R/W	0x0000	Right channel energy average filter coefficient setting(the coefficient [reg05[10:0],reg06] is 3.24 format 2s complement)

DAC DAP High Gain Decay Time Coef Register

Offset: 0x49C			Register Name: AC_DAC_DAPHGDEC Default Value: 0x0000_0100
Bit	Read/Write	Default/Hex	Description
15:11	/	/	/
10:0	R/W	0x0100	Gain smooth filter decay time coefficient setting(the coefficient [reg07[10:0], reg08] is 3.24 format 2s complement)

DAC DAP Low Gain Decay Time Coef Register

Offset: 0x4A0			Register Name: AC_DAC_DAPLGDEC Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:0	R/W	0x0000	Gain smooth filter decay time coefficient setting(the coefficient [reg07[10:0], reg08] is 3.24 format 2s complement)

DAC DAP High Gain Attack Time Coef Register

Offset: 0x4A4			Register Name: AC_DAC_DAPHGATC Default Value: 0x0000_0100
Bit	Read/Write	Default/Hex	Description
15:11	/	/	/
10:0	R/W	0x0100	Gain smooth filter attack time coefficient setting(the coefficient [reg09[10:0], reg0a] is 3.24 format 2s complement)

DAC DAP Low Gain Decay Time Coef Register

Offset: 0x4A8	Register Name: AC_DAC_DAPLGATC

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			Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:0	R/W	0x0000	Gain smooth filter attack time coefficient setting(the coefficient [reg09[10:0], reg0a] is 3.24 format 2s complement)

DAC DAP High Energy Threshold Register

Offset: 0x4AC			Register Name: AC_DAC_DAPHETHD Default Value: 0x0000_04FB
Bit	Read/Write	Default/Hex	Description
15:0	R/W	0x04FB	The DRC Energy compress threshold parameter T setting(the T = [reg0b, reg0c] is 8.24 format 2s complement)

DAC DAP Low Energy Threshold Register

Offset: 0x4B0			Register Name: AC_DAC_DAPLETHD Default Value: 0x0000_9ED0
Bit	Read/Write	Default/Hex	Description
15:0	R/W	0x9ED0	The DRC Energy compress threshold parameter T setting(the T = [reg0b, reg0c] is 8.24 format 2s complement)

DAC DAP High Gain K Parameter Register

Offset: 0x4B4			Register Name: AC_DAC_DAPHGKPA Default Value: 0x0000_0780
Bit	Read/Write	Default/Hex	Description
15:0	R/W	0x0780	The DRC gain curve slope k parameter setting(the K = [reg0d[10:0], reg0e] is 3.24 format 2s complement)

DAC DAP Low Gain K Parameter Register

Offset: 0x4B8			Register Name: AC_DAC_DAPLGKPA Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:0	R/W	0x0000	The DRC gain curve slope k parameter setting(the K = [reg0d[10:0], reg0e] is 3.24 format 2s complement)

DAC DAP High Gain Offset Parameter Register

Offset: 0x4BC			Register Name: AC_DAC_DAPHGOPA Default Value: 0x0000_0100
Bit	Read/Write	Default/Hex	Description
15:0	R/W	0x0100	The DRC gain curve offset O parameter setting(the O = [reg0f[12:0], reg10] is 5.24 format 2s complement)

DAC DAP Low Gain Offset Parameter Register

Offset: 0x4C0	Register Name: AC_DAC_DAPLGOPA

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			Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:0	R/W	0x0000	The DRC gain curve offset O parameter setting(the K = [reg0f[12:0], reg10] is 5.24 format 2s complement)

DAC DAP Optimum Register

Offset: 0x4C4			Register Name: AC_DAC_DAPOPT Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:6	/	/	/
5	R/W	0	DRC gain defaut value setting 0: The default gain is 1 1: The default gain is 0
4:0	R/W	0x00	The hysteresis of the gain smooth filter to use the decay time coefficient or the attack time coefficient. When in the decay time state, if g(n-1)-g(n)>hysteresis, then the state will change to attack time state, and when in the attack time, if g(n)-g(n-1)>hysteresis, then the state will change to decay time state. Note the hysteresis of 0x00 and 0x04 is the same. 00000: 2^{-16} 00001: 2^{-19} 00010: 2^{-18} 00011: 2^{-17} 00100: 2^{-16} ---------- 10011: 2^{-1} 10100 ~11111: 1 hysteresis = 2^{n-20} ,except n=0x00, and n less 0x14.

AGC Enable Register

Offset: 0x4D0			Register Name: AGC_ENA Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15	R/W	0x0	AIF1_AD0L_AGC_ENA AIF1 ADC timeslot 0 left channel AGC enable 0: Disable 1: Enable

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14	R/W	0x0	AIF1_AD0R_AGC_ENA AIF1 ADC timeslot 0 right channel AGC enable 0: Disable 1: Enable
13	R/W	0x0	AIF1_AD1L_AGC_ENA AIF1 ADC timeslot 1 left channel AGC enable 0: Disable 1: Enable
12	R/W	0x0	AIF1_AD1R_AGC_ENA AIF1 ADC timeslot 1 right channel AGC enable 0: Disable 1: Enable
11	R/W	0x0	AIF2_ADCL_AGC_ENA AIF2 ADC left channel AGC enable 0: Disable 1: Enable
10	R/W	0x0	AIF2_ADCR_AGC_ENA AIF2 ADC right channel AGC enable 0: Disable 1: Enable
9	R/W	0x0	AIF2_DACL_AGC_ENA AIF2 DAC left channel AGC enable 0: Disable 1: Enable
8	R/W	0x0	AIF2_DACR_AGC_ENA AIF2 DAC right channel AGC enable 0: Disable 1: Enable
7	R/W	0x0	ADCL_AGC_ENA ADC left channel AGC enable 0: Disable 1: Enable
6	R/W	0x0	ADCR_AGC_ENA ADC right channel AGC enable 0: Disable 1: Enable
5:0	R/W	0x0	Reserved

DRC Enable Register

Offset: 0x4D4			Register Name: DRC_ENA Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15	R/W	0x0	AIF1_DAC0_DRC_ENA AIF1 DAC timeslot 0 DRC enable 0: Disable

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			1: Enable
14	R/W	0x0	Reserved
13	R/W	0x0	AIF1_DAC1_DRC_ENA AIF1 DAC timeslot 1 DRC enable 0: Disable 1: Enable
12	R/W	0x0	Reserved
11	R/W	0x0	AIF2_DAC_DRC_ENA AIF2 DAC DRC enable 0: Disable 1: Enable
10:8	R/W	0x0	Reserved
7	R/W	0x0	DAC_DRC_ENA DAC DRC enable 0: Disable 1: Enable
6:0	R/W	0x0	Reserved

SRC1 Control 1 Register

Offset: 0x4E0			Register Name: SRC1_CTRL1 Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15	R/W	0x0	SRC1_RATI_ENA SRC1 Manual setting ratio enable 0-disable 1-enable
14	R	0x0	SRC1_LOCK_STS SRC1 Ratio lock status 0-not locked 1-locked
13	R	0x0	SRC1_FIFO_OVR SRC1 FIFO Overflow status 0-normal 1-overflowed
12:10	R	0x0	SRC1_FIFO_LEV_[8:6] SRC1 FIFO Level high 3-bit
9:0	R/W	0x0	SRC1_RATI_SET_[25:16] Manual setting ratio high 10-bit

SRC1 Control 2 Register

Offset: 0x4E4			Register Name: SRC1_CTROL2 Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:0	R/W	0x0	SRC1_RATI_StET_[15:0] Manual setting ratio low 16-bit

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SRC1 Control 3 Register

Offset: 0x4E8			Register Name: SRC1_CTRL3 Default Value: 0x0000_0040
Bit	Read/Write	Default/Hex	Description
15:10	R	0x0	SRC1_FIFO_LEV_[5:0] SRC1 FIFO Level low 6-bit
9:0	R	0x40	SRC1_RATI_VAL_[25:16] Calculated ratio high 10-bit

SRC1 Control 4 Register

Offset: 0x4EC			Register Name: SRC1_CTRL4 Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:0	R	0x0	SRC1_RATI_VAL_[15:0] Calculated ratio low 16-bit

SRC2 Control 1 Register

Offset: 0x4F0			Register Name: SRC2_CTRL1 Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15	R/W	0x0	SRC2_RATI_ENA SRC2 Manual setting ratio enable 0-disable 1-enable
14	R	0x0	SRC2_LOCK_STS SRC2 Ratio lock status 0-not locked 1-locked
13	R	0x0	SRC2_FIFO_OVR SRC2 FIFO Overflow status 0-normal 1-overflowed
12:10	R	0x0	SRC2_FIFO_LEV_[8:6] SRC2 FIFO Level high 3-bit
9:0	R/W	0x0	SRC2_RATI_SET_[25:16] Manual setting ratio high 10-bit

SRC2 Control 2 Register

Offset: 0x4F4			Register Name: SRC2_CTRL2 Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:0	R/W	0x0	SRC2_RATI_SET_[15:0] Manual setting ratio low 16-bit

SRC2 Control 3 Register

Offset: 0x4F8			Register Name: SRC2_CTRL3 Default Value: 0x0000_0040

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Bit	Read/Write	Default/Hex	Description
15:10	R	0x0	SRC2_FIFO_LEV_[5:0] SRC2 FIFO Level low 6-bit
9:0	R	0x40	SRC2_RATI_VAL_[25:16] Calculated ratio high 10-bit

SRC2 Control 4 Register

Offset: 0x4FC			Register Name: SRC2_CTRL4 Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
15:0	R	0x0	SRC2_RATI_VAL_[15:0] Calculated ratio low 16-bit

Note that the following 25 8-bit registers can be controlled by configuring 0x01F015C0 register through the APB0 BUS, as shown below. (*Reset: register reset; ADDR[4:0]: offset of corresponding 8-bit registers; W/R: W/R enable; WDAT[7:0]：write；RDAT[7:0]：read)*

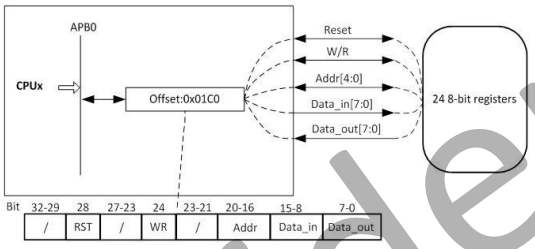

Figure 3.16-5 Register Diagram

Headphone Volume Control Register

Offset:0x00			Register Name: HP_VOLC
Bit	Read/Write	Default/Hex	Description
7	R/W	0x0	PA clock gating control; when system VDD is off and Audio analog channel is working, this bit must be set to 1, because the PA clock come from system VDD domain. When this bit is 1, the Zero cross over function will be disabled automatically. 0: not gating; 1: gating
6	R/W	0x0	/
5:0	R/W	0x0	HPVOL Headphone Volume Control, (HPVOL): Total 64 level, from 0dB to -62dB, 1dB/step, mute when 000000

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Left Output Mixer Source Control Register

Offset:0x01			Register Name: LOMIXSC
Bit	Read/Write	Default/Hex	Description
7	R/W	0x0	/
6:0	R/W	0x0	LMIXMUTE Left Output Mixer Mute Control 0-Mute, 1-Not mute Bit 6: MIC1 Boost stage Bit 5: MIC2 Boost stage Bit 4: PHONEP-PHONEN Bit 3: PHONEN Bit 2: LINEINL Bit 1: Left channel DAC Bit 0: Right channel DAC

Right Output Mixer Source Control Register

Offset:0x02			Register Name: ROMIXSC
Bit	Read/Write	Default/Hex	Description
7	R/W	0x0	/
6:0	R/W	0x0	RMIXMUTE Right Output Mixer Mute Control 0-Mute, 1-Not mute Bit 6: MIC1 Boost stage Bit 5: MIC2 Boost stage Bit 4: PHONEP-PHONEN Bit 3: PHONEP Bit 2: LINEINR Bit 1: Right channel DAC Bit 0: Left channel DAC

DAC Analog Enable and PA Source Control Register

Offset:0x03			Register Name: DAC_PA_SRC
Bit	Read/Write	Default/Hex	Description
7	R/W	0x0	DACAREN Internal Analog Right channel DAC Enable 0:Disable; 1:Enable
6	R/W	0x0	DACALEN Internal Analog Left channel DAC Enable 0:Disable; 1:Enable
5	R/W	0x0	RMIXEN Right Analog Output Mixer Enable 0:Disable; 1:Enable

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4	R/W	0x0	LMIXEN Left Analog Output Mixer Enable 0:Disable; 1:Enable
3	R/W	0x0	RHPPAMUTE All input source to Right Headphone PA mute, including Right Output mixer and Internal Right channel DAC: 0:Mute, 1: Not mute
2	R/W	0x0	LHPPAMUTE All input source to Left Headphone PA mute, including Left Output mixer and Internal Left channel DAC: 0:Mute, 1: Not mute
1	R/W	0x0	RHPIS Right Headphone Power Amplifier (PA) Input Source Select 0: Right channel DAC 1: Right Analog Mixer
0	R/W	0x0	LHPIS Left Headphone Power Amplifier (PA) Input Source Select 0: Left channel DAC 1: Left Analog Mixer

Phonein Stereo Gain Control Register

Offset:0x04			Register Name: PHONEIN_GCTRL
Bit	Read/Write	Default/Hex	Description
7	R/W	0x0	/
6:4	R/W	0x3	PHONEPG, (volpnp) PHONEP to Right output mixer Gain Control From -4.5dB to 6dB, 1.5dB/step, default is 0dB
3	R/W	0x0	/
2:0	R/W	0x3	PHONENG, (volpnn) PHONEN to Left output mixer Gain Control From -4.5dB to 6dB, 1.5dB/step, default is 0dB

Linein and Phonein_P-N Gain Control Register

Offset:0x05			Register Name: LINEIN_GCTRL
Bit	Read/Write	Default/Hex	Description
7	R/W	0x0	/
6:4	R/W	0x3	LINEING, (volln) LINEINL/R to L/R output mixer Gain Control From -4.5dB to 6dB, 1.5dB/step, default is 0dB
3	R/W	0x0	/
2:0	R/W	0x3	PHONINEG, (volpg) PHONEIN(P-N) gain stage to L/R output mixer Gain Control From -4.5dB to 6dB, 1.5dB/step, default is 0dB

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MIC1 and MIC2 Gain Control Register

Offset:0x06			Register Name: MICIN_GCTRL
Bit	Read/Write	Default/Hex	Description
7	R/W	0x0	/
6:4	R/W	0x3	MIC1G, (volm1) MIC1 BOOST stage to L or R output mixer Gain Control From -4.5dB to 6dB, 1.5dB/step, default is 0dB
3	R/W	0x0	/
2:0	R/W	0x3	MIC2G, (volm2) MIC2 BOOST stage to L or R output mixer Gain Control From -4.5dB to 6dB, 1.5dB/step, default is 0dB

PA Enable and HP Control Register

Offset:0x07			Register Name: PAEN_HP_CTRL
Bit	Read/Write	Default/Hex	Description
7	R/W	0x0	HPPAEN Right & Left Headphone Power Amplifier Enable 0-disable 1-enable
6:5	R/W	0x0	HPCOM_FC HPCOM function control 00: HPCOM off & output is floating 01: HPL inverting output 10: HPR inverting output 11: Direct driver for HPL & HPR
4	R/W	0x1	COMPTEN HPCOM output protection enable when it is set as Direct driver for HPL/R 0: protection disable 1: protection enable
3:2	R/W	0x1	PA_ANTI_POP_CTRL, (slopelengthsel) PA Anti-pop time Control 00:131ms; 01: 262ms; 10: 393ms; 11:524ms
1	R/W	0x0	LTRNMUTE, (hprisinvhpl) Left HPOUT Negative To Right HPOUT Mute 0: Mute, 1: Not mute
0	R/W	0x0	RTLNMUTE, (hplisinvhpr) Right HPOUT Negative To Left HPOUT Mute 0: Mute, 1: Not mute

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Phoneout Control Register

Offset:0x08			Register Name: PHONEOUT_CTRL
Bit	Read/Write	Default/Hex	Description
7:5	R/W	0x3	PHONEOUTG Phone-out Gain Control From -4.5dB to 6dB, 1.5dB/step, default is 0dB
4	R/W	0x0	PHONEOUT enable 0: Enable, 1: Disable
3	R/W	0x0	PHONEOUTS3 MIC1 Boost stage to Phone out mute 0: Mute, 1: Not mute
2	R/W	0x0	PHONEOUTS2 MIC2 Boost stage to Phone out mute 0: Mute, 1: Not mute
1	R/W	0x0	PHONEOUTS1 Right Output mixer to Phone out mute 0: Mute, 1: Not mute
0	R/W	0x0	PHONEOUTS0 Left Output mixer to Phone out mute 0: Mute, 1: Not mute

Phonep-n Gain Control Register

Offset:0x09			Register Name: PHONEP-N_GAIN_CTR
Bit	Read/Write	Default/Hex	Description
7:3	R/W	0x0	/
2:0	R/W	0x4	PHONEPREG PHONEP-PHONEN pre-amplifier gain control -12dB to 9dB, 3dB/step, default is 0dB

Mic2 Boost Enable Control Register

Offset:0x0A			Register Name: MIC2G_LINEEN_CTRL
Bit	Read/Write	Default/Hex	Description
7	R/W	0x0	MIC2AMPEN MIC2 Boost AMP Enable 0-Disable; 1-Enable
6:4	R/W	0x4	MIC2BOOST MIC2 Boost AMP Gain Control 0dB when 000, 24dB to 42dB when 001 to 111, 3dB/step, default is 33dB
3:0	R/W	0x0	/

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Mic1 Boost and MICBIAS Control Register

Offset:0x0B			Register Name: MIC1G_MICBIAS_CTRL
Bit	Read/Write	Default/Hex	Description
7	R/W	0x0	HMICBIASEN Headset Microphone Bias enable 0: disable, 1: enable
6	R/W	0x0	MMICBIASEN Master Microphone Bias enable 0: disable, 1: enable
5	R/W	0x0	HMICBIAS MODE Headset MIC Bias Mode select 0:HMICBIAS auto suspend when HMIC is absent 1:HMICBIAS always on when HMICBIASEN IS 1
4	R/W	0x1	/
3	R/W	0x0	MIC1AMPEN MIC1 Boost AMP Enable 0-Disable; 1-Enable
2:0	R/W	0x4	MIC1BOOST MIC1 Boost AMP Gain Control 0dB when 000, 24dB to 42dB when 001 to 111, 3dB/step, default is 33dB

Left ADC Mixer Source Control Register

Offset:0x0C			Register Name: LADCMIXSC
Bit	Read/Write	Default/Hex	Description
7	R/W	0x0	/
6:0	R/W	0x0	LADCMIXMUTE Left ADC Mixer Mute Control: 0-Mute, 1-Not mute Bit 6: MIC1 Boost stage Bit 5: MIC2 Boost stage Bit 4: PHONEP-PHONEN Bit 3: PHONEN Bit 2: LINEINL Bit 1: Left output mixer Bit 0: Right output mixer

Right ADC Mixer Source Control Register

Offset:0x0D			Register Name: RADCMIXSC
Bit	Read/Write	Default/Hex	Description
7	R/W	0x0	/
6:0	R/W	0x0	RADCMIXMUTE

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			Right ADC Mixer Mute Control: 0: Mute; 1:On Bit 6: MIC1 Boost stage Bit 5: MIC2 Boost stage Bit 4: PHONEP-PHONEN Bit 3: PHONEP Bit 2: LINEINR Bit 1: Right output mixer Bit 0: Left output mixer

Reserved Register

Offset:0x0E			Register Name: Reserved Register
Bit	Read/Write	Default/Hex	Description
7:0	R/W	0x0	PA_ANTI_POP_CTRL, (slopelengthsel) PA Anti-pop time Control 000: 131ms; 001: 262ms; 010: 393ms; 011: 524ms; 100: 655ms; 101: 786ms; 110: 786ms; 111: 1048ms;

ADC Analog Part Enable Register

Offset:0x0F			Register Name: ADC_AP_EN
Bit	Read/Write	Default/Hex	Description
7	R/W	0x0	ADCREN ADC Right Channel Enable 0-Disable; 1-Enable
6	R/W	0x0	ADCLEN ADC Left Channel Enable 0-Disable; 1-Enable
5:3	R/W	0x0	/
2:0	R/W	0x3	ADCG ADC Input Gain Control From -4.5dB to 6dB, 1.5dB/step default is 0dB

ADDA Analog Performance Turning 2 Register

Offset:0x12			Register Name: ADDA_APT2
Bit	Read/Write	Default/Hex	Description
7	R/W	0x0	function enable for master volume change at zero cross over 0: disable; 1: enable
6	R/W	0x1	Timeout control for master volume change at zero cross over 0: 32ms; 1: 64ms
5:4	R/W	0x0	PTDBS HPCOM protect de-bounce time setting 00: 2-3ms; 01: 4-6ms; 10: 8-12ms; 11: 16-24ms

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3	R/W	0x0	PA_SLOPE_SELECT PA slope select cosine or ramp 0: select cosine 1: select ramp
2:0	R/W	0x2	USB_BIAS_CUR. USB bias current tuning From 23uA to 30uA, Default is 25uA

Bias Calibration Data Register

Offset:0x17			Register Name: BIASCALI
Bit	Read/Write	Default/Hex	Description
7:0	R	0x20	BIASCALI Bias Calibration Data, 6bit

Bias Register Setting Data Register

Offset:0x18			Register Name: BIASVERIFY
Bit	Read/Write	Default/Hex	Description
7:0	R/W	0x20	BIASVERIFY Bias Register Setting Data, 6bit

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3.17 KEYADC

3.17.1 Overview

The R16 supports a 6-bit KEYADC for key application.

It includes the following features:

- Support APB 32-bits bus width
- Support interrupt
- Support Hold Key and General Key
- Support single key and continue key mode
- Support 6-bit resolution
- Support voltage input range between 0 to 2V
- Support sample rate up to 250Hz

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3.17.2 Principles of Operation

The KEYADC converted data can be accessed by interrupt and polling method. If software can't access the last converted data instantly, the new converted data would update the old one at new sampling data.

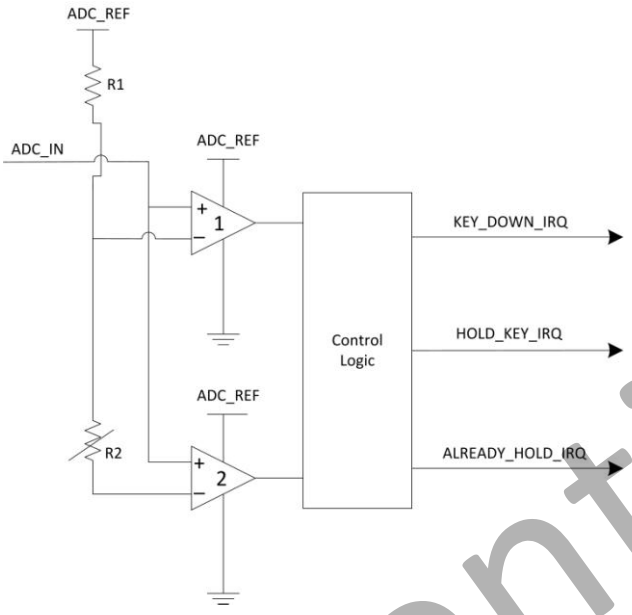

Figure 3.17-1 Hold Key and General Key Function

When ADC_IN Signal change from 3.0V to less than 2.0V (Level A), the comparator24 send first interrupt to control logic; When ADC_IN Signal change from 2.0V to less than certain level (Program can set), the comparator25 give second interrupt. If the control Logic get the first interrupt, In a certain time range (program can set), doesn't get second interrupt, it will send hold key interrupt to the host; If the control Logic get the first interrupt, In a certain time range (program can set), get second interrupt, it will send key down interrupt to the host; If the control logic only get the second interrupt, doesn't get the first interrupt, it will send already hold interrupt to the host.

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3.17.3 KEYADC Register List

Module Name	Base Address
KEYADC	0x01C22800

Register Name	Offset	Description
KEYADC_CTRL	0x00	KEYADC Control Register
KEYADC_INTC	0x04	KEYADC Interrupt Control Register
KEYADC_INTS	0x08	KEYADC Interrupt Status Register
KEYADC_DATA	0x0c	KEYADC Data Register

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3.17.4 KEYADC Register Description

KEYADC Control Register

Offset: 0x000			Register Name: KEYADC_CTRL
Bit	Read/Write	Default/Hex	Description
31: 24	R/W	0x1	FIRST_CONCERT_DLY. ADC First Convert Delay setting, ADC conversion is delayed by n samples
23:22	R/W	0x0	Reserved to 0
21:20	/	/	/
19:16	R/W	0x0	CONTINUE_TIME_SELECT. Continue Mode time select, one of 8*(N+1) sample as a valuable sample data
15:14	/	/	/
13:12	R/W	0x0	KEY_MODE_SELECT. Key Mode Select: 00: Normal Mode 01: Single Mode 10: Continue Mode
11:8	R/W	0x1	LEVELA_B_CNT. Level A to Level B time threshold select, judge ADC convert value in level A to level B in n+1 samples
7	R/W	0x0	KEY_ADC_HOLD_KEY_EN KEY_ADC Hold Key Enable 0: Disable 1: Enable
6	R/W	0x1	KEYADC_HOLD_EN. KEYADC Sample hold Enable 0: Disable 1: Enable
5: 4	R/W	0x2	LEVELB_VOL. Level B Corresponding Data Value setting (the real voltage value) 00: 0x3C (~1.9v) 01: 0x39 (~1.8v) 10: 0x36 (~1.7v) 11: 0x33 (~1.6v)
3: 2	R/W	0x2	KEYADC_SAMPLE_RATE. KEYADC Sample Rate 00: 250 Hz 01: 125 Hz 10: 62.5 Hz 11: 32.25 Hz

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1	/	/	/
0	R/W	0x0	KEYADC_EN. KEYADC enable 0: Disable 1: Enable

KEYADC Interrupt Control Register

Offset: 0x04			Register Name: KEYADC_INTC
Bit	Read/Write	Default/Hex	Description
31:5	/	/	/
4	R/W	0x0	ADC0_KEYUP_IRQ_EN. ADC 0 Key Up IRQ Enable 0: Disable 1: Enable
3	R/W	0x0	ADC0_ALRDY_HOLD_IRQ_EN. ADC 0 Already Hold IRQ Enable 0: Disable 1: Enable
2	R/W	0x0	ADC0_HOLD_IRQ_EN. ADC 0 Hold Key IRQ Enable 0: Disable 1: Enable
1	R/W	0x0	ADC0_KEYDOWN_EN ADC 0 Key Down Enable 0: Disable 1: Enable
0	R/W	0x0	ADC0_DATA_IRQ_EN. ADC 0 Data IRQ Enable 0: Disable 1: Enable

KEYADC Interrupt Status Register

Offset: 0x08			Register Name: KEYADC_INT
Bit	Read/Write	Default/Hex	Description
31:5	/	/	/
4	R/W	0x0	ADC0_KEYUP_PENDING. ADC 0 Key up pending Bit When general key pull up, it the corresponding interrupt is enabled. 0: No IRQ 1: IRQ Pending Note: Writing 1 to the bit will clear it and its corresponding

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			interrupt if the interrupt is enable
3	R/W	0x0	ADC0_ALRDY_HOLD_PENDING. ADC 0 Already Hold Pending Bit When hold key pull down and pull the general key down, if the corresponding interrupt is enabled. 0: No IRQ 1: IRQ Pending Notes: Writing 1 to the bit will clear it and its corresponding interrupt if the interrupt is enable
2	R/W	0x0	ADC0_HOLDKEY_PENDING. ADC 0 Hold Key pending Bit When Hold key pull down, the status bit is set and the interrupt line is set if the corresponding interrupt is enabled. 0: NO IRQ 1: IRQ Pending Note: Writing 1 to the bit will clear it and its corresponding interrupt if the interrupt is enable.
1	R/W	0x0	ADC0_KEYDOWN_PENDING. ADC 0 Key Down IRQ Pending Bit When General key pull down, the status bit is set and the interrupt line is set if the corresponding interrupt is enabled. 0: No IRQ 1: IRQ Pending Note: Writing 1 to the bit will clear it and its corresponding interrupt if the interrupt is enable.
0	R/W	0x0	ADC0_DATA_PENDING. ADC 0 Data IRQ Pending Bit 0: No IRQ 1: IRQ Pending Note: Writing 1 to the bit will clear it and its corresponding interrupt if the interrupt is enable.

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KEYADC Data Register

Offset: 0x0c			Register Name: KEYADC_DATA
Bit	Read/Write	Default/Hex	Description
31:6	/	/	/
5:0	R	0x0	KEYADC_DATA. KEYADC Data

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3.18 Thermal Sensor Controller

3.18.1 Overview

The R16 supports thermal sensor controller to monitor the chip temperature.

It includes the following feature:

- Low power consumption

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3.18.2 Clock Tree and ADC Conversion Time

CLK_IN = 24MHz

Conversion Time = 1/(24MHz/14Cycles) =0.583 (us)

THERMAL_PER (configured by the value of THERMAL_PER) is must be greater than 2*(ACQ + Conversion Time)

Then: THERMAL_PER > 2(ACQ + Conversion Time)

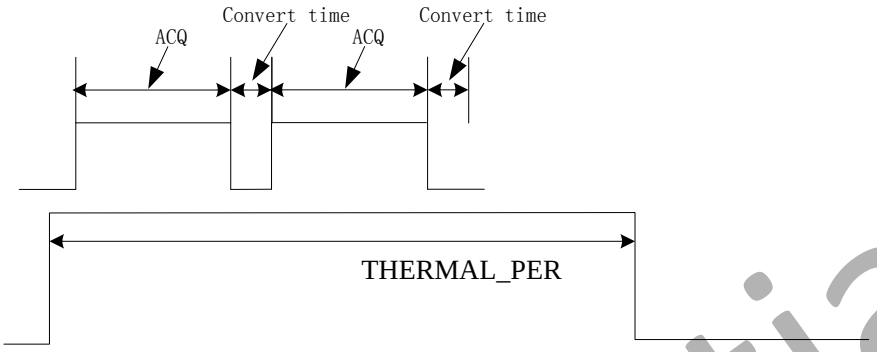

Figure3.18-1 ADC Clock Tree

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3.18.3 Thermal Measurement

Tem=（Dig-1665）/6.18 Celsius degree

The Dig should read from thermal value register.

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3.18.4 Thermal Sensor Controller Register List

Module Name	Base Address
THS	0x01C25000

Register Name	Offset	Description
THS_CTRL0	0x00	THS Control Register0
THS_CTRL1	0x04	THS Control Register1
THS_INT	0x10	THS INT Control Register
THS_STAT	0x14	Temperature Statues Register
TEMP_TPR	0x18	Temperature Period Register
TEMP_DATA	0x20	Temperature Data Value Register
TEMP_CATA	0x40	Temperature Calibration Data Register

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3.18.5 Thermal Sensor Controller Register Description

THS Control Register 0

Offset: 0x00			Register Name: THS_CTRL0
Bit	Read/Write	Default/Hex	Description
31:22	/	/	/
21:20	R/W	0x0	DATA_CLK_DIVIDER. DATA Clock Divider(CLK_IN) 00: CLK/2 01: CLK/3 10: CLK/6 11: CLK/1
19:16	/	/	/
15:0	R/W	0x0	TACQ. DATA acquire time CLK_IN/(16*(N+1))

THS Control Register 1

Offset: 0x04			Register Name: THS_CTRL1
Bit	Read/Write	Default /Hex	Description
31:9	/	/	/
8	R/W	0x1	CHOP_TEMP_EN Chop temperature calibration enable 0: Disable 1: Enable
7	R/W	0x0	GPADC_CALI_EN. ADC Calibration 1: start Calibration, it is clear to 0 after calibration
6:0	/	/	/

THS Control Register 1

Offset: 0x10			Register Name: THS_INT
Bit	Read/Write	Default /Hex	Description
31:19	/	/	/
18	R/W	0x0	TEMP_IRQ_EN Temperature IRQ Enable 0: Disable 1: Enable
17:0	/	/	/

THS DATA Status Register

Offset: 0x14			Register Name: DATA_FIFOS
Bit	Read/Write	Default/Hex	Description

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31:19	/	/	/
18	R/W	0x0	THS_DATA_PENDING. Thermal sensor data pending 0: No Pending 1: Thermal sensor data Pending Write '1' to clear this interrupt or automatic clear if data pending condition fails
17:0	/	/	/

THS Period Register

Offset: 0x18			Register Name: THS_TPR
Bit	Read/Write	Default/Hex	Description
31:17	/	/	/
16	R/W	0x0	THS_EN. Thermal sensor enable
15:0	R/W	0x0	THS_PER. Thermal sensor Period 4096*(1/clk_in)

THS Data Register

Offset: 0x20			Register Name: THS_DATA
Bit	Read/Write	Default/Hex	Description
31:12	/	/	/
11:0	R	0x0	THS_DATA Thermal sensor data

Temperature Calibration Data Register

Offset: 0x40			**Register Name: THS_TPR**
Bit	Read/Write	Default/Hex	Description
31:12	/	/	/
11:0	R/W	0x800	TEMP_CDATA. Temperature Calibration Data Value Note： write value from reading out of SID in the register

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3.19 Crypto Engine

3.19.1 Crypto Engine Description

The Crypto Engine (CE) is one encrypt/ decrypt function accelerator. It is suitable for a variety of applications. It supports both encryption and decryption. Several modes are supported by the CE module. Both of CPU mode and DMA method are supported for different application.

It includes the following features:

- AES, DES, 3DES, SHA-1, MD5 are supported by this system
- ECB, CBC, CTR modes for DES/3DES
- ECB, CBC, CTR ,CTS modes for AES
- 128-bits, 192-bits and 256-bits key size for AES
- 160-bits hardware PRNG with 192-bits seed
- 32-words RX FIFO and 32-words TX FIFO for high speed application
- CPU mode and DMA mode are supported

The Crypto Engine block diagram is shown below.

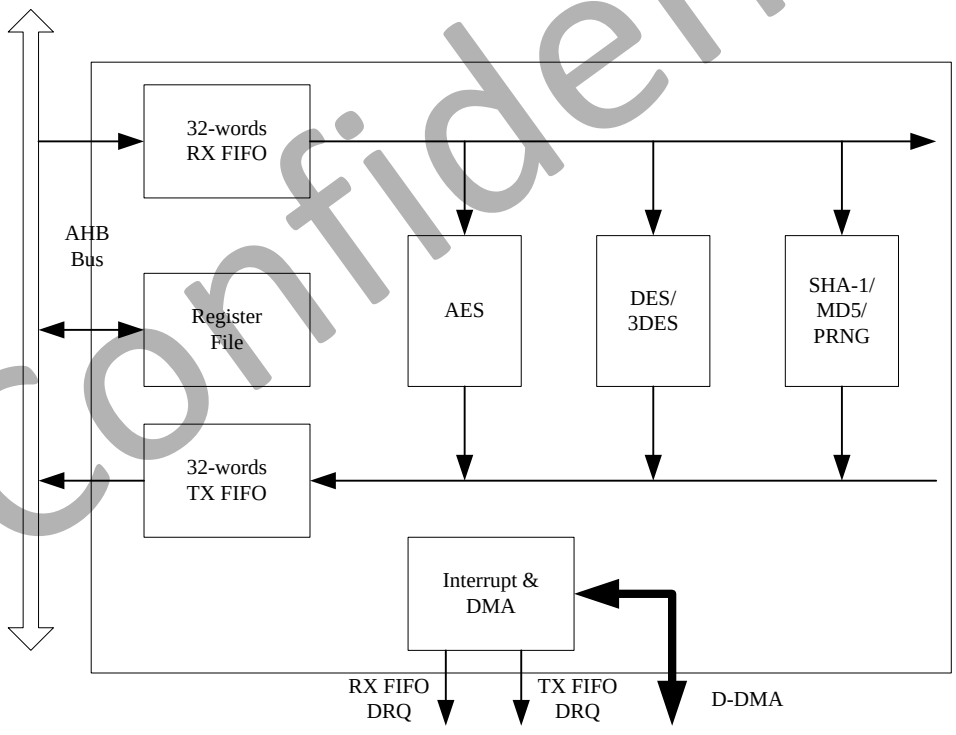

Figure 3.19-1 Crypto Engine block diagram

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3.19.2 Crypto Engine Register List

Module Name	Base Address
CE	0x01C15000

Register Name	Offset	Description
CE_CTL	0x00	Crypto Engine Control Register
CE_KEY0	0x04	Crypto Engine Input Key 0/ PRNG Seed 0
CE_KEY1	0x08	Crypto Engine Input Key 1/ PRNG Seed 1
…	…	…
CE_KEY7	0x20	Crypto Engine Input Key 7
CE_IV0	0x24	Crypto Engine Initialization Vector 0
CE_IV1	0x28	Crypto Engine Initialization Vector 1
CE_IV2	0x2C	Crypto Engine Initialization Vector 2
CE_IV3	0x30	Crypto Engine Initialization Vector 3
CE_CNT0	0x34	Crypto Engine Preload Counter 0
CE_CNT1	0x38	Crypto Engine Preload Counter 1
CE_CNT2	0x3C	Crypto Engine Preload Counter 2
CE_CNT3	0x40	Crypto Engine Preload Counter 3
CE_FCSR	0x44	Crypto Engine FIFO Control/ Status Register
CE_ICSR	0x48	Crypto Engine Interrupt Control/ Status Register
CE_MD0	0x4C	SHA1/MD5 Message Digest 0/PRNG Data0
CE_MD1	0x50	SHA1/MD5 Message Digest 1/PRNG Data1
CE_MD2	0x54	SHA1/MD5 Message Digest 2/PRNG Data2
CE_MD3	0x58	SHA1/MD5 Message Digest 3/PRNG Data3
CE_MD4	0x5C	SHA1/MD5 Message Digest 4/PRNG Data4
CE_CTS_LEN	0x60	AES-CTS ciphertext length
CE_RXFIFO	0x200	RX FIFO input port
CE_TXFIFO	0x204	TX FIFO output port

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3.19.3 Crypto Engine Register Description

Crypto Engine Control Register

Offset: 0x00			Register Name: CE_CTL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:28	/	/	/
27:24	R/W	0	SKEY_SELECT AES/DES/3DES key select 0: Select input SS_KEYx (Normal Mode) 1: Select SID_RKEYx from Security ID 2: / 3-10: Select internal Key n (n from 0 to 7) Others: Reserved
18:16	R	x	DIE_ID Die Bonding ID
15	R/W	0	PRNG_MODE PRNG generator mode 0: One-shot mode 1: Continue mode
14	R/W	0	IV_MODE IV Steady of SHA-1/MD5 constants 0: Constants 1: Arbitrary IV Notes: It is only used for SHA-1/MD5 engine. If the number of IV word is beyond of 4, Counter 0 register is used for IV4.
13:12	R/W	0	CE_OP_MODE CE Operation Mode 00: Electronic Code Book (ECB) mode 01: Cipher Block Chaining (CBC) mode 10: Counter (CTR) mode 11: Reserved
11:10	R/W	0	CTR_WIDTH Counter Width for CTR Mode 00: 16-bits Counter 01: 32-bits Counter 10: 64-bits Counter 11: 128-bits Counter
9:8	R/W	0	AES_KEY_SIZE Key Size for AES 00: 128-bits 01: 192-bits 10: 256-bits 11: Reserved
7	R/W	0	CE_OP_DIR

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			CE Operation Direction 0: Encryption 1: Decryption
6:4	R/W	0	CE_METHOD CE Method 000: AES 001: DES 010: Triple DES (3DES) 011: SHA-1 100: MD5 101: PRNG Others: Reserved
3	/	/	/
2	R/W	0	SHA1_MD5_END_BIT SHA-1/MD5 Data End bit Write '1' to tell SHA-1/MD5 engine that the text data is end. If there is some data in FIFO, the engine would fetch these data and process them. After finishing message digest, this bit is clear to '0' by hardware and message digest can be read out from digest registers. Notes: It is only used for SHA-1/MD5 engine.
1	R/W	0	PRNG_START PRNG start bit In PRNG one-shot mode, write '1' to start PRNG. After generating one group random data (5 words), this bit is clear to '0' by hardware.
0	R/W	0	CE_ENABLE CE Enable 0: Disable 1: Enable

Crypto Engine Key [n] Register

Offset: 0x04 +4*n			Register Name: CE_KEY[n] Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0	CE_KEY Key[n] Input Value (n= 0~7)/ PRNG Seed[n] (n= 0~5)

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Crypto Engine IV[n] Register

Offset: 0x24 +4*n			Register Name: CE_IV[n] Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0	CE_IV_VALUE Initialization Vector (IV[n]) Input Value (n= 0~3)

Crypto Engine Counter[n] Register

Offset: 0x34 +4*n			Register Name: CE_CTR[n] Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0	CE_CTR_VALUE Counter mode preload Counter Input Value (n= 0~3)

Crypto Engine FIFO Control/ Status Register

Offset: 0x44			Register Name: CE_FCSR Default Value: 0x6000_0F0F
Bit	Read/Write	Default/Hex	Description
31	/	/	/
30	R	0x1	RXFIFO_STATUS RX FIFO Empty 0: No room for new word in RX FIFO 1: More than one room for new word in RX FIFO (>= 1 word)
29:24	R	0x20	RXFIFO_EMP_CNT RX FIFO Empty Space Word Counter
23	/	/	/
22	R	0	TXFIFO_STATUS TX FIFO Data Available Flag 0: No available data in TX FIFO 1: More than one data in TX FIFO (>= 1 word)
21:16	R	0	TXFIFO_AVA_CNT TX FIFO Available Word Counter
15:13	/	/	/
12:8	R/W	0xF	RXFIFO_INT_TRIG_LEVEL RX FIFO Empty Trigger Level Interrupt and DMA request trigger level for RXFIFO normal condition Trigger Level = RXTL + 1 Notes: RX FIFO is used for input the data.
7:5	/	/	/
4:0	R/W	0xF	TXFIFO_INT_TRIG_LEVEL TX FIFO Trigger Level Interrupt and DMA request trigger level for TXFIFO normal condition

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			Trigger Level = TXTL + 1 Notes: TX FIFO is used for output the result data.

Crypto Engine Interrupt Control/ Status Register

Offset: 0x48			Register Name: CE_ICSR Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:11	/	/	/
10	R/W	0	RXFIFO_EMP_PENDING_BIT RX FIFO Empty Pending bit 0: No pending 1: RX FIFO Empty pending Notes: Write '1' to clear or automatic clear if interrupt condition fails.
9	/	/	/
8	R/W	0	TXFIFO_AVA_PENDING_BIT TX FIFO Data Available Pending bit 0: No TX FIFO pending 1: TX FIFO pending Notes: Write '1' to clear or automatic clear if interrupt condition fails.
7:5	/	/	/
4	R/W	0	DRQ_ENABLE DRQ Enable 0: Disable DRQ (CPU polling mode) 1: Enable DRQ (DMA mode)
3	/	/	/
2	R/W	0	RXFIFO_EMP_INT_ENABLE RX FIFO Empty Interrupt Enable 0: Disable 1: Enable Notes: If it is set to '1', when the number of empty room is great or equal (>=) the preset threshold, the interrupt is trigger and the correspond flag is set.
1	/	/	/
0	R/W	0	TXFIFO_AVA_INT_ENABLE TX FIFO Data Available Interrupt Enable 0: Disable 1: Enable Notes: If it is set to '1', when available data number is great or equal (>=) the preset threshold, the interrupt is trigger and the correspond flag is set.

Crypto Engine Message Digest[n] Register

Offset: 0x4C +4*n	Register Name: CE_MD[n] Default Value: 0x0000_0000

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Bit	Read/Write	Default/Hex	Description
31:0	R	0	CE_MID_DATA SHA1/ MD5 Message digest MD[n] for SHA1/MD5 (n= 0~4)

Crypto Engine CTS Length Register

Offset: 0x60			Register Name: CE_CTS_LEN Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0	AES-CTS ciphertext length in byte unit The value of '0' means no data.

Crypto Engine RX FIFO Register

Offset: 0x200			Register Name: CE_RX Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:0	W	0	CE_RX_FIFO 32-bits RX FIFO for Input

Crypto Engine TX FIFO Register

Offset: 0x204			Register Name: CE_TX Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:0	R	0	CE_TX_FIFO 32-bits TX FIFO for Output

Crypto Engine Clock Requirement

Clock Name	Description	Requirement
ahb_clk	AHB bus clock	>=24MHz
ce_clk	CE serial clock	<= 150MHz

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3.20 Port Controller

3.20.1 Port Description

The chip has 7 ports for multi-functional input/out pins. They are shown below:

- Port B(PB): 8 input/output port
- Port C(PC): 17 input/output port
- Port D(PD): 22 input/output port
- Port E(PE) : 18 input/output port
- Port F(PF) : 6 input/output port
- Port G(PG) : 14 input/output port
- Port H(PH) : 10 input/output port

For various system configurations, these ports can be easily configured by software. All these ports can be configured as GPIO if multiplexed functions are not used. The external PIO interrupt sources are supported and interrupt mode can be configured by software.

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3.20.2 Port Register List

Module Name	Base Address
PIO	0x01C20800

Register Name	Offset	Description
Pn_CFG0	n*0x24+0x00	Port n Configure Register 0 (n from 1 to 7)
Pn_CFG1	n*0x24+0x04	Port n Configure Register 1 (n from 1 to 7)
Pn_CFG2	n*0x24+0x08	Port n Configure Register 2 (n from 1 to 7)
Pn_CFG3	n*0x24+0x0C	Port n Configure Register 3 (n from 1 to 7)
Pn_DAT	n*0x24+0x10	Port n Data Register (n from 1 to 7)
Pn_DRV0	n*0x24+0x14	Port n Multi-Driving Register 0 (n from 1 to 7)
Pn_DRV1	n*0x24+0x18	Port n Multi-Driving Register 1 (n from 1 to 7)
Pn_PUL0	n*0x24+0x1C	Port n Pull Register 0 (n from 1 to 7)
Pn_PUL1	n*0x24+0x20	Port n Pull Register 1 (n from 1 to 7)
Pn_INT_CFG0	0x200+n*0x20+0x00	PIO Interrrupt Configure Register 0
Pn _INT_CFG1	0x200+n*0x20+0x04	PIO Interrrupt Configure Register 1
Pn _INT_CFG2	0x200+n*0x20+0x08	PIO Interrrupt Configure Register 2
Pn _INT_CFG3	0x200+n*0x20+0x0C	PIO Interrrupt Configure Register 3
Pn _INT_CTL	0x200+n*0x20+0x10	PIO Interrupt Control Register
Pn _INT_STA	0x200+n*0x20+0x14	PIO Interrupt Status Register
Pn _INT_DEB	0x200+n*0x20+0x18	PIO Interrupt Debounce Register

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3.20.3 Port Register Description

PB Configure Register 0

Offset: 0x24			Register Name: PB_CFG0 Default Value: 0x7777_7777
Bit	Read/Write	Default	Description
31	/	/	/
30:28	R/W	0x7	PB7_SELECT 000: Input 001: Output 010: PCM0_DIN 011: AIF2_DIN 100: PB_EINT7 101: Reserved 110: Reserved 111: IO Disable
27	/	/	/
26:24	R/W	0x7	PB6_SELECT 000: Input 001: Output 010: PCM0_DOUT 011: AIF2_DOUT 100: PB_EINT6 101: Reserved 110: Reserved 111: IO Disable
23	/	/	/
22:20	R/W	0x7	PB5_SELECT 000: Input 001: Output 010: PCM0_BCLK 011: AIF2_BCLK 100: PB_EINT5 101: Reserved 110: Reserved 111: IO Disable
19	/	/	/
18:16	R/W	0x7	PB4_SELECT 000: Input 001: Output 010: PCM0_SYNC 011: AIF2_SYNC 100: PB_EINT4 101: Reserved 110: Reserved 111: IO Disable
15	/	/	/
14:12	R/W	0x7	PB3_SELECT 000: Input 001: Output 010: UART2_CTS 011: Reserved 100: PB_EINT3 101: Reserved 110: Reserved 111: IO Disable
11	/	/	/
10:8	R/W	0x7	PB2_SELECT 000: Input 001: Output 010: UART2_RTS 011: Reserved 100: PB_EINT2 101: Reserved 110: Reserved 111: IO Disable
7	/	/	/
6:4	R/W	0x7	PB1_SELECT

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			000: Input 010: UART2_RX 100: PB_EINT1 110: Reserved	001: Output 011: UART0_RX 101: Reserved 111: IO Disable
3	/	/	/	
2:0	R/W	0x7	PB0_SELECT 000: Input 010: UART2_TX 100: PB_EINT0 110: Reserved	001: Output 011: UART0_TX 101: Reserved 111: IO Disable

PB Configure Register 1

Offset: 0x28			Register Name: PB_CFG1 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

PB Configure Register 2

Offset: 0x2C			Register Name: PB_CFG2 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

PB Configure Register 3

Offset: 0x30			Register Name: PB_CFG3 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

PB Data Register

Offset: 0x34			Register Name: PB_DAT Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:8	/	/	/
7:0	R/W	0	PB_DAT If the port is configured as input, the corresponding bit is the pin state. If the port is configured as output, the pin state is the same as the corresponding bit. The read bit value is the value setup by software. If the port is configured as functional pin, the undefined value will be read.

PB Multi-Driving Register 0

Offset: 0x38			Register Name: PB_DRV0 Default Value: 0x0000_5555
Bit	Read/Write	Default	Description
31:16	/	/	Reserved

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[2i+1:2i] (i=0~7)	R/W	0x1	PB_DRV PB[n] Multi-Driving Select (n = 0~7) 00: Level 0 01: Level 1 10: Level 2 11: Level 3

PB Multi-Driving Register 1

Offset: 0x3C			Register Name: PB_DRV1 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

PB Pull Register 0

Offset: 0x40			Register Name: PB_PULL0 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31;16	/	/	Reserved
[2i+1:2i] (i=0~7)	R/W	0x0	PB_PULL PB[n] Pull-up/down Select (n = 0~7) 00: Pull-up/down disable 01: Pull-up 10: Pull-down 11: Reserved

PB Pull Register 1

Offset: 0x44			Register Name: PB_PULL1 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

PC Configure Register 0

Offset: 0x48			Register Name: PC_CFG0 Default Value: 0x7777_7777
Bit	Read/Write	Default	Description
31	/	/	/
30:28	R/W	0x7	PC7_SELECT 000: Input 001: Output 010: NAND_RB1 011: Reserved 100: Reserved 101: Reserved 110: Reserved 111: IO Disable
27	/	/	/
26:24	R/W	0x7	PC6_SELECT 000: Input 001: Output 010: NAND_RB0 011: SDC2_CMD 100: Reserved 101: Reserved 110: Reserved 111: IO Disable
23	/	/	/
22:20	R/W	0x7	PC5_SELECT 000: Input 001: Output

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			010: NAND_RE	011: SDC2_CLK
			100: Reserved	101: Reserved
			110: Reserved	111: IO Disable
19	/	/	/	
			PC4_SELECT	
			000: Input	001: Output
			010: NAND_CE0	011: Reserved
			100: Reserved	101: Reserved
18:16	R/W	0x7	110: Reserved	111: IO Disable
15	/	/	/	
			PC3_SELECT	
			000: Input	001: Output
			010: NAND_CE1	011: SPI0_CS
			100: Reserved	101: Reserved
14:12	R/W	0x7	110: Reserved	111: IO Disable
11	/	/	/	
			PC2_SELECT	
			000: Input	001: Output
			010: NAND_CLE	011: SPI0_CLK
			100: Reserved	101: Reserved
10:8	R/W	0x7	110: Reserved	111: IO Disable
7	/	/	/	
			PC1_SELECT	
			000: Input	001: Output
			010: NAND_ALE	011: SPI0_MISO
			100: Reserved	101: Reserved
6:4	R/W	0x7	110: Reserved	111: IO Disable
3	/	/	/	
			PC0_SELECT	
			000: Input	001: Output
			010: NAND_WE	011: SPI0_MOSI
			100: Reserved	101: Reserved
2:0	R/W	0x7	110: Reserved	111: IO Disable

PC Configure Register 1

Offset: 0x4C			Register Name: PC_CFG1 Default Value: 0x7777_7777	
Bit	Read/Write	Default	Description	
31	/	/	/	
			PC15_SELECT	
			000: Input	001: Output
			010: NAND_DQ7	011: SDC2_D7
			100: Reserved	101: Reserved
30:28	R/W	0x7	110: Reserved	111: IO Disable
27	/	/	/	
26:24	R/W	0x7	PC14_SELECT	

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			000: Input	001: Output
			010: NAND_DQ6	011: SDC2_D6
			100: Reserved	101: Reserved
			110: Reserved	111: IO Disable
23	/	/	/	
22:20	R/W	0x7	PC13_SELECT 000: Input 010: NAND_DQ5 100: Reserved 110: Reserved	001: Output 011: SDC2_D5 101: Reserved 111: IO Disable
19	/	/	/	
18:16	R/W	0x7	PC12_SELECT 000: Input 010: NAND_DQ4 100: Reserved 110: Reserved	001: Output 011: SDC2_D4 101: Reserved 111: IO Disable
15	/	/	/	
14:12	R/W	0x7	PC11_SELECT 000: Input 010: NAND_DQ3 100: Reserved 110: Reserved	001: Output 011: SDC2_D3 101: Reserved 111: IO Disable
11	/	/	/	
10:8	R/W	0x7	PC10_SELECT 000: Input 010: NAND_DQ2 100: Reserved 110: Reserved	001: Output 011: SDC2_D2 101: Reserved 111: IO Disable
7	/	/	/	
6:4	R/W	0x7	PC9_SELECT 000: Input 010: NAND_DQ1 100: Reserved 110: Reserved	001: Output 011: SDC2_D1 101: Reserved 111: IO Disable
3	/	/	/	
2:0	R/W	0x7	PC8_SELECT 000: Input 010: NAND_DQ0 100: Reserved 110: Reserved	001: Output 011: SDC2_D0 101: Reserved 111: IO Disable

PC Configure Register 2

Offset: 0x50			Register Name: PC_CFG2 Default Value: 0x0000_0777
Bit	Read/Write	Default	Description
31:11	/	/	/

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10:8	R/W	0x7	/
7	/	/	/
6:4	R/W	0x7	/
3	/	/	/
2:0	R/W	0x7	PC16_SELECT 000: Input 001: Output 010: NAND_DQS 011: SDC2_RST 100: Reserved 101: Reserved 110: Reserved 111: IO Disable

PC Configure Register 3

Offset: 0x54			Register Name: PC_CFG3 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

PC Data Register

Offset: 0x58			Register Name: PC_DAT Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:19	/	/	/
18:0	R/W	0	PC_DAT If the port is configured as input, the corresponding bit is the pin state. If the port is configured as output, the pin state is the same as the corresponding bit. The read bit value is the value setup by software. If the port is configured as functional pin, the undefined value will be read.

PC Multi-Driving Register 0

Offset: 0x5C			Register Name: PC_DRV0 Default Value: 0x5555_5555
Bit	Read/Write	Default	Description
[2i+1:2i] (i=0~15)	R/W	0x1	PC_DRV PC[n] Multi-Driving_SELECT (n = 0~15) 00: Level 0 01: Level 1 10: Level 2 11: Level 3

PC Multi-Driving Register 1

Offset: 0x60			Register Name: PC_DRV1 Default Value: 0x0000_0015
Bit	Read/Write	Default	Description
31:6	/	/	/
[2i+1:2i] (i=0~2)	R/W	0x1	PC_DRV PC[n] Multi-Driving Select (n = 16~18) 00: Level 0 01: Level 1 10: Level 2 11: Level 3

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PC Pull Register 0

Offset: 0x64			Register Name: PC_PULL0 Default Value: 0x0000_5140
Bit	Read/Write	Default	Description
[2i+1:2i] (i=0~15)	R/W	0x00005140	PC_PULL PC[n] Pull-up/down Select (n = 0~15) 00: Pull-up/down disable 01: Pull-up 10: Pull-down 11: Reserved

PC Pull Register 1

Offset: 0x68			Register Name: PC_PULL1 Default Value: 0x0000_0014
Bit	Read/Write	Default	Description
31:6	/	/	/
[2i+1:2i] (i=0~2)	R/W	0x00000014	PC_PULL PC[n] Pull-up/down Select (n = 16~18) 00: Pull-up/down disable 01: Pull-up 10: Pull-down 11: Reserved

PD Configure Register 0

Offset: 0x6C			Register Name: PD_CFG0 Default Value: 0x7777_7777
Bit	Read/Write	Default	Description
31	/	/	/
30:28	R/W	0x7	PD7_SELECT 000: Input 001: Output 010: LCD_D7 011: SDC1_D3 100: Reserved 101: Reserved 110: Reserved 111: IO Disable
27	/	/	Reserved
26:24	R/W	0x7	PD6_SELECT 000: Input 001: Output 010: LCD_D6 011: SDC1_D2 100: Reserved 101: Reserved 110: Reserved 111: IO Disable
23	/	/	/
22:20	R/W	0x7	PD5_SELECT 000: Input 001: Output 010: LCD_D5 011: SDC1_D1 100: Reserved 101: Reserved 110: Reserved 111: IO Disable
19	/	/	/
18:16	R/W	0x7	PD4_SELECT 000: Input 001: Output 010: LCD_D4 011: SDC1_D0

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			100: Reserved	101: Reserved
			110: Reserved	111: IO Disable
15	/	/	/	
			PD3_SELECT	
			000: Input	001: Output
			010: LCD_D3	011: SD1_CMD
			100: Reserved	101: Reserved
14:12	R/W	0x7	110: Reserved	111: IO Disable
11	/	/	/	
			PD2_SELECT	
			000: Input	001: Output
			010: LCD_D2	011: SDC1_CLK
			100: Reserved	101: Reserved
10:8	R/W	0x7	110: Reserved	111: IO Disable
7	/	/	/	
6:4	R/W	0x7	/	
3	/	/	/	
2:0	R/W	0x7	/	

PD Configure Register 1

Offset: 0x70			Register Name: PD_CFG1 Default Value: 0x7777_7777	
Bit	Read/Write	Default	Description	
31	/	/	/	
			PD15_SELECT	
			000: Input	001: Output
			010: LCD_D15	011: Reserved
			100: Reserved	101: Reserved
30:28	R/W	0x7	110: Reserved	111: IO Disable
27	/	/	/	
			PD14_SELECT	
			000: Input	001: Output
			010: LCD_D14	011: Reserved
			100: Reserved	101: Reserved
26:24	R/W	0x7	110: Reserved	111: IO Disable
23	/	/	/	
			PD13_SELECT	
			000: Input	001: Output
			010: LCD_D13	011: UART1_CTS
			100: Reserved	101: Reserved
22:20	R/W	0x7	110: Reserved	111: IO Disable
19	/	/	/	
			PD12_SELECT	
			000: Input	001: Output
			010: LCD_D12	011: UART1_RTS
18:16	R/W	0x7	100: Reserved	101: Reserved

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			110: Reserved	111: IO Disable
15	/	/	/	
14:12	R/W	0x7	PD11_SELECT 000: Input 010: LCD_D11 100: Reserved 110: Reserved	001: Output 011: UART1_RX 101: Reserved 111: IO Disable
11	/	/	/	
10:8	R/W	0x7	PD10_SELECT 000: Input 010: LCD_D10 100: Reserved 110: Reserved	001: Output 011: UART1_TX 101: Reserved 111: IO Disable
7	/	/	/	
6:4	R/W	0x7	/	
3	/	/	/	
2:0	R/W	0x7	/	

PD Configure Register 2

Offset: 0x74			Register Name: PD_CFG2 Default Value: 0x7777_7777	
Bit	Read/Write	Default	Description	
31	/	/	/	
30:28	R/W	0x7	PD23_SELECT 000: Input 010: LCD_D23 100: Reserved 110: Reserved	001: Output 011: LVDS_VN2 101: Reserved 111: IO Disable
27	/	/	/	
26:24	R/W	0x7	PD22_SELECT 000: Input 010: LCD_D22 100: Reserved 110: Reserved	001: Output 011: LVDS_VP2 101: Reserved 111: IO Disable
23	/	/	/	
22:20	R/W	0x7	PD21_SELECT 000: Input 010: LCD_D21 100: Reserved 110: Reserved	001: Output 011: LVDS_VN1 101: Reserved 111: IO Disable
19	/	/	/	
18:16	R/W	0x7	PD20_SELECT 000: Input 010: LCD_D20 100: Reserved 110: Reserved	001: Output 011: LVDS_VP1 101: Reserved 111: IO Disable

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15	/	/	/
14:12	R/W	0x7	PD19_SELECT 000: Input 001: Output 010: LCD_D19 011: LVDS_VN0 100: Reserved 101: Reserved 110: Reserved 111: IO Disable
11	/	/	/
10:8	R/W	0x7	PD18_SELECT 000: Input 001: Output 010: LCD_D18 011: LVDS_VP0 100: Reserved 101: Reserved 110: Reserved 111: IO Disable
7	/	/	/
6:4	R/W	0x7	/
3	/	/	/
2:0	R/W	0x7	/

PD Configure Register 3

Offset: 0x78			Register Name: PD_CFG3 Default Value: 0x0000_7777
Bit	Read/Write	Default	Description
31:16	/	/	/
15	/	/	/
14:12	R/W	0x7	PD27_SELECT 000: Input 001: Output 010: LCD_VSYNC 011: LVDS_VN3 100: Reserved 101: Reserved 110: Reserved 111: IO Disable
11	/	/	Reserved
10:8	R/W	0x7	PD26_SELECT 000: Input 001: Output 010: LCD_HSYNC 011: LVDS_VP3 100: Reserved 101: Reserved 110: Reserved 111: IO Disable
7	/	/	/
6:4	R/W	0x7	PD25_SELECT 000: Input 001: Output 010: LCD_DE 011: LVDS_VNC 100: Reserved 101: Reserved 110: Reserved 111: IO Disable
3	/	/	/
2:0	R/W	0x7	PD24_SELECT 000: Input 001: Output 010: LCD_CLK 011: LVDS_VPC 100: Reserved 101: Reserved 110: Reserved 111: IO Disable

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PD Data Register

Offset: 0x7C			Register Name: PD_DAT Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:28	/	/	/
27:0	R/W	0	PD_DAT If the port is configured as input, the corresponding bit is the pin state. If the port is configured as output, the pin state is the same as the corresponding bit. The read bit value is the value setup by software. If the port is configured as functional pin, the undefined value will be read.

PD Multi-Driving Register 0

Offset: 0x80			Register Name: PD_DRV0 Default Value: 0x5555_5555
Bit	Read/Write	Default	Description
[2i+1:2i] (i=0~15)	R/W	0x1	PD_DRV PD[n] Multi-Driving Select (n = 0~15) 00: Level 0 01: Level 1 10: Level 2 11: Level 3

PD Multi-Driving Register 1

Offset: 0x84			Register Name: PD_DRV1 Default Value: 0x0055_5555
Bit	Read/Write	Default	Description
31:24	/	/	/
[2i+1:2i] (i=0~11)	R/W	0x1	PD_DRV PD[n] Multi-Driving Select (n = 16~27) 00: Level 0 01: Level 1 10: Level 2 11: Level 3

PD Pull Register 0

Offset: 0x88			Register Name: PD_PULL0 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
[2i+1:2i] (i=0~15)	R/W	0x0	PD_PULL PD[n] Pull-up/down Select (n = 0~15) 00: Pull-up/down disable 01: Pull-up 10: Pull-down 11: Reserved

PD Pull Register 1

Offset: 0x8C			Register Name: PD_PULL1 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:24	/	/	/

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[2i+1:2i] (i=0~11)	R/W	0x0	PD_PULL PD[n] Pull-up/down Select (n = 16~27) 00: Pull-up/down disable 01: Pull-up enable 10: Pull-down 11: Reserved

PE Configure Register 0

Offset: 0x90			Register Name: PE_CFG0 Default Value: 0x7777_7777
Bit	Read/Write	Default	Description
31	/	/	/
30:28	R/W	0x7	PE7_SELECT 000: Input 001: Output 010: CSI_D3 011: Reserved 100: Reserved 101: Reserved 110: Reserved 111: IO Disable
27	/	/	/
26:24	R/W	0x7	PE6_SELECT 000: Input 001: Output 010: CSI_D2 011: Reserved 100: Reserved 101: Reserved 110: Reserved 111: IO Disable
23	/	/	/
22:20	R/W	0x7	PE5_SELECT 000: Input 001: Output 010: CSI_D1 011: Reserved 100: Reserved 101: Reserved 110: Reserved 111: IO Disable
19	/	/	/
18:16	R/W	0x7	PE4_SELECT 000: Input 001: Output 010: CSI_D0 011: Reserved 100: Reserved 101: Reserved 110: Reserved 111: IO Disable
15	/	/	/
14:12	R/W	0x7	PE3_SELECT 000: Input 001: Output 010: CSI_VSYNC 011: Reserved 100: Reserved 101: Reserved 110: Reserved 111: IO Disable
11	/	/	/
10:8	R/W	0x7	PE2_SELECT 000: Input 001: Output 010: CSI_HSYNC 011: Reserved 100: Reserved 101: Reserved 110: Reserved 111: IO Disable
7	/	/	/

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			PE1_SELECT	
			000: Input	001: Output
			010: CSI_MCLK	011: Reserved
			100: Reserved	101: Reserved
6:4	R/W	0x7	110: Reserved	111: IO Disable
3	/	/	/	
			PE0_SELECT	
			000: Input	001: Output
			010: CSI_PCLK	011: Reserved
			100: Reserved	101: Reserved
2:0	R/W	0x7	110: Reserved	111: IO Disable

PE Configure Register 1

Offset: 0x94			Register Name: PE_CFG1 Default Value: 0x7777_7777	
Bit	Read/Write	Default	Description	
31	/	/	/	
			PE15_SELECT	
			000: Input	001: Output
			010: Reserved	011: Reserved
			100: Reserved	101: Reserved
30:28	R/W	0x7	110: Reserved	111: IO Disable
27	/	/	/	
			PE14_SELECT	
			000: Input	001: Output
			010: Reserved	011: Reserved
			100: Reserved	101: Reserved
26:24	R/W	0x7	110: Reserved	111: IO Disable
23	/	/	/	
			PE13_SELECT	
			000: Input	001: Output
			010: CSI_SDA	011: TWI2_SDA
			100: Reserved	101: Reserved
22:20	R/W	0x7	110: Reserved	111: IO Disable
19	/	/	/	
			PE12_SELECT	
			000: Input	001: Output
			010: CSI_SCK	011: TWI2_SCK
			100: Reserved	101: Reserved
18:16	R/W	0x7	110: Reserved	111: IO Disable
15	/	/	/	
			PE11_SELECT	
			000: Input	001: Output
			010: CSI_D7	011: Reserved
			100: Reserved	101: Reserved
14:12	R/W	0x7	110: Reserved	111: IO Disable

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11	/	/	/
10:8	R/W	0x7	PE10_SELECT 000: Input 001: Output 010: CSI_D6 011: Reserved 100: Reserved 101: Reserved 110: Reserved 111: IO Disable
7	/	/	/
6:4	R/W	0x7	PE9_SELECT 000: Input 001: Output 010: CSI_D5 011: Reserved 100: Reserved 101: Reserved 110: Reserved 111: IO Disable
3	/	/	/
2:0	R/W	0x7	PE8_SELECT 000: Input 001: Output 010: CSI_D4 011: Reserved 100: Reserved 101: Reserved 110: Reserved 111: IO Disable

PE Configure Register 2

Offset: 0x98			Register Name: PE_CFG2 Default Value: 0x0000_0077
Bit	Read/Write	Default	Description
31:7	/	/	/
6:4	R/W	0x7	PE17_SELECT 000: Input 001: Output 010: Reserved 011: Reserved 100: Reserved 101: Reserved 110: Reserved 111: IO Disable
3	/	/	/
2:0	R/W	0x7	PE16_SELECT 000: Input 001: Output 010: Reserved 011: Reserved 100: Reserved 101: Reserved 110: Reserved 111: IO Disable

PE Configure Register 3

Offset: 0x9C			Register Name: PE_CFG2 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

PE Data Register

Offset: 0xA0			Register Name: PE_DAT Default Value: 0x0000_0000
Bit	Read/Write	Default	Description

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31:18	/	/	/
17:0	R/W	0	PE_DAT If the port is configured as input, the corresponding bit is the pin state. If the port is configured as output, the pin state is the same as the corresponding bit. The read bit value is the value setup by software. If the port is configured as functional pin, the undefined value will be read.

PE Multi-Driving Register 0

Offset: 0xA4			Register Name: PE_DRV0 Default Value: 0x5555_5555
Bit	Read/Write	Default	Description
[2i+1:2i] (i=0~15)	R/W	0x1	PE_DRV PE[n] Multi-Driving Select (n = 0~15) 00: Level 0 01: Level 1 10: Level 2 11: Level 3

PE Multi-Driving Register 1

Offset: 0xA8			Register Name: PE_DRV1 Default Value: 0x0000_0005
Bit	Read/Write	Default	Description
31:4	/	/	/
[2i+1:2i] (i=0~1)	R/W	0x1	PE_DRV PE[n] Multi-Driving Select (n = 16~17) 00: Level 0 01: Level 1 10: Level 2 11: Level 3

PE Pull Register 0

Offset: 0xAC			Register Name: PE_PULL0 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
[2i+1:2i] (i=0~15)	R/W	0x0	PE_PULL PE[n] Pull-up/down Select (n = 0~15) 00: Pull-up/down disable 01: Pull-up 10: Pull-down 11: Reserved

PE Pull Register 1

Offset: 0xB0			Register Name: PE_PULL1 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:4	/	/	/
[2i+1:2i] (i=0~1)	R/W	0x0	PE_PULL PE[n] Pull-up/down Select (n = 16~17) 00: Pull-up/down disable 01: Pull-up 10: Pull-down 11: Reserved

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PF Configure Register 0

Offset: 0xB4			Register Name: PF_CFG0 Default Value: 0x0037_3733	
Bit	Read/Write	Default	Description	
31:23	/	/	/	
22:20	R/W	0x3	PF5_SELECT 000: Input 010: SDC0_D2 100: Reserved 110: Reserved	001: Output 011: JTAG_CK1 101: Reserved 111: IO Disable
19	/	/	/	
18:16	R/W	0x7	PF4_SELECT 000: Input 010: SDC0_D3 100: Reserved 110: Reserved	001: Output 011: UART0_RX 101: Reserved 111: IO Disable
15	/	/	/	
14:12	R/W	0x3	PF3_SELECT 000: Input 010: SDC0_CMD 100: Reserved 110: Reserved	001: Output 011: JTAG_DO1 101: Reserved 111: IO Disable
11	/	/	/	
10:8	R/W	0x7	PF2_SELECT 000: Input 010: SDC0_CLK 100: Reserved 110: Reserved	001: Output 011: UART0_TX 101: Reserved 111: IO Disable
7	/	/	/	
6:4	R/W	0x3	PF1_SELECT 000: Input 010: SDC0_D0 100: Reserved 110: Reserved	001: Output 011: JTAG_DI1 101: Reserved 111: IO Disable
3	/	/	/	
2:0	R/W	0x3	PF0_SELECT 000: Input 010: SDC0_D1 100: Reserved 110: Reserved	001: Output 011: JTAG_MS1 101: Reserved 111: IO Disable

PF Configure Register 1

Offset: 0xB8			Register Name: PF_CFG1 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

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PF Configure Register 2

Offset: 0xBC			Register Name: PF_CFG2 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

PF Configure Register 3

Offset: 0xC0			Register Name: PF_CFG3 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

PF Data Register

Offset: 0xC4			Register Name: PF_DAT Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:6	/	/	/
5:0	R/W	0	PF_DAT If the port is configured as input, the corresponding bit is the pin state. If the port is configured as output, the pin state is the same as the corresponding bit. The read bit value is the value setup by software. If the port is configured as functional pin, the undefined value will be read.

PF Multi-Driving Register 0

Offset: 0xC8			Register Name: PF_DRV0 Default Value: 0x0000_0555
Bit	Read/Write	Default	Description
31:12	/	/	/
[2i+1:2i] (i=0~5)	R/W	0x1	PF_DRV PF[n] Multi-Driving Select (n = 0~5) 00: Level 0 01: Level 1 10: Level 2 11: Level 3

PF Multi-Driving Register 1

Offset: 0xCC			Register Name: PF_DRV1 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

PF Pull Register 0

Offset: 0xD0			Register Name: PF_PULL0 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:12	/	/	/

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[2i+1:2i] (i=0~5)	R/W	0x0	PF_PULL PF[n] Pull-up/down Select (n = 0~5) 00: Pull-up/down disable 01: Pull-up 10: Pull-down 11: Reserved

PF Pull Register 1

Offset: 0xD4			Register Name: PF_PULL1 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

PG Configure Register 0

Offset: 0xD8			Register Name: PG_CFG0 Default Value: 0x7777_7777
Bit	Read/Write	Default	Description
31	/	/	/
30:28	R/W	0x7	PG7_SELECT 000: Input 001: Output 010: UART1_RX 011: Reserved 100: PG_EINT7 101: Reserved 110: Reserved 111: IO Disable
27	/	/	/
26:24	R/W	0x7	PG6_SELECT 000: Input 001: Output 010: UART1_TX 011: Reserved 100: PG_EINT6 101: Reserved 110: Reserved 111: IO Disable
23	/	/	/
22:20	R/W	0x7	PG5_SELECT 000: Input 001: Output 010: SDC1_D3 011: Reserved 100: PG_EINT5 101: Reserved 110: Reserved 111: IO Disable
19	/	/	/
18:16	R/W	0x7	PG4_SELECT 000: Input 001: Output 010: SDC1_D2 011: Reserved 100: PG_EINT4 101: Reserved 110: Reserved 111: IO Disable
15	/	/	/
14:12	R/W	0x7	PG3_SELECT 000: Input 001: Output 010: SDC1_D1 011: Reserved 100: PG_EINT3 101: Reserved 110: Reserved 111: IO Disable
11	/	/	/

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			PG2_SELECT	
			000: Input	001: Output
			010: SDC1_D0	011: Reserved
			100: PG_EINT2	101: Reserved
10:8	R/W	0x7	110: Reserved	111: IO Disable
7	/	/	/	
			PG1_SELECT	
			000: Input	001: Output
			010: SDC1_CMD	011: Reserved
			100: PG_EINT1	101: Reserved
6:4	R/W	0x7	110: Reserved	111: IO Disable
3	/	/	/	
			PG0_SELECT	
			000: Input	001: Output
			010: SDC1_CLK	011: Reserved
			100: PG_EINT0	101: Reserved
2:0	R/W	0x7	110: Reserved	111: IO Disable

PG Configure Register 1

Offset: 0xDC			Register Name: PG_CFG1 Default Value: 0x0077_7777	
Bit	Read/Write	Default	Description	
31:23	/	/	/	
			PG13_SELECT	
			000: Input	001: Output
			010: PCM1_DIN	011: AIF3_DIN
			100: PG_EINT13	101: Reserved
22:20	R/W	0x7	110: Reserved	111: IO Disable
19	/	/	/	
			PG12_SELECT	
			000: Input	001: Output
			010: PCM1_DOUT	011: AIF3_DOUT
			100: PG_EINT12	101: Reserved
18:16	R/W	0x7	110: Reserved	111: IO Disable
15	/	/	/	
			PG11_SELECT	
			000: Input	001: Output
			010: PCM1_BCLK	011: AIF3_BCLK
			100: PG_EINT11	101: Reserved
14:12	R/W	0x7	110: Reserved	111: IO Disable
11	/	/	/	
			PG10_SELECT	
			000: Input	001: Output
			010: PCM1_SYNC	011: AIF3_SYNC
			100: PG_EINT10	101: Reserved
10:8	R/W	0x7	110: Reserved	111: IO Disable

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7	/	/	/
6:4	R/W	0x7	PG9_SELECT 000: Input 001: Output 010: UART1_CTS 011: Reserved 100: PG_EINT9 101: Reserved 110: Reserved 111: IO Disable
3	/	/	/
2:0	R/W	0x7	PG8_SELECT 000: Input 001: Output 010: UART1_RTS 011: Reserved 100: PG_EINT8 101: Reserved 110: Reserved 111: IO Disable

PG Configure Register 2

Offset: 0xE0			Register Name: PG_CFG2 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

PG Configure Register 3

Offset: 0xE4			Register Name: PG_CFG3 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

PG Data Register

Offset: 0xE8			Register Name: PG_DAT Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:14	/	/	/
13:0	R/W	0	PG_DAT If the port is configured as input, the corresponding bit is the pin state. If the port is configured as output, the pin state is the same as the corresponding bit. The read bit value is the value setup by software. If the port is configured as functional pin, the undefined value will be read.

PG Multi-Driving Register 0

Offset: 0xEC			Register Name: PG_DRV0 Default Value: 0x0555_5555
Bit	Read/Write	Default	Description
31:28	/	/	/
[2i+1:2i] (i=0~13)	R/W	0x1	PG_DRV PG[n] Multi-Driving Select (n = 0~13) 00: Level 0 01: Level 1 10: Level 2 11: Level 3

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PG Multi-Driving Register 1

Offset: 0xF0			Register Name: PG_DRV1 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

PG Pull Register 0

Offset: 0xF4			Register Name: PG_PULL0 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:28	/	/	/
[2i+1:2i] (i=0~13)	R/W	0x0	PG_PULL PG[n] Pull-up/down Select (n = 0~13) 00: Pull-up/down disable 01: Pull-up 10: Pull-down 11: Reserved

PG Pull Register 1

Offset: 0xF8			Register Name: PG_PULL1 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

PH Configure Register 0

Offset: 0xFC			Register Name: PH_CFG0 Default Value: 0x7777_7777
Bit	Read/Write	Default	Description
31	/	/	/
30:28	R/W	0x7	PH7_SELECT 000: Input 001: Output 010: SPI0_CLK 011: UART3_RX 100: Reserved 101: Reserved 110: Reserved 111: IO Disable
27	/	/	/
26:24	R/W	0x7	PH6_SELECT 000: Input 001: Output 010: SPI0_CS 011: UART3_TX 100: Reserved 101: Reserved 110: Reserved 111: IO Disable
23	/	/	/
22:20	R/W	0x7	PH5_SELECT 000: Input 001: Output 010: TWI1_SDA 011: Reserved 100: Reserved 101: Reserved 110: Reserved 111: IO Disable
19	/	/	/

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			PH4_SELECT	
			000: Input	001: Output
			010: TWI1_SCK	011: Reserved
			100: Reserved	101: Reserved
18:16	R/W	0x7	110: Reserved	111: IO Disable
15	/	/	/	
			PH3_SELECT	
			000: Input	001: Output
			010: TWI0_SDA	011: Reserved
			100: Reserved	101: Reserved
14:12	R/W	0x7	110: Reserved	111: IO Disable
11	/	/	/	
			PH2_SELECT	
			000: Input	001: Output
			010: TWI0_SCK	011: Reserved
			100: Reserved	101: Reserved
10:8	R/W	0x7	110: Reserved	111: IO Disable
7	/	/	/	
			PH1_SELECT	
			000: Input	001: Output
			010: PWM1	011: Reserved
			100: Reserved	101: Reserved
6:4	R/W	0x7	110: Reserved	111: IO Disable
3	/	/	/	
			PH0_SELECT	
			000: Input	001: Output
			010: PWM0	011: Reserved
			100: Reserved	101: Reserved
2:0	R/W	0x7	110: Reserved	111: IO Disable

PH Configure Register 1

Offset: 0x100			Register Name: PH_CFG1 Default Value: 0x0000_0077	
Bit	Read/Write	Default	Description	
31:7	/	/	/	
			PH9_SELECT	
			000: Input	001: Output
			010: SPI0_MISO	011: UART3_CTS
			100: Reserved	101: Reserved
6:4	R/W	0x7	110: Reserved	111: IO Disable
3	/	/	/	
			PH8_SELECT	
			000: Input	001: Output
			010: SPI0_MOSI	011: UART3_RTS
			100: Reserved	101: Reserved
2:0	R/W	0x7	110: Reserved	111: IO Disable

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PH Configure Register 2

Offset: 0x104			Register Name: PH_CFG2 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

PH Configure Register 3

Offset: 0x108			Register Name: PH_CFG3 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

PH Data Register

Offset: 0x10C			Register Name: PH_DAT Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:10	/	/	/
9:0	R/W	0	PH_DAT If the port is configured as input, the corresponding bit is the pin state. If the port is configured as output, the pin state is the same as the corresponding bit. The read bit value is the value setup by software. If the port is configured as functional pin, the undefined value will be read.

PH Multi-Driving Register 0

Offset: 0x110			Register Name: PH_DRV0 Default Value: 0x0005_5555
Bit	Read/Write	Default	Description
31:20	/	/	/
[2i+1:2i] (i=0~9)	R/W	0x1	PH_DRV PH[n] Multi-Driving Select (n = 0~9) 00: Level 0 01: Level 1 10: Level 2 11: Level 3

PH Multi-Driving Register 1

Offset: 0x114			Register Name: PH_DRV1 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

PH PULL REGister 0

Offset: 0x118			Register Name: PH_PULL0 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description

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31:20	/	/	/
[2i+1:2i] (i=0~9)	R/W	0	PH_PULL PH[n] Pull-up/down Select (n = 0~9) 00: Pull-up/down disable 01: Pull-up 10: Pull-down 11: Reserved

PH Pull Register 1

Offset: 0x11C			Register Name: PH_PULL1 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

PB External Interrupt Configure Register 0

Offset: 0x220			Register Name:PB_EINT_CFG0 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
[4i+3:4i] (i=0~7)	R/W	0	EINT_CFG External INTn Mode (n = 0~7) 0x0: Positive Edge 0x1: Negative Edge 0x2: High Level 0x3: Low Level 0x4: Double Edge (Positive/ Negative) Others: Reserved

PB External Interrupt Configure Register 1

Offset: 0x224			Register Name: PB_EINT_CFG1 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

PB External Interrupt Configure Register 2

Offset: 0x228			Register Name: PB_EINT_CFG2 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

PB External Interrupt Configure Register 3

Offset: 0x22C			Register Name: PB_EINT_CFG3 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

PB External Interrupt Control Register

Offset: 0x230	Register Name: PB_EINT_CTL Default Value: 0x0000_0000

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Bit	Read/Write	Default	Description
31:8	/	/	/
[n] (n=0~7)	R/W	0	EINT_CTL External INTn Enable (n = 0~7) 0: Disable 1: Enable

PB External Interrupt Status Register

Offset: 0x234			Register Name: PB_EINT_STATUS Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:8	/	/	/
[n] (n=0~7)	R/W	0	EINT_STATUS External INTn Pending Bit (n = 0~7) 0: No IRQ pending 1: IRQ pending Write '1' to clear

PB External Interrupt Debounce Register

Offset: 0x238			Register Name: PB_EINT_DEB Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:7	/	/	/
6:4	R/W	0	DEB_CLK_PRE_SCALE Debounce Clock Pre-scale n The selected clock source is prescaled by 2^n.
3:1	/	/	/
0	R/W	0	PIO_INT_CLK_SELECT PIO Interrupt Clock Select 0: LOSC 32Khz 1: HOSC 24Mhz

PG External Interrupt Configure Register 0

Offset: 0x240			Register Name:PG_EINT_CFG0 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
[4i+3:4i] (i=0~7)	R/W	0	EINT_CFG External INTn Mode (n = 0~7) 0x0: Positive Edge 0x1: Negative Edge 0x2: High Level 0x3: Low Level 0x4: Double Edge (Positive/ Negative) Others: Reserved

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PG External Interrupt Configure Register 1

Offset: 0x244			Register Name: PG_EINT_CFG1 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:24	/	/	/
[4i+3:4i] (i=0~5)	R/W	0	ENT_CFG External INTn Mode (n = 8~13) 0x0: Positive Edge 0x1: Negative Edge 0x2: High Level 0x3: Low Level 0x4: Double Edge (Positive/ Negative) Others: Reserved

PG External Interrupt Configure Register 2

Offset: 0x248			Register Name: PG_EINT_CFG2 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

PG External Interrupt Configure Register 3

Offset: 0x24C			Register Name: PG_EINT_CFG3 Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:0	/	/	/

PG External Interrupt Control Register

Offset: 0x250			Register Name: PG_EINT_CTL Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:14	/	/	/
[n] (n=0~13)	R/W	0	EINT_CTL External INTn Enable (n = 0~13) 0: Disable 1: Enable

PG External Interrupt Status Register

Offset: 0x254			Register Name: PG_EINT_STATUS Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:14	/	/	/
[n] (n=0~13)	5R/W	0	EINT_STATUS External INTn Pending Bit (n = 0~13) 0: No IRQ pending 1: IRQ pending Write '1' to clear

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PG External Interrupt Debounce Register

Offset: 0x258			Register Name: PG_EINT_DEB Default Value: 0x0000_0000
Bit	Read/Write	Default	Description
31:7	/	/	/
6:4	R/W	0	DEB_CLK_PRE_SCALE Debounce Clock Pre-scale n The selected clock source is prescaled by 2^n.
3:1	/	/	/
0	R/W	0	PIO_INT_CLK_SELECT PIO Interrupt Clock Select 0: LOSC 32Khz 1: HOSC 24Mhz

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Chapter 4 Memory

This chapter describes the memory subsystem of R16 processor from following perspectives:

- SDRAM Controller
- NAND Flash Controller

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4.1 SDRAM Controller

4.1.1 Overview

The SDRAM Controller (DRAMC) provides a simple, flexible, burst-optimized interface to all industry standard DDR3/DDR3L SDRAM.

The DRAMC automatically handles memory management, initialization, and refresh operations. It gives the host CPU a simple command interface, hiding details of the required address, page, and burst handling procedures. All memory parameters are runtime-configurable, including timing, memory setting, SDRAM type, and Extended-Mode-Register settings.

The DRAMC includes the following features:

- Compatible with the JEDEC standard DDR3/DDR3L SDRAM
- 16-bits data width
- Support power voltage of 1.35V and 1.5V
- Support memory capacity up to 2GB
- Support 16 address lines and 3 bank address lines per channel
- Automatically generate initialization and refresh sequences
- Runtime-configurable parameters setting
- Configurable clock frequency
- Priority of transferring through multiple ports is programmable
- Support random read or write operations

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4.2 NAND Flash Controller

4.2.1 Overview

The NDFC is the NAND Flash Controller which supports all NAND/MLC flash memory available in the market. New type flash can be supported by software re-configuration.

The On-the-fly error correction code (ECC) is built-in NDFC for enhancing reliability. BCH is implemented and it can detect and correct up to 64 bits error per 512 or 1024 bytes data. The on chip ECC and parity checking circuitry of NDFC frees CPU for other tasks. The ECC function can be disabled by software.

The data can be transferred by DMA or by CPU memory-mapped IO method. The NDFC provides automatic timing control for reading or writing external Flash. The NDFC maintains the proper relativity for CLE, CE# and ALE control signal lines. Three modes are supported for serial read access. The conventional serial access is mode 0 and mode 1 is for EDO type and mode 2 for extension EDO type. NDFC can monitor the status of R/B# signal line.

Block management and wear leveling management are implemented in software.

The NAND Flash Controller (NDFC) includes the following features:

- Comply to ONFI 2.3 and Toggle 1.0
- Support 64-bit ECC per 512 bytes or 1024 bytes
- 8-bit RAW NAND flash controller sharing pin with eMMC
- Support up to 2 CE and 2 RB signals
- Support SLC/MLC/TLC NAND and EF-NAND

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4.2.2 Block Diagram

The NAND Flash Controller (NDFC) system block diagram is shown below:

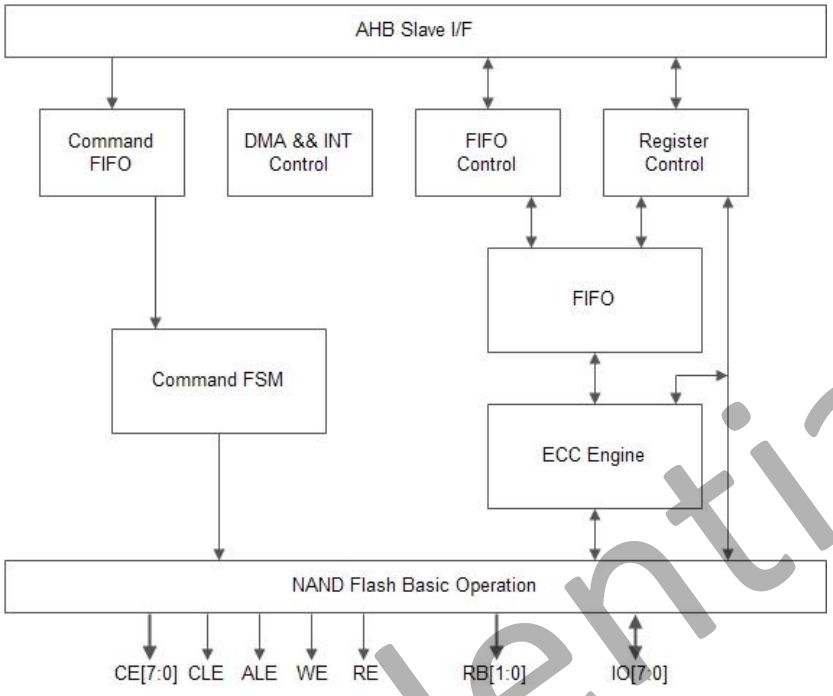

Figure4.2-1 NDFC Block Diagram

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4.2.3 NDFC Timing Diagram

Typically, there are two kinds of serial access method. One method is conventional method which fetching data at the rise edge of NDFC_RE# signal line. Another one is EDO type which fetching data at the next fall edge of NDFC_RE# signal line.

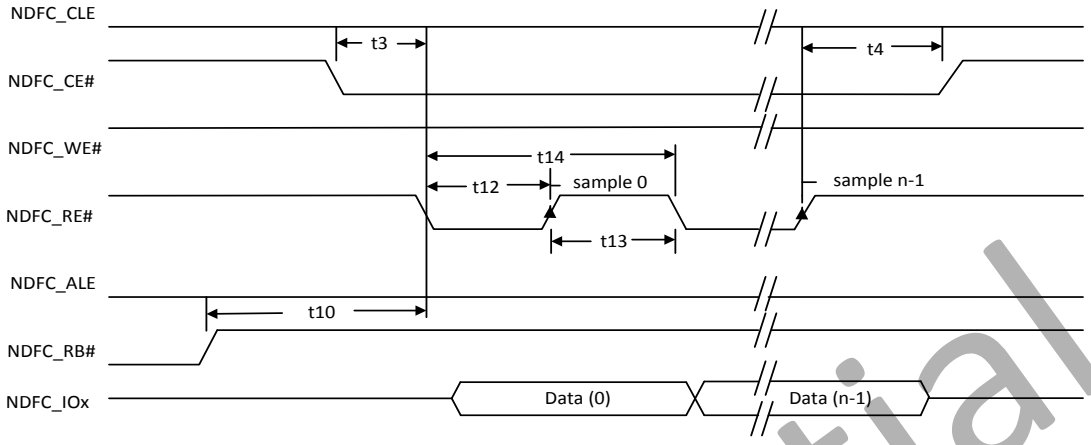

Figure4.2-2 Conventional Serial Access Cycle Diagram (SAM0)

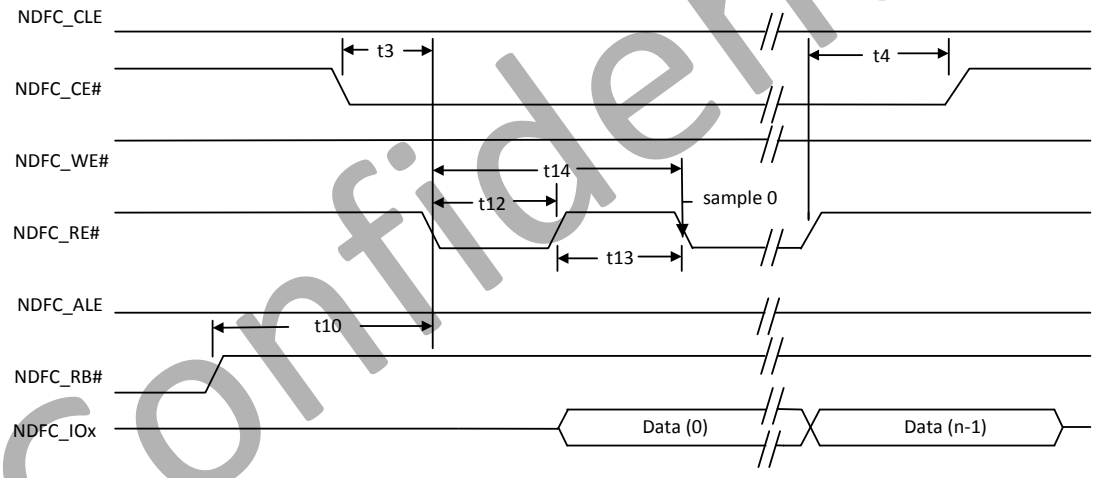

Figure4.2-3 EDO type Serial Access after Read Cycle (SAM1)

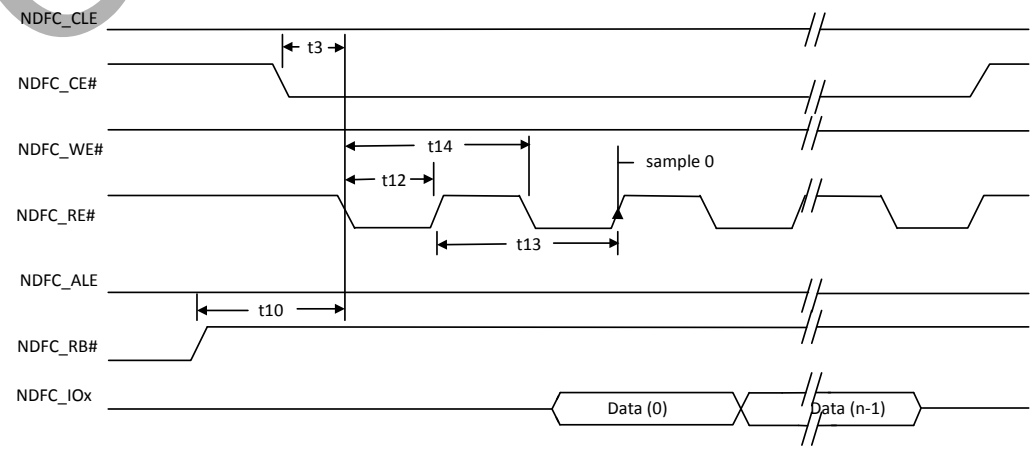

Figure4.2-4 Extending EDO type Serial Access Mode (SAM2)

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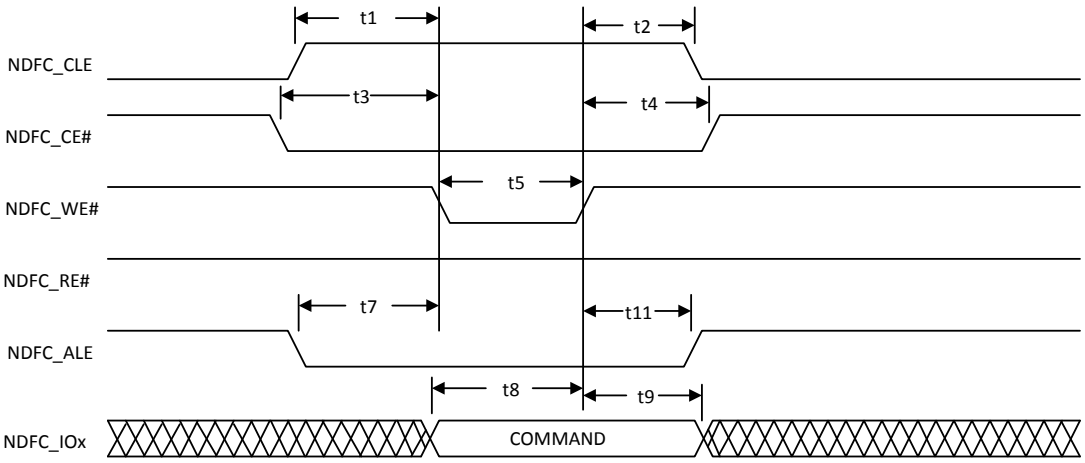

Figure4.2-5 Command Latch Cycle

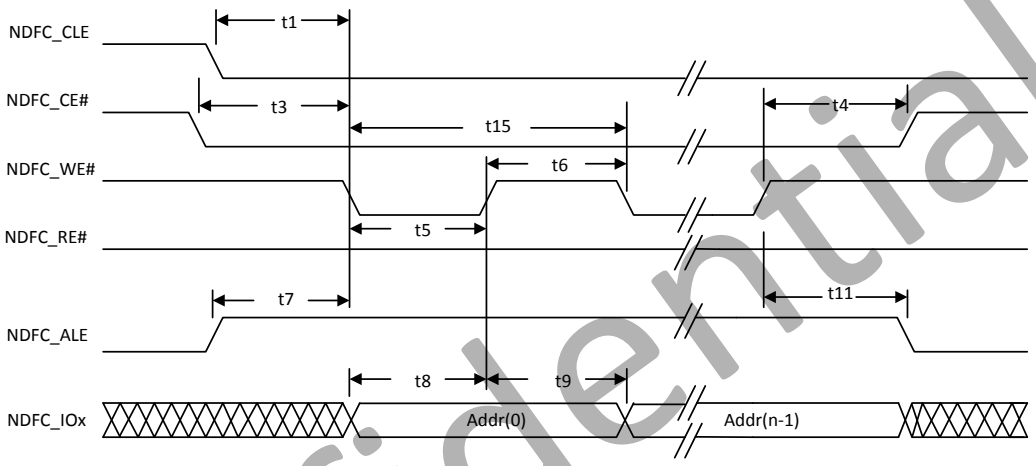

Figure4.2-6 Address Latch Cycle

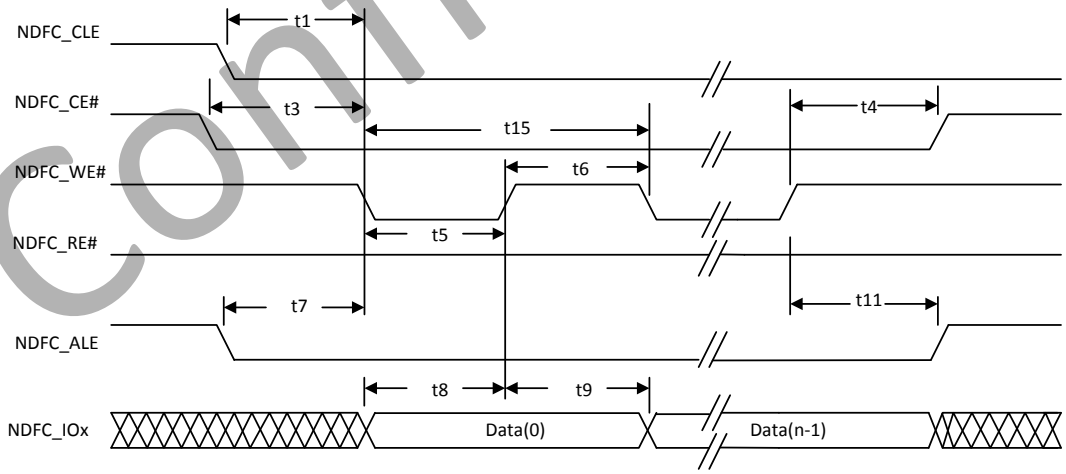

Figure4.2-7 Write Data to Flash Cycle

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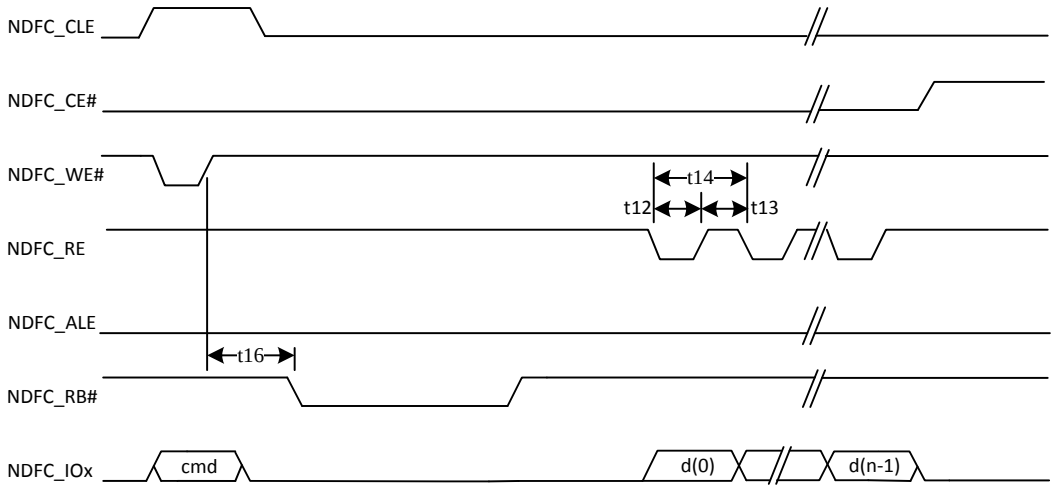

Figure4.2-8 Waiting R/B# ready Diagram

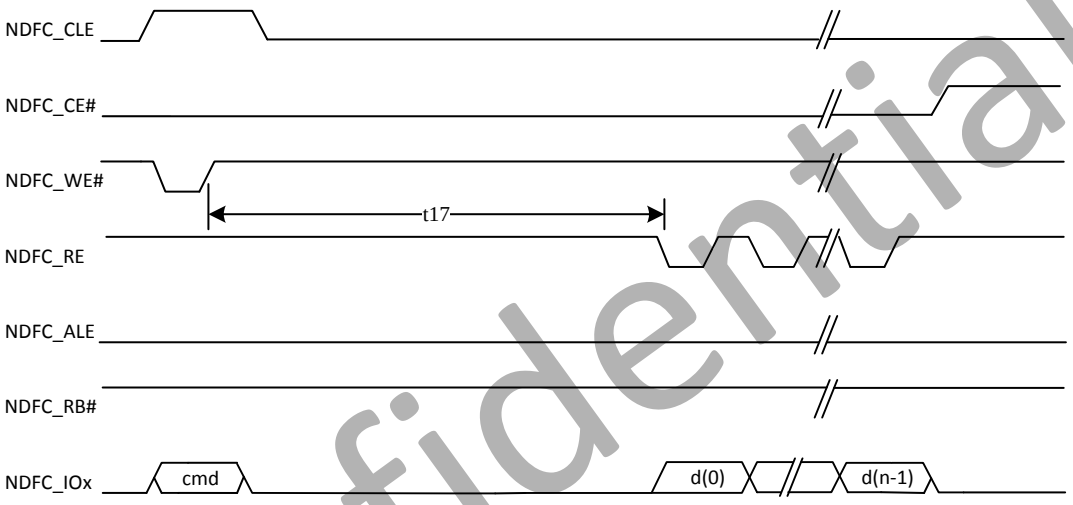

Figure4.2-9 WE# high to RE# low Timing Diagram

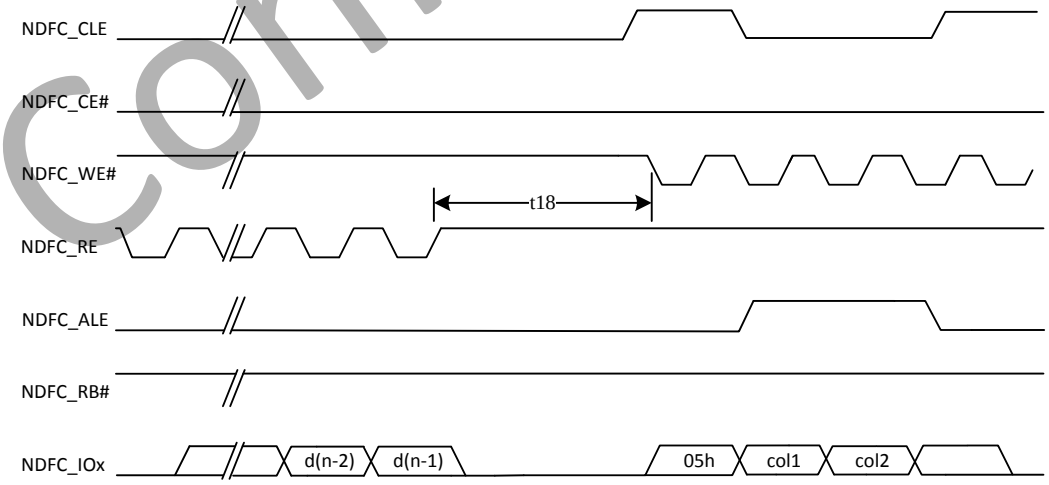

Figure4.2-10 RE# high to WE# low Timing Diagram

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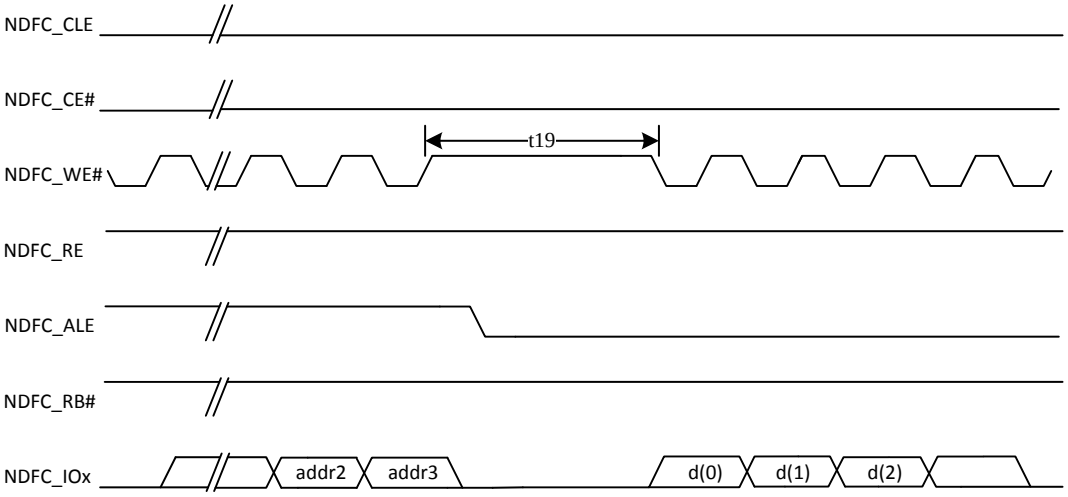

Figure4.2-11 Address to Data Loading Timing Diagram

Timing cycle list

ID	Parameter	Timing	Notes
T1	NDFC_CLE setup time	T	
T2	NDFC_CLE hold time	T	
T3	NDFC_CE setup time	T	
T4	NDFC_CE hold time	T	
T5	NDFC_WE# pulse width	T	
T6	NDFC_WE# hold time	T	
T7	NDFC_ALE setup time	T	
T8	Data setup time	T	
T9	Data hold time	T	
T10	Ready to NDFC_RE# low	3T	
T11	NDFC_ALE hold time	T	
T12	NDFC_RE# pulse width	T	
T13	NDFC_RE# hold time	T	
T14	Read cycle time	2T	
T15	Write cycle time	2T	
T16	NDFC_WE# high to R/B# busy	tWB	Specified by timing configure register(NDFC_TIMING_CFG)
T17	NDFC_WE# high to NDFC_RE# low	tWHR	Specified by timing configure register(NDFC_TIMING_CFG)
T18	NDFC_RE# high to NDFC_WE# low	tRHW	Specified by timing configure register(NDFC_TIMING_CFG)
T19	Address to Data Loading time	tADL	Specified by timing configure register(NDFC_TIMING_CFG)

Note: T is the clock period duration of NDFC_CLK (x2).

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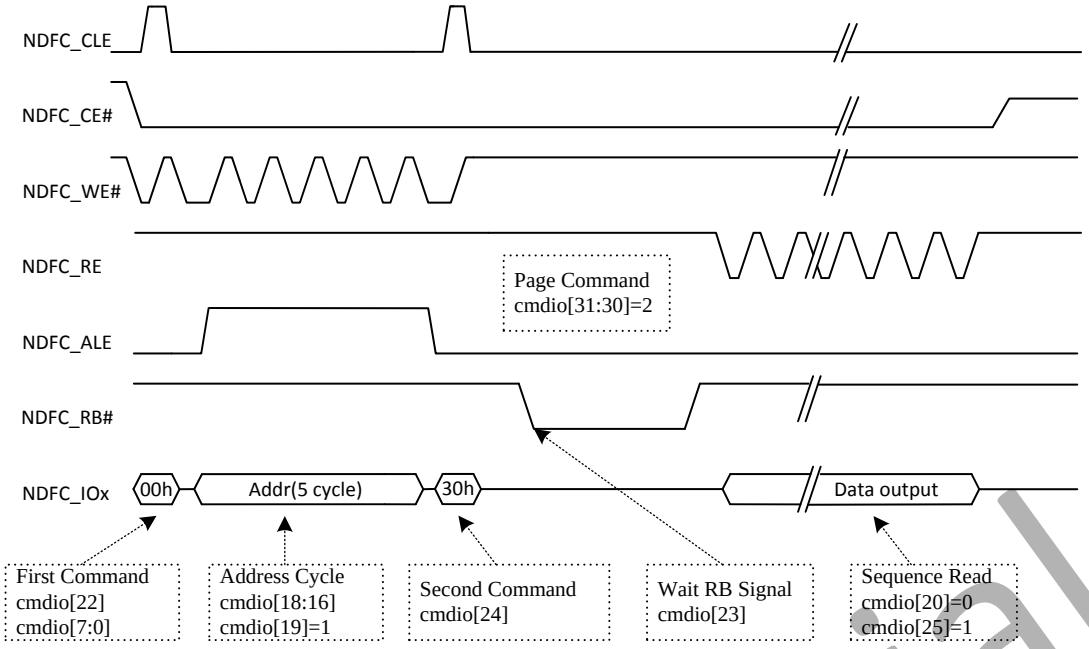

Figure4.2-12 Page Read Command Diagram

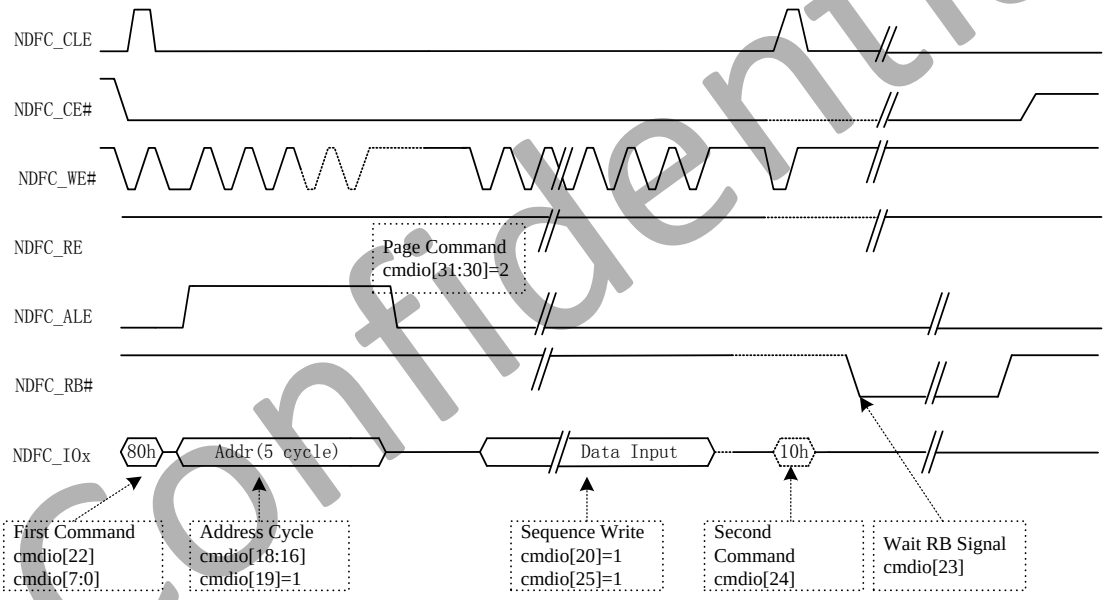

Figure4.2-13 Page Program Diagram

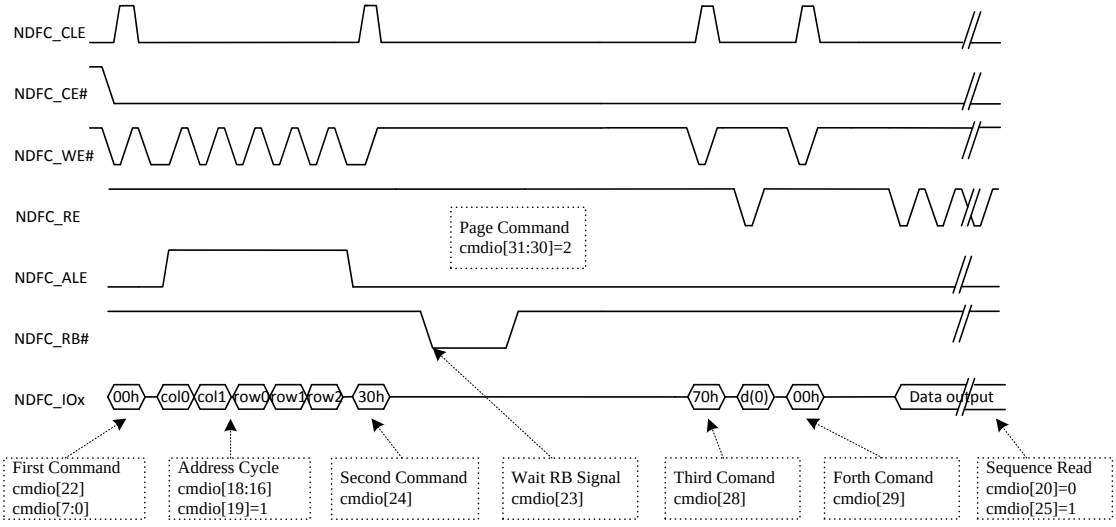

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Figure4.2-14 EF-NAND Page Read Diagram

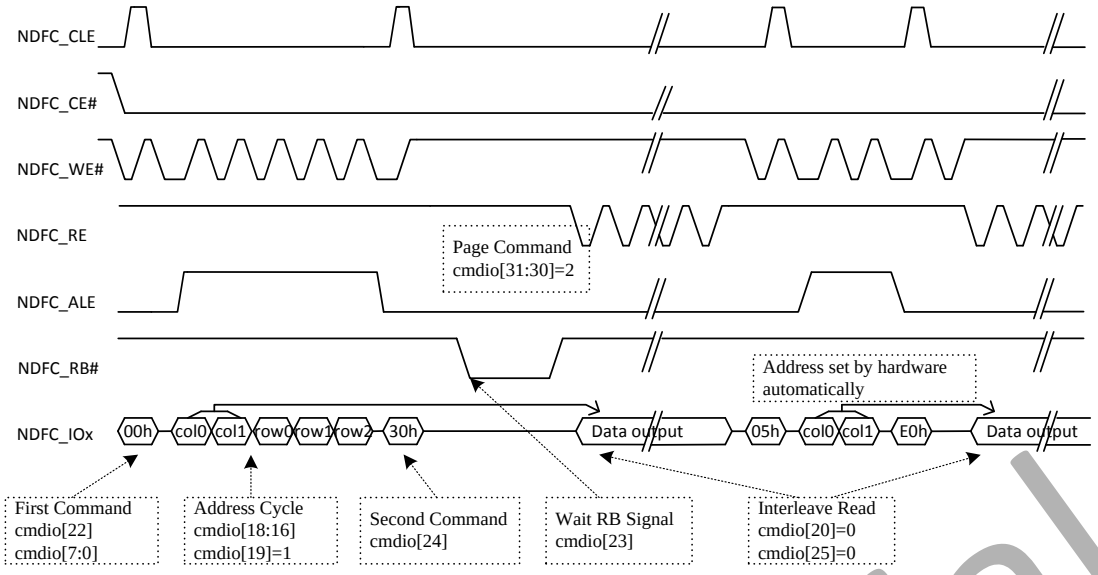

Figure4.2-15 Interleave Page Read Diagram

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Chapter 5 Display

This section describes the display subsystem from following perspectives:

- TCON
- Display Engine Front-End
- Display Engine Back-End
- MIPI DSI
- IEP (SAT, DRC, Write-back Controller)

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5.1 Display Subsystem Block Diagram

The display subsystem of R16 processor consists of 6 sections, including DEFE, DEBE, SAT, DRC, TCON, and write-back controller. The six sections play different role in this subsystem, and cooperate with each other to meet diversified display requirements.

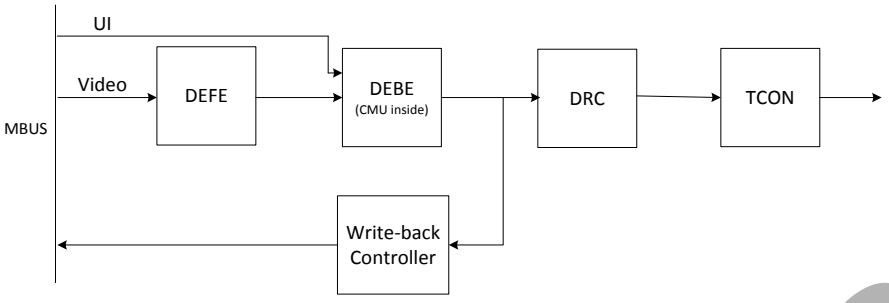

Figure 5.1-1 R16 Display Subsystem Block Diagram

DEFE: video scaling, color space conversion, etc
DEBE: layer blending, etc
SAT: color adjustment for better vision effect
DRC: content-based backlight control for energy efficiency
TCON: LCD driver
Write-Back Controller: capture data between display engine and TCON for Miracast application

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5.2 TCON

This section describes the timing controller of R16 platform.

5.2.1 Overview

- Support LVDS interface with single link, up to 1280 x 800@60fps
- Support RGB interface with DE/SYNC mode, up to 1280 x 800@60fps
- Support serial RGB/dummy RGB/CCIR656 interface, up to 800 x 480@60fps
- Support i80 interface with 18/16/9/8 bit, support TE, up to 800 x 480@60fps
- Supported pixel formats: RGB888, RGB666 and RGB565
- Support dither function from RGB666/RGB565 to RGB888
- Support Gamma correction with R/G/B channel independence

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5.2.2 Block Diagram

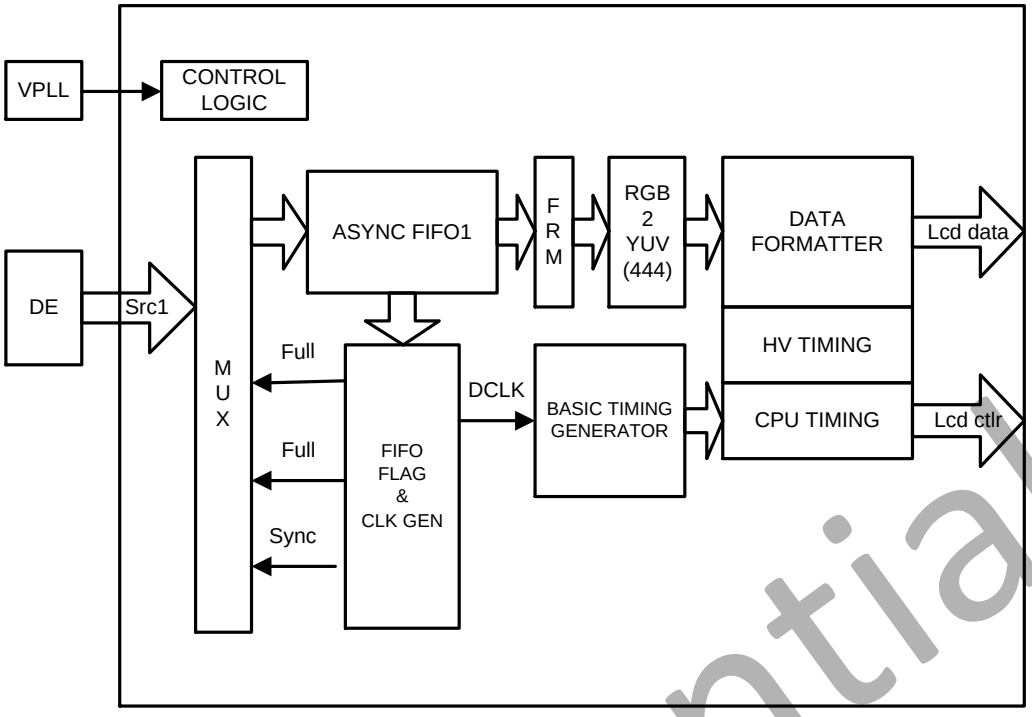

Figure 5.2-1 TCON Block Diagram

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5.2.3 TCON Function Description

HV_I/F (Sync+DE mode)

HV I/F is also known as Sync + DE mode, which is widely used in TFT LCD module for PMP/MP4 applications. Its signals are defined as below:

Main Signal	I/O Type	Description
Vsync	O	Vertical sync, indicating one new frame
Hsync	O	Horizontal sync, indicating one new scan line
DCLK	O	Dot clock, pixel data are synchronized by this clock
LDE	O	LCD data enable
LCD[17:0]	O	18-bit RGB/YUV output from input FIFO for panel

HV control signals are active low.

Following is the panel interface timing diagram:

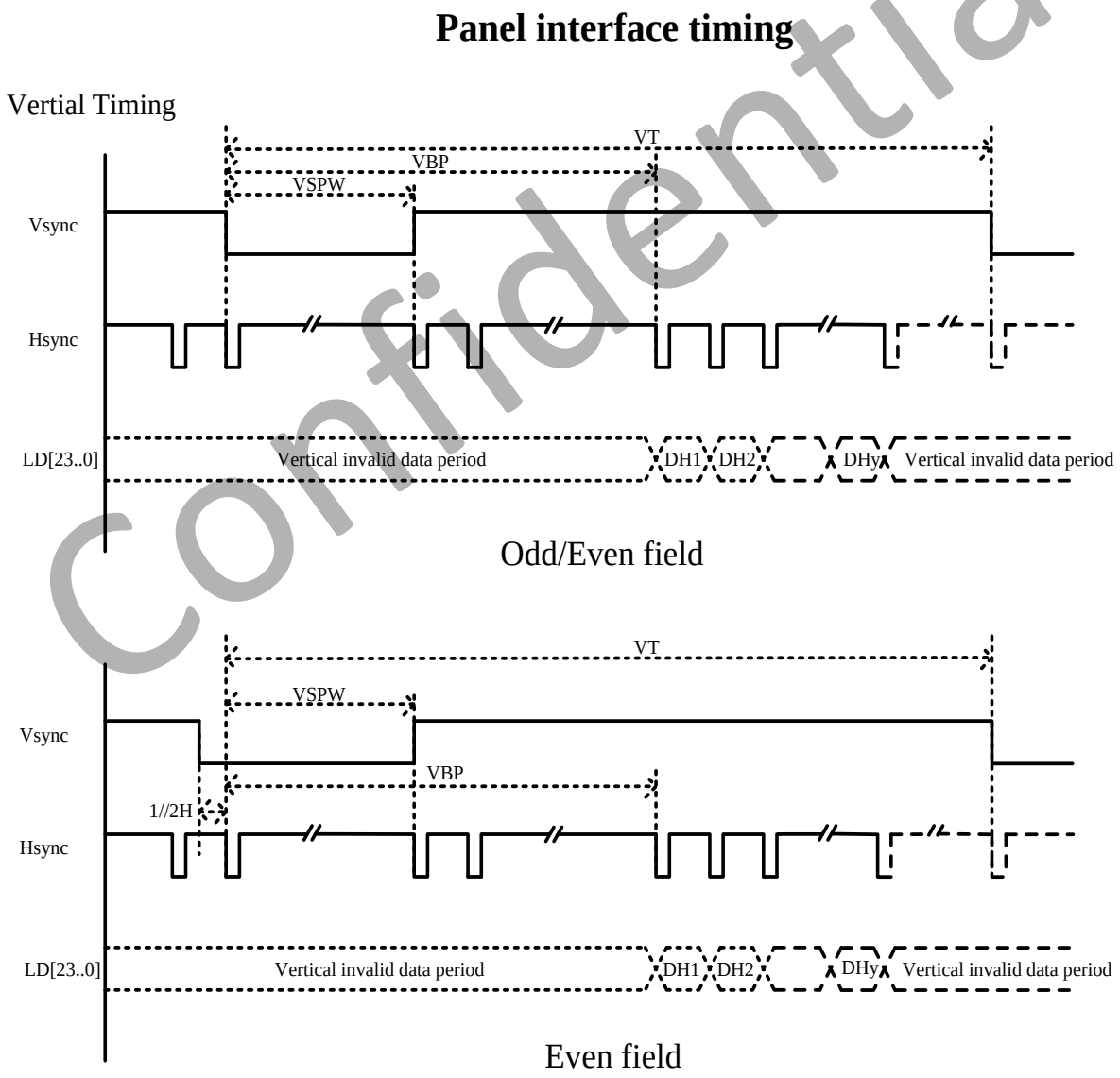

Figure 5.2-2 Panel Interface Timing

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CCIR output SAV/EAV sync signal

When in HV serial YUV output mode, its timing is CCIR656 /601 compatible. SAV add right before active area every line; EAV add right after active area every line.

Its logic:

F = "0" for Field 1 F = "1" for Field 2

V = "1" during vertical blanking

H = "0" at SAV H = "1" at EAV

P3–P0 = protection bits

P3 = V ⊕ H

P2 = F ⊕ H

P1 = F ⊕ V

P0 = F ⊕ V ⊕ H

Where ⊕ represents the exclusive-OR function

The 4 byte SAV/EAV sequences are:

	8-bit Data								10-bit Data	
	D9 (MSB)	D8	D7	D6	D5	D4	D3	D2	D1	D0
Preamble	1	1	1	1	1	1	1	1	1	1
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
Status word	1	F	V	H	P3	P2	P1	P0	0	0

CPU_I/F

CPU I/F LCD panel is the most commonly used interface for small size, low resolution LCD panels.

CPU control signals are active low.

Main Signal	I/O Type	Description
CS	O	Chip select, active low
WR	O	Write strobe, active low
RD	O	Read strobe, active low
A1	O	Address bit, controlled by LCD_CPUI/F bit 21
D[17:0]	I/O	Digital RGB output signal

Following figure describes the relationship between basic timing and CPU timing. WR is 180 degree delay of DCLK; CS is active when pixel data are valid; RD is always set to 1; A1 are set by "**LCD_CPU I/F**".

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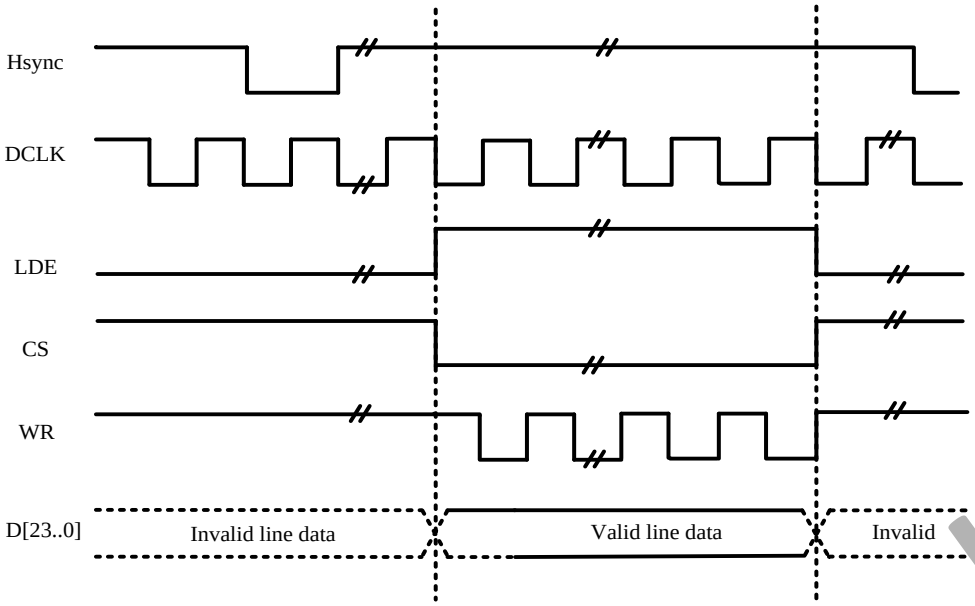

Figure 5.2-3 Relations between Basic Timing and CPU Timing

When CPU I/F is in IDLE state, it can generate WR/RD timing by setting "**LCD_CPUI/F**". CS strobe is one DCLK width, WR/RD strobe is half DCLK width.

LVDS_IF

JEDIA mode

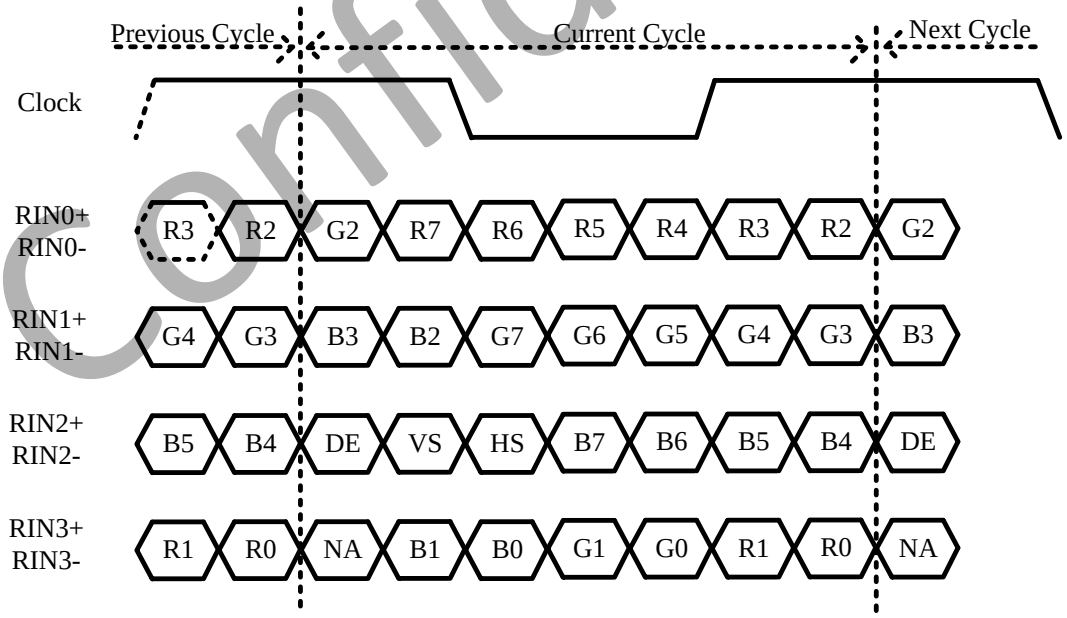

Figure 5.2-4 Single channel: JEDIA mode

NS mode

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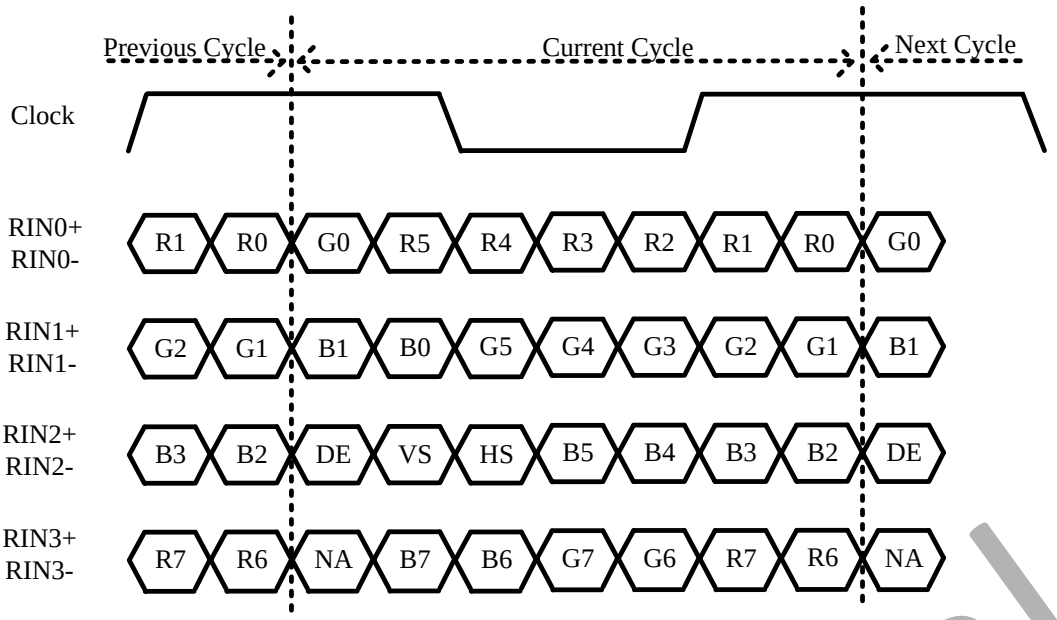

Figure 5.2-5 Single channel: NS mode

CMAP Module

This module is used to map color data from DE.

Every 4 input pixels as a unit and a unit is divided into 12 bytes. Output byte can select one of these 12 bytes. Note that even line and odd line can be different, and output can be 12 bytes(4 pixels) or reduced to 6 bytes(2 pixels).

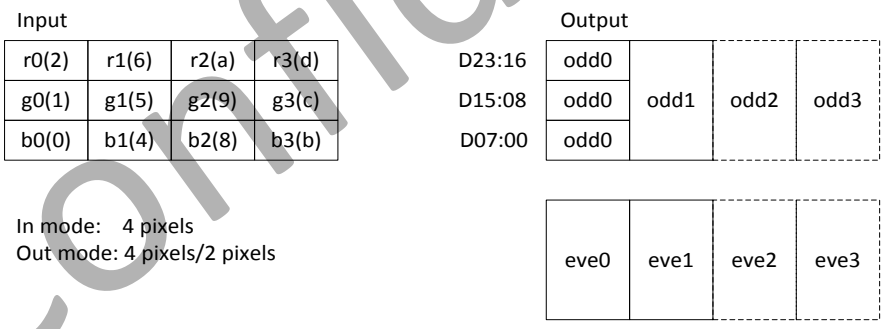

Figure 5.2-6 CMAP Module

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5.2.4 TCON Register List

Module Name	Base Address
TCON	0x01C0C000

Register Name	Offset	Description
TCON_GCTL_REG	0x000	TCON Global Control Register
TCON_GINT0_REG	0x004	TCON Global Interrupt Register0
TCON_GINT1_REG	0x008	TCON Global Interrupt Register1
TCON0_FRM_CTL_REG	0x010	TCON FRM Control Register
TCON0_CTL_REG	0x040	TCON0 Control Register
TCON0_DCLK_REG	0x044	TCON0 Data Clock Register
TCON0_BASIC0_REG	0x048	TCON0 Basic Timing Register0
TCON0_BASIC1_REG	0x04C	TCON0 Basic Timing Register1
TCON0_BASIC2_REG	0x050	TCON0 Basic Timing Register2
TCON0_BASIC3_REG	0x054	TCON0 Basic Timing Register3
TCON0_HV_IF_REG	0x058	TCON0 Hv Panel Interface Register
TCON0_CPU_IF_REG	0x060	TCON0 CPU Panel Interface Register
TCON0_CPU_WR_REG	0x064	TCON0 CPU Panel Write Data Register
TCON0_CPU_RD0_REG	0x068	TCON0 CPU Panel Read Data Register0
TCON0_CPU_RD1_REG	0x06C	TCON0 CPU Panel Read Data Register1
TCON0_LVDS_IF_REG	0x084	TCON0 LVDS Panel Interface Register
TCON0_IO_POL_REG	0x088	TCON0 IO Polarity Register
TCON0_IO_TRI_REG	0x08C	TCON0 IO Control Register
TCON_ECC_FIFO_REG	0x0F8	TCON ECC FIFO Register
TCON_DEBUG_REG	0x0FC	TCON debug register
TCON_CEU_CTL_REG	0x100	TCON CEU Control Register
TCON_CEU_COEF_MUL_REG	0x110+N*0x04	TCON CEU Coefficient Register0 (N=0,1,2,4,5,6,8,9,10)
TCON_CEU_COEF_ADD_REG	0x11C+N*0x10	TCON CEU Coefficient Register1 (N=0,1,2)
TCON_CEU_COEF_RANG_REG	0x140+N*0x04	TCON CEU Coefficient Register2 (N=0,1,2)
TCON0_CPU_TRI0_REG	0x160	TCON0 CPU Panel Trigger Register0
TCON0_CPU_TRI1_REG	0x164	TCON0 CPU Panel Trigger Register1
TCON0_CPU_TRI2_REG	0x168	TCON0 CPU Panel Trigger Register2
TCON0_CPU_TRI3_REG	0x16C	TCON0 CPU Panel Trigger Register3
TCON_CMAP_CTL_REG	0x180	TCON Color Map Control Register
TCON_CMAP_ODD0_REG	0x190	TCON Color Map Odd Line Register0
TCON_CMAP_ODD1_REG	0x194	TCON Color Map Odd Line Register1
TCON_CMAP_EVEN0_REG	0x198	TCON Color Map Even Line Register0
TCON_CMAP_EVEN1_REG	0x19C	TCON Color Map Even Line Register1
TCON_SAFE_PERIOD_REG	0x1F0	TCON Safe Period Register
TCON0_LVDS_ANA0_REG	0x220	TCON0 LVDS Analog Register0

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TCON0_GAMMA_TABLE_REG	0x400-0x7FF	TCON0 GAMMA TABLE REG

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5.2.5 TCON Register Description

TCON_GCTL_REG

Offset: 0x000			Register Name: TCON_GCTL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0	TCON_En 0: disable 1: enable When it's disabled, the module will be reset to idle state.
30	R/W	0	TCON_Gamma_En 0: disable 1: enable
29:0	/	/	/

TCON_GINT0_REG

Offset: 0x004			Register Name: TCON_GINT0_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0	TCON0_Vb_Int_En 0: disable 1: enable
30	/	/	/
29	R/W	0	TCON0_Line_Int_En 0: disable 1: enable
28	/	/	/1: enable
27	R/W	0	TCON0_Tri_Finish_Int_En 0: disable 1: enable
26:	R/W	0	TCON0_Tri_Counter_Int_En 0: disable 1: enable
25:16	/	/	/
15	R/W	0	TCON0_Vb_Int_Flag Asserted during vertical no-display period every frame. Write 0 to clear it.
14	/	/	/
13	R/W	0	TCON0_Line_Int_Flag trigger when SY0 match the current TCON0 scan line Write 0 to clear it.
12	/	/	/
11	R/W	0	TCON0_Tri_Finish_Int_Flag trigger when cpu trigger mode finish Write 0 to clear it.
10	R/W	0	TCON0_Tri_Counter_Int_Flag trigger when tri counter reache this value

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			Write 0 to clear it.
9	R/W	0	TCON0_Tri_Underflow_Flag only used in dsi video mode, tri when sync by dsi but not finish Write 0 to clear it.
8:0	/	/	/

TCON_GINT1_REG

Offset: 0x008			Register Name: TCON_GINT1_REG
Bit	Read/Write	Default/Hex	Description
31:28	/	/	/
27:16	R/W	0	TCON0_Line_Int_Num scan line for TCON0 line trigger(including inactive lines) Setting it for the specified line for trigger0. Note: SY0 is writable only when LINE_TRG0 disable.
15:0	/	/	/

TCON0_FRM_CTL_REG

Offset: 0x010			Register Name: TCON0_FRM_CTL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0	TCON0_Frm_En 0:disable 1:enable
30:7	/	/	/
6	R/W	0	TCON0_Frm_Mode_R 0: 6bit frm output 1: 5bit frm output
5	R/W	0	TCON0_Frm_Mode_G 0: 6bit frm output 1: 5bit frm output
4	R/W	0	TCON0_Frm_Mode_B 0: 6bit frm output 1: 5bit frm output
3:2	/	/	/
1:0	R/W	0	TCON0_Frm_Test 00: FRM 01: half 5/6bit, half FRM 10: half 8bit, half FRM 11: half 8bit, half 5/6bit

TCON0_CTL_REG

Offset: 0x040			Register Name: TCON0_CTL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0	TCON0_En 0: disable 1: enable

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			Note: It executes at the beginning of the first blank line of TCON0 timing.
30:29	/	/	/
28	R/W	0	TCON0_Work_Mode 0: normal 1: dynamic freq
27:26	/	/	/
25:24	R/W	0	TCON0_IF 00: HV(Sync+DE) 01: 8080 I/F 1x:reservd
23	R/W	0	TCON0_RB_Swap 0: default 1: swap RED and BLUE data at FIFO1
22	/	/	/
21	R/W	0	TCON0_FIFO1_Rst Write 1 and then 0 at this bit will reset FIFO 1 Note: 1 holding time must more than 1 DCLK
20:9	/	/	/
8:4	R/W	0	TCON0_Start_Delay STA delay NOTE: valid only when TCON0_EN == 1
3	/	/	/
2:0	R/W	0	TCON0_SRC_SEL: 000: DE0 001: reserved 010: reserved 011: reserved 100: Test Data all 0 101: Test Data all 1 11x: reserved

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TCON0_DCLK REG

Offset: 0x044			Register Name: TCON0_DCLK REG
Bit	Read/Write	Default/Hex	Description

31:28	R/W	0	TCON0_Dclk_En
			LCLK_EN[3:0] :TCON0 clock enable
			4'h0,'h4,4'h6,4'ha7:dclk_en=0;dclk1_en=0;dclk2_en=0;dclkm2_en=0;
			4'h1: dclk_en = 1; dclk1_en = 0; dclk2_en = 0; dclkm2_en = 0;
			4'h2: dclk_en = 1; dclk1_en = 0; dclk2_en = 0; dclkm2_en = 1;
			4'h3: dclk_en = 1; dclk1_en = 1; dclk2_en = 0; dclkm2_en = 0;
			4'h5: dclk_en = 1; dclk1_en = 0; dclk2_en = 1; dclkm2_en = 0;
			4'h8,4'h9,4'ha,4'hb,4'hc,4'hd,4'he,4'hf:
			dclk_en = 1;
			dclk1_en = 1;
			dclk2_en = 1;
			dclkm2_en = 1;

27:7	/	/	/
6:0	R/W	0	TCON0_Dclk_Div Tdclk = Tsclk * DCLKDIV Note: 1.if dclk1&dclk2 used， DCLKDIV >=6 2.if dclk only， DCLKDIV >=1

TCON0_BASIC0_REG

Offset: 0x048			Register Name: TCON0_BASIC0_REG
Bit	Read/Write	Default/Hex	Description
31:28	/	/	/
27:16	R/W	0	TCON0_X Panel width is X+1
15:12	/	/	/
11:0	R/W	0	TCON0_Y Panel height is Y+1

TCON0_BASIC1_REG

Offset: 0x04C			Register Name: TCON0_BASIC1_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0	Reserved
30:29	/	/	/
28:16	R/W	0	HT Thcycle = (HT+1) * Tdclk Computation

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			1) parallel:HT = X + BLANK Limitation: 1) parallel :HT >= (HBP +1) + (X+1) +2 2) serial 1: HT >= (HBP +1) + (X+1) *3+2 3) serial 2: HT >= (HBP +1) + (X+1) *3/2+2
15:12	/	/	/
11:0	R/W	0	HBP horizontal back porch (in dclk) Thbp = (HBP +1) * Tdclk

TCON0_BASIC2_REG

Offset: 0x050			Register Name: TCON0_BASIC2_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:16	R/W	0	VT TVT = (VT)/2 * Thsync Note: VT/2 >= (VBP+1) + (Y+1) +2
15:12	/	/	/
11:0	R/W	0	VBP Tvbp = (VBP +1) * Thsync

TCON0_BASIC3_REG

Offset: 0x054			Register Name: TCON0_BASIC3_REG
Bit	Read/Write	Default/Hex	Description
31:26	/	/	/
25:16	R/W	0	HSPW Thspw = (HSPW+1) * Tdclk Note: HT> (HSPW+1)
15:10	/	/	/
9:0	R/W	0	VSPW Tvspw = (VSPW+1) * Thsync Note: VT/2 > (VSPW+1)

TCON0_HV_IF_REG

Offset: 0x058			Register Name: TCON0_HV_IF_REG
Bit	Read/Write	Default/Hex	Description
31:28	R/W	0	HV_Mode 0000: 24bit/1cycle parallel mode 1000: 8bit/3cycle RGB serial mode(RGB888) 1010: 8bit/4cycle Dummy RGB(DRGB) 1011: 8bit/4cycle RGB Dummy(RGBD) 1100: 8bit/2cycle YUV serial mode(CCIR656)
27:26	R/W	0	RGB888_SM0 serial RGB888 mode Output sequence at odd lines of the panel (line 1, 3, 5, 7…) 00: R→G→B

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			01: B→R→G 10: G→B→R 11: R→G→B
25:24	R/W	0	RGB888_SM1 serial RGB888 mode Output sequence at even lines of the panel (line 2, 4, 6, 8…) 00: R→G→B 01: B→R→G 10: G→B→R 11: R→G→B
23:22	R/W	0	YUV_SM serial YUV mode Output sequence 2-pixel-pair of every scan line 00: YUYV 01: YVYU 10: UYVY 11: VYUY
1:20	R/W	0	YUV EAV/SAV F line delay 0:F toggle right after active video line 1:delay 2 line(CCIR NTSC) 2:delay 3 line(CCIR PAL) 3:reserved
19:0	/	/	/

TCON0_CPU_IF_REG

Offset: 0x060			Register Name: TCON0_CPU_IF_REG
Bit	Read/Write	Default/Hex	Description
31:28	R/W	0	CPU_Mode 0000: 18bit/256K mode 0010: 16bit mode0 0100: 16bit mode1 0110: 16bit mode2 1000: 16bit mode3 1010: 9bit mode 1100: 8bit 256K mode 1110: 8bit 65K mode xxx1: 24bit for DSI
27	/	/	/
26	R/W	0	DA pin A1 value in 8080 mode auto/flash states
25	R/W	0	CA pin A1 value in 8080 mode WR/RD execute
24	/	/	/
23	R	0	Wr_Flag 0:write operation is finishing 1:write operation is pending

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22	R	0	Rd_Flag 0:read operation is finishing 1:read operation is pending
21:18	/	/	/
17	R/W	0	AUTO auto Transfer Mode: If it's 1, all the valid data during this frame are write to panel. Note: This bit is sampled by Vsync
16	R/W	0	FLUSH direct transfer mode: If it's enabled, FIFO1 is regardless of the HV timing, pixels data keep being transferred unless the input FIFO was empty. Data output rate control by DCLK.
15:6	/	/	/
5:4	R/W	0	Trigger_Sync_Mode 0: start frame flush immediately by bit1. 1: start frame flush sync to TE PIN. rising by bit1. 2. start frame flush sync to TE PIN. falling by bit1. when set as 1 or 2, io0 is map as TE input.
3	R/W	0	Trigger_FIFO_Bist_En 0: disable 1: enable Entry addr is 0xFF8
2	R/W	0	Trigger_FIFO_En 0:enable 1:disable
1	R/W	0	Trigger_Start write '1' to start a frame flush, write'0' has no effect. this flag indicated frame flush is running software must make sure write '1' only when this flag is '0'.
0	R/W	0	Trigger_En 0: trigger mode disable 1: trigger mode enable

TCON0_CPU_WR_REG

Offset: 0x064			Register Name: TCON0_CPU_WR_REG
Bit	Read/Write	Default/Hex	Description
31:24	/	/	/
23:0	W	0	Data_Wr data write on 8080 bus, launch a write operation on 8080 bus

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TCON0_CPU_RD0_REG

Offset: 0x068			Register Name: TCON0_CPU_RD0_REG
Bit	Read/Write	Default/Hex	Description
31:24	/	/	/
23:0	R	/	Data_Rd0 data read on 8080 bus, launch a new read operation on 8080 bus

TCON0_CPU_RD1_REG

Offset: 0x06C			Register Name: TCON0_CPU_RD1_REG
Bit	Read/Write	Default/Hex	Description
31:24	/	/	/
23:0	R	/	Data_Rd1 data read on 8080 bus, without a new read operation on 8080 bus

TCON0_LVDS_IF_REG

Offset: 0x084			Register Name: TCON0_LVDS_IF_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0	TCON0_LVDS_En 0: disable 1: enable
30	R/W	0	TCON0_LVDS_Link_Sel 0: single link 1: dual link
29	R/W	0	TCON0_LVDS_Even_Odd_Dir 0: normal 1: reverse
28	R/W	0	TCON0_LVDS_Dir 1: normal 2: reverse NOTE: LVDS direction
27	R/W	0	TCON0_LVDS_Mode 0: NS mode 1: JEIDA mode
26	R/W	0	TCON0_LVDS_BitWidth 0: 24bit 1: 18bit
25:24	R/W	0	/
23	R/W	0	TCON0_LVDS_Correct_Mode 0: mode0 1: mode1
22:21	/	/	/
20	R/W	0	TCON0_LVDS_Clk_Sel 0: MIPI PLL 1: TCON0 CLK

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19:0	/	/	/

TCON0_IO_POL_REG

Offset: 0x088			Register Name: TCON0_IO_POL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0	IO_Output_Sel 0: normal output 1: register output when set as '1', d[23:0], io0, io1,io3 sync to dclk
30:28	R/W	0	DCLK_Sel 000: used DCLK0(normal phase offset) 001: used DCLK1(1/3 phase offset) 010: used DCLK2(2/3 phase offset) 101: DCLK0/2 phase 0 100: DCLK0/2 phase 90 reserved
27	R/W	0	IO3_Inv 0: not invert 1: invert
26	R/W	0	IO2_ Inv 0: not invert 1: invert
25	R/W	0	IO1_Inv 0: not invert 1: invert
24	R/W	0	IO0_Inv 0: not invert 1: invert
23:0	R/W	0	Data_Inv TCON0 output port D[23:0] polarity control, with independent bit control: 0s: normal polarity 1s: invert the specify output

TCON0_IO_TRI_REG

Offset: 0x08C			Register Name: TCON0_IO_TRI_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28	/	/	RGB_Endian 0: normal 1: bits_invert
27	R/W	1	IO3_Output_Tri_En 1: disable 0: enable
26	R/W	1	IO2_Output_Tri_En 1: disable

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			0: enable
25	R/W	1	IO1_Output_Tri_En 1: disable 0: enable
24	R/W	1	IO0_Output_Tri_En 1: disable 0: enable
23:0	R/W	0xFFFFFF	Data_Output_Tri_En TCON0 output port D[23:0] output enable, with independent bit control: 1s: disable 0s: enable

TCON_ECC_FIFO_REG

Offset: 0x0F8			Register Name: TCON_ECC_FIFO_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	/	ECC_FIFO_BIST_EN 0: disable 1: enable
30	R/W	/	ECC_FIFO_ERR_FLAG
29:24	/	/	/
23:16	R/W	/	ECC_FIFO_ERR_BITS
15:9	/	/	/
8	R/W	/	ECC_FIFO_BLANK_EN 0: disable ecc function in blanking 1: enable ecc function in blanking ECC function is tent to trigged in blanking area at hv mode, set '0' when in hv mode
7:0	R/W	/	ECC_FIFO_SETTING Note：bit3 0 enable，1 disable

TCON_DEBUG_REG

Offset: 0x0FC			Register Name: TCON_DEBUG_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	/	TCON0_FIFO_Under_Flow
30	/	/	/
29	R	/	TCON0_Field_Polarity 0: second field 1: first field
28	/	/	/
27:16	R	/	TCON0_Current_Line
15:14	/	/	/
13	R/W	0	ECC_FIFO_Bypass 0: used 1: bypass
12:0	/	/	/

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TCON_CEU_CTL_REG

Offset: 0x100			Register Name: TCON_CEU_CTL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0	CEU_en 0: bypass 1: enable
30:0	/	/	/

TCON_CEU_COEF_MUL_REG

Offset: 0x110+N*0x04 (N=0,1,2,4,5,6,8,9,10)			Register Name: TCON_CEU_COEF_MUL_REG
Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:0	R/W	0	CEU_Coef_Mul_Value signed 13bit value, range of (-16,16) N=0: Rr N=1: Rg N=2: Rb N=4: Gr N=5: Gg N=6: Gb N=8: Br N=9: Bg N=10: Bb

TCON_CEU_COEF_ADD_REG

Offset: 0x11C+N*0x10 (N=0,1,2)			Register Name: TCON_CEU_COEF_ADD_REG
Bit	Read/Write	Default/Hex	Description
31:19	/	/	/
18:0	R/W	0	CEU_Coef_Add_Value signed 19bit value, range of (-16384, 16384) N=0: Rc N=1: Gc N=2: Bc

TCON_CEU_COEF_RANG_REG

Offset: 0x140+N*0x04 (N=0,1,2)			Register Name: TCON_CEU_COEF_RANG_REG
Bit	Read/Write	Default/Hex	Description
31:24	/	/	/
23:16	R/W	0	CEU_Coef _Range_Min unsigned 8bit value, range of [0,255]
15:8	/	/	/

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7:0	R/W	0	CEU Coef _Range_Max unsigned 8bit value, range of [0,255]

TCON0_CPU_TRI0_REG

Offset: 0x160			Register Name: TCON0_CPU_TRI0_REG
Bit	Read/Write	Default/Hex	Description
31:28	/	/	/
27:16	R/W	0	Block_Space should be set >20*pixel_cycle
15:12	/	/	/
11:0	R/W	0	Block_Size

TCON0_CPU_TRI1_REG

Offset: 0x164			Register Name: TCON0_CPU_TRI1_REG
Bit	Read/Write	Default/Hex	Description
31:16	R	0	Block_Current_Num
15:0	R/W	0	Block_Num

TCON0_CPU_TRI2_REG

Offset: 0x168			Register Name: TCON0_CPU_TRI2_REG
Bit	Read/Write	Default/Hex	Description
31:16	R/W	0x20	Start_Delay Tdly = (Start_Delay +1) * be_clk*8
15	R/W	0	Trans_Start_Mode 0: ecc_FIFO+tri_FIFO 1: tri_FIFO
14:13	R/W	0	Sync_Mode 0x: auto 10: 0 11: 1
12:0	R/W	0	Trans_Start_Set

TCON0_CPU_TRI3_REG

Offset: 0x16C			Register Name: TCON0_CPU_TRI3_REG
Bit	Read/Write	Default/Hex	Description
31:30	/	/	/
29:28	R/W	0	Tri_Int_Mode 00: disable 01: counter mode 10: te rising mode 11: te falling mode when set as 01, Tri_Counter_Int occur in cycle of (Count_N+1)×(Count_M+1)×4 dclk.

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			when set as 10 or 11, io0 is map as TE input.
27:24	/	/	/
23:8	R/W	0	Counter_N
7:0	R/W	0	Counter_M

TCON_CMAP_CTL_REG

Offset: 0x180			Register Name: TCON_CMAP_CTL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0	Color_Map_En 0: bypass 1: enable This module only work when X is divided by 4
30:1	/	/	/
0	R/W	0	Out_Format 0: 4 pixel output mode: Out0 -> Out1 -> Out2 -> Out3 1: 2 pixel output mode: Out0 -> Out1

TCON_CMAP_ODD0_REG

Offset: 0x190			Register Name: TCON_CMAP_ODD0_REG
Bit	Read/Write	Default/Hex	Description
31:16	R/W	0	Out_Odd1
15:0	R/W	0	Out_Odd0 bit15-12: Reserved bit11-08: Out_Odd0[23:16] bit07-04: Out_Odd0[15:8] bit03-00: Out_Odd0[7:0] 0x0: in_b0 0x1: in_g0 0x2: in_r0 0x3: reserved 0x4: in_b1 0x5: in_g1 0x6: in_r1 0x7: reservd 0x8: in_b2 0x9: in_g2 0xa: in_r2 0xb: reserved 0xc: in_b3 0xd: in_g3 0xe: in_r3 0xf: reserved

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TCON_CMAP_ODD1_REG

Offset: 0x194			Register Name: TCON_CMAP_ODD1_REG
Bit	Read/Write	Default/Hex	Description
31:16	R/W	0	Out_Odd3
15:0	R/W	0	Out_Odd2

TCON_CMAP_EVEN0_REG

Offset: 0x198			Register Name: TCON_CMAP_EVEN0_REG
Bit	Read/Write	Default/Hex	Description
31:16	R/W	0	Out_Even1
15:0	R/W	0	Out_Even0

TCON_CMAP_ EVEN1_REG

Offset: 0x19C			Register Name: TCON_CMAP_ EVEN1_REG
Bit	Read/Write	Default/Hex	Description
31:16	R/W	0	Out_Even3
15:0	R/W	0	Out_Even2

TCON_SAFE_PERIOD_REG

Offset: 0x1F0			Register Name: TCON_SAFE_PERIOD_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:16	R/W	0	Safe_Period_FIFO_Num
15:2	/	/	/
1:0	R/W	0	Safe_Period_Mode 0: unsafe 1: safe 2: safe at ecc_FIFO_curr_num > safe_period_FIFO_num 3: safe at 2 and safe at sync active

TCON0_LVDS_ANA0_REG

Offset: 0x220			Register Name: TCON0_LVDS_ANA0_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0	lvds0_en_mb enable the bias circuit of the LVDS_Ana module
30	R/W	0	lvds0_en_ldo
29:25	/	/	/
24	R/W	0	lvds0_en_drvc enable all circuits working when transmitting the data in channel clock of LVDS_tx0
23:20	R/W	0	lvds0_en_drv enable all circuits working when transmitting the data in channel<3:0> of LVDS_tx0
19	/	/	/
18:17	R/W	0	lvds0_reg_c

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			adjust current flowing through Rload of Rx to change the differential signals amplitude 0:250mV 1:300mV 2:350mV 3:400mV
16	R/W	0	lvds0_reg_denc choose data output or PLL test clock output in LVDS_tx
15:12	R/W	0	lvds0_reg_den choose data output or PLL test clock output in LVDS_tx
11:10	/	/	/
9:8	R/W	0	lvds0_reg_v adjust common mode voltage of the differential signals in five channels
7:6	/	/	/
5:4	R/W	0	lvds0_reg_pd fine adjust the slew rate of output data
3:2	/	/	/
1	R/W	0	lvds0_reg_pwslv adjust voltage amplitude of low power in LVDS_Ana
0	R/W	0	lvds0_reg_pwsmb adjust voltage amplitude of mbias voltage reference in LVDS_Ana

Control Signal and Data Port Mapping

PD	I/F	Sync RGB					CPU/I80 Interface						LVDS Interface
		Para RGB	Serial RGB			CCIR 656	Para RGB 666	Para RGB 565	Serial RGB 666		Serial RGB 565		Sing Link
	Cycle		1st	2nd	3rd				1st	2nd	1st	2nd	
PD27	IO0	VSYNC					CS						D3N
PD26	IO1	HSYNC					RD						D3P
PD25	IO3	DE					RS						CKN
PD24	IO2	DCLK					WR						CKP
PD23	D23	R5					R5	R4					D2N
PD22	D22	R4					R4	R3					D2P
PD21	D21	R3					R3	R2					D1N
PD20	D20	R2					R2	R1					D1P
PD19	D19	R1					R1	R0					D0N
PD18	D18	R0					R0	G5					D0P
PD15	D15	G5					G5	G4					
PD14	D14	G4					G4	G3					
PD13	D13	G3					G3						
PD12	D12	G2	D17	D27	D37	D7	G2	G2	R5	G2	R4	G2	

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PD11	D11	G1	D16	D26	D36	D6	G1	G1	R4	G1	R3	G1	
PD10	D10	G0	D15	D25	D35	D5	G0	G0	R3	G0	R2	G0	
PD7	D7	B5	D14	D24	D34	D4	B5	B4	R2	B5	R1	B4	
PD6	D6	B4	D13	D23	D33	D3	B4	B3	R1	B4	R0	B3	
PD5	D5	B3	D12	D22	D32	D2	B3	B2	R0	B3	G5	B2	
PD4	D4	B2	D11	D21	D31	D1	B2	B1	G5	B2	G4	B1	
PD3	D3	B1	D10	D20	D30	D0	B1	B0	G4	B1	G3	B0	
PD2	D2	B0					B0		G3	B0			

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5.3 Display Engine Front-End

5.3.1 Overview

The display engine front-end (DEFE) provides image resizing function for display engine. It receives data from DRAM, performs the image resizing function, and outputs to DEBE module.
The DEFE can receive ARGB/YUV420/YUV422/YUV411 data format, and then converts to ARGB8888 for display. Horizontal and vertical direction scaling are implemented independently.

The DEFE features:

- Support YUV444/ YUV422/ YUV420/ YUV411/ ARGB8888 data format
- Support 1/16× to 32× resize ratio
- Support 32-phase 4-tap horizontal anti-alias filter, 32-phase 4-tap vertical anti-alias filter
- Support input size up to 2048×2048
- Support output size up 1280x1280

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5.3.2 DEFE Block Diagram

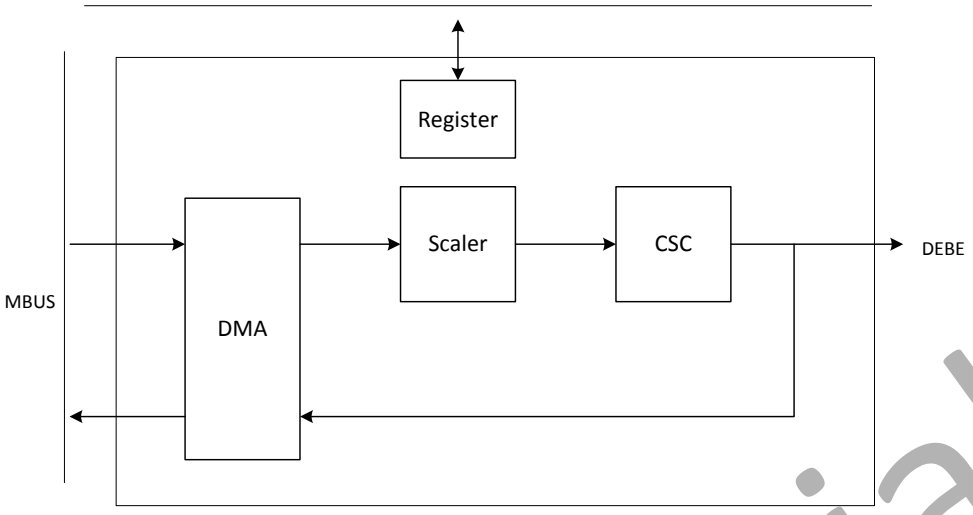

Figure 5.3-1 DEFE Block Diagram

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5.3.3 DEFE Register List

Module Name	Base Address
DEFE	0x01e00000

Register Name	Offset	Description
DEFE_EN_REG	0x0000	DEFE Module Enable Register
DEFE_FRM_CTRL_REG	0x0004	DEFE Frame Process Control Register
DEFE_BYPASS_REG	0x0008	DEFE CSC By-Pass Register
DEFE_AGTH_SEL_REG	0x000C	DEFE Algorithm Selection Register
DEFE_LINT_CTRL_REG	0x0010	DEFE Line Interrupt Control Register
DEFE_BUF_ADDR0_REG	0x0020	DEFE Input Channel 0 Buffer Address Register
DEFE_BUF_ADDR1_REG	0x0024	DEFE Input Channel 1 Buffer Address Register
DEFE_BUF_ADDR1_REG	0x0028	DEFE Input Channel 2 Buffer Address Register
DEFE_FIELD_CTRL_REG	0x002C	DEFE Field Sequence Register
DEFE_TB_OFF0_REG	0x0030	DEFE Channel 0 Tile-Based Offset Register
DEFE_TB_OFF1_REG	0x0034	DEFE Channel 1 Tile-Based Offset Register
DEFE_TB_OFF2_REG	0x0038	DEFE Channel 2 Tile-Based Offset Register
DEFE_LINESTRD0_REG	0x0040	DEFE Channel 0 Line Stride Register
DEFE_LINESTRD1_REG	0x0044	DEFE Channel 1 Line Stride Register
DEFE_LINESTRD2_REG	0x0048	DEFE Channel 2 Line Stride Register
DEFE_INPUT_FMT_REG	0x004C	DEFE Input Format Register
DEFE_WB_ADDR_REG	0x0050	DEFE Write Back Address Register
DEFE_OUTPUT_FMT_REG	0x005C	DEFE Output Format Register
DEFE_INT_EN_REG	0x0060	DEFE Interrupt Enable Register
DEFE_INT_STATUS_REG	0x0064	DEFE Interrupt Status Register
DEFE_STATUS_REG	0x0068	DEFE Status Register
DEFE_CSC_COEF00_REG	0x0070	DEFE CSC Coefficient 00 Register
DEFE_CSC_COEF01_REG	0x0074	DEFE CSC Coefficient 01 Register
DEFE_CSC_COEF02_REG	0x0078	DEFE CSC Coefficient 02 Register
DEFE_CSC_COEF03_REG	0x007C	DEFE CSC Coefficient 03 Register
DEFE_CSC_COEF10_REG	0x0080	DEFE CSC Coefficient 10 Register
DEFE_CSC_COEF11_REG	0x0084	DEFE CSC Coefficient 11 Register
DEFE_CSC_COEF12_REG	0x0088	DEFE CSC Coefficient 12 Register
DEFE_CSC_COEF13_REG	0x008C	DEFE CSC Coefficient 13 Register
DEFE_CSC_COEF20_REG	0x0090	DEFE CSC Coefficient 20 Register
DEFE_CSC_COEF21_REG	0x0094	DEFE CSC Coefficient 21 Register
DEFE_CSC_COEF22_REG	0x0098	DEFE CSC Coefficient 22 Register
DEFE_CSC_COEF23_REG	0x009C	DEFE CSC Coefficient 23 Register
DEFE_WB_LINESTRD_EN_REG	0x00D0	DEFE Write Back Line Stride Enable Register
DEFE_WB_LINESTRD_REG	0x00D4	DEFE Write Back Channel 3 Line Stride Register
DEFE_CH0_INSIZE_REG	0x0100	DEFE Channel 0 Input Size Register
DEFE_CH0_OUTSIZE_REG	0x0104	DEFE Channel 0 Output Size Register
DEFE_CH0_HORZFACT_REG	0x0108	DEFE Channel 0 Horizontal Factor Register

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DEFE_CH0_VERTFACT_REG	0x010C	DEFE Channel 0 Vertical Factor Register
DEFE_CH0_HORZPHASE_REG	0x0110	DEFE Channel 0 Horizontal Initial Phase Register
DEFE_CH0_VERTPHASE0_REG	0x0114	DEFE Channel 0 Vertical Initial Phase 0 Register
DEFE_CH0_VERTPHASE1_REG	0x0118	DEFE Channel 0 Vertical Initial Phase 1 Register
DEFE_CH0_HORZTAP_REG	0x0120	DEFE Channel 0 Horizontal Tap Offset Register
DEFE_CH0_VERTTAP_REG	0x0128	DEFE Channel 0 Vertical Tap Offset Register
DEFE_CH1_INSIZE_REG	0x0200	DEFE Channel 1 Input Size Register
DEFE_CH1_OUTSIZE_REG	0x0204	DEFE Channel 1 Output Size Register
DEFE_CH1_HORZFACT_REG	0x0208	DEFE Channel 1 Horizontal Factor Register
DEFE_CH1_VERTFACT_REG	0x020C	DEFE Channel 1 Vertical Factor Register
DEFE_CH1_HORZPHASE_REG	0x0210	DEFE Channel 1 Horizontal Initial Phase Register
DEFE_CH1_VERTPHASE0_REG	0x0214	DEFE Channel 1 Vertical Initial Phase 0 Register
DEFE_CH1_VERTPHASE1_REG	0x0218	DEFE Channel 1 Vertical Initial Phase 1 Register
DEFE_CH1_HORZTAP_REG	0x0220	DEFE Channel 1 Horizontal Tap Offset Register
DEFE_CH1_VERTTAP_REG	0x0228	DEFE Channel 1 Vertical Tap Offset Register
DEFE_CH0_HORZCOEF_REGN	0x0400+N*4	DEFE Channel 0 Horizontal Filter Coefficient Register (N=0:31)
DEFE_CH0_VERTCOEF_REGN	0x0500+N*4	DEFE Channel 0 Vertical Filter Coefficient Register(N=0:31)
DEFE_CH1_HORZCOEF_REGN	0x0600+N*4	DEFE Channel 1 Horizontal Filter Coefficient Register(N=0:31)
DEFE_CH1_VERTCOEF_REGN	0x0700+N*4	DEFE Channel 1 Vertical Filter Coefficient Register (N=0:31)

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5.3.4 DEFE Register Description

DEFE_EN_REG

Offset: 0x0			Register Name: DEFE_EN_REG
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/
0	R/W	0x0	EN DEFE enable 0: Disable 1: Enable When DEFE enable bit is disabled, the clock of DEFE module will be disabled If this bit is transition from 0 to 1, the frame process control register and the interrupt enable register will be initiated to default value, and the state machine of the module is reset

DEFE_FRM_CTRL_REG

Offset: 0x4			Register Name: DEFE_FRM_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31:24	/	/	/
23	R/W	0x0	COEF_ACCESS_CTRL Fir coef ram access control 0: CPU doesn't access fir coef ram 1: CPU will access fir coef ram This bit will be set to 1 before CPU access fir coef ram
22:17	/	/	/
16	R/W	0x0	FRM_START Frame start & reset control 0: reset 1: start If the bit is written to zero, the whole state machine and data paths of DEFE module will be reset. When the bit is written to 1, DEFE will start a new frame process.
15:12	/	/	/
11	R/W	0x0	OUT_CTRL DEFE output control 0: enable DEFE output to DEBE 1: disable DEFE output to DEBE If DEFE write back function is enabled, DEFE output to DEBE isn't recommended.
10:3	/	/	/

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2	R/W	0x0	WB_EN Write back enable 0: Disable 1: Enable If output to DEBE is enabled, the writing back process will start when write back enable bit is set and a new frame processing begins. The bit will be self-cleared when writing-back frame process starts.
1	/	/	
0	R/W	0x0	REG_RDY_EN Register ready enable 0: not ready 1: registers configuration ready As same as filter coefficients configuration, in order to ensure the display is correct, the correlative display configuration registers are buffered too, the programmer also can change the value of correlative registers in any time. When the registers setting is finished, the programmer should set the bit if the programmer need the new configuration in next scaling frame. When the new frame start, the bit will also be self-cleared.

DEFE_BYPASS_REG

Offset: 0x8			Register Name: DEFE_BYPASS_REG
Bit	Read/Write	Default/Hex	Description
31:2	/	/	/
1	R/W	0x0	CSC_BYPASS_EN CSC by-pass enable 0: CSC enable 1: CSC will be by-passed Actually, in order ensure the module working be correct, This bit only can be set when input data format is the same as output data format (both YUV or both RGB)
0	/	/	/

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DEFE_AGTH_SEL_REG

Offset: 0xC			Register Name: DEFE_AGTH_SEL_REG
Bit	Read/Write	Default/Hex	Description
31:9	/	/	/
8	R/W	0x0	LINEBUF_AGTH DEFE line buffer algorithm select 0: horizontal filtered result 1: original data
7:0	/	/	/

DEFE_LINT_CTRL_REG

Offset: 0x10			Register Name: DEFE_LINT_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31:28	/	/	/
27:16	R	0x0	CURRENT_LINE
15	R/W	0x0	FIELD_SEL Field select 0: each field 1: end field(field counter in reg0x2c)
14:13	/	/	/
12:0	R/W	0x0	TRIG_LINE Trigger line number of line interrupt

DEFE_BUF_ADDR0_REG

Offset: 0x20			Register Name: DEFE_BUF_ADDR0_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0x0	BUF_ADDR DEFE frame buffer address In tile-based type: The address is the start address of the line in the first tile used to generating output frame. In non-tile-based type: The address is the start address of the first line.

DEFE_BUF_ADDR1_REG

Offset: 0x24			Register Name: DEFE_BUF_ADDR1_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0x0	BUF_ADDR DEFE frame buffer address In tile-based type: The address is the start address of the line in the first tile used to generating output frame.

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			In non-tile-based type: The address is the start address of the first line.

DEFE_BUF_ADDR2_REG

Offset: 0x28			Register Name: DEFE_BUF_ADDR2_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0x0	BUF_ADDR DEFE frame buffer address In tile-based type: The address is the start address of the line in the first tile used to generating output frame. In non-tile-based type: The address is the start address of the first line.

DEFE_FIELD_CTRL_REG

Offset: 0x2C			Register Name: DEFE_FIELD_CTRL_REG
Bit	Read/Write	Default/Hex	Description
31:30	/	/	/
29:24	R/W	0x20	FIR_OFFSET FIR compute initial value
23:13	/	/	/
12	R/W	0x0	FIELD_LOOP_MOD Field loop mode 0：the last field； 1：the full frame
11	/	/	/
10:8	R/W	0x0	VALID_FIELD_CNT Valid field counter bit the valid value = this value + 1；
7:0	R/W	0x0	FIELD_CNT Field counter each bit specify a field to display，0：top field，1：bottom field

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DEFE_TB_OFF0_REG

Offset: 0x30			Register Name: DEFE_TB_OFF0_REG
Bit	Read/Write	Default/Hex	Description
31:21	/	/	/
20:16	R/W	0x0	X_OFFSET1 The x offset of the bottom-right point in the end tile
15:13	/	/	/
12:8	R/W	0x0	Y_OFFSET0 The y offset of the top-left point in the first tile
7:5	/	/	/
4:0	R/W	0x0	X_OFFSET0 The x offset of the top-left point in the first tile

DEFE_TB_OFF1_REG

Offset: 0x34			Register Name: DEFE_TB_OFF1_REG
Bit	Read/Write	Default/Hex	Description
31:21	/	/	/
20:16	R/W	0x0	X_OFFSET1 The x offset of the bottom-right point in the end tile
15:13	/	/	/
12:8	R/W	0x0	Y_OFFSET0 The y offset of the top-left point in the first tile
7:5	/	/	/
4:0	R/W	0x0	X_OFFSET0 The x offset of the top-left point in the first tile

DEFE_TB_OFF2_REG

Offset: 0x38			Register Name: DEFE_TB_OFF2_REG
Bit	Read/Write	Default/Hex	Description
31:21	/	/	/
20:16	R/W	0x0	X_OFFSET1 The x offset of the bottom-right point in the end tile
15:13	/	/	/
12:8	R/W	0x0	Y_OFFSET0 The y offset of the top-left point in the first tile
7:5	/	/	/
4:0	R/W	0x0	X_OFFSET0 The x offset of the top-left point in the first tile

DEFE_LINESTRD0_REG

Offset: 0x40	Register Name: DEFE_LINESTRD0_REG

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Bit	Read/Write	Default/Hex	Description
31:0	R/W	0x0	LINE_STRIDE In tile-based type The stride length is the distance from the start of the end line in one tile to the start of the first line in next tile(here next tile is in vertical direction) In non-tile-based type The stride length is the distance from the start of one line to the start of the next line.

DEFE_LINESTRD1_REG

Offset: 0x44			Register Name: DEFE_LINESTRD1_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0x0	LINE_STRIDE In tile-based type The stride length is the distance from the start of the end line in one tile to the start of the first line in next tile(here next tile is in vertical direction) In non-tile-based type The stride length is the distance from the start of one line to the start of the next line.

DEFE_LINESTRD2_REG

Offset: 0x48			Register Name: DEFE_LINESTRD2_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0x0	LINE_STRIDE In tile-based type The stride length is the distance from the start of the end line in one tile to the start of the first line in next tile(here next tile is in vertical direction) In non-tile-based type The stride length is the distance from the start of one line to the start of the next line.

DEFE_INPUT_FMT_REG

Offset: 0x4C			Register Name: DEFE_INPUT_FMT_REG
Bit	Read/Write	Default/Hex	Description
31:17	/	/	/
16	R/W	0x0	BYTE_SEQ Input data byte sequence selection 0: P3P2P1P0(word) 1: P0P1P2P3(word)
15:13	/	/	/

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12	R/W	0x0	SCAN_MOD Scanning Mode selection 0: non-interlace 1: interlace
11	/	/	/
10:8	R/W	0x0	DATA_MOD Input data mode selection 000: non-tile-based planar data 001: interleaved data 010: non-tile-based UV combined data 100: tile-based planar data 110: tile-based UV combined data other: reserved
7	/	/	/
6:4	R/W	0x0	DATA_FMT Input component data format In non-tile-based planar data mode: 000: YUV 4:4:4 001: YUV 4:2:2 010: YUV 4:2:0 011: YUV 4:1:1 101: RGB888 Other: Reserved In interleaved data mode: 000: YUV 4:4:4 001: YUV 4:2:2 101: ARGB8888 Other: reserved In non-tile-based UV combined data mode: 001: YUV 4:2:2 010: YUV 4:2:0 011: YUV 4:1:1 Other: reserved In tile-based planar data mode: 001: YUV 4:2:2 010: YUV 4:2:0 011: YUV 4:1:1 Other: Reserved In tile-based UV combined data mode: 001: YUV 4:2:2 010: YUV 4:2:0 011: YUV 4:1:1

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			Other: reserved
3:2	/	/	/
1:0	R/W	0x0	DATA_PS Pixel sequence In interleaved YUV422 data mode: 00: Y1V0Y0U0 01: V0Y1U0Y0 10: Y1U0Y0V0 11: U0Y1V0Y0 In interleaved YUV444 data mode: 00: VUYA 01: AYUV Other: reserved In UV combined data mode: (UV component) 00: V1U1V0U0 01: U1V1U0V0 Other: reserved In interleaved ARGB8888 data mode: 00: BGRA 01: ARGB Other: reserved

DEFE_WB_ADDR_REG

Offset: 0x50			Register Name: DEFE_WB_ADDR_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0x0	WB_ADDR Write-back address setting for output data.

DEFE_OUTPUT_FMT_REG

Offset: 0x5C			Register Name: DEFE_OUTPUT_FMT_REG
Bit	Read/Write	Default/Hex	Description
31:18	/	/	/
17:16	R/W	0	WB_Ch_Sel Write back channel select(chsel) 0/1: Ch3 2: Ch4 3: Ch5 Other: reserved
15:9	/	/	/
8	R/W	0x0	BYTE_SEQ Output data byte sequence selection 0: P3P2P1P0(word)

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			1: P0P1P2P3(word) For ARGB, when this bit is 0, the byte sequence is BGRA, and when this bit is 1, the byte sequence is ARGB;
7:5	/	/	/
4	R/W	0x0	SCAN_MOD Output interlace enable 0: disable 1: enable When output interlace enable, scaler selects YUV initial phase according to LCD field signal
3	/	/	/
2:0	R/W	0x0	DATA_FMT Data format 000: planar RGB888 conversion data format 001: interleaved BGRA8888 conversion data format (Alpha always 0xff) 010: interleaved ARGB8888 conversion data format (Alpha always 0xff) 100: planar YUV 444 101: planar YUV 420(only support YUV input and not interleaved mode) 110: planar YUV 422(only support YUV input) 111: planar YUV 411(only support YUV input) Other: reserved

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DEFE_INT_EN_REG

Offset: 0x60			Register Name: DEFE_INT_EN_REG
Bit	Read/Write	Default/Hex	Description
31:11	/	/	/
10	R/W	0x0	REG_LOAD_EN Register ready load interrupt enable
9	R/W	0x0	LINE_EN Line interrupt enable
8	/	/	/
7	R/W	0x0	WB_EN Write-back end interrupt enable 0: Disable 1: Enable
6:0	/	/	/

DEFE_INT_STATUS_REG

Offset: 0x64			Register Name: DEFE_INT_STATUS_REG
Bit	Read/Write	Default/Hex	Description
31:11	/	/	/
10	R/W	0x0	REG_LOAD_STATUS Register ready load interrupt status
9	R/W	0x0	LINE_STATUS Line interrupt status
8	/	/	/
7	R/W	0x0	WB_STATUS Write-back end interrupt status
6:0	/	/	/

DEFE_STATUS_REG

Offset: 0x68			Register Name: DEFE_STATUS_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:16	R	0x0	LINE_ON_SYNC Line number(when sync reached)
15	R/W	0x0	WB_ERR_SYNC Sync reach flag when capture in process
14	R/W	0x0	WB_ERR_LOSEDATA Lose data flag when capture in process
13	/	/	/
12	R	0x0	WB_ERR_STATUS write-back error status 0: valid write back 1: un-valid write back This bit is cleared through write 0 to reset/start bit in frame control register

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11	R	0x0	COEF_ACCESS_STATUS Fir coef access status 0: scaler module can access fir coef ram 1: CPU can access fir coef ram This bit must be 1 before CPU access fir coef ram. When this bit is 1, scaler module will fetch 0x00004000 from ram.
10:6	/	/	/
5	R	0x0	LCD_FIELD LCD field status 0: top field 1: bottom field
4	R	0x0	DRAM_STATUS Access dram status 0: idle 1: busy This flag indicates whether DEFE is accessing dram
3	/	/	/
2	R	0x0	CFG_PENDING Register configuration pending 0: no pending 1: configuration pending This bit indicates the registers for the next frame has been configured. This bit will be set when configuration ready bit is set and this bit will be cleared when a new frame process begin.
1	R	0x0	WB_STATUS Write-back process status 0: write-back end or write-back disable 1: write-back in process This flag indicates that a full frame has not been written back to memory. The bit will be set when write-back enable bit is set, and be cleared when write-back process end.
0	R	0x0	FRM_BUSY Frame busy. This flag indicates that the frame is being processed. The bit will be set when frame process reset & start is set, and be cleared when frame process reset or disabled.

DEFE_CSC_COEF00_REG

Offset: 0x70	Register Name: DEFE_CSC_COEF00_REG

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Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:0	R/W	0x0	COEF the Y/G coefficient the value equals to coefficient*2^{10}

DEFE_CSC_COEF01_REG

Offset: 0x74			Register Name: DEFE_CSC_COEF01_REG
Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:0	R/W	0x0	COEF the Y/G coefficient the value equals to coefficient*2^{10}

DEFE_CSC_COEF02_REG

Offset: 0x78			Register Name: DEFE_CSC_COEF02_REG
Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:0	R/W	0x0	COEF the Y/G coefficient the value equals to coefficient*2^{10}

DEFE_CSC_COEF03_REG

Offset: 0x7C			Register Name: DEFE_CSC_COEF03_REG
Bit	Read/Write	Default/Hex	Description
31:14	/	/	/
13:0	R/W	0x0	CONT the Y/G constant the value equals to coefficient*2^{4}

DEFE_CSC_COEF10_REG

Offset: 0x80			Register Name: DEFE_CSC_COEF10_REG
Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:0	R/W	0x0	COEF the U/R coefficient the value equals to coefficient*2^{10}

DEFE_CSC_COEF11_REG

Offset: 0x84			Register Name: DEFE_CSC_COEF11_REG
Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:0	R/W	0x0	COEF the U/R coefficient the value equals to coefficient*2^{10}

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DEFE_CSC_COEF12_REG

Offset: 0x88			Register Name: DEFE_CSC_COEF12_REG
Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:0	R/W	0x0	COEF the U/R coefficient the value equals to coefficient*2^{10}

DEFE_CSC_COEF13_REG

Offset: 0x8C			Register Name: DEFE_CSC_COEF13_REG
Bit	Read/Write	Default/Hex	Description
31:14	/	/	/
13:00	R/W	0x0	CONT the U/R constant the value equals to coefficient*2^{4}

DEFE_CSC_COEF20_REG

Offset: 0x90			Register Name: DEFE_CSC_COEF20_REG
Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:0	R/W	0x0	COEF the V/B coefficient the value equals to coefficient*2^{10}

DEFE_CSC_COEF21_REG

Offset: 0x94			Register Name: DEFE_CSC_COEF21_REG
Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:0	R/W	0x0	COEF the V/B coefficient the value equals to coefficient*2^{10}

DEFE_CSC_COEF22_REG

Offset: 0x98			Register Name: DEFE_CSC_COEF22_REG
Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:0	R/W	0x0	COEF the V/B coefficient the value equals to coefficient*2^{10}

DEFE_CSC_COEF23_REG

Offset: 0x9C			Register Name: DEFE_CSC_COEF23_REG
Bit	Read/Write	Default/Hex	Description
31:14	/	/	/
13:00	R/W	0x0	CONT the V/B constant

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			the value equals to coefficient*2^4

DEFE_WB_LINESTRD_EN_REG

Offset: 0xD0			Register Name: DEFE_WB_LINESTRD_EN_REG
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/
0	R/W	0x0	EN Write back line-stride enable 0: disable 1: enable

DEFE_WB_LINESTRD_REG

Offset: 0xD4			Register Name: DEFE_WB_LINESTRD_REG
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/
0	R/W	0x0	LINE_STRD Ch3 write back line-stride

DEFE_CH0_INSIZE_REG

Offset: 0x100			Register Name: DEFE_CH0_INSIZE_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:16	R/W	0x0	IN_HEIGHT Input image Y/G component height Input image height = The value of these bits add 1
15:13	/	/	/
12:0	R/W	0x0	IN_WIDTH Input image Y/G component width The image width = The value of these bits add 1 When line buffer result selection is original data, the maximum width is 1366.

DEFE_CH0_OUTSIZE_REG

Offset: 0x104			Register Name: DEFE_CH0_OUTSIZE_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:16	R/W	0x0	OUT_HEIGHT Output layer Y/G component height The output layer height = The value of these bits add 1
15:13	/	/	/
12:0	R/W	0x0	OUT_WIDTH Output layer Y/G component width The output layer width = The value of these bits add 1

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			When line buffer result selection is horizontal filtered result, the maximum width is 1366.

DEFE_CH0_HORZFACT_REG

Offset: 0x108			Register Name: DEFE_CH0_HORZFACT_REG
Bit	Read/Write	Default/Hex	Description
31:24	/	/	/
23:16	R/W	0x0	FACTOR_INT The integer part of the horizontal scaling ratio the horizontal scaling ratio = input width/output width
15:0	R/W	0x0	FACTOR_FRAC The fractional part of the horizontal scaling ratio the horizontal scaling ratio = input width/output width

DEFE_CH0_VERTFACT_REG

Offset: 0x10C			Register Name: DEFE_CH0_VERTFACT_REG
Bit	Read/Write	Default/Hex	Description
31:24	/	/	/
23:16	R/W	0x0	FACTOR_INT The integer part of the vertical scaling ratio the vertical scaling ratio = input height/output height
15:0	R/W	0x0	FACTOR_FRAC The fractional part of the vertical scaling ratio the vertical scaling ratio = input height /output height

DEFE_CH0_HORZPHASE_REG

Offset: 0x110			Register Name: DEFE_CH0_HORZPHASE_REG
Bit	Read/Write	Default/Hex	Description
31:20	/	/	/
19:0	R/W	0x0	PHASE Y/G component initial phase in horizontal (complement) This value equals to initial phase * 2^{16}

DEFE_CH0_VERTPHASE0_REG

Offset: 0x114			Register Name: DEFE_CH0_VERTPHASE0_REG
Bit	Read/Write	Default/Hex	Description
31:20	/	/	/
19:0	R/W	0x0	PHASE Y/G component initial phase in vertical for top field (complement) This value equals to initial phase * 2^{16}

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DEFE_CH0_VERTPHASE1_REG

Offset: 0x118			Register Name: DEFE_CH0_VERTPHASE1_REG
Bit	Read/Write	Default/Hex	Description
31:20	/	/	/
19:0	R/W	0x0	PHASE Y/G component initial phase in vertical for bottom field (complement) This value equals to initial phase * 2^{16}

DEFE_CH0_HORZTAP_REG

Offset: 0x120			Register Name: DEFE_CH0_HORZTAP_REG
Bit	Read/Write	Default/Hex	Description
31	/	/	/
30:24	R/W	0x1	TAP3 Tap 3 offset in horizontal
23	/	/	/
22:16	R/W	0x1	TAP2 Tap 2 offset in horizontal
15	/	/	/
14:8	R/W	0x1	TAP1 Tap 1 offset in horizontal
7	/	/	/
6:0	R/W	0x7D	TAP0 Tap 0 offset in horizontal

DEFE_CH0_VERTTAP_REG

Offset: 0x128			Register Name: DEFE_CH0_VERTTAP_REG
Bit	Read/Write	Default/Hex	Description
31	/	/	/
30:24	R/W	0x1	TAP3 Tap 3 offset in vertical
23	/	/	/
22:16	R/W	0x1	TAP2 Tap 2 offset in vertical
15	/	/	/
14:8	R/W	0x1	TAP1 Tap 1 offset in vertical
7	/	/	/
6:0	R/W	0x7F	TAP0 Tap 0 offset in vertical

DEFE_CH1_INSIZE_REG

Offset: 0x200			Register Name: DEFE_CH1_INSIZE_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/

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28:16	R/W	0x0	IN_HEIGHT Input image U/R component height Input image height = The value of these bits add 1
15:13	/	/	/
12:0	R/W	0x0	IN_WIDTH Input image U/R component width The image width = The value of these bits add 1 When line buffer result selection is original data, the maximum width is 1366.

DEFE_CH1_OUTSIZE_REG

Offset: 0x204			Register Name: DEFE_CH1_OUTSIZE_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:16	R/W	0x0	OUT_HEIGHT Output layer U/R component height The output layer height = The value of these bits add 1
15:13	/	/	/
12:0	R/W	0x0	OUT_WIDTH Output layer U/R component width The output layer width = The value of these bits add 1 When line buffer result selection is horizontal filtered result, the maximum width is 1366.

DEFE_CH1_HORZFACT_REG

Offset: 0x208			Register Name: DEFE_CH1_HORZFACT_REG
Bit	Read/Write	Default/Hex	Description
31:24	/	/	/
23:16	R/W	0x0	FACTOR_INT The integer part of the horizontal scaling ratio the horizontal scaling ratio = input width/output width
15:0	R/W	0x0	FACTOR_FRAC The fractional part of the horizontal scaling ratio the horizontal scaling ratio = input width/output width

DEFE_CH1_VERTFACT_REG

Offset: 0x20C			Register Name: DEFE_CH1_VERTFACT_REG
Bit	Read/Write	Default/Hex	Description
31:24	/	/	/
23:16	R/W	0x0	FACTOR_INT

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			The integer part of the vertical scaling ratio the vertical scaling ratio = input height/output height
15:0	R/W	0x0	FACTOR_FRAC The fractional part of the vertical scaling ratio the vertical scaling ratio = input height /output height

DEFE_CH1_HORZPHASE_REG

Offset: 0x210			Register Name: DEFE_CH1_HORZPHASE_REG
Bit	Read/Write	Default/Hex	Description
31:20	/	/	/
19:0	R/W	0x0	PHASE U/R component initial phase in horizontal (complement) This value equals to initial phase * 2^{16}

DEFE_CH1_VERTPHASE0_REG

Offset: 0x214			Register Name: DEFE_CH1_VERTPHASE0_REG
Bit	Read/Write	Default/Hex	Description
31:20	/	/	/
19:0	R/W	0x0	PHASE U/R component initial phase in vertical for top field (complement) This value equals to initial phase * 2^{16}

DEFE_CH1_VERTPHASE1_REG

Offset: 0x218			Register Name: DEFE_CH1_VERTPHASE1_REG
Bit	Read/Write	Default/Hex	Description
31:20	/	/	/
19:0	R/W	0x0	PHASE U/R component initial phase in vertical for bottom field (complement) This value equals to initial phase * 2^{16}

DEFE_CH1_HORZTAP_REG

Offset: 0x220			Register Name: DEFE_CH1_HORZTAP_REG
Bit	Read/Write	Default/Hex	Description
31	/	/	/
30:24	R/W	0x1	TAP3 Tap 3 offset in horizontal
23	/	/	/
22:16	R/W	0x1	TAP2 Tap 2 offset in horizontal
15	/	/	/
14:8	R/W	0x1	TAP1 Tap 1 offset in horizontal

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7	/	/	/
6:0	R/W	0x7D	TAP0 Tap 0 offset in horizontal

DEFE_CH1_VERTTAP_REG

Offset: 0x228			Register Name: DEFE_CH1_VERTTAP_REG
Bit	Read/Write	Default/Hex	Description
31	/	/	/
30:24	R/W	0x1	TAP3 Tap 3 offset in vertical
23	/	/	/
22:16	R/W	0x1	TAP2 Tap 2 offset in vertical
15	/	/	/
14:8	R/W	0x1	TAP1 Tap 1 offset in vertical
7	/	/	/
6:0	R/W	0x7F	TAP0 Tap 0 offset in vertical

DEFE_CH0_HORZCOEF_REGN (N=0 :31)

Offsetn: 0x400+N*4			Register Name: DEFE_CH0_HORZCOEF_REGN
Bit	Read/Write	Default/Hex	Description
31:24	R/W	0x0	TAP3 Horizontal tap3 coefficient The value equals to coefficient*2^6
23:16	R/W	0x0	TAP2 Horizontal tap2 coefficient The value equals to coefficient*2^6
15:8	R/W	0x0	TAP1 Horizontal tap1 coefficient The value equals to coefficient*2^6
7:0	R/W	0x0	TAP0 Horizontal tap0 coefficient The value equals to coefficient*2^6

DEFE_CH0_VERTCOEF_REGN (N=0 :31)

Offsetn: 0x500+N*4			Register Name: DEFE_CH0_VERTCOEF_REGN
Bit	Read/Write	Default/Hex	Description
31:24	R/W	0x0	TAP3 Vertical tap3 coefficient The value equals to coefficient*2^6

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23:16	R/W	0x0	TAP2 Vertical tap2 coefficient The value equals to coefficient*2^6
15:8	R/W	0x0	TAP1 Vertical tap1 coefficient The value equals to coefficient*2^6
7:0	R/W	0x0	TAP0 Vertical tap0 coefficient The value equals to coefficient*2^6

DEFE_CH1_HORZCOEF_REGN (N=0 :31)

Offsetn: 0x600+N*4			Register Name: DEFE_CH1_HORZCOEF_REGN
Bit	Read/Write	Default/Hex	Description
31:24	R/W	0x0	TAP3 Horizontal tap3 coefficient The value equals to coefficient*2^6
23:16	R/W	0x0	TAP2 Horizontal tap2 coefficient The value equals to coefficient*2^6
15:8	R/W	0x0	TAP1 Horizontal tap1 coefficient The value equals to coefficient*2^6
7:0	R/W	0x0	TAP0 Horizontal tap0 coefficient The value equals to coefficient*2^6

DEFE_CH1_VERTCOEF_REGN (N=0 :31)

Offsetn: 0x700+N*4			Register Name: DEFE_CH1_VERTCOEF_REGN
Bit	Read/Write	Default/Hex	Description
31:24	R/W	0x0	TAP3 Vertical tap3 coefficient The value equals to coefficient*2^6
23:16	R/W	0x0	TAP2 Vertical tap2 coefficient The value equals to coefficient*2^6
15:8	R/W	0x0	TAP1

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			Vertical tap1 coefficient The value equals to coefficient*2^6
7:0	R/W	0x0	TAP0 Vertical tap0 coefficient The value equals to coefficient*2^6

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5.4 Display Engine Back-End

5.4.1 Overview

The display engine back-end (DEBE) provides overlay and alpha blending functions after receiving data from DEFE or SDRAM. After alpha blended, the data will either be delivered to Color Correction for image enhancement, or bypassed to flowing part LCD, etc.
The DEBE has two pipes data path.

The DEBE features:

- Support layer size up to 2048x2048 pixels
- Support four layers overlay in one pipe
- Support alpha blending
- Support pre-multiply alpha image data
- Support color key
- Support output color correction
- Supported input formats: RGB655 / RGB565 / RGB556 / RGB888 / ARGB1555 / ARGB4444 / RGB8888 / iYUV422 / iYUV444 / YUV422 / YUV420 / YUV411

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5.4.2 DEBE Block Diagram

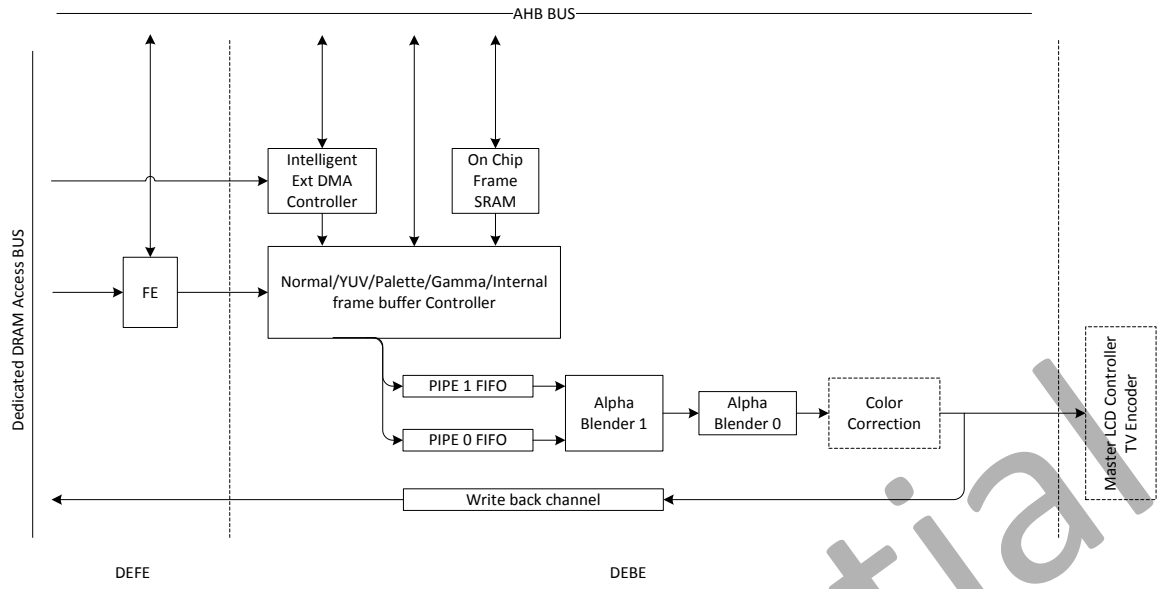

Figure 5.4-1 DEBE Block Diagram

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5.4.3 DEBE Register List

Module name	Base address
DEBE	0x01E6 0000

Register name	Offset	Description
DEBE_MODCTL_REG	0x800	DE back-end mode control register
DEBE_BACKCOLOR_REG	0x804	DE-back color control register
DEBE_DISSIZE_REG	0x808	DE-back display size setting register
DEBE_LAYSIZE_REG	0x810 – 0x81C	DE-layer size register
DEBE_LAYCOOR_REG	0x820 – 0x82C	DE-layer coordinate control register
DEBE_LAYLINEWIDTH_REG	0x840 – 0x84C	DE-layer frame buffer line width register
DEBE_LAYFB_L32ADD_REG	0x850 – 0x85C	DE-layer frame buffer low 32 bit address register
DEBE_LAYFB_H4ADD_REG	0x860	DE-layer frame buffer high 4 bit address register
DEBE_REGBUFFCTL_REG	0x870	DE-Register buffer control register
DEBE_CKMAX_REG	0x880	DE-color key MAX register
DEBE_CKMIN_REG	0x884	DE-color key MIN register
DEBE_CKCFG_REG	0x888	DE-color key configuration register
DEBE_ATTCTL_REG0	0x890 – 0x89C	DE-layer attribute control register0
DEBE_ATTCTL_REG1	0x8A0 – 0x8AC	DE-layer attribute control register1
DEBE_IYUVCTL_REG	0x920	DE backend input YUV channel control register
DEBE_IYUVADD_REG	0x930 – 0x938	DE backend YUV channel frame buffer address register
DEBE_IYUVLINEWIDTH_REG	0x940 – 0x948	DE backend YUV channel buffer line width register
DEBE_YGCOEF_REG	0x950 – 0x958	DE backend Y/G coefficient register
DEBE_YGCONS_REG	0x95C	DE backend Y/G constant register
DEBE_URCOEF_REG	0x960 – 0x968	DE backend U/R coefficient register
DEBE_URCONS_REG	0x96C	DE backend U/R constant register
DEBE_VBCOEF_REG	0x970 – 0x978	DE backend V/B coefficient register
DEBE_VBCONS_REG	0x97C	DE backend V/B constant register
DEBE_OCCTL_REG	0x9C0	DE backend output color control register
DEBE_OCRCOEF_REG	0x9D0-0x9D8	DE backend output color R coefficient register
DEBE_OCRCONS_REG	0x9DC	DE backend output color R constant register
DEBE_OCGCOEF_REG	0x9E0-0x9E8	DE backend output color G coefficient register
DEBE_OCGCONS_REG	0x9EC	DE backend output color G constant register
DEBE_OCBCOEF_REG	0x9F0-0x9F8	DE backend output color B coefficient register
DEBE_OCBCONS_REG	0x9FC	DE backend output color B constant register

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5.4.4 DEBE Register Description

DE back-end mode control register

Offset: 0x800			Register Name: DEBE_MODCTL_REG
Bit	Read/Write	Default/Hex	Description
31:30	/	/	/
29	R/W	0	LINE_SEL Start top/bottom line selection in interlace mode
28	R/W	0	ITLMOD_EN Interlace mode enable 0:disable 1:enable
27	/	/	/
22:20	R/W	0	OUT_SEL Output selection 000:LCD 110:FE0 only Other: reserved
19:18	/	/	/
17	R/W	0	OSCA_EN Output scaling function enable 0:disable 1:enable
16:12	/	/	/
11	R/W	0	LAY3_EN Layer3 Enable/Disable 0: Disabled 1: Enabled
10	R/W	0	LAY2_EN Layer2 Enable/Disable 0: Disabled 1: Enabled
9	R/W	0	LAY1_EN Layer1 Enable/Disable 0: Disabled 1: Enabled
8	R/W	0	LAY0_EN Layer0 Enable/Disable 0: Disabled 1: Enabled
7:2	/	/	/
1	R/W	0	START_CTL Normal output channel Start & Reset control 0: reset 1: start

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0	R/W	0	DEBE_EN DE back-end enable/disable 0: disable 1: enable

DE-back color control register

Offset: 0x804			Register Name: DEBE_BACKCOLOR_REG
Bit	Read/Write	Default/Hex	Description
31:24	/	/	/
23:16	R/W	UDF	BK_RED Red Red screen background color value
15:8	R/W	UDF	BK_GREEN Green Green screen background color value
7:0	R/W	UDF	BK_BLUE Blue Blue screen background color value

DE-back display size setting register

Offset: 0x808			Register Name: DEBE_DISSIZE_REG
Bit	Read/Write	Default/Hex	Description
31:16	R/W	UDF	DIS_HEIGHT Display height The real display height = The value of these bits add 1
15:0	R/W	UDF	DIS_WIDTH Display width The real display width = The value of these bits add 1

DE-layer size register

Offset: Layer 0: 0x810 Layer 1: 0x814 Layer 2: 0x818 Layer 3: 0x81C			Register Name: DEBE_LAYSIZE_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:16	R/W	UDF	LAY_HEIGHT Layer Height The Layer Height = The value of these bits add 1
15:13	/	/	/
12:0	R/W	UDF	LAY_WIDTH Layer Width The Layer Width = The value of these bits add 1

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DE-layer coordinate control register

Offset: Layer 0: 0x820 Layer 1: 0x824 Layer 2: 0x828 Layer 3: 0x82C			Register Name: DEBE_LAYCOOR_REG
Bit	Read/Write	Default/Hex	Description
31:16	R/W	UDF	LAY_YCOOR Y coordinate Y is the left-top y coordinate of layer on screen in pixels The Y represent the two's complement
15:0	R/W	UDF	LAY_XCOOR X coordinate X is left-top x coordinate of the layer on screen in pixels The X represent the two's complement

Note: Setting the layer0-layer3 the coordinate (left-top) on screen control information

DE-layer frame buffer line width register

Offset: Layer 0: 0x840 Layer 1: 0x844 Layer 2: 0x848 Layer 3: 0x84C			Register Name: DEBE_LAYLINEWIDTH_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	UDF	LAY_LINEWIDTH Layer frame buffer line width in bits

Note: If the layer is selected by video channel or YUV channel, the setting of this register will be ignored.

DE-layer frame buffer low 32 bit address register

Offset: Layer 0: 0x850 Layer 1: 0x854 Layer 2: 0x858 Layer 3: 0x85C			Register Name: DEBE_LAYFB_L32ADD_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	UDF	LAYFB_L32ADD Buffer start Address Layer Frame start Buffer Address in bit

Note: If the layer is selected by video channel or YUV channel, the setting of this register will be ignored.

DE-layer frame buffer high 4 bit address register

Offset: 0x860			Register Name: DEBE_LAYFB_H4ADD_REG
Bit	Read/Write	Default/Hex	Description
31:28	/	/	/

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27:24	R/W	UDF	LAY3FB_H4ADD Layer3 Layer Frame Buffer Address in bit
23:20	/	/	/
19:16	R/W	UDF	LAY2FB_H4ADD Layer2 Layer Frame Buffer Address in bit
15:12	/	/	/
11:8	R/W	UDF	LAY1FB_H4ADD Layer1 Layer Frame Buffer Address in bit
7:4	/	/	/
3:0	R/W	UDF	LAY0FB_H4ADD Layer0 Layer Frame Buffer Address in bit

Note: If the layer is selected by video channel or YUV channel, the setting of this register will be ignored.

DE-Register buffer control register

Offset: 0x870			Register Name: DEBE_REGBUFFCTL_REG
Bit	Read/Write	Default/Hex	Description
31:2	/	/	/
1	R/W	0X00	REGAUTOLOAD_DIS Module registers loading auto mode disable control 0: registers auto loading mode 1: disable registers auto loading mode, the registers will be loaded by write 1 to bit0 of this register
0	R/W	0X00	REGLOADCTL Register load control When the Module registers loading auto mode disable control bit is set, the registers will be loaded by write 1 to the bit, and the bit will self clean when the registers is loading done.

DE-color key MAX register

Offset: 0x880			Register Name: DEBE_CKMAX_REG
Bit	Read/Write	Default/Hex	Description
31:24	/	/	/
23:16	R/W	UDF	CKMAX_R Red Red color key max
15:8	R/W	UDF	CKMAX_G Green Green color key max
7:0	R/W	UDF	CKMAX_B Blue

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			Blue color key max

DE-color key MIN register

Offset: 0x884			Register Name: DEBE_CKMIN_REG
Bit	Read/Write	Default/Hex	Description
31:24	/	/	/
23:16	R/W	UDF	CKMIN_R Red Red color key min
15:8	R/W	UDF	CKMIN_G Green Green color key min
7:0	R/W	UDF	CKMIN_B Blue Blue color key min

DE-color key configuration register

Offset: 0x888			Register Name: DEBE_CKCFG_REG
Bit	Read/Write	Default/Hex	Description
31:6	/	/	/
5:4	R/W	UDF	CKR_MATCH Red Match Rule 00: always match 01: always match 10: match if (Color Min=<Color<=Color Max) 11: match if (Color>Color Max or Color<Color Min)
3:2	R/W	UDF	CKG_MATCH Green Match Rule 00: always match 01: always match 10: match if (Color Min=<Color<=Color Max) 11: match if (Color>Color Max or Color<Color Min)
1:0	R/W	UDF	CKB_MATCH Blue Match Rule 00: always match 01: always match 10: match if (Color Min=<Color<=Color Max) 11: match if (Color>Color Max or Color<Color Min)

DE-layer attribute control register0

Offset: Layer0: 0x890 Layer1: 0x894 Layer2: 0x898 Layer3: 0x89C			Register Name: DEBE_ATTCTL_REG0
Bit	Read/Write	Default/Hex	Description

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31:24	R/W	UDF	LAY_GLBALPHA Alpha value Alpha value is used for this layer
23:22	R/W	UDF	LAY_WORKMOD Layer working mode selection 00: normal mode (Non-Index mode)
21:20	R/W	UDF	PREMUL 0: normal input layer 1: pre-multiply input layer Other: reserved
19:18	R/W	UDF	CKEN Color key Mode 00: disabled color key 01: The layer color key match another channel pixel data in Alpha Blender1. 1x: Reserved Only 2 channels pixel data can get to Alpha Blender1 at the same screen coordinate.
17:16	/	/	/
15	R/W	UDF	LAY_PIPESEL Pipe Select 0: select Pipe 0 1: select Pipe 1
14:12	/	/	/
11:10	R/W	UDF	LAY_PRISEL Priority The rule is: 11>10>01>00 When more than 2 layers are enabled, the priority value of each layer must be different, soft designer must keep the condition. If more than 1 layer selects the same pipe, in the overlapping area, only the pixel of highest priority layer can pass the pipe to blender1. If both 2 pipes are selected by layers, in the overlapping area, the alpha value will use the alpha value of higher priority layer in the blender1.
9:5	/	/	/
4	R/W	UDF	LAY_VDOSEL Video channel selection control 0:select video channel 0 (FE0) 1: Reserved The selection setting is only valid when Layer video

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			channel selection is enabled.
3	/	/	/
2	R/W	UDF	LAY_YUVEN YUV channel selection 0: disable 1: enable Setting 2 or more layers YUV channel mode is illegal, programmer should confirm it.
1	R/W	UDF	LAY_VDOEN Layer video channel selection enable control 0: disable 1: enable Normally, one layer can not be set both video channel and YUV channel mode, if both 2 mode is set, the layer will work in video channel mode, YUV channel mode will be ignored, programmer should confirm it. Setting 2 or more layers video channel mode is illegal, programmer should confirm it.
0	R/W	UDF	LAY_GLBALPHAEN Alpha Enable 0: Disabled the alpha value of this register 1: Enabled the alpha value of this register for the layer

DE-layer attribute control register1

Offset: Layer0: 0x8A0 Layer1: 0x8A4 Layer2: 0x8A8 Layer3: 0x8AC			Register Name: DEBE_ATTCTL_REG1
Bit	Read/Write	Default/Hex	Description
31:16	/	/	/
15:14	R/W	UDF	LAY_HSCAFCT Setting the internal frame buffer scaling factor, only valid in internal frame buffer mode SH Height scale factor 00: no scaling 01: *2 10: *4 11: Reserved
13:12	R/W	UDF	LAY_WSCAFCT Setting the internal frame buffer scaling factor, only valid in internal frame buffer mode

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			SW Width scale factor 00: no scaling 01: *2 10: *4 11: Reserved
11:8	R/W	UDF	LAY_FBFMT Frame buffer format Normal mode data format 00XX: Reserved 0100: color 16-bpp (R:6/G:5/B:5) 0101: color 16-bpp (R:5/G:6/B:5) 0110: color 16-bpp (R:5/G:5/B:6) 0111: color 16-bpp (Alpha:1/R:5/G:5/B:5) 1000: color 16-bpp (R:5/G:5/B:5/Alpha:1) 1001: color 24-bpp (Padding:8/R:8/G:8/B:8) 1010: color 32-bpp (Alpha:8/R:8/G:8/B:8) 1011: color 24-bpp (R:8/G:8/B:8) 1100: color 16-bpp (Alpha:4/R:4/G:4/B:4) 1101: color 16-bpp (R:4/G:4/B:4/Alpha:4) Other: Reserved
7:3	/	/	/
2	R/W	UDF	LAY_BRSWAPEN B R channel swap 0: RGB. Follow the bit[11:8]----RGB 1: BGR. Swap the B R channel in the data format.
1:0	R/W	UDF	LAY_FBPS PS Pixels Sequence See the follow table “Pixels Sequence”

DE backend input YUV channel control register

Offset: 0x920			Register Name: DEBE_IYUVCTL_REG
Bit	Read/Write	Default/Hex	Description
31:15	/	/	/
14:12	R/W	UDF	IYUV_FBFMT Input data format 000: planar YUV 411 001: planar YUV 422 010: planar YUV 444 011: interleaved YUV 422 100: interleaved YUV 444 Other: illegal
11:10	/	/	/
9:8	R/W	UDF	IYUV_FBPS Pixel sequence

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			In planar data format mode: 00: Y3Y2Y1Y0 01: Y0Y1Y2Y3 (the other 2 components are same) Other: illegal In interleaved YUV 422 data format mode: 00: UYVY 01: YUYV 10: VYUY 11: YVYU In interleaved YUV 444 data format mode: 00: AYUV 01: VUYA Other: illegal
7:5	/	/	/
4	R/W	UDF	IYUV_LINNEREN 0: linner 1:
3:1	/	/	/
0	R/W	UDF	IYUV_EN YUV channel enable control 0: disable 1: enable

Source data input data ports:

nput buffer channel	Planar YUV	Interleaved YUV
Channel0	Y	YUV
Channel1	U	-
Channel2	V	-

DE backend YUV channel frame buffer address register

Offset: Channel 0 : 0x930 Channel 1 : 0x934 Channel 2 : 0x938			Register Name: DEBE_IYUVADD_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	UDF	IYUV_ADD Buffer Address Frame buffer address in BYTE

DE backend YUV channel buffer line width register

Offset: Channel 0 : 0x940 Channel 1 : 0x944 Channel 2 : 0x948			Register Name: DEBE_IYUVLINEWIDTH_REG
Bit	Read/Write	Default/Hex	Description

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31:0	R/W	UDF	IYUV_LINEWIDTH Line width The width is the distance from the start of one line to the start of the next line. Description in bits

YUV to RGB conversion algorithm formula:

R =
(R Y component coefficient * Y) +
(R U component coefficient * U) +
(R V component coefficient * V) +
R constant

G =
(G Y component coefficient * Y) +
(G U component coefficient * U) +
(G V component coefficient * V) +
G constant

B =
(B Y component coefficient * Y) +
(B U component coefficient * U) +
(B V component coefficient * V) +
B constant

DE backend Y/G coefficient register

Offset: G/Y component: 0x950 R/U component: 0x954 B/V component: 0x958			Register Name: DEBE_YGCOEF_REG
Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:0	R/W	UDF	IYUV_YGCOEF the Y/G coefficient the value equals to coefficient*2^{10}

DE backend Y/G constant register

Offset: 0x95C			Register Name: DEBE_YGCONS_REG
Bit	Read/Write	Default/Hex	Description
31:14	/	/	/
13:0	R/W	UDF	IYUV_YGCONS the Y/G constant the value equals to coefficient*2^{4}

DE backend U/R coefficient register

Offset:	Register Name: DEBE_URCOEF_REG

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G/Y component: 0x960 R/U component: 0x964 B/V component: 0x968			
Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:0	R/W	UDF	IYUV_URCOEF the U/R coefficient the value equals to coefficient*2^{10}

DE backend U/R constant register

Offset: 0x96C			Register Name: DEBE_URCONS_REG
Bit	Read/Write	Default/Hex	Description
31:14	/	/	/
13:0	R/W	UDF	IYUV_URCONS the U/R constant the value equals to coefficient*2^{4}

DE backend V/B coefficient register

Offset: G/Y component: 0x970 R/U component: 0x974 B/V component: 0x978			Register Name: DEBE_VBCOEF_REG
Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:0	R/W	UDF	IYUV_VBCOEF the V/B coefficient the value equals to coefficient*2^{10}

DE backend V/B constant register

Offset: 0x97C			Register Name: DEBE_VBCONS_REG
Bit	Read/Write	Default/Hex	Description
31:14	/	/	/
13:0	R/W	UDF	IYUV_VBCONS the V/B constant the value equals to coefficient*2^{4}

DE backend output color control register

Offset: 0x9C0			Register Name: DEBE_OCCTL_REG
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/
0	R/W	UDF	OC_EN Color control module enable control 0: disable 1: enable

Color correction conversion algorithm formula:

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R =
(R R component coefficient * R) +
(R G component coefficient * G) +
(R B component coefficient * B) +
R constant

G =
(G R component coefficient * R) +
(G G component coefficient * G) +
(G B component coefficient * B) +
G constant

B =
(B R component coefficient * R) +
(B G component coefficient * G) +
(B B component coefficient * B) +
B constant

DE backend output color R coefficient register

Offset: R component: 0x9D0 G component: 0x9D4 B component: 0x9D8			Register Name: DEBE_OCRCOEF_REG
Bit	Read/Write	Default/Hex	Description
31:14	/	/	/
13:0	R/W	UDF	OC_RCOEF the R coefficient the value equals to coefficient*2^{10}

DE backend output color R constant register

Offset: 0x9DC			Register Name: DEBE_OCRCONS_REG
Bit	Read/Write	Default/Hex	Description
31:15	/	/	/
14:0	R/W	UDF	OC_RCONS the R constant the value equals to coefficient*2^{4}

DE backend output color G coefficient register

Offset: R component: 0x9E0 G component: 0x9E4 B component: 0x9E8			Register Name: DEBE_OCGCOEF_REG
Bit	Read/Write	Default/Hex	Description
31:14	/	/	/
13:0	R/W	UDF	OC_GCOEF the G coefficient

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			the value equals to coefficient*2^{10}

DE backend output color G constant register

Offset: 0x9EC			Register Name: DEBE_OCGCONS_REG
Bit	Read/Write	Default/Hex	Description
31:15	/	/	/
14:0	R/W	UDF	OC_GCONS the G constant the value equals to coefficient*2^4

DE backend output color B coefficient register

Offset: G/Y component: 0x9F0 R/U component: 0x9F4 B/V component: 0x9F8			Register Name: DEBE_OCBCOEF_REG
Bit	Read/Write	Default/Hex	Description
31:14	/	/	/
13:0	R/W	UDF	OC_BCOEF the B coefficient the value equals to coefficient*2^{10}

DE backend output color B constant register

Offset: 0x9FC			Register Name: DEBE_OCBCONS_REG
Bit	Read/Write	Default/Hex	Description
31:15	/	/	/
14:0	R/W	UDF	OC_BCONS the B constant the value equals to coefficient*2^4

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5.5 MIPI DSI

5.5.1 Overview

The Display Serial Interface (DSI) specifies the interface between a host processor and peripheral such as a display module.

The MIPI DSI of R16 processor features:

- Comply with MIPI DSI v1.01 and MIPI D-PHY v1.00
- 1 / 2 / 3 / 4 data lane configuration and up to 700Mbps per lane
- Support ECC, CRC generation and EOT package
- Support up to 1280x800@60fps with 4 data lanes
- Support command mode
- Support video mode
  - Non-burst mode with sync pulses
  - Non-burst mode with sync event
  - Burst mode
- Supported pixel formats: RGB888, RGB666, RGB666 packed, and RGB565
- Support MIPI DCS, bidirectional configuration in LP

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5.5.2 Block Diagram

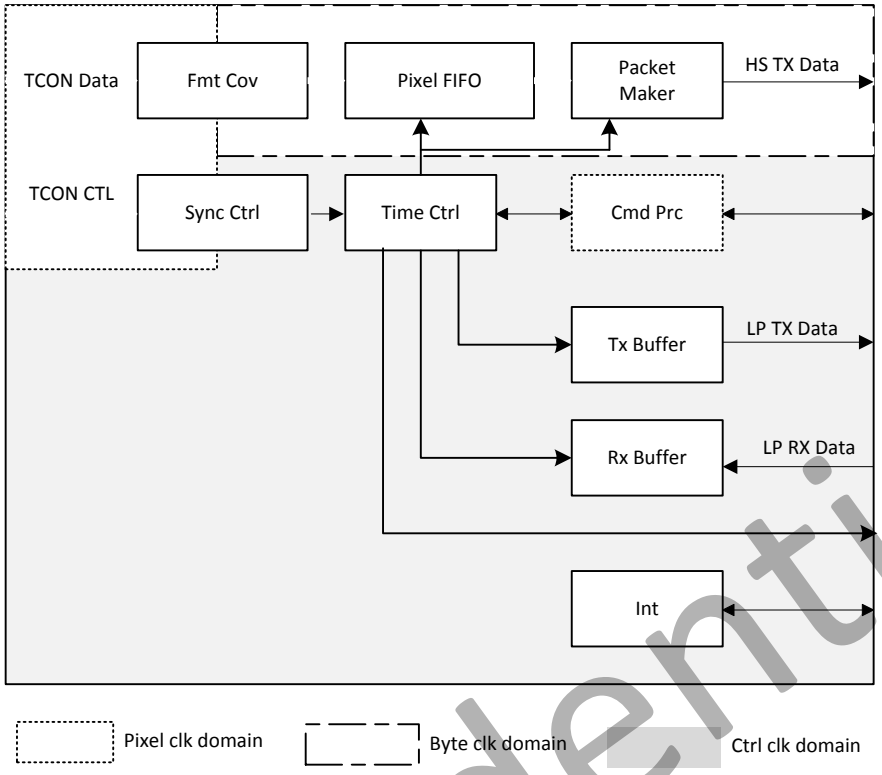

Figure 5.5-1 MIPI DSI Block Diagram

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5.5.3 DSI Register List

Module Name	Base Address
DSI	0x01CA0000

Register Name	Offset	Description
DSI_CTL_REG	0x000	DSI control register
DSI_GINT0_REG	0x004	DSI global interrupt register0
DSI_GINT1_REG	0x008	DSI global interrupt register1
DSI_BASIC_CTL_REG	0x00C	DSI basic control register
DSI_BASIC_CTL0_REG	0x010	DSI basic control register0
DSI_BASIC_CTL1_REG	0x014	DSI basic control register1
DSI_BASIC_SIZE0_REG	0x018	DSI basic timing register0
DSI_BASIC_SIZE1_REG	0x01C	DSI basic timing register1
DSI_PIXEL_CTL0_REG	0x080	DSI pixel control register0
DSI_PIXEL_CTL1_REG	0x084	DSI pixel control register1
DSI_PIXEL_PH_REG	0x090	DSI pixel packet header register
DSI_PIXEL_PD_REG	0x094	DSI pixel packet data register
DSI_PIXEL_PF0_REG	0x098	DSI pixel packet footer register0
DSI_PIXEL_PF1_REG	0x09C	DSI pixel packet footer register1
DSI_SYNC_HSS_REG	0x0B0	DSI H Sync Start register
DSI_SYNC_HSE_REG	0x0B4	DSI H Sync End register
DSI_SYNC_VSS_REG	0x0B8	DSI V Sync Start register
DSI_SYNC_VSE_REG	0x0BC	DSI V Sync End register
DSI_BLK_HSA0_REG	0x0C0	DSI Blanking H Sync Active register0
DSI_BLK_HSA1_REG	0x0C4	DSI Blanking H Sync Active register1
DSI_BLK_HBP0_REG	0x0C8	DSI Blanking H Back Porch register0
DSI_BLK_HBP1_REG	0x0CC	DSI Blanking H Back Porch register0
DSI_BLK_HFP0_REG	0x0D0	DSI Blanking H Front Porch register0
DSI_BLK_HFP1_REG	0x0D4	DSI Blanking H Front Porch register1
DSI_BLK_HBLK0_REG	0x0E0	DSI H Blanking register0
DSI_BLK_HBLK1_REG	0x0E4	DSI H Blanking register1
DSI_BLK_VBLK0_REG	0x0E8	DSI V Blanking register0
DSI_BLK_VBLK1_REG	0x0EC	DSI V Blanking register1
DSI_CMD_CTL_REG	0x200	DSI command control register
DSI_CMD_RX_REG	0x240+N*0x04	DSI command rx register (N=0,1,2,3,4,5,6,7)
DSI_CMD_TX_REG	0x300+N*0x04	DSI command tx register (N=0,1,2,…,63)

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5.5.4 DSI Register Description

DSI_CTL_REG

Offset: 0x000			Register Name: DSI_CTL_REG
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/
0	R/W	0	DSI_EN 0: disable 1: enable When it's disabled, the module will be reset to idle state.

DSI_GINT0_REG

Offset: 0x004			Register Name: DSI_GINT0_REG
Bit	Read/Write	Default/Hex	Description
31:20	/	/	/
19	R/W	0	Video_Line_Int_Flag
18	R/W	0	Video_Vb_Int_Flag
17	R/W	0	Instru_Step_Flag
16	R/W	0	Instru_End_Flag
15:4	/	/	/
3	R/W	0	Video_Line_Int_En 0: disable 1: enable
2	R/W	0	Video_Vb_Int_En 0: disable 1: enable
1	R/W	0	Instru_Step_En 0: disable 1: enable
0	R/W	0	Instru_End_En 0: disable 1: enable

DSI_GINT1_REG

Offset: 0x008			Register Name: DSI_GINT1_REG
Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:0	R/W	0	Video_Line_Int_Num

DSI_BASIC_CTL_REG

Offset: 0x00C			Register Name: DSI_GINT1_REG
Bit	Read/Write	Default/Hex	Description
31:27	/	/	/
26:24	R/W	0	brdy_l_sel
23:16	R/W	0	brdy_set

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15:8	/	/	/
7:4	R/W	0	Trail_inv 0: disable 1: enable
3	R/W	0	Trail_fill 0: disable 1: enable fill 2bytes as trail
2	R/W	0	HBP_dis 0: Normal mode 1: HBP diable
1	R/W	0	HSA_HSE_dis 0: Normal mode 1: HSA and HSE diable
0	R/W	0	Video_Mode_Burst 0: Normal mode 1: Burst mode when in burst mode, enter lp11 in line

DSI_BASIC_CTL0_REG

Offset: 0x010			Register Name: DSI_BASIC_CTL0_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28	R/W	0	Vsync_Existence 0: exit 1: no exit
27:19	/	/	/
18	R/W	0	HS_Eotp_En 0: disable 1: enable enable eotp packet at the end of every HS transmission format: “08h” “0fh” “0fh” “01h”
17	R/W	0	CRC_En 0: disable 1: enable
16	R/W	0	ECC_En 0: disable 1: enable
15:13	/	/	/
12	R/W	0	FIFO_Gating 0: disable 1: enable Gating data from TCON, note that TCON data is gating in frame unit.
11	/	/	/
10	R/W	0	FIFO_Manual_Reset write ‘1’ to reset all correlation FIFO, write’0’ has no effect.

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9:6	/	/	/
5:4	R/W	0	Src_Sel 00: tcon data 01: test data 1x: reservd write '1' to reset all correlation FIFO, write'0' has no effect.
3:1	/	/	/
0	R/W	0	Instru_En 0: disable 1: enable When instruction enable, dsi process from instruction0.

DSI_BASIC_CTL1_REG

Offset: 0x014			Register Name: DSI_BASIC_CTL1_REG
Bit	Read/Write	Default/Hex	Description
31:12	R/W	0	reserved
11:4	R/W	0	Video_Start_Delay delay by lines, only valid in video mode
3	/	/	/
2	R/W	0	Video_Precision_Mode_Align 0: cut mode 1: fill mode
1	R/W	0	Video_Frame_Start 0：normal mode 1：precision mode set '0' start new frame by inst, set '1' start new frame by cntr.
0	R/W	0	DSI_Mode 0: command mode 1: video mode in video mode,enable timing define in basic size

DSI_BASIC_SIZE0_REG

Offset: 0x018			Register Name: DSI_BASIC_SIZE0_REG
Bit	Read/Write	Default/Hex	Description
31:28	/	/	/
27:16	R/W	0	Video_VBP
15:12	/	/	/
11:0	R/W	0	Video_VSA

DSI_BASIC_SIZE1_REG

Offset: 0x01C	Register Name: DSI_BASIC_SIZE1_REG

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Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:16	R/W	0	Video_VT
15:12	/	/	/
11:0	R/W	0	Video_VACT

DSI_PIXEL_CTL0_REG

Offset: 0x080			Register Name: DSI_PIXEL_CTL0_REG
Bit	Read/Write	Default/Hex	Description
31:17	/	/	/
16	R/W	0	PD_Plug_Dis disable PD plug before pixel bytes
15:5	/	/	/
4	R/W	0	Pixel_Endian 0: LSB first 1: MSB first
3:0	R/W	0	Pixel_Format Command mode 0: 24bit (rgb888) 1: 18bit (rgb666) 2: 16bit (rgb565) 3: 12bit (rgb444) 4: 8bit (rgb332) 5: 3bit (rgb111) Video mode 8: 24bit(rgb888) 9: 18bit(rgb666L) 10: 18bit (rgb666) 11: 16bit(rgb565) others: reserved

DSI_PIXEL_CTL1_REG

Offset: 0x084			Register Name: DSI_PIXEL_CTL1_REG
Bit	Read/Write	Default/Hex	Description
31:0	/	/	/

DSI_PIXEL_PH_REG

Offset: 0x090			Register Name: DSI_PIXEL_PH_REG
Bit	Read/Write	Default/Hex	Description
31:24	R/W	0	ECC only valid when DSI ECC is disable
23:8	R/W	0	WC WC is byte numbers of PD in a pixel packet
7:6	R/W	0	VC

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			Virtual Channel
5:0	R/W	0	DT video mode 24bit, set as “3eh” video mode L18bit, set as “2eh” video mode 18it, set as “1eh” video mode 16bit, set as “0eh” command mode, set as “39h”

DSI_PIXEL_PD_REG

Offset: 0x094			Register Name: DSI_PIXEL_PD_REG
Bit	Read/Write	Default/Hex	Description
31:24	/	/	/
23:16	R/W	0	PD_TranN Used in transmissions except 1st one, set as “3Ch”,only valid when PD_Plug_Dis is set to ‘0’
15:8	/	/	/
7:0	R/W	0	PD_Tran0 Used in 1st transmission, set as “2Ch”, only valid when PD_Plug_Dis is set to ‘0’

DSI_PIXEL_PF0_REG

Offset: 0x098			Register Name: DSI_PIXEL_PF0_REG
Bit	Read/Write	Default/Hex	Description
31:16	/	/	/
15:0	R/W	0	CRC_Force CRC force to this value, this value is only valid when CRC is disable

DSI_PIXEL_PF1_REG

Offset: 0x09C			Register Name: DSI_PIXEL_PF1_REG
Bit	Read/Write	Default/Hex	Description
31:16	R/W	0xffff	CRC_Init_LineN CRC initial to this value in transmission except 1st one, only valid when CRC is enabled.
15:0	R/W	0xffff	CRC_Init_Line0 CRC initial to this value in 1st transmission every frame, only valid when CRC is enabled.

DSI_SYNC_HSS_REG

Offset: 0x0B0			Register Name: DSI_SYNC_HSS_REG
Bit	Read/Write	Default/Hex	Description
31:24	R/W	0	ECC set as “12h”
23:16	R/W	0	D1 set as “00h”
15:8	R/W	0	D0

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			set as “00h”
7:6	R/W	0	VC Virtual Channel
5:0	R/W	0	DT HSS, set as “21h”

DSI_SYNC_HSE_REG

Offset: 0x0B4			Register Name: DSI_SYNC_HSE_REG
Bit	Read/Write	Default/Hex	Description
31:24	R/W	0	ECC set as “01h”
23:16	R/W	0	D1 set as “00h”
15:8	R/W	0	D0 set as “00h”
7:6	R/W	0	VC Virtual Channel
5:0	R/W	0	DT HSE, set as “31h”

DSI_SYNC_VSS_REG

Offset: 0x0B8			Register Name: DSI_SYNC_VSS_REG
Bit	Read/Write	Default/Hex	Description
31:24	R/W	0	ECC set as “07h”
23:16	R/W	0	D1 set as “00h”
15:8	R/W	0	D0 set as “00h”
7:6	R/W	0	VC Virtual Channel
5:0	R/W	0	DT VSS, set as “01h”

DSI_SYNC_VSE_REG

Offset: 0x0BC			Register Name: DSI_SYNC_VSE_REG
Bit	Read/Write	Default/Hex	Description
31:24	R/W	0	ECC set as “14h”
23:16	R/W	0	D1 set as “00h”
15:8	R/W	0	D0 set as “00h”
7:6	R/W	0	VC Virtual Channel
5:0	R/W	0	DT

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			VSE, set as “11h”

DSI_BLK_HSA0_REG

Offset: 0x0C0			Register Name: DSI_BLK_HSA0_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0	HSA_PH Note that bit23:8 is WC, define byte numbers of PD in a blank packet

DSI_BLK_HSA1_REG

Offset: 0x0C4			Register Name: DSI_BLK_HSA1_REG
Bit	Read/Write	Default/Hex	Description
31:16	R/W	0	HSA_PF
15:8	/	/	/
7:0	R/W	0	HSA_PD

DSI_BLK_HBP0_REG

Offset: 0x0C8			Register Name: DSI_BLK_HBP0_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0	HBP_PH Note that bit23:8 is WC, define byte numbers of PD in a blank packet

DSI_BLK_HBP1_REG

Offset: 0x0CC			Register Name: DSI_BLK_HBP1_REG
Bit	Read/Write	Default/Hex	Description
31:16	R/W	0	HBP_PF
15:8	/	/	/
7:0	R/W	0	HBP_PD

DSI_BLK_HFP0_REG

Offset: 0x0D0			Register Name: DSI_BLK_HFP0_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0	HFP_PH Note that bit23:8 is WC, define byte numbers of PD in a blank packet

DSI_BLK_HFP1_REG

Offset: 0x0D4			Register Name: DSI_BLK_HFP1_REG
Bit	Read/Write	Default/Hex	Description
31:16	R/W	0	HFP_PF

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15:8	/	/	/
7:0	R/W	0	HFP_PD

DSI_BLK_HBLK0_REG

Offset: 0x0E0			Register Name: DSI_BLK_HBLK0_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0	HBLK_PH Note that bit23:8 is WC, define byte numbers of PD in a blank packet

DSI_BLK_HBLK1_REG

Offset: 0x0E4			Register Name: DSI_HBLK_BLK1_REG
Bit	Read/Write	Default/Hex	Description
31:16	R/W	0	HBLK_PF
15:8	/	/	/
7:0	R/W	0	HBLK_PD

DSI_BLK_VBLK0_REG

Offset: 0x0E8			Register Name: DSI_BLK_VBLK0_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0	VBLK_PH Note that bit23:8 is WC, define byte numbers of PD in a blank packet

DSI_BLK_VBLK1_REG

Offset: 0x0EC			Register Name: DSI_BLK_VBLK1_REG
Bit	Read/Write	Default/Hex	Description
31:16	R/W	0	VBLK_PF
15:8	/	/	/
7:0	R/W	0	VBLK_PD

DSI_CMD_CTL_REG

Offset: 0x200			Register Name: DSI_CMD_CTL_REG
Bit	Read/Write	Default/Hex	Description
31:25	/	/	/
26	R/W	0	RX_Overflow 1: rx data is overflow register buffer Note: Write‘1’ to clear this bit. Write’0’ has no effect.
25	R/W	0	RX_Flag 1: rx has happened Note: Write‘1’ to clear this bit. Write’0’ has no effect.
24	R	0	RX_Status 0: rx is finish 1: rx is pending

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20:16	R	0	RX_Size (RX_Size+1) is number of bytes in the last rx.
15:9	/	/	/
9	R/W	0	TX_Flag 1: tx has happened Note: Write'1' to clear this bit. Write'0' has no effect.
8	R	0	TX_Status 0: tx is finish 1: tx is pending
7:0	R/W	0	TX_Size (TX_Size+1) is number of bytes ready to tx

DSI_CMD_RX_REG

Offset: 0x240+N*0x04 (N=0,1,2,3,4,5,6,7)			Register Name: DSI_CMD_RX_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0	Data Bit: 31:24 23:16 15:8 7:0 N=0: Byte03 Byte02 Byte01 Byte00 N=1: Byte07 Byte06 Byte05 Byte04 N=2: Byte11 Byte10 Byte09 Byte08 N=3: Byte15 Byte14 Byte13 Byte12 N=4: Byte19 Byte18 Byte17 Byte16 N=5: Byte23 Byte22 Byte21 Byte20 N=6: Byte27 Byte26 Byte25 Byte24 N=7: Byte31 Byte30 Byte29 Byte28 Data from rx, only in LPDT Only read when RX_Flag is set. No way to clear this FIFO.

DSI_CMD_TX_REG

Offset:0x300+N*0x04 (N=0,1,2…255)			Register Name: DSI_CMD_TX_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0	Data Bit: 31:24 23:16 15:8 7:0 N=0: Byte03 Byte02 Byte01 Byte00 N=1: Byte07 Byte06 Byte05 Byte04 N=2: Byte11 Byte10 Byte09 Byte08 N=3: Byte15 Byte14 Byte13 Byte12 N=4: Byte19 Byte18 Byte17 Byte16 N=5: Byte23 Byte22 Byte21 Byte20 N=6: Byte27 Byte26 Byte25 Byte24 N=7: Byte31 Byte30 Byte29 Byte28 Data for tx, transmission in HS and LPDT, defined by INST_REG

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5.6 IEP

The IEP (Image Enhancement Processor) of R16 processor includes SAT, DRC, and write back controller.

5.6.1 SAT

Saturation enhancement (SAT) is introduced in R16 platform to adjust saturation so that a better vivid vision effect can be achieved.

It includes the following features:

- Support 1280x800 input/output
- Support saturation histogram to adjust the enhance level.

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5.6.2 DRC

DRC (Dynamic Range Control) adjusts the image mapping curve according to the histogram frame by frame. The control function can be defined by the software driver according to the application. A typical application is content-based backlight control.

It includes the following features:

- Support 1280x800 input/output
- Support HISTOGRAM and DRC in YUV or HSV color space

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5.6.3 Write-Back Controller

Overview

Write-Back Controller is a circuit for capturing data between display engine and LCD controller. Data will be written back to SDRAM.

The Write-Back controller includes following features:

- Support 1280x800 pixels write-back
- Support source cropping
- Support RGB888 and YUV444 format input
- Support write-back pitch setting
- Support interleaved ARGB8888 and NV12/NV21 output
- Support down sample to 1/2X, 1/4X
- Color space converter included

Write-Back Controller Block Diagram

Figure 5.6-1 Write-Back Controller Block Diagram

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5.6.4 Write-Back Controller Register List

Module name	Base address
Write-back Controller	0x01E7 0200

Register name	Offset	Description
WBC_GCTRL_REG	0x000	Module General Control Register
WBC_SIZE_REG	0x004	Input Size Register
WBC_CROP_COORD_REG	0x008	Cropping Coordinate Register
WBC_CROP_SIZE_REG	0x00c	Cropping Size Register
WBC_CH0_ADDR_REG	0x010	Write-Back Channel 0 Address Register
WBC_CH1_ADDR_REG	0x014	Write-Back Channel 1 Address Register
WBC_CH0_LSTRD_REG	0x020	Write-Back Channel 0 Linestride Register
WBC_CH1_LSTRD_REG	0x024	Write-Back Channel 1 Linestride Register
WBC_RESIZER_REG	0x030	Resizer Setting Register
WBC_FORMAT_REG	0x034	Output Format Register
WBC_INT_REG	0x038	Interrupt Control Register
WBC_STATUS_REG	0x03c	Module Status Register
WBC_BURST_REG	0x040	DMA Burst Setting
WBC_CSC_COEF00_REG	0x050	CSC Coefficient 00 Register
WBC_CSC_COEF01_REG	0x054	CSC Coefficient 01 Register
WBC_CSC_COEF02_REG	0x058	CSC Coefficient 02 Register
WBC_CSC_COEF03_REG	0x05c	CSC Coefficient 03 Register
WBC_CSC_COEF10_REG	0x060	CSC Coefficient 10 Register
WBC_CSC_COEF11_REG	0x064	CSC Coefficient 11 Register
WBC_CSC_COEF12_REG	0x068	CSC Coefficient 12 Register
WBC_CSC_COEF13_REG	0x06c	CSC Coefficient 13 Register
WBC_CSC_COEF20_REG	0x070	CSC Coefficient 20 Register
WBC_CSC_COEF21_REG	0x074	CSC Coefficient 21 Register
WBC_CSC_COEF22_REG	0x078	CSC Coefficient 22 Register
WBC_CSC_COEF23_REG	0x07c	CSC Coefficient 23 Register

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5.6.5 Write-Back Controller Register Description

Module general control register

Offset: 0X000			Register name: WBC_GCTRL_REG
Bit	Read/Write	Default/Hex	Description
31	R/W	0	BIST_EN BIST enable 0: disable 1: enable
30:21	/	/	/
20	R/W	0	WB_STOP_TIMING When error occurs, module stop accessing dram or not. 0: Write-back DONOT stop. 1: Write-back stops.
19:17	/	/	/
16	R/W	0	WB_EN Start write-back process. 0: Enable 1: Disable If **WB_MODE** set to 0, the write back process will start when **WB_EN** is set and a new frame processing begins. Otherwise, if **WB_MODE** set to 1**,** write back process will start immediately. The bit will be self-cleared when writing-back frame process starts.
15:13	/	/	/
12	R/W	0	IN_PORT_SEL Input port selection 0: port 0 (DRC input) 1: port 1 (DRC output)
11:09	/	/	/
08	R/W	0	WB_MODE Write-back mode setting 0: Capture mode: Write-back and display simultaneously.(support port 0 and port 1) 1: Write-back only mode: Write-back to dram only, display will disable.(support port 1 only)
07:05	/	/	/
04	R/W	0	REG_RDY_EN Buffered registers configuration ready switch 0: Not ready 1: Registers configuration ready Note: When the new frame start, the bit will also be self-cleared.
03:01	/	/	/
00	R/W	0	EN

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			Module enable 0: Disable 1: Enable

Input size register

Offset: 0X004			Register name: WBC_SIZE_REG
Bit	Read/Write	Default/Hex	Description
31:27	/	/	/
26:16	R/W	0	HEIGHT Input height The real input height = The value of these bits + 1.
15:11	/	/	/
10:00	R/W	0	WIDTH Input width The real input width = The value of these bits + 1.

Cropping coordinate register

Offset: 0X008			Register name: WBC_CROP_COORD_REG
Bit	Read/Write	Default/Hex	Description
31:27	/	/	/
26:16	R/W	0	CROP_TOP Cropping top position Top position is the left-top y coordinate of input window in pixels
15:11	/	/	/
10:00	R/W	0	CROP_LEFT Cropping left position Left position is left-top x coordinate of input window in pixels

Cropping size register

Offset: 0X00c			Register name: WBC_CROP_SIZE_REG
Bit	Read/Write	Default/Hex	Description
31:27	/	/	/
26:16	R/W	0	CROP_HEIGHT Cropping region height The real cropping region height = the value of these bits + 1.
15:11	/	/	/
10:00	R/W	0	CROP_WIDTH Cropping region width The real cropping region width = the value of these bits + 1.

Write-back channel 0 address register

Offset: 0X010			Register name: WBC_CH0_ADDR_REG
Bit	Read/Write	Default/Hex	Description

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31:00	R/W	0	ADDR Write-back channel 0 address in BYTE. When output format is ARGB, **ADDR** must 4 bytes aligning.

Write-back channel 1 address register

Offset: 0X014			Register name: WBC_CH1_ADDR_REG
Bit	Read/Write	Default/Hex	Description
31:00	R/W	0	ADDR Write-back channel 1 address in BYTE. When output format is ARGB, **ADDR** must 4 bytes aligning.

Write-back channel 0 linestride register

Offset: 0X020			Register name: WBC_CH0_LSTRD_REG
Bit	Read/Write	Default/Hex	Description
31:00	R/W	0	LSTRD Write-back channel 0 linestride in BYTE. When output format is ARGB, **LSTRD** must 4 bytes aligning.

Write-back channel 1 linestride register

Offset: 0X024			Register name: WBC_CH1_LSTRD_REG
Bit	Read/Write	Default/Hex	Description
31:00	R/W	0	LSTRD Write-back channel 1 linestride in BYTE. When output format is ARGB, **LSTRD** must 4 bytes aligning.

Resizer setting register

Offset: 0X030			Register name: WBC_RESIZER_REG
Bit	Read/Write	Default/Hex	Description
31:02	/	/	/
01:00	R/W	0	FACTOR Output down sample factor. 0: 1X 1: 1/2X 2: 1/4X 3: reserved

Output format register

Offset: 0X034			Register name: WBC_FORMAT_REG
Bit	Read/Write	Default/Hex	Description
31:05	/	/	/
04	R/W	0	PS Output format pixel sequence

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			In **ARGB8888** data mode: 0: BGRA(bit31 to bit0) 1: ARGB In **UV combined** data mode: (UV component) 00: V1U1V0U0 01: U1V1U0V0
03:01	/	/	/
00	R/W	0	FORMAT Output format selection 0: Interleaved ARGB8888 (alpha is always 0xff) 1: Non tile-based UV combined YUV420.

Interrupt control register

Offset: 0X038			Register name: WBC_INT_REG
Bit	Read/Write	Default/Hex	Description
31:17	/	/	/
16	R/W	0	WB_END_INT_TIMING Timing when write-back end interrupt sends 0: last data writing to SDRAM 1: last command sending to mbus
15:07	/	/	/
06	R/W	0	WB_UNFINISH_INT_EN Write-back unfinish error interrupt enable 0: Enable 1: Disable
05	R/W	0	WB_FIFO_OVF_INT_EN Write-back FIFO overflow error interrupt enable 0: Enable 1: Disable
04	R/W	0	WB_FIFO_EMPTY_INT_EN Write-back FIFO empty error interrupt enable 0: Enable 1: Disable
03:01	/	/	/
00	R/W	0	WB_END_INT_EN Write-back end interrupt enable 0: Enable 1: Disable

Module status register

Offset: 0X03c			Register name: WBC_STATUS_REG
Bit	Read/Write	Default/Hex	Description
31:09	/	/	/
08	R	0	WB_BUSY

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			Write-back process status 0: write-back end or write-back disable 1: write-back in process This flag indicates that a full frame has not been written back to the memory. The bit will be set when write-back enable bit is set, and be cleared when write-back process end. When module restarts, this bit will be also cleared. When error occur
07	/	/	/
06	R/W	0	WB_UNFINISH_ERR Write-back unfinish error status 0: No error 1: Error Write 1 to clear. Module restarts, this bit will be also cleared.
05	R/W	0	WB_FIFO_OVF_ERR Write-back FIFO overflow error status 0: No error 1: Error Write 1 to clear. Module restarts, this bit will be also cleared.
04	R/W	0	WB_FIFO_EMPTY_ERR Write-back FIFO empty error status 0: No error 1: Error Write 1 to clear. Module restarts, this bit will be also cleared.
03:01	/	/	/
00	R/W	0	WB_END_FLAG Write-back process finish flag 0: write-back unfinished 1: write-back finished This flag indicates that a full frame has not been written back to the memory. The bit will be set when write-back process end. Write 1 to clear. Module restarts, this bit will be also cleared.

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DMA burst setting

Offset: 0x040			Register Name: WBC_DMA_REG
Bit	Read/Write	Default/Hex	Description
31:02	/	/	/
01:00	R/W	0x0	BURST_LEN DMA burst length 0: 16 words 1: 32 words 2: 64 words 3: 128 words

CSC coefficient 00 register

Offset: 0x050			Register Name: WBC_CSC_COEF00_REG
Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:00	R/W	0x0	COEF the Y/R coefficient the value equals to coefficient*2^{10}

CSC coefficient 01 register

Offset: 0x054			Register Name: WBC_CSC_COEF01_REG
Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:00	R/W	0x0	COEF the Y/R coefficient the value equals to coefficient*2^{10}

CSC coefficient 02 register

Offset: 0x058			Register Name: WBC_CSC_COEF02_REG
Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:0	R/W	0x0	COEF the Y/R coefficient the value equals to coefficient*2^{10}

CSC coefficient 03 register

Offset: 0x05c			Register Name: WBC_CSC_COEF03_REG
Bit	Read/Write	Default/Hex	Description
31:14	/	/	/
13:0	R/W	0x0	CONT the Y/R constant the value equals to coefficient*2^{4}

CSC coefficient 10 register

Offset: 0x060	Register Name: WBC_CSC_COEF10_REG

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Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:0	R/W	0x0	COEF the U/G coefficient the value equals to coefficient*2^{10}

CSC coefficient 11 register

Offset: 0x064			Register Name: WBC_CSC_COEF11_REG
Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:0	R/W	0x0	COEF the U/G coefficient the value equals to coefficient*2^{10}

CSC coefficient 12 register

Offset: 0x068			Register Name: WBC_CSC_COEF12_REG
Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:0	R/W	0x0	COEF the U/G coefficient the value equals to coefficient*2^{10}

CSC coefficient 13 register

Offset: 0x06c			Register Name: WBC_CSC_COEF13_REG
Bit	Read/Write	Default/Hex	Description
31:14	/	/	/
13:00	R/W	0x0	CONT the U/G constant the value equals to coefficient*2^{4}

CSC coefficient 20 register

Offset: 0x070			Register Name: WBC_CSC_COEF20_REG
Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:0	R/W	0x0	COEF the V/B coefficient the value equals to coefficient*2^{10}

CSC coefficient 22 register

Offset: 0x074			Register Name: WBC_CSC_COEF21_REG
Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:0	R/W	0x0	COEF the V/B coefficient the value equals to coefficient*2^{10}

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CSC coefficient 22 register

Offset: 0x078			Register Name: WBC_CSC_COEF22_REG
Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:0	R/W	0x0	COEF the V/B coefficient the value equals to coefficient*2^{10}

CSC coefficient 23 register

Offset: 0x07c			Register Name: WBC_CSC_COEF23_REG
Bit	Read/Write	Default/Hex	Description
31:14	/	/	/
13:00	R/W	0x0	CONT the V/B constant the value equals to coefficient*2^{4}

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Chapter 6 Video Input

This chapter details the video input system of R16 processor from following perspectives:

- CSI

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6.1 CSI

The R16 processor comes with one parallel CMOS sensor interface that supports up to 5M pixels.

6.1.1 Features

- Support 8bit yuv422 CMOS sensor interface
- Support CCIR656 protocol for NTSC and PAL
- Maximum still capture resolution to 5M
- Maximum video capture resolution to 1080p@30fps
- Parsing interleaved YCbCr 422 data into planar or MB Y, Cb, Cr output to memory
- Parsing YCbCr 420 data into planar or MB Y, Cb, Cr output to memory
- Parsing interlaced data into field or frame output to memory
- Received data double buffer support
- Crop and scale support
- H/V-flip and rotation support
- Frame rate counter statistic

CCI

- Compatible with I2C transmission in 7-bit slave ID and 1-bit R/W
- Automatic transmission
- Support 0/8/16/32-bit register address
- Support 8/16/32-bit data
- Support 64-byte FIFO input CCI data
- Synchronized with CSI signal and delay trigger supported
- Support repeated transmission with sync signal

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6.1.2 Block Diagram

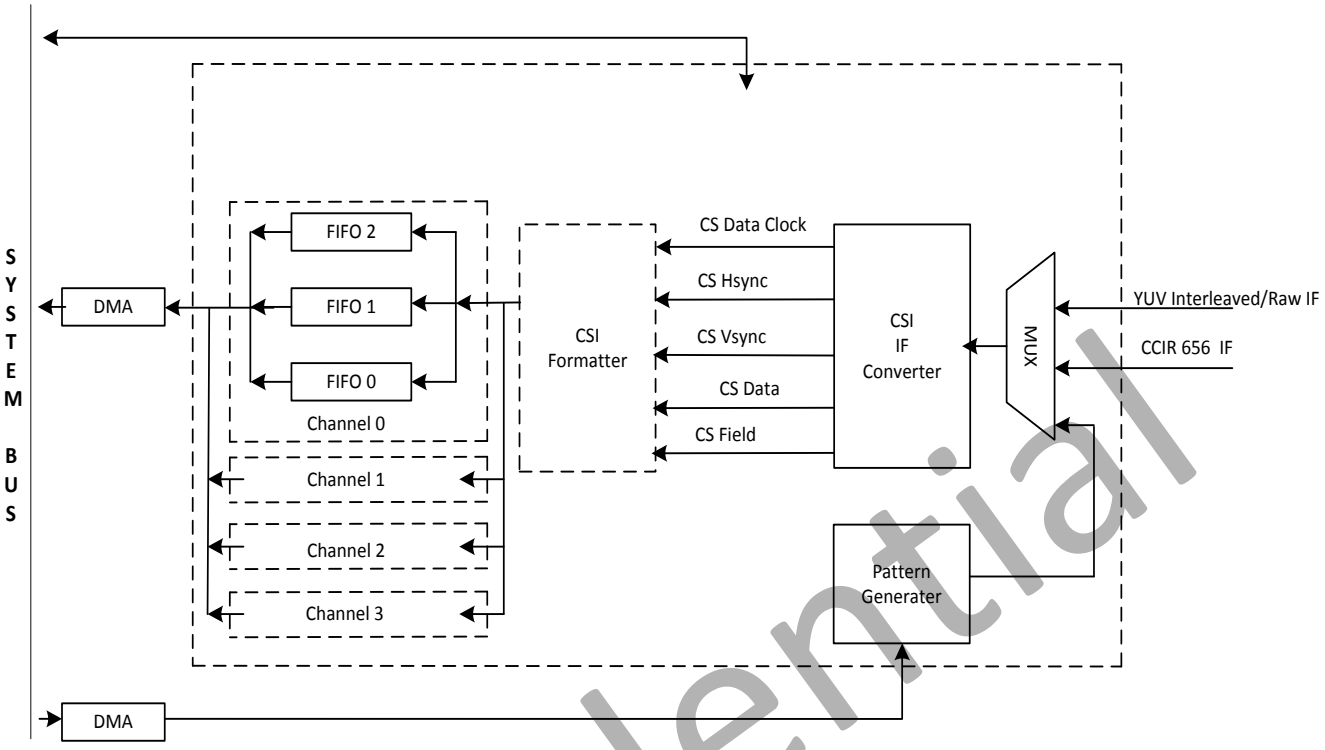

Figure 6.1-1 CSI Block Diagram

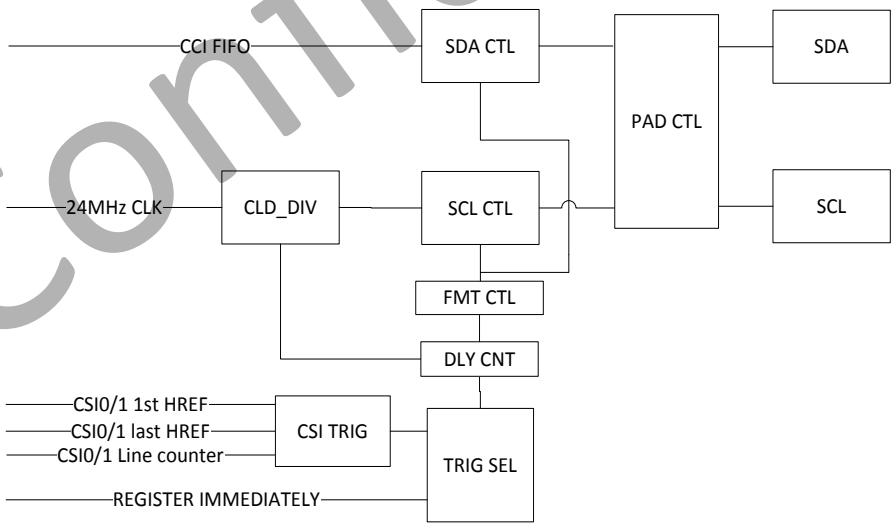

Figure 6.1-2 CCI Block Diagram

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6.1.3 CSI Function Description

CSI FIFO Distribution

Interface	YUYV422 Interleaved/Raw			BT656 Interface	
Input format	YUV422		Raw	YUV422	
Output format	Planar	UV combined/ MB	Raw/RGB/PRGB	Planar	UV combined/MB
CH0_FIFO0	Y pixel data	Y pixel data	All pixels data	Y	Y
CH0_FIFO1	Cb (U) pixel data	Cb (U) Cr (V) pixel data	-	Cb (U)	CbCr (UV)
CH0_FIFO2	Cr (V) pixel data	-	-	Cr (V)	

Interface	BT656 Interface		Channels		
Input format	YUV422				
Output format	Planar	UV combined/ MB			
CH0_FIFO0	Y	Y	1	2	4
CH0_FIFO1	Cb (U)	CbCr (UV)			
CH0_FIFO2	Cr (V)	-			
CH1_FIFO0	Y	Y	-		
CH1_FIFO1	Cb (U)	CbCr (UV)			
CH1_FIFO2	Cr (V)	-			
CH2_FIFO0	Y	Y		-	
CH2_FIFO1	Cb (U)	CbCr (UV)			
CH2_FIFO2	Cr (V)	-			
CH3_FIFO0	Y	Y			
CH3_FIFO1	Cb (U)	CbCr (UV)			
CH3_FIFO2	Cr (V)	-			

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Timing

CSI timing

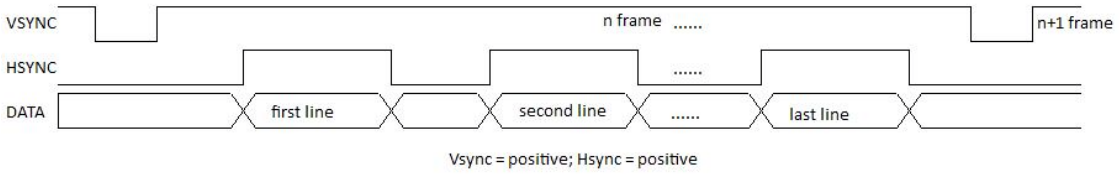

Figure 6.1-2 Vref= positive; Href= positive

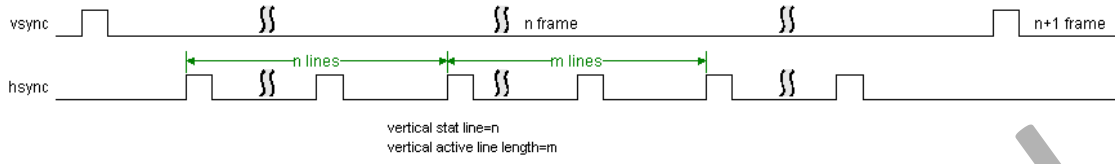

Figure 6.1-3 vertical size setting

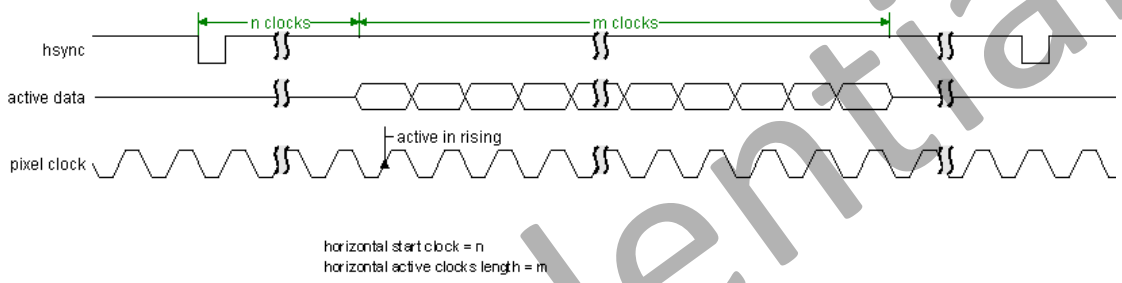

Figure 6.1-4 horizontal size setting and pixel clock timing(Href= positive)

CCIR656 Header Code

CCIR656 Header Data Bit Definition

Data Bit	First Word(0xFF)	Second Word(0x00)	Third Word(0x00)	Fourth Word
CS D[9] (MSB)	1	0	0	1
CS D[8]	1	0	0	F
CS D[7]	1	0	0	V
CS D[6]	1	0	0	H
CS D[5]	1	0	0	P3
CS D[4]	1	0	0	P2
CS D[3]	1	0	0	P1
CS D[2]	1	0	0	P0
CS D[1]	x	x	x	x
CS D[0]	x	x	x	x

For compatibility with an 8-bit interface, CS D[1] and CS D[0] are not defined.

Decode	F	V	H	P3	P2	P1	P0
Field 1 start of active video (SAV)	0	0	0	0	0	0	0
Field 1 end of active video (EAV)	0	0	1	1	1	0	1

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Field 1 SAV (digital blanking)	0	1	0	1	0	1	1
Field 1 EAV (digital blanking)	0	1	1	0	1	1	0
Field 2 SAV	1	0	0	0	1	1	1
Field 2 EAV	1	0	1	1	0	1	0
Field 2 SAV (digital blanking)	1	1	0	1	1	0	0
Field 2 EAV (digital blanking)	1	1	1	0	0	0	1

Offset Definition

Offset in horizontal and vertical can be added when receiving image. Unit is pixel.
For YUV422 format, pixel unit is a YU/YV combination.
For YUV420 format, pixel unit is a YU/YV combination in YC line, and only a Y in Y line.
For Bayer_raw format, pixel unit is a R/G/B single component.
For RGB565, pixel unit is two bytes of RGB565 package.
For RGB888, pixel unit is three bytes of RGB combination.

Flip Definition

Both horizontal and vertical flip are supported at the same time. This function is implemented in the process of each FIFO writing data to memory, only flipping the data of separate FIFO, not changing component to FIFO distribution.

If horizontal flip is enabled, one or more pixels will be took as a unit:
For YUV format, a unit of $Y_0U_0Y_1V_1$ will parser and flip the Y component in one channel, and UV will be treated as a whole. In planar output mode, U and V will be flipped separately. In UV combined output mode, UV will be flipped as a whole. So, a sequence of $Y_1U_0Y_0V_1$ will be.

For Bayer_raw format, situation is much like. A GR/BG sequence will be changed to BG/RG. A unit of square has four pixels.

For RGB565/RGB888, one unit of two/three bytes of component will be flipped with original sequence.

Camera Communication Interface

The CCI module support master mode i2c-compatible single read and write access to camera and related devices.

It reads a series of packet from FIFO(accessed by registers) and transmit with the format defined in specific register(or packet data).

In compact mode, format register define the slave ID, R/W flag, register address width (0/8/16/32…bit), data width (8/16/32…bit) and access counter.
In complete mode, all data and format will be loaded from memory packet.
The access counter should be set to N(N> 0), and it will read N packets from FIFO. The total bytes should not exceed 64 for FIFO input mode.

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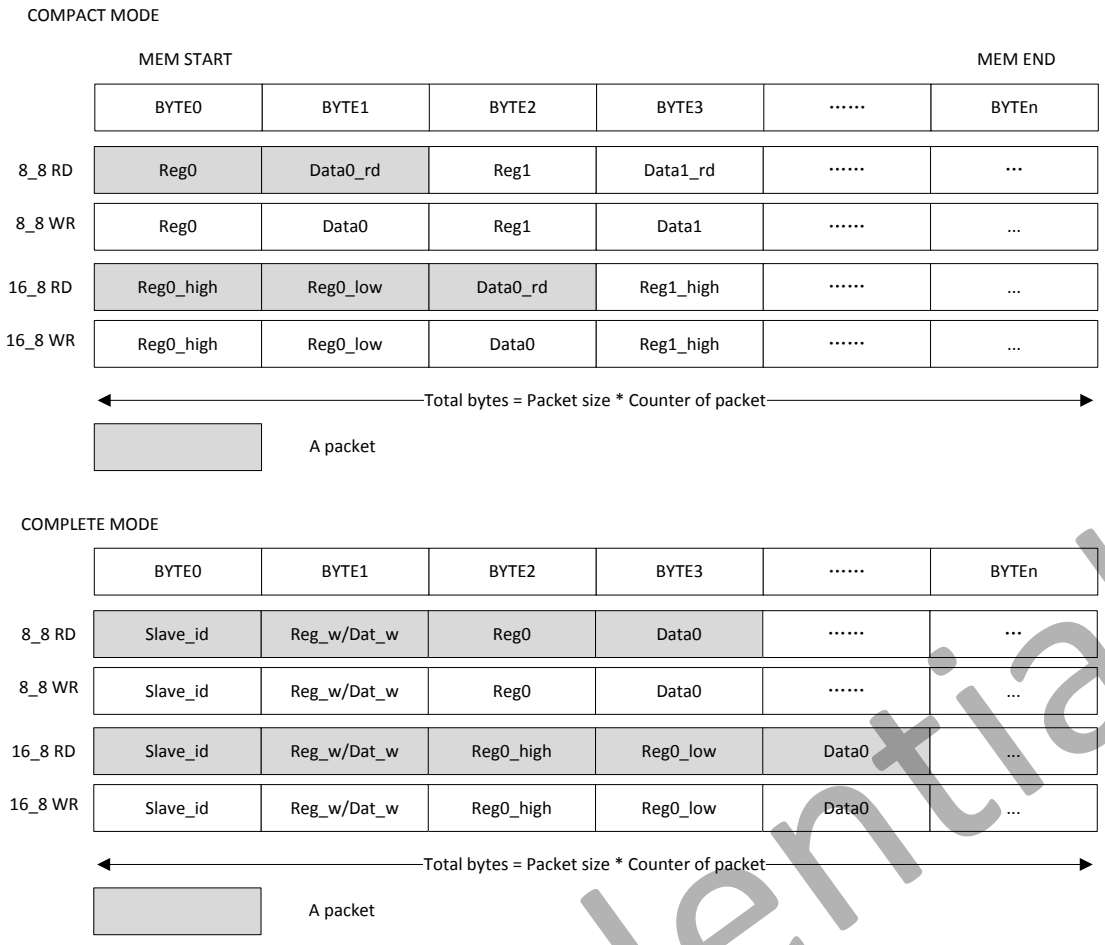

Figure 6.1-5 Camera Communication

A packet is several bytes filled with register address and data(if in complete mode, slave id and width should be filled too) as the i2c access sequence defined. That is, the low address byte will be transmitted/received first. Bytes will be sent in write access, while some address will be written back with the data received in read access.

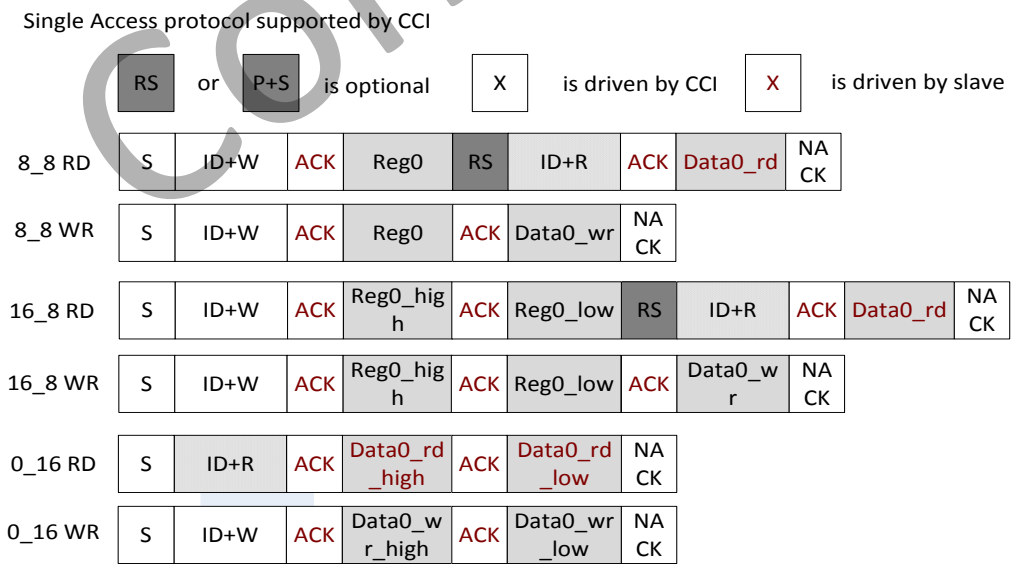

Figure 6.1-6 Single Acess protocol

After set the execution bit, the module will do the transmission automatically and return the result - success or fail. If any access fail, the whole transmission will be stopped and returns the number when it fail in the access

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counter.

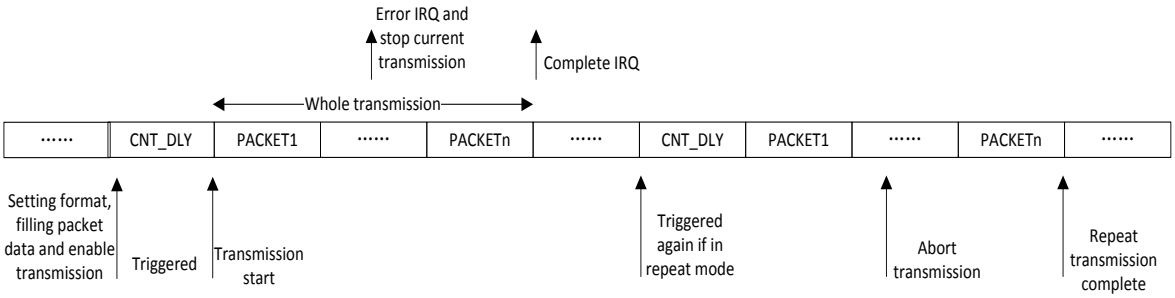

Figure 6.1-7 transmission process

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6.1.4 CSI Register List

Module Name	Base Address
CSI	0x01CB0000

Register Name	Offset	Register Name
CSI_EN_REG	0x0000	CSI Enable register
CSI_IF_CFG_REG	0x0004	CSI Interface Configuration Register
CSI_CAP_REG	0x0008	CSI Capture Register
CSI_SYNC_CNT_REG	0x000C	CSI Synchronization Counter Register
CSI_FIFO_THRS_REG	0x0010	CSI FIFO Threshold Register
CSI_FIFO_STAT_REG	0x0014	CSI FIFO Statistic Register
CSI_PCLK_STAT_REG	0x0018	CSI PCLK Statistic Register
CSI_PTN_LEN_REG	0x0030	CSI Pattern Generation Length register
CSI_PTN_ADDR_REG	0x0034	CSI Pattern Generation Address register
CSI_VER_REG	0x003C	CSI Version Register
CSI_C0_CFG_REG	0x0044	CSI Channel_0 configuration register
CSI_C0_SCALE_REG	0x004C	CSI Channel_0 scale register
CSI_C0_F0_BUFA_REG	0x0050	CSI Channel_0 FIFO 0 output buffer-A address register
CSI_C0_F1_BUFA_REG	0x0058	CSI Channel_0 FIFO 1 output buffer-A address register
CSI_C0_F2_BUFA_REG	0x0060	CSI Channel_0 FIFO 2 output buffer-A address register
CSI_C0_CAP_STA_REG	0x006C	CSI Channel_0 status register
CSI_C0_INT_EN_REG	0x0070	CSI Channel_0 interrupt enable register
CSI_C0_INT_STA_REG	0x0074	CSI Channel_0 interrupt status register
CSI_C0_HSIZE_REG	0x0080	CSI Channel_0 horizontal size register
CSI_C0_VSIZE_REG	0x0084	CSI Channel_0 vertical size register
CSI_C0_BUF_LEN_REG	0x0088	CSI Channel_0 line buffer length register
CSI_C0_FLIP_SIZE_REG	0x008C	CSI Channel_0 flip size register
CSI_C0_FRM_CLK_CNT_REG	0x0090	CSI Channel_0 frame clock counter register
CSI_C0_ACC_ITNL_CLK_CNT_REG	0x0094	CSI Channel_0 accumulated and internal clock counter register
CSI_C1_CFG_REG	0x0144	CSI Channel_1 configuration register
CSI_C1_SCALE_REG	0x014C	CSI Channel_1 scale register
CSI_C1_F0_BUFA_REG	0x0150	CSI Channel_1 FIFO 0 output buffer-A address register
CSI_C1_F1_BUFA_REG	0x0158	CSI Channel_1 FIFO 1 output buffer-A address register
CSI_C1_F2_BUFA_REG	0x0160	CSI Channel_1 FIFO 2 output buffer-A address register

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CSI_C1_CAP_STA_REG	0x016C	CSI Channel_1 status register
CSI_C1_INT_EN_REG	0x0170	CSI Channel_1 interrupt enable register
CSI_C1_INT_STA_REG	0x0174	CSI Channel_1 interrupt status register
CSI_C1_HSIZE_REG	0x0180	CSI Channel_1 horizontal size register
CSI_C1_VSIZE_REG	0x0184	CSI Channel_1 vertical size register
CSI_C1_BUF_LEN_REG	0x0188	CSI Channel_1 line buffer length register
CSI_C1_FLIP_SIZE_REG	0x018C	CSI Channel_1 flip size register
CSI_C1_FRM_CLK_CNT_REG	0x0190	CSI Channel_1 frame clock counter register
CSI_C1_ACC_ITNL_CLK_CNT_REG	0x0194	CSI Channel_1 accumulated and internal clock counter register
CSI_C2_CFG_REG	0x0244	CSI Channel_2 configuration register
CSI_C2_SCALE_REG	0x024C	CSI Channel_2 scale register
CSI_C2_F0_BUFA_REG	0x0250	CSI Channel_2 FIFO 0 output buffer-A address register
CSI0_C2_F1_BUFA_REG	0x0258	CSI Channel_2 FIFO 1 output buffer-A address register
CSI_C2_F2_BUFA_REG	0x0260	CSI Channel_2 FIFO 2 output buffer-A address register
CSI_C2_CAP_STA_REG	0x26C	CSI Channel_2 status register
CSI_C2_INT_EN_REG	0x0270	CSI Channel_2 interrupt enable register
CSI_C2_INT_STA_REG	0x0274	CSI Channel_2 interrupt status register
CSI_C2_HSIZE_REG	0x0280	CSI Channel_2 horizontal size register
CSI_C2_VSIZE_REG	0x0284	CSI Channel_2 vertical size register
CSI_C2_BUF_LEN_REG	0x0288	CSI Channel_2 line buffer length register
CSI_C2_FLIP_SIZE_REG	0x028C	CSI Channel_2 flip size register
CSI_C2_FRM_CLK_CNT_REG	0x0290	CSI Channel_2 frame clock counter register
CSI_C2_ACC_ITNL_CLK_CNT_REG	0x0294	CSI Channel_2 accumulated and internal clock counter register
CSI_C3_CFG_REG	0x0344	CSI Channel_3 configuration register
CSI_C3_SCALE_REG	0x034C	CSI Channel_3 scale register
CSI_C3_F0_BUFA_REG	0x0350	CSI Channel_3 FIFO 0 output buffer-A address register
CSI_C3_F1_BUFA_REG	0x0358	CSI Channel_3 FIFO 1 output buffer-A address register
CSI_C3_F2_BUFA_REG	0x0360	CSI Channel_3 FIFO 2 output buffer-A address register
CSI_C3_CAP_STA_REG	0x036C	CSI Channel_3 status register
CSI_C3_INT_EN_REG	0x0370	CSI Channel_3 interrupt enable register
CSI_C3_INT_STA_REG	0x0374	CSI Channel_3 interrupt status register
CSI_C3_HSIZE_REG	0x0380	CSI Channel_3 horizontal size register
CSI_C3_VSIZE_REG	0x0384	CSI Channel_3 vertical size register
CSI_C3_BUF_LEN_REG	0x0388	CSI Channel_3 line buffer length register
CSI_C3_FLIP_SIZE_REG	0x038C	CSI Channel_3 flip size register
CSI_C3_FRM_CLK_CNT_REG	0x0390	CSI Channel_3 frame clock counter register
CSI_C3_ACC_ITNL_CLK_CNT_REG	0x0394	CSI Channel_3 accumulated and internal clock

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		counter register
CCI_CTRL	0x3000	CCI control register
CCI_CFG	0x3004	CCI transmission config register
CCI_FMT	0x3008	CCI packet format register
CCI_BUS_CTRL	0x300C	CCI bus control register
CCI_INT_CTRL	0x3014	CCI interrupt control register
CCI_LC_TRIG	0x3018	CCI line counter trigger register
CCI_FIFO_ACC	0x3100	CCI FIFO access register
CCI_RSV_REG	0x3200	CCI reserved register

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6.1.5 CSI Register Description

CSI Enable Register

Offset: 0x0000			Register Name: CSI0_EN_REG
Bit	Read/Write	Default/Hex	Description
31	/	/	/
30	R/W	0x0	VER_EN CSI Version Register Read Enable: 0: Disable 1: Enable
29:24	/	/	/
23:16	R/W	0x00	PTN_CYCLE Pattern generating cycle counter. The pattern in dram will be generated in cycles of PTN_CYCLE+1.
15:5	/	/	/
4	R/W	0x0	PTN_START CSI Pattern Generating Start 0: Finish other: Start Software write this bit to“1” to start pattern generating from DRAM. When finished, the hardware will clear this bit to“0”automatically. Generating cycles depends on PTN_CYCLE.
3	R/W	0	CLK_CNT_SPL Sampling time for clk counter per frame 0: Sampling clock counter every frame done 1: Sampling clock counter every vsync
2	R/W	0	CLK_CNT clk count per frame
1	R/W	0	PTN_GEN_EN Pattern Generation Enable
0	R/W	0	CSI_EN Enable 0: Reset and disable the CSI module 1: Enable the CSI module

CSI Interface Configuration Register

Offset: 0x0004			Register Name: CSI0_IF_CFG_REG
Bit	Read/Write	Default/Hex	Description
31:24	/	/	/
23	R/W	0	CSI_SRC_SWAP 0: normal 1: swap src Normally, Csi0/1 parser the h/v and data to Csi0/1

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			interface; Enable this bit will swap the signals after Csi1/0 parser to Csi0/1 interface.
22	/	/	/
21	R/W	0	SRC_TYPE Source type 0: Progressed 1: Interlaced
20	R/W	0	FPS_DS Fps down sample 0: no down sample 1: 1/2 fps, only receives the first frame every 2 frames
19	R/W	0	FIELD For YUV HV timing, Field polarity 0: negative(field=0 indicate odd, field=1 indicate even) 1: positive(field=1 indicate odd, field=0 indicate even) For BT656 timing, Field sequence 0: Normal sequence (field 0 first) 1: Inverse sequence (field 1 first)
18	R/W	1	VREF_POL Vref polarity 0: negative 1: positive This register is not apply to CCIR656 interface.
17	R/W	0	HERF_POL Href polarity 0: negative 1: positive This register is not apply to CCIR656 interface.
16	R/W	1	CLK_POL Data clock type 0: active in falling edge 1: active in rising edge
15:12	/	/	/
11:10	R/W	0	SEQ_8PLUS2 When select IF_DATA_WIDTH to be 8+2bit, odd/even pixel byte at CSI-D[11:4] will be rearranged to D[11:2]+2'b0 at the actual csi data bus according to these sequences: 00: 6'bx+D[9:8], D[7:0] 01: D[9:2], 6'bx+D[1:0] 10: D[7:0], D[9:8]+6'bx 11: D[7:0], 6'bx+D[9:8]
9:8	R/W	0	IF_DATA_WIDTH 00: 8 bit data bus 01: 10 bit data bus 10: 12 bit data bus

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			11: 8+2bit data bus
7	R/W	0	MIPI_IF MIPI Interface Enable: 0: CSI 1: MIPI
6:5	/	/	/
4:0	R/W	0	CSI_IF YUV: 00000: YUYV422 Interleaved or RAW (All data in one data bus) 00001: YUV422 UV Combined (Y in one data bus and UV in another) 00010: YUV444 Planar (Y/U/V in separated data bus) 00011: YUV444 Planar to YUV422 UV Combined CCIR656: 00100: YUYV422 Interleaved or RAW (All data in one data bus) 00101: YUV422 UV Combined (Y in one data bus and UV in another) 00110: YUV444 Planar (Y/U/V in separated data bus) 00111: YUV444 Planar to YUV422 UV Combined 01100: CCIR656 2 channels (All data interleaved in one data bus) 01101: CCIR656 4 channels (All data interleaved in one data bus) Others: Reserved

CSI Capture Register

Offset: 0x0008			Register Name: CSI0_CAP_REG
Bit	Read/Write	Default/Hex	Description
31:30	/	/	/
29:26	R/W	0x00	CH3_CAP_MASK Vsync number masked before capture.
25	R/W	0	CH3_VCAP_ON Video capture control: Capture the video image data stream on channel 3. 0: Disable video capture If video capture is in progress, the CSI stops capturing image data at the end of the current frame, and all of the current frame data is written to output FIFO. 1: Enable video capture The CSI starts capturing image data at the start of the next frame.

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24	R/W	0	CH3_SCAP_ON Still capture control: Capture a single still image frame on channel 3. 0: Disable still capture. 1: Enable still capture The CSI module starts capturing image data at the start of the next frame. The CSI module captures only one frame of image data. This bit is self clearing and always reads as a 0.
23:22	/	/	/
21:18	R/W	0x00	CH2_CAP_MASK Vsync number masked before capture.
17	R/W	0	CH2_VCAP_ON Video capture control: Capture the video image data stream on channel 2. 0: Disable video capture If video capture is in progress, the CSI stops capturing image data at the end of the current frame, and all of the current frame data is written to output FIFO. 1: Enable video capture The CSI starts capturing image data at the start of the next frame.
16	R/W	0	CH2_SCAP_ON Still capture control: Capture a single still image frame on channel 2. 0: Disable still capture. 1: Enable still capture The CSI module starts capturing image data at the start of the next frame. The CSI module captures only one frame of image data. This bit is self clearing and always reads as a 0.
15:14	/	/	/
13:10	R/W	0x00	CH1_CAP_MASK Vsync number masked before capture.
09	R/W	0	CH1_VCAP_ON Video capture control: Capture the video image data stream on channel 1. 0: Disable video capture If video capture is in progress, the CSI stops capturing image data at the end of the current frame, and all of the current frame data is written to output FIFO. 1: Enable video capture The CSI starts capturing image data at the start of the next frame.
08	R/W	0	CH1_SCAP_ON Still capture control: Capture a single still image frame on channel 1. 0: Disable still capture.

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			1: Enable still capture The CSI module starts capturing image data at the start of the next frame. The CSI module captures only one frame of image data. This bit is self clearing and always reads as a 0.
07:06	/	/	/
05:02	R/W	0x00	CH0_CAP_MASK Vsync number masked before capture.
01	R/W	0	CH0_VCAP_ON Video capture control: Capture the video image data stream on channel 0. 0: Disable video capture If video capture is in progress, the CSI stops capturing image data at the end of the current frame, and all of the current frame data is written to output FIFO. 1: Enable video capture The CSI starts capturing image data at the start of the next frame.
00	R/W	0	CH0_SCAP_ON Still capture control: Capture a single still image frame on channel 0. 0: Disable still capture. 1: Enable still capture The CSI module starts capturing image data at the start of the next frame. The CSI module captures only one frame of image data. This bit is self clearing and always reads as a 0.

CSI Synchronization Counter Register

Offset: 0x000c			Register Name: CSI0_SYNC_CNT_REG
Bit	Read/Write	Default/Hex	Description
31:24	/	/	/
23:00	R	0	SYNC_CNT The counter value between vsync of Csi0 channel 0 and vsync of Csi1 channel 0 , using 24MHz.

CSI FIFO Threshold Register

Offset: 0x0010			Register Name: CSI0_FIFO_THRS_REG
Bit	Read/Write	Default/Hex	Description
31:24	/	/	/
23:16	R/W	0x0f	PTN_GEN_DLY Clocks delayed before pattern generating start.
15:12	/	/	/
11:00	R/W	0x400	FIFO_THRS When CSI0 FIFO occupied memory exceed the threshold, dram frequency can not change.

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CSI FIFO Statistic Register

Offset: 0x0014			Register Name: CSI0_FIFO_STAT_REG
Bit	Read/Write	Default/Hex	Description
31:12	/	/	/
11:00	R	/	FIFO_FRM_MAX Indicates the maximum depth of FIFO being occupied for whole frame. Update at every vsync or framedone.

CSI PCLK Statistic Register

Offset: 0x0018			Register Name: CSI0_PCLK_STAT_REG
Bit	Read/Write	Default/Hex	Description
31	/	/	/
30:16	R	/	PCLK_CNT_LINE_MAX Indicates maximum pixel clock counter value for each line. Update at every vsync or framedone.
15	/	/	/
14:00	R	/	PCLK_CNT_LINE_MIN Indicates minimum pixel clock counter value for each line. Update at every vsync or framedone.

CSI Pattern Generation Length Register

Offset: 0x0030			Register Name: CSI0_PTN_LEN_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0x0	PTN_LEN The pattern length in byte when generating pattern.

CSI Pattern Generation Address Register

Offset: 0x0034			Register Name: CSI0_PTN_ADDR_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0x0	PTN_ADDR The pattern DRAM address when generating pattern.

CSI Version Register

Offset: 0x003C			Register Name: CSI0_VER_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	/	VER Version of hardware circuit. Only can be read when version register read enable is on.

CSI Channel_0 configuration register

Offset: 0x0044			Register Name: CSI0_C0_CFG_REG
Bit	Read/Write	Default/Hex	Description
31:24	R/W	0	PAD_VAL Padding value when OUTPUT_FMT is prgb888 0x00~0xff
23:20	R/W	3	INPUT_FMT

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			Input data format 0000: RAW stream 0001: reserved 0010: reserved 0011: YUV422 0100: YUV420 Others: reserved
19:16	R/W	0	OUTPUT_FMT Output data format When the input format is set RAW stream 0000: field-raw-8 0001: field-raw-10 0010: field-raw-12 0011: reserved 0100: field-rgb565 0101: field-rgb888 0110: field-prgb888 0111: field-uv-combined 1000: frame-raw-8 1001: frame-raw-10 1010: frame-raw-12 1011: reserved 1100: frame-rgb565 1101: frame-rgb888 1110: frame-prgb888 1111: frame-uv-combined When the input format is set Bayer RGB242 0000: planar RGB242 When the input format is set YUV422 0000: field planar YCbCr 422 0001: field planar YCbCr 420 0010: frame planar YCbCr 420 0011: frame planar YCbCr 422 0100: field planar YCbCr 422 UV combined 0101: field planar YCbCr 420 UV combined 0110: frame planar YCbCr 420 UV combined 0111: frame planar YCbCr 422 UV combined 1000: field MB YCbCr 422 1001: field MB YCbCr 420 1010: frame MB YCbCr 420 1011: frame MB YCbCr 422 1100: field planar YCbCr 422 10bit UV combined 1101: field planar YCbCr 420 10bit UV combined 1110: Reserved

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			1111: Reserved When the input format is set YUV420 0000: Reserved 0001: field planar YCbCr 420 0010: frame planar YCbCr 420 0011: Reserved 0100: Reserved 0101: field planar YCbCr 420 UV combined 0110: frame planar YCbCr 420 UV combined 0111: Reserved 1000: Reserved 1001: field MB YCbCr 420 1010: frame MB YCbCr 420 1011: Reserved 1100: Reserved 1101: field planar YCbCr 420 10bit UV combined 1110: Reserved 1111: Reserved Others: reserved
15:14	/	/	/
13	R/W	0	VFLIP_EN Vertical flip enable When enabled, the received data will be arranged in vertical flip. 0:Disable 1:Enable
12	R/W	0	HFLIP_EN Horizontal flip enable When enabled, the received data will be arranged in horizontal flip. 0:Disable 1:Enable
11:10	R/W	0	FIELD_SEL Field selection. 00: capturing with field 1. 01: capturing with field 2. 10: capturing with either field. 11: reserved
09:08	R/W	2	INPUT_SEQ Input data sequence, only valid for YUV422 and YUV420 input format. All data interleaved in one channel: 00: YUYV

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			01: YVYU 10: UYVY 11: VYUY Y and UV in separated channel: x0: UV x1: VU
07:00	/	/	/

CSI Channel_0 scale register

Offset: 0x004C			Register Name: CSI0_C0_SCALE_REG
Bit	Read/Write	Default/Hex	Description
31:01	/	/	/
00	R/W	0	QUART_EN When this bit is set to 1, input image will be decimated to quarter size. All input format are supported.

CSI Channel_0 FIFO 0 output buffer-A address register

Offset: 0x0050			Register Name: CSI0_C0_F0_BUFA_REG
Bit	Read/Write	Default/Hex	Description
31:00	R/W	0	C0F0_BUFA FIFO 0 output buffer-A address

CSI Channel_0 FIFO 1 output buffer-A address register

Offset: 0x0058			Register Name: CSI0_C0_F1_BUFA_REG
Bit	Read/Write	Default/Hex	Description
31:00	R/W	0	C0F1_BUFA FIFO 1 output buffer-A address

CSI Channel_0 FIFO 2 output buffer-A address register

Offset: 0x0060			Register Name: CSI0_C0_F2_BUFA_REG
Bit	Read/Write	Default/Hex	Description
31:00	R/W	0	C0F2_BUFA FIFO 2 output buffer-A address

CSI Channel_0 status register

Offset: 0x006C			Register Name: CSI0_C0_CAP_STA_REG
Bit	Read/Write	Default/Hex	Description
31:03	/	/	/
02	R	0	FIELD_STA The status of the received field 0: Field 0 1: Field 1

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01	R	0	VCAP_STA Video capture in progress Indicates the CSI is capturing video image data (multiple frames). The bit is set at the start of the first frame after enabling video capture. When software disables video capture, it clears itself after the last pixel of the current frame is captured.
00	R	0	SCAP_STA Still capture in progress Indicates the CSI is capturing still image data (single frame). The bit is set at the start of the first frame after enabling still frame capture. It clears itself after the last pixel of the first frame is captured. For CCIR656 interface, if the output format is frame planar YCbCr 420 mode, the frame end means the field2 end, the other frame end means filed end.

CSI Channel_0 interrupt enable register

Offset: 0x0070			Register Name: CSI0_C0_INT_EN_REG
Bit	Read/Write	Default/Hex	Description
31:08	/	/	/
07	R/W	0	VS_INT_EN vsync flag The bit is set when vsync come. And at this time load the buffer address for the coming frame. So after this irq come, change the buffer address could only effect next frame
06	R/W	0	HB_OF_INT_EN Hblank FIFO overflow The bit is set when 3 FIFOs still overflow after the hblank.
05	R/W	0	MUL_ERR_INT_EN Multi-channel writing error Indicates error has been detected for writing data to a wrong channel.
04	R/W	0	FIFO2_OF_INT_EN FIFO 2 overflow The bit is set when the FIFO 2 become overflow.
03	R/W	0	FIFO1_OF_INT_EN FIFO 1 overflow The bit is set when the FIFO 1 become overflow.
02	R/W	0	FIFO0_OF_INT_EN FIFO 0 overflow The bit is set when the FIFO 0 become overflow.
01	R/W	0	FD_INT_EN Frame done Indicates the CSI has finished capturing an image frame.

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			Applies to video capture mode. The bit is set after each completed frame capturing data is written to buffer as long as video capture remains enabled.
00	R/W	0	CD_INT_EN Capture done Indicates the CSI has completed capturing the image data. For still capture, the bit is set when one frame data has been written to buffer. For video capture, the bit is set when the last frame has been written to buffer after video capture has been disabled. For CCIR656 interface, if the output format is frame planar YCbCr 420 mode, the frame end means the field2 end, the other frame end means field end.

CSI Channel_0 interrupt status register

Offset: 0x0074			Register Name: CSI0_C0_INT_STA_REG
Bit	Read/Write	Default/Hex	Description
31:08	/	/	/
07	R/W	0	VS_PD vsync flag
06	R/W	0	HB_OF_PD Hblank FIFO overflow
05	R/W	0	MUL_ ERR_PD Multi-channel writing error
04	R/W	0	FIFO2_OF_PD FIFO 2 overflow
03	R/W	0	FIFO1_OF_PD FIFO 1 overflow
02	R/W	0	FIFO0_OF_PD FIFO 0 overflow
01	R/W	0	FD_PD Frame done
00	R/W	0	CD_PD Capture done

CSI Channel_0 horizontal size register

Offset: 0x0080			Register Name: CSI0_C0_HSIZE_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:16	R/W	500	HOR_LEN Horizontal pixel clock length. Valid pixel clocks of a line.
15:13	/	/	/
12:00	R/W	0	HOR_START Horizontal pixel unit start. Pixel is valid from this unit.

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CSI Channel_0 vertical size register

Offset: 0x0084			Register Name: CSI0_C0_VSIZE_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:16	R/W	1E0	VER_LEN Vertical line length. Valid line number of a frame.
15:13	/	/	/
12:00	R/W	0	VER_START Vertical line start. data is valid from this line.

CSI Channel_0 buffer length register

Offset: 0x0088			Register Name: CSI0_C0_BUF_LEN_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:16	R/W	140	BUF_LEN_C Buffer length of chroma C in a line. Unit is byte.
15:13	/	/	/
12:00	R/W	280	BUF_LEN Buffer length of luminance Y in a line. Unit is byte.

CSI Channel_0 flip size register

Offset: 0x008C			Register Name: CSI0_C0_FLIP_SIZE_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:16	R/W	1E0	VER_LEN Vertical line number when in vflip mode.
15:13	/	/	/
12:00	R/W	280	VALID_LEN Valid components of a line when in flip mode.

CSI Channel_0 frame clock counter register

Offset: 0x0090			Register Name: CSI0_C0_FRM_CLK_CNT_REG
Bit	Read/Write	Default/Hex	Description
31:24	/	/	/
23:00	R	0	FRM_CLK_CNT Counter value between every frame. For instant hardware frame rate statics. The internal counter is added by one every 24MHz clock cycle. When frame done or vsync comes, the internal counter value is sampled to FRM_CLK_CNT, and cleared to 0.

CSI Channel_0 accumulated and internal clock counter register

Offset: 0x0094	Register Name: CSI0_C0_ACC_ITNL_CLK_CNT_REG

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Bit	Read/Write	Default/Hex	Description
31:24	R/W	0	ACC_CLK_CNT The accumulated value of FRM_CLK_CNT for software frame rate statics. Every interrupt of frame done, the software check this accumulated value and clear it to 0. If the ACC_CLK_CNT is larger than 1, the software has lost frame. When frame done or vsync comes, ACC_CLK_CNT = ACC_CLK_CNT + 1, and cleared to 0 when writing 0 to this register.
23:00	R	0	ITNL_CLK_CNT The instant value of internal frame clock counter. When frame done interrupt comes, the software can query this counter for judging whether it is the time for updating the double buffer address registers.

CSI Channel_1 configuration register

Offset: 0x0144			Register Name: CSI0_C1_CFG_REG
Bit	Read/Write	Default/Hex	Description
31:24	R/W	0	PAD_VAL Padding value when OUTPUT_FMT is prgb888 0x00~0xff
23:20	R/W	3	INPUT_FMT Input data format 0000: RAW stream 0001: reserved 0010: reserved 0011: YUV422 0100: YUV420 Others: reserved
19:16	R/W	0	OUTPUT_FMT Output data format When the input format is set RAW stream 0000: field-raw-8 0001: field-raw-10 0010: field-raw-12 0011: reserved 0100: field-rgb565 0101: field-rgb888 0110: field-prgb888 0111: field-uv-combined 1000: frame-raw-8 1001: frame-raw-10 1010: frame-raw-12 1011: reserved

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			1100: frame-rgb565 1101: frame-rgb888 1110: frame-prgb888 1111: frame-uv-combined When the input format is set Bayer RGB242 0000: planar RGB242 When the input format is set YUV422 0000: field planar YCbCr 422 0001: field planar YCbCr 420 0010: frame planar YCbCr 420 0011: frame planar YCbCr 422 0100: field planar YCbCr 422 UV combined 0101: field planar YCbCr 420 UV combined 0110: frame planar YCbCr 420 UV combined 0111: frame planar YCbCr 422 UV combined 1000: field MB YCbCr 422 1001: field MB YCbCr 420 1010: frame MB YCbCr 420 1011: frame MB YCbCr 422 1100: field planar YCbCr 422 10bit UV combined 1101: field planar YCbCr 420 10bit UV combined 1110: Reserved 1111: Reserved When the input format is set YUV420 0000: Reserved 0001: field planar YCbCr 420 0010: frame planar YCbCr 420 0011: Reserved 0100: Reserved 0101: field planar YCbCr 420 UV combined 0110: frame planar YCbCr 420 UV combined 0111: Reserved 1000: Reserved 1001: field MB YCbCr 420 1010: frame MB YCbCr 420 1011: Reserved 1100: Reserved 1101: field planar YCbCr 420 10bit UV combined 1110: Reserved 1111: Reserved Others: reserved
15:14	/	/	/

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13	R/W	0	VFLIP_EN Vertical flip enable When enabled, the received data will be arranged in vertical flip. 0:Disable 1:Enable
12	R/W	0	HFLIP_EN Horizontal flip enable When enabled, the received data will be arranged in horizontal flip. 0:Disable 1:Enable
11:10	R/W	0	FIELD_SEL Field selection. 00: capturing with field 1. 01: capturing with field 2. 10: capturing with either field. 11: reserved
09:08	R/W	2	INPUT_SEQ Input data sequence, only valid for YUV422 and YUV420 input format. All data interleaved in one channel: 00: YUYV 01: YVYU 10: UYVY 11: VYUY Y and UV in separated channel: x0: UV x1: VU
07:00	/	/	/

CSI Channel_1 scale register

Offset: 0x014C			Register Name: CSI0_C1_SCALE_REG
Bit	Read/Write	Default/Hex	Description
31:01	/	/	/
00	R/W	0	QUART_EN When this bit is set to 1, input image will be decimated to quarter size. All input format are supported.

CSI Channel_1 FIFO 0 output buffer-A address register

Offset: 0x0150			Register Name: CSI0_C1_F0_BUFA_REG
Bit	Read/Write	Default/Hex	Description
31:00	R/W	0	C1F0_BUFA FIFO 0 output buffer-A address

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CSI Channel_1 FIFO 1 output buffer-A address register

Offset: 0x0158			Register Name: CSI0_C1_F1_BUFA_REG
Bit	Read/Write	Default/Hex	Description
31:00	R/W	0	C1F1_BUFA FIFO 1 output buffer-A address

CSI Channel_1 FIFO 2 output buffer-A address register

Offset: 0x0160			Register Name: CSI0_C1_F2_BUFA_REG
Bit	Read/Write	Default/Hex	Description
31:00	R/W	0	C1F2_BUFA FIFO 2 output buffer-A address

CSI Channel_1 status register

Offset: 0x016C			Register Name: CSI0_C1_CAP_STA_REG
Bit	Read/Write	Default/Hex	Description
31:03	/	/	/
02	R	0	FIELD_STA The status of the received field 0: Field 0 1: Field 1
01	R	0	VCAP_STA Video capture in progress Indicates the CSI is capturing video image data (multiple frames). The bit is set at the start of the first frame after enabling video capture. When software disables video capture, it clears itself after the last pixel of the current frame is captured.
00	R	0	SCAP_STA Still capture in progress Indicates the CSI is capturing still image data (single frame). The bit is set at the start of the first frame after enabling still frame capture. It clears itself after the last pixel of the first frame is captured. For CCIR656 interface, if the output format is frame planar YCbCr 420 mode, the frame end means the field2 end, the other frame end means filed end.

CSI Channel_1 interrupt enable register

Offset: 0x0170			Register Name: CSI0_C1_INT_EN_REG
Bit	Read/Write	Default/Hex	Description
31:08	/	/	/
07	R/W	0	VS_INT_EN

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			vsync flag The bit is set when vsync come. And at this time load the buffer address for the coming frame. So after this irq come, change the buffer address could only effect next frame
06	R/W	0	HB_OF_INT_EN Hblank FIFO overflow The bit is set when 3 FIFOs still overflow after the hblank.
05	R/W	0	MUL_ERR_INT_EN Multi-channel writing error Indicates error has been detected for writing data to a wrong channel.
04	R/W	0	FIFO2_OF_INT_EN FIFO 2 overflow The bit is set when the FIFO 2 become overflow.
03	R/W	0	FIFO1_OF_INT_EN FIFO 1 overflow The bit is set when the FIFO 1 become overflow.
02	R/W	0	FIFO0_OF_INT_EN FIFO 0 overflow The bit is set when the FIFO 0 become overflow.
01	R/W	0	FD_INT_EN Frame done Indicates the CSI has finished capturing an image frame. Applies to video capture mode. The bit is set after each completed frame capturing data is written to buffer as long as video capture remains enabled.
00	R/W	0	CD_INT_EN Capture done Indicates the CSI has completed capturing the image data. For still capture, the bit is set when one frame data has been written to buffer. For video capture, the bit is set when the last frame has been written to buffer after video capture has been disabled. For CCIR656 interface, if the output format is frame planar YCbCr 420 mode, the frame end means the field2 end, the other frame end means field end.

CSI Channel_1 interrupt status register

Offset: 0x0174			Register Name: CSI0_C1_INT_STA_REG
Bit	Read/Write	Default/Hex	Description
31:08	/	/	/
07	R/W	0	VS_PD vsync flag
06	R/W	0	HB_OF_PD Hblank FIFO overflow

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05	R/W	0	MUL_ ERR_PD Multi-channel writing error
04	R/W	0	FIFO2_OF_PD FIFO 2 overflow
03	R/W	0	FIFO1_OF_PD FIFO 1 overflow
02	R/W	0	FIFO0_OF_PD FIFO 0 overflow
01	R/W	0	FD_PD Frame done
00	R/W	0	CD_PD Capture done

CSI Channel_1 horizontal size register

Offset: 0x0180			Register Name: CSI0_C1_HSIZE_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:16	R/W	500	HOR_LEN Horizontal pixel clock length. Valid pixel clocks of a line.
15:13	/	/	/
12:00	R/W	0	HOR_START Horizontal pixel clock start.Pixel data is valid from this clock.

CSI Channel_1 vertical size register

Offset: 0x0184			Register Name: CSI0_C1_VSIZE_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:16	R/W	1E0	VER_LEN Vertical line length. Valid line number of a frame.
15:13	/	/	/
12:00	R/W	0	VER_START Vertical line start. data is valid from this line.

CSI Channel_1 buffer length register

Offset: 0x0188			Register Name: CSI0_C1_BUF_LEN_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:16	R/W	140	BUF_LEN_C Buffer length of chroma C in a line. Unit is byte.
15:13	/	/	/
12:00	R/W	280	BUF_LEN

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			Buffer length of luminance Y in a line. Unit is byte.

CSI Channel_1 flip size register

Offset: 0x018C			Register Name: CSI0_C1_FLIP_SIZE_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:16	R/W	1E0	VER_LEN Vertical line number when in vflip mode.
15:13	/	/	/
12:00	R/W	280	VALID_LEN Valid components of a line when in flip mode.

CSI Channel_1 frame clock counter register

Offset: 0x0190			Register Name: CSI0_C1_FRM_CLK_CNT_REG
Bit	Read/Write	Default/Hex	Description
31:24	/	/	/
23:00	R	0	FRM_CLK_CNT Counter value between every frame. For instant hardware frame rate statics. The internal counter is added by one every 24MHz clock cycle. When frame done or vsync comes, the internal counter value is sampled to FRM_CLK_CNT, and cleared to 0. Then the FRM_CLK_CNT is added to ACC_CLK_CNT.

CSI Channel_1 accumulated and internal clock counter register

Offset: 0x0194			Register Name: CSI0_C1_ACC_ITNL_CLK_CNT_REG
Bit	Read/Write	Default/Hex	Description
31:24	R/W	0	ACC_CLK_CNT The accumulated value of FRM_CLK_CNT for software frame rate statics. Every interrupt of frame done, the software check this accumulated value and clear it to 0. If the ACC_CLK_CNT is larger than 1, the software has lost frame. When frame done or vsync comes, ACC_CLK_CNT = ACC_CLK_CNT + 1, and cleared to 0 when writing 0 to this register.
23:00	R	0	ITNL_CLK_CNT The instant value of internal frame clock counter. When frame done interrupt comes, the software can query this counter for judging whether it is the time for updating the double buffer address registers.

CSI Channel_2 configuration register

Address: 0x0244	Register Name: CSI0_C2_CFG_REG

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Bit	Read/Write	Default/Hex	Description
31:24	R/W	0	PAD_VAL Padding value when OUTPUT_FMT is prgb888 0x00~0xff
23:20	R/W	3	INPUT_FMT Input data format 0000: RAW stream 0001: reserved 0010: reserved 0011: YUV422 0100: YUV420 Others: reserved
19:16	R/W	0	OUTPUT_FMT Output data format When the input format is set RAW stream 0000: field-raw-8 0001: field-raw-10 0010: field-raw-12 0011: reserved 0100: field-rgb565 0101: field-rgb888 0110: field-prgb888 0111: field-uv-combined 1000: frame-raw-8 1001: frame-raw-10 1010: frame-raw-12 1011: reserved 1100: frame-rgb565 1101: frame-rgb888 1110: frame-prgb888 1111: frame-uv-combined When the input format is set Bayer RGB242 0000: planar RGB242 When the input format is set YUV422 0000: field planar YCbCr 422 0001: field planar YCbCr 420 0010: frame planar YCbCr 420 0011: frame planar YCbCr 422 0100: field planar YCbCr 422 UV combined 0101: field planar YCbCr 420 UV combined 0110: frame planar YCbCr 420 UV combined 0111: frame planar YCbCr 422 UV combined 1000: field MB YCbCr 422 1001: field MB YCbCr 420

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			1010: frame MB YCbCr 420 1011: frame MB YCbCr 422 1100: field planar YCbCr 422 10bit UV combined 1101: field planar YCbCr 420 10bit UV combined 1110: Reserved 1111: Reserved When the input format is set YUV420 0000: Reserved 0001: field planar YCbCr 420 0010: frame planar YCbCr 420 0011: Reserved 0100: Reserved 0101: field planar YCbCr 420 UV combined 0110: frame planar YCbCr 420 UV combined 0111: Reserved 1000: Reserved 1001: field MB YCbCr 420 1010: frame MB YCbCr 420 1011: Reserved 1100: Reserved 1101: field planar YCbCr 420 10bit UV combined 1110: Reserved 1111: Reserved Others: reserved
15:14	/	/	/
13	R/W	0	VFLIP_EN Vertical flip enable When enabled, the received data will be arranged in vertical flip. 0:Disable 1:Enable
12	R/W	0	HFLIP_EN Horizontal flip enable When enabled, the received data will be arranged in horizontal flip. 0:Disable 1:Enable
11:10	R/W	0	FIELD_SEL Field selection. 00: capturing with field 1. 01: capturing with field 2. 10: capturing with either field. 11: reserved
09:08	R/W	2	INPUT_SEQ

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			Input data sequence, only valid for YUV422 and YUV420 input format. All data interleaved in one channel: 00: YUYV 01: YVYU 10: UYVY 11: VYUY Y and UV in separated channel: x0: UV x1: VU
07:00	/	/	/

CSI Channel_2 scale register

Offset: 0x024C			Register Name: CSI0_C2_SCALE_REG
Bit	Read/Write	Default/Hex	Description
31:01	/	/	/
00	R/W	0	QUART_EN When this bit is set to 1, input image will be decimated to quarter size. All input format are supported.

CSI Channel_2 FIFO 0 output buffer-A address register

Offset : 0x0250			Register Name: CSI0_C2_F0_BUFA_REG
Bit	Read/Write	Default/Hex	Description
31:00	R/W	0	C2F0_BUFA FIFO 0 output buffer-A address

CSI Channel_2 FIFO 1 output buffer-A address register

Offset: 0x0258			Register Name: CSI0_C2_F1_BUFA_REG
Bit	Read/Write	Default/Hex	Description
31:00	R/W	0	C2F1_BUFA FIFO 1 output buffer-A address

CSI Channel_2 FIFO 2 output buffer-A address register

Offset: 0x0260			Register Name: CSI0_C2_F2_BUFA_REG
Bit	Read/Write	Default/Hex	Description
31:00	R/W	0	C2F2_BUFA FIFO 2 output buffer-A address

CSI Channel_2 status register

Offset: 0x026C			Register Name: CSI0_C2_CAP_STA_REG
Bit	Read/Write	Default/Hex	Description

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31:03	/	/	/
02	R	0	FIELD_STA The status of the received field 0: Field 0 1: Field 1
01	R	0	VCAP_STA Video capture in progress Indicates the CSI is capturing video image data (multiple frames). The bit is set at the start of the first frame after enabling video capture. When software disables video capture, it clears itself after the last pixel of the current frame is captured.
00	R	0	SCAP_STA Still capture in progress Indicates the CSI is capturing still image data (single frame). The bit is set at the start of the first frame after enabling still frame capture. It clears itself after the last pixel of the first frame is captured. For CCIR656 interface, if the output format is frame planar YCbCr 420 mode, the frame end means the field2 end, the other frame end means filed end.

CSI Channel_2 interrupt enable register

Offset: 0x0270			Register Name: CSI0_C2_INT_EN_REG
Bit	Read/Write	Default/Hex	Description
31:08	/	/	/
07	R/W	0	VS_INT_EN vsync flag The bit is set when vsync come. And at this time load the buffer address for the coming frame. So after this irq come, change the buffer address could only effect next frame
06	R/W	0	HB_OF_INT_EN Hblank FIFO overflow The bit is set when 3 FIFOs still overflow after the hblank.
05	R/W	0	MUL_ERR_INT_EN Multi-channel writing error Indicates error has been detected for writing data to a wrong channel.
04	R/W	0	FIFO2_OF_INT_EN FIFO 2 overflow The bit is set when the FIFO 2 become overflow.
03	R/W	0	FIFO1_OF_INT_EN FIFO 1 overflow The bit is set when the FIFO 1 become overflow.
02	R/W	0	FIFO0_OF_INT_EN

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			FIFO 0 overflow The bit is set when the FIFO 0 become overflow.
01	R/W	0	FD_INT_EN Frame done Indicates the CSI has finished capturing an image frame. Applies to video capture mode. The bit is set after each completed frame capturing data is written to buffer as long as video capture remains enabled.
00	R/W	0	CD_INT_EN Capture done Indicates the CSI has completed capturing the image data. For still capture, the bit is set when one frame data has been written to buffer. For video capture, the bit is set when the last frame has been written to buffer after video capture has been disabled. For CCIR656 interface, if the output format is frame planar YCbCr 420 mode, the frame end means the field2 end, the other frame end means field end.

CSI Channel_2 interrupt status register

Offset: 0x0274			Register Name: CSI0_C2_INT_STA_REG
Bit	Read/Write	Default/Hex	Description
31:08	/	/	/
07	R/W	0	VS_PD vsync flag
06	R/W	0	HB_OF_PD Hblank FIFO overflow
05	R/W	0	MUL_ ERR_PD Multi-channel writing error
04	R/W	0	FIFO2_OF_PD FIFO 2 overflow
03	R/W	0	FIFO1_OF_PD FIFO 1 overflow
02	R/W	0	FIFO0_OF_PD FIFO 0 overflow
01	R/W	0	FD_PD Frame done
00	R/W	0	CD_PD Capture done

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CSI Channel_2 horizontal size register

Offset: 0x0280			Register Name: CSI0_C2_HSIZE_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:16	R/W	500	HOR_LEN Horizontal pixel clock length. Valid pixel clocks of a line.
15:13	/	/	/
12:00	R/W	0	HOR_START Horizontal pixel clock start. Pixel data is valid from this clock.

CSI Channel_2 vertical size register

Offset: 0x0284			Register Name: CSI0_C2_VSIZE_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:16	R/W	1E0	VER_LEN Vertical line length. Valid line number of a frame.
15:13	/	/	/
12:00	R/W	0	VER_START Vertical line start. data is valid from this line.

CSI Channel_2 buffer length register

Offset 0x0288			Register Name: CSI0_C2_BUF_LEN_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:16	R/W	140	BUF_LEN_C Buffer length of chroma C in a line. Unit is byte.
15:13	/	/	/
12:00	R/W	280	BUF_LEN Buffer length of luminance Y in a line. Unit is byte.

CSI Channel_2 flip size register

Offset: 0x028C			Register Name: CSI0_C2_FLIP_SIZE_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:16	R/W	1E0	VER_LEN Vertical line number when in vflip mode.
15:13	/	/	/
12:00	R/W	280	VALID_LEN Valid components of a line when in flip mode.

CSI Channel_2 frame clock counter register

Offset: 0x0290			Register Name: CSI0_C2_FRM_CLK_CNT_REG
Bit	Read/Write	Default/Hex	Description
31:24	/	/	/
23:00	R	0	FRM_CLK_CNT

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			Counter value between every frame. For instant hardware frame rate statics. The internal counter is added by one every 24MHz clock cycle. When frame done or vsync comes, the internal counter value is sampled to FRM_CLK_CNT, and cleared to 0. Then the FRM_CLK_CNT is added to ACC_CLK_CNT.

CSI Channel_2 accumulated and internal clock counter register

Offset: 0x0294			Register Name: CSI0_C2_ACC_ITNL_CLK_CNT_REG
Bit	Read/Write	Default/Hex	Description
31:24	R/W	0	ACC_CLK_CNT The accumulated value of FRM_CLK_CNT for software frame rate statics. Every interrupt of frame done, the software check this accumulated value and clear it to 0. If the ACC_CLK_CNT is larger than 1, the software has lost frame. When frame done or vsync comes, ACC_CLK_CNT = ACC_CLK_CNT + 1, and cleared to 0 when writing 0 to this register.
23:00	R	0	ITNL_CLK_CNT The instant value of internal frame clock counter. When frame done interrupt comes, the software can query this counter for judging whether it is the time for updating the double buffer address registers.

CSI Channel_3 configuration register

Offset: 0x0344			Register Name: CSI0_C3_CFG_REG
Bit	Read/Write	Default/Hex	Description
31:24	R/W	0	PAD_VAL Padding value when OUTPUT_FMT is prgb888 0x00~0xff
23:20	R/W	3	INPUT_FMT Input data format 0000: RAW stream 0001: reserved 0010: reserved 0011: YUV422 0100: YUV420 Others: reserved
19:16	R/W	0	OUTPUT_FMT Output data format When the input format is set RAW stream 0000: field-raw-8 0001: field-raw-10

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			0010: field-raw-12 0011: reserved 0100: field-rgb565 0101: field-rgb888 0110: field-prgb888 0111: field-uv-combined 1000: frame-raw-8 1001: frame-raw-10 1010: frame-raw-12 1011: reserved 1100: frame-rgb565 1101: frame-rgb888 1110: frame-prgb888 1111: frame-uv-combined When the input format is set Bayer RGB242 0000: planar RGB242 When the input format is set YUV422 0000: field planar YCbCr 422 0001: field planar YCbCr 420 0010: frame planar YCbCr 420 0011: frame planar YCbCr 422 0100: field planar YCbCr 422 UV combined 0101: field planar YCbCr 420 UV combined 0110: frame planar YCbCr 420 UV combined 0111: frame planar YCbCr 422 UV combined 1000: field MB YCbCr 422 1001: field MB YCbCr 420 1010: frame MB YCbCr 420 1011: frame MB YCbCr 422 1100: field planar YCbCr 422 10bit UV combined 1101: field planar YCbCr 420 10bit UV combined 1110: Reserved 1111: Reserved When the input format is set YUV420 0000: Reserved 0001: field planar YCbCr 420 0010: frame planar YCbCr 420 0011: Reserved 0100: Reserved 0101: field planar YCbCr 420 UV combined 0110: frame planar YCbCr 420 UV combined 0111: Reserved 1000: Reserved

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			1001: field MB YCbCr 420 1010: frame MB YCbCr 420 1011: Reserved 1100: Reserved 1101: field planar YCbCr 420 10bit UV combined 1110: Reserved 1111: Reserved Others: reserved
15:14	/	/	/
13	R/W	0	VFLIP_EN Vertical flip enable When enabled, the received data will be arranged in vertical flip. 0:Disable 1:Enable
12	R/W	0	HFLIP_EN Horizontal flip enable When enabled, the received data will be arranged in horizontal flip. 0:Disable 1:Enable
11:10	R/W	0	FIELD_SEL Field selection. 00: capturing with field 1. 01: capturing with field 2. 10: capturing with either field. 11: reserved
09:08	R/W	2	INPUT_SEQ Input data sequence, only valid for YUV422 and YUV420 input format. All data interleaved in one channel: 00: YUYV 01: YVYU 10: UYVY 11: VYUY Y and UV in separated channel: x0: UV x1: VU
07:00	/	/	/

CSI Channel_3 scale register

Offset: 0x034C			Register Name: CSI0_C3_SCALE_REG
Bit	Read/Write	Default/Hex	Description

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31:01	/	/	/
00	R/W	0	QUART_EN When this bit is set to 1, input image will be decimated to quarter size. All input format are supported.

CSI Channel_3 FIFO 0 output buffer-A address register

Offset: 0x0350			Register Name: CSI0_C3_F0_BUFA_REG
Bit	Read/Write	Default/Hex	Description
31:00	R/W	0	C3F0_BUFA FIFO 0 output buffer-A address

CSI Channel_3 FIFO 1 output buffer-A address register

Offset : 0x0358			Register Name: CSI0_C3_F1_BUFA_REG
Bit	Read/Write	Default/Hex	Description
31:00	R/W	0	C3F1_BUFA FIFO 1 output buffer-A address

CSI Channel_3 FIFO 2 output buffer-A address register

Offset: 0x0360			Register Name: CSI0_C3_F2_BUFA_REG
Bit	Read/Write	Default/Hex	Description
31:00	R/W	0	C3F2_BUFA FIFO 2 output buffer-A address

CSI Channel_3 status register

Offset: 0x036C			Register Name: CSI0_C3_CAP_STA_REG
Bit	Read/Write	Default/Hex	Description
31:03	/	/	/
02	R	0	FIELD_STA The status of the received field 0: Field 0 1: Field 1
01	R	0	VCAP_STA Video capture in progress Indicates the CSI is capturing video image data (multiple frames). The bit is set at the start of the first frame after enabling video capture. When software disables video capture, it clears itself after the last pixel of the current frame is captured.
00	R	0	SCAP_STA Still capture in progress Indicates the CSI is capturing still image data (single frame). The bit is set at the start of the first frame after enabling still frame capture. It clears itself after the last

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			pixel of the first frame is captured. For CCIR656 interface, if the output format is frame planar YCbCr 420 mode, the frame end means the field2 end, the other frame end means filed end.

CSI Channel_3 interrupt enable register

Offset: 0x0370			Register Name: CSI0_C3_INT_EN_REG
Bit	Read/Write	Default/Hex	Description
31:08	/	/	/
07	R/W	0	VS_INT_EN vsync flag The bit is set when vsync come. And at this time load the buffer address for the coming frame. So after this irq come, change the buffer address could only effect next frame
06	R/W	0	HB_OF_INT_EN Hblank FIFO overflow The bit is set when 3 FIFOs still overflow after the hblank.
05	R/W	0	MUL_ERR_INT_EN Multi-channel writing error Indicates error has been detected for writing data to a wrong channel.
04	R/W	0	FIFO2_OF_INT_EN FIFO 2 overflow The bit is set when the FIFO 2 become overflow.
03	R/W	0	FIFO1_OF_INT_EN FIFO 1 overflow The bit is set when the FIFO 1 become overflow.
02	R/W	0	FIFO0_OF_INT_EN FIFO 0 overflow The bit is set when the FIFO 0 become overflow.
01	R/W	0	FD_INT_EN Frame done Indicates the CSI has finished capturing an image frame. Applies to video capture mode. The bit is set after each completed frame capturing data is written to buffer as long as video capture remains enabled.
00	R/W	0	CD_INT_EN Capture done Indicates the CSI has completed capturing the image data. For still capture, the bit is set when one frame data has been written to buffer. For video capture, the bit is set when the last frame has been written to buffer after video capture has been disabled. For CCIR656 interface, if the output format is frame planar

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			YCbCr 420 mode, the frame end means the field2 end, the other frame end means field end.

CSI Channel_3 interrupt status register

Offset: 0x0374			Register Name: CSI0_C3_INT_STA_REG
Bit	Read/Write	Default/Hex	Description
31:08	/	/	/
07	R/W	0	VS_PD vsync flag
06	R/W	0	HB_OF_PD Hblank FIFO overflow
05	R/W	0	MUL_ ERR_PD Multi-channel writing error
04	R/W	0	FIFO2_OF_PD FIFO 2 overflow
03	R/W	0	FIFO1_OF_PD FIFO 1 overflow
02	R/W	0	FIFO0_OF_PD FIFO 0 overflow
01	R/W	0	FD_PD Frame done
00	R/W	0	CD_PD Capture done

CSI Channel_3 horizontal size register

Offset: 0x0380			Register Name: CSI0_C3_HSIZE_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:16	R/W	500	HOR_LEN Horizontal pixel clock length. Valid pixel clocks of a line.
15:13	/	/	/
12:00	R/W	0	HOR_START Horizontal pixel clock start.Pixel data is valid from this clock.

CSI Channel_3 vertical size register

Offset: 0x0384			Register Name: CSI0_C3_VSIZE_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:16	R/W	1E0	VER_LEN Vertical line length. Valid line number of a frame.

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15:13	/	/	/
12:00	R/W	0	VER_START Vertical line start. data is valid from this line.

CSI Channel_3 buffer length register

Offset: 0x0388			Register Name: CSI0_C3_BUF_LEN_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:16	R/W	140	BUF_LEN_C Buffer length of chroma C in a line. Unit is byte.
15:13	/	/	/
12:00	R/W	280	BUF_LEN Buffer length of luminance Y in a line. Unit is byte.

CSI Channel_3 flip size register

Offset: 0x038C			Register Name: CSI0_C3_FLIP_SIZE_REG
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28:16	R/W	1E0	VER_LEN Vertical line number when in vflip mode.
15:13	/	/	/
12:00	R/W	280	VALID_LEN Valid components of a line when in flip mode.

CSI Channel_3 frame clock counter register

Offset: 0x0390			Register Name: CSI0_C3_FRM_CLK_CNT_REG
Bit	Read/Write	Default/Hex	Description
31:24	/	/	/
23:00	R	0	FRM_CLK_CNT Counter value between every frame. For instant hardware frame rate statics. The internal counter is added by one every 24MHz clock cycle. When frame done or vsync comes, the internal counter value is sampled to FRM_CLK_CNT, and cleared to 0. Then the FRM_CLK_CNT is added to ACC_CLK_CNT.

CSI Channel_3 accumulated and internal clock counter register

Offset: 0x0394			Register Name: CSI0_C3_ACC_ITNL_CLK_CNT_REG
Bit	Read/Write	Default/Hex	Description
31:24	R/W	0	ACC_CLK_CNT The accumulated value of FRM_CLK_CNT for software frame rate statics. Every interrupt of frame done, the software check this accumulated value and clear it to 0. If the ACC_CLK_CNT is larger than 1, the software has lost frame.

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			When frame done or vsync comes, ACC_CLK_CNT = ACC_CLK_CNT + 1, and cleared to 0 when writing 0 to this register.
23:00	R	0	ITNL_CLK_CNT The instant value of internal frame clock counter. When frame done interrupt comes, the software can query this counter for judging whether it is the time for updating the double buffer address registers.

CCI Control Register

Offset: 0x000			Register Name: CCI_CTRL
Bit	Read/Write	Default/Hex	Description
31	R/W	0	SINGLE_TRAN 0: Transmission idle 1: Start single transmission Automatically cleared to '0' when finished. Abort current transmission immediately if changing from '1' to '0'. If slave not respond for the expected status over the time defined by TIMEOUT, current transmission will stop. PACKET_CNT will return the sequence number when transmission fail. All format setting and data will be loaded from registers and FIFO when transmission start.
30	R/W	0	REPEAT_TRAN 0: transmission idle 1: repeated transmission When this bit is set to 1, transmission repeats when trigger signal (such as VSYNC/ VCAP done) repeats. If changing this bit from '1' to '0' during transmission, the current transmission will be guaranteed then stop.
29	R/W	0	RESTART_MODE 0: RESTART 1: STOP+START Define the CCI action after sending register address.
28	R/W	0	READ_TRAN_MODE 0: send slave_id+W 1: do not send slave_id+W Setting this bit to 1 if reading from a slave which register width is equal to 0.
27:24	R	0	TRAN_RESULT 000: OK 001: FAIL Other: Reserved
23:16	R	/	CCI_STA 0x00: bus error 0x08: START condition transmitted

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			0x10: Repeated START condition transmitted 0x18: Address + Write bit transmitted, ACK received 0x20: Address + Write bit transmitted, ACK not received 0x28: Data byte transmitted in master mode, ACK received 0x30: Data byte transmitted in master mode, ACK not received 0x38: Arbitration lost in address or data byte 0x40: Address + Read bit transmitted, ACK received 0x48: Address + Read bit transmitted, ACK not received 0x50: Data byte received in master mode, ACK received 0x58: Data byte received in master mode, ACK not received 0x01: Timeout when sending 9th SCL clk Other: Reserved
15:2	/	/	/
1	R/W	0	SOFT_RESET 0: normal 1: reset
0	R/W	0	CCI_EN 0: Module disable 1: Module enable

CCI Transmission Configuration Register

Offset: 0x004			Register Name: CCI_CFG
Bit	Read/Write	Default/Hex	Description
31:24	R/W	0x10	TIMEOUT_N When sending the 9th clock, assert fail signal when slave device did not response after **N*F_{SCL}** cycles. And software must do a reset to CCI module and send a stop condition to slave.
23:16	R/W	0x00	INTERVAL Define the interval between each packet in 40*F_{SCL} cycles. 0~255
15	R/W	0	PACKET_MODE Select where to load slave id / data width 0: Compact mode 1: Complete mode In compact mode, slave id/register width / data width will be loaded from CCI_FMT register, only address and data read from memory. In complete mode, they will be loaded from packet memory.
14:8	/	/	/
7	R/W	0	SRC_SEL 0: From register CCI_FIFO_ACC

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			1: From dram address define by CCI_PARA_BASE Read packet data source select.
6:4	R/W	0	TRIG_MODE Transmit mode: 000: Immediately, no trigger 001: Reserved 010: CSI0 int trigger 011: CSI1 int trigger
3:0	R/W	0	CSI_TRIG CSI Int trig signal select: 0000: First HREF start 0001: Last HREF done 0010: Line counter trigger other: Reserved

CCI Packet Format Register

Offset: 0x008			Register Name: CCI_FMT
Bit	Read/Write	Default/Hex	Description
31:25	R/W	0	SLV_ID 7bit address
24	R/W	0	CMD 0: write 1: read
23:20	R/W	1	ADDR_BYTE How many bytes be sent as address 0~15
19:16	R/W	1	DATA_BYTE How many bytes be sent/received as data 1~15 Normally use ADDR_DATA with 0_2, 1_1, 1_2, 2_1, 2_2 access mode. If DATA bytes is 0, transmission will not start. In complete mode, the ADDR_BYTE and DATA_BYTE is defined in a byte's high/low 4bit.
15:0	R/W	1	PACKET_CNT FIFO data be transmitted as PACKET_CNT packets in current format. Total bytes not exceed 32bytes.

CCI Bus Control Register

Offset: 0x00C			Register Name: CCI_BUS_CTRL
Bit	Read/Write	Default/Hex	Description
31:16	R/W	0	DLY_CYC 0~65535 F_{SCL} cycles between each transmission
15	R/W	0	DLY_TRIG 0: disable 1: execute transmission after internal counter delay when

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			triggered
14:12	R/W	0x2	CLK_N CCI bus sampling clock F0=24MHz/2^CLK_N
11:8	R/W	0x5	CLK_M CCI output SCL frequency is F_{SCL}=F1/10=(F0/(CLK_M+1))/10
7	R	/	SCL_STA SCL current status
6	R	/	SDA_STA SDA current status
5	R/W	0	SCL_PEN SCL PAD enable
4	R/W	0	SDA_PEN SDA PAD enable
3	R/W	0	SCL_MOV SCL manual output value
2	R/W	0	SDA_MOV SDA manual output value
1	R/W	0	SCL_MOE SCL manual output en
0	R/W	0	SDA_MOE SDA manual output en

CCI Dram Input Base Register

Offset: 0x010			Register Name: CCI_PARA_BASE
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0	DRAM_BASE Dram address for CCI data, used in dram input mode. CCI transmission read/write data from/to dram in byte.

CCI Interrupt Control Register

Offset: 0x014			Register Name: CCI_INT_CTRL
Bit	Read/Write	Default/Hex	Description
31:18	/	/	/
17	R/W	0	S_TRAN_ERR_INT_EN
16	R/W	0	S_TRAN_COM_INT_EN
15:2	/	/	/
1	R/W	0	S_TRAN_ERR_PD
0	R/W	0	S_TRAN_COM_PD

CCI Line Counter Trigger Control Register

Offset: 0x018			Register Name: CCI_LC_TRIG
Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12:0	R/W	0	LN_CNT 0~8191: line counter send trigger when 1st~8192th line is

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			received.

CCI FIFO Access Register

Offset: 0x100~0x13f			Register Name: CCI_FIFO_ACC
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0	DATA_FIFO From 0x100 to 0x13f, CCI data FIFO is 64bytes, used in FIFO input mode. CCI transmission read/write data from/to FIFO in byte.

CCI Reserved Register

Offset: 0x200~0x220			Register Name: CCI_RSV_REG
Bit	Read/Write	Default/Hex	Description
31:0	R/W	/	From 0x200 to 0x220 address, normal TWI registers are copied here. All transmission will be act like hardware controlling these registers. And don't change them in transmission.

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Chapter 7 Interfaces

This chapter describes the external peripherals of R16 processor, including:

- SD/MMC
- TWI
- SPI
- UART
- USB OTG
- USB Host
- Digital audio interface
- RSB

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7.1 SD/MMC

7.1.1 Overview

The R16 processor comes with three SD/MMC controllers. The SD/MMC controller can be configured as a Secure Digital Multimedia Card controller, which simultaneously supports Secure Digital I/O (SDIO), Multimedia Cards (MMC), eMMC Card.

The SD/MMC controller includes the following features:

- Support Secure Digital memory protocol commands (up to SD2.0)
- Support Secure Digital I/O protocol commands(up to SDIO2.0)
- Support multimedia card protocol commands (up to MMC4.41)
- Support hardware CRC generation and error detection
- Support host pull-up control
- Support SDIO interrupts in 1-bit and 4-bit modes
- Support SDIO suspend and resume operation
- Support block size of 1 to 65535 bytes
- Support descriptor-based internal DMA controller

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7.1.2 SD/MMC Timing Diagram

Please refer to relative specification:

- Physical Layer Specification Ver2.00 Final
- SDIO Specification Ver2.00
- Multimedia Cards (MMC – version 4.2)
- JEDEC Standard – JESD84-44, Embedded Multimedia Card (eMMC) Card Product Standard

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7.2 TWI

7.2.1 Overview

This TWI(Two Wire Interface) controller can be used as an interface between CPU host and the serial TWI bus. It can support all the standard TWI transfer, including Slave and Master. The communication to the TWI bus is carried out on a byte-wise basis using interrupt or polled handshaking. This TWI Controller can be operated in standard mode (100Kbps) or fast-mode, supporting data rate up to 400Kbps. Multiple Masters and 10-bit addressing Mode are supported for this specified application. General Call Addressing is also supported in Slave mode.

The TWI controller includes the following features:

- Software-programmable for Slave or Master
- Support Repeated START signal
- Multi-master systems supported
- Allows 10-bit addressing with TWI bus
- Perform arbitration and clock synchronization
- Own address and General Call address detection
- Interrupt on address detection
- Support speeds up to 400Kbits/s (‘fast mode’)
- Allow operation from a wide range of input clock frequencies

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7.2.2 TWI Controller Timing Diagram

Data transferred are always in a unit of 8-bit (byte), followed by an acknowledge bit. The number of bytes that can be transmitted per transfer is unrestricted. Data is transferred in serial with the MSB first. Between each byte of data transfer, a receiver device will hold the clock line SCL low to force the transmitter into a wait state while waiting the response from microprocessor.

Data transfer with acknowledge is obligatory. The clock line is driven by the master all the time, including the acknowledge-related clock cycle, except for the SCL holding between each byte. After sending each byte, the transmitter releases the SDA line to allow the receiver to pull down the SDA line and send an acknowledge signal (or leave it high to send a "not acknowledge") to the transmitter.

When a slave receiver doesn't acknowledge the slave address (unable to receive because of no resource available), the data line must be left high by the slave so that the master can then generate a STOP condition to abort the transfer. Slave receiver can also indicate not to want to send more data during a transfer by leave the acknowledge signal high. And the master should generate the STOP condition to abort the transfer.

Below diagram provides an illustration the relation of SDA signal line and SCL signal line on the TWI serial bus.

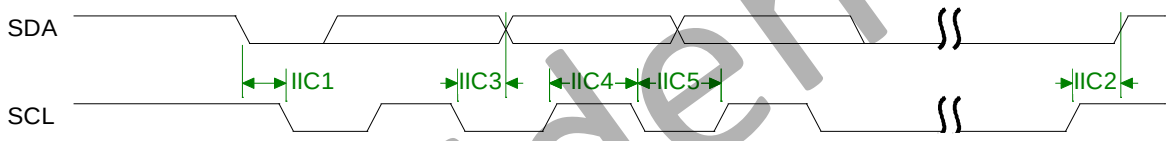

Figure 7.2-1 TWI Timing Diagram

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7.2.3 TWI Controller Register List

Module Name	Base Address
TWI0	0x01C2AC00
TWI1	0x01C2B000
TWI2	0x01C2B400

Register Name	Offset	Description
TWI_ADDR	0x0000	TWI Slave address
TWI_XADDR	0x0004	TWI Extended slave address
TWI_DATA	0x0008	TWI Data byte
TWI_CNTR	0x000C	TWI Control register
TWI_STAT	0x0010	TWI Status register
TWI_CCR	0x0014	TWI Clock control register
TWI_SRST	0x0018	TWI Software reset
TWI_EFR	0x001C	TWI Enhance Feature register
TWI_LCR	0x0020	TWI Line Control register

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7.2.4 TWI Controller Register Description

TWI Slave Address Register

Offset: 0x00			Register Name: TWI_ADDR Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7:1	R/W	0	SLA Slave address 7-bit addressing SLA6, SLA5, SLA4, SLA3, SLA2, SLA1, SLA0 10-bit addressing 1, 1, 1, 1, 0, SLAX[9:8]
0	R/W	0	GCE General call address enable 0: Disable 1: Enable

Note:

For 7-bit addressing:

SLA6 – SLA0 is the 7-bit address of the TWI when in slave mode. When the TWI receives this address after a START condition, it will generate an interrupt and enter slave mode. (SLA6 corresponds to the first bit received from the TWI bus.) If GCE is set to '1', the TWI will also recognize the general call address (00h).

For 10-bit addressing:

When the address received starts with 11110b, the TWI recognizes this as the first part of a 10-bit address and if the next two bits match ADDR[2:1] (i.e. SLAX9 and SLAX8 of the device's extended address), it sends an ACK. (The device does not generate an interrupt at this point.) If the next byte of the address matches the XADDR register (SLAX7 – SLAX0), the TWI generates an interrupt and goes into slave mode.

TWI Extend Address Register

Offset: 0x04			Register Name: TWI_XADDR Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7:0	R/W	0	SLAX Extend Slave Address SLAX[7:0]

TWI Data Register

Offset: 0x08			Register Name: TWI_DATA Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7:0	R/W	0	TWI_DATA Data byte for transmitting or received

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TWI Control Register

Offset: 0x0C			Register Name: TWI_CNTR Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7	R/W	0	INT_EN Interrupt Enable 1'b0: The interrupt line always low 1'b1: The interrupt line will go high when INT_FLAG is set.
6	R/W	0	BUS_EN TWI Bus Enable 1'b0: The TWI bus inputs ISDA/ISCL are ignored and the TWI Controller will not respond to any address on the bus 1'b1: The TWI will respond to calls to its slave address – and to the general call address if the GCE bit in the ADDR register is set. Notes: In master operation mode, this bit should be set to '1'
5	R/W	0	M_STA Master Mode Start When M_STA is set to '1', TWI Controller enters master mode and will transmit a START condition on the bus when the bus is free. If the M_STA bit is set to '1' when the TWI Controller is already in master mode and one or more bytes have been transmitted, then a repeated START condition will be sent. If the M_STA bit is set to '1' when the TWI is being accessed in slave mode, the TWI will complete the data transfer in slave mode then enter master mode when the bus has been released. The M_STA bit is cleared automatically after a START condition has been sent: writing a '0' to this bit has no effect.
4	R/W	0	M_STP Master Mode Stop If M_STP is set to '1' in master mode, a STOP condition is transmitted on the TWI bus. If the M_STP bit is set to '1' in slave mode, the TWI will behave as if a STOP condition has been received, but no STOP condition will be transmitted on the TWI bus. If both M_STA and M_STP bits are set, the TWI will first transmit the STOP condition (if in master mode) then transmit the START condition. The M_STP bit is cleared automatically: writing a '0' to this bit has no effect.

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3	R/W	0	INT_FLAG Interrupt Flag INT_FLAG is automatically set to '1' when any of 28 (out of the possible 29) states is entered (see 'STAT Register' below). The only state that does not set INT_FLAG is state F8h. If the INT_EN bit is set, the interrupt line goes high when IFLG is set to '1'. If the TWI is operating in slave mode, data transfer is suspended when INT_FLAG is set and the low period of the TWI bus clock line (SCL) is stretched until '1' is written to INT_FLAG. The TWI clock line is then released and the interrupt line goes low.
2	R/W	0	A_ACK Assert Acknowledge When A_ACK is set to '1', an Acknowledge (low level on SDA) will be sent during the acknowledge clock pulse on the TWI bus if: 1. Either the whole of a matching 7-bit slave address or the first or the second byte of a matching 10-bit slave address has been received. 2. The general call address has been received and the GCE bit in the ADDR register is set to '1'. 3. A data byte has been received in master or slave mode. When A_ACK is '0', a Not Acknowledge (high level on SDA) will be sent when a data byte is received in master or slave mode. If A_ACK is cleared to '0' in slave transmitter mode, the byte in the DATA register is assumed to be the 'last byte'. After this byte has been transmitted, the TWI will enter state C8h then return to the idle state (status code F8h) when INT_FLAG is cleared. The TWI will not respond as a slave unless A_ACK is set.
1:0	R/W	0	/

TWI Status Register

Offset: 0x10			Register Name: TWI_STAT Default Value: 0x0000_00F8
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7:0	R	0xF8	STA Status Information Byte Code Status 0x00: Bus error

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			0x08: START condition transmitted 0x10: Repeated START condition transmitted 0x18: Address + Write bit transmitted, ACK received 0x20: Address + Write bit transmitted, ACK not received 0x28: Data byte transmitted in master mode, ACK received 0x30: Data byte transmitted in master mode, ACK not received 0x38: Arbitration lost in address or data byte 0x40: Address + Read bit transmitted, ACK received 0x48: Address + Read bit transmitted, ACK not received 0x50: Data byte received in master mode, ACK transmitted 0x58: Data byte received in master mode, not ACK transmitted 0x60: Slave address + Write bit received, ACK transmitted 0x68: Arbitration lost in address as master, slave address + Write bit received, ACK transmitted 0x70: General Call address received, ACK transmitted 0x78: Arbitration lost in address as master, General Call address received, ACK transmitted 0x80: Data byte received after slave address received, ACK transmitted 0x88: Data byte received after slave address received, not ACK transmitted 0x90: Data byte received after General Call received, ACK transmitted 0x98: Data byte received after General Call received, not ACK transmitted 0xA0: STOP or repeated START condition received in slave mode 0xA8: Slave address + Read bit received, ACK transmitted 0xB0: Arbitration lost in address as master, slave address + Read bit received, ACK transmitted 0xB8: Data byte transmitted in slave mode, ACK received 0xC0: Data byte transmitted in slave mode, ACK not received 0xC8: Last byte transmitted in slave mode, ACK received 0xD0: Second Address byte + Write bit transmitted, ACK received 0xD8: Second Address byte + Write bit transmitted, ACK not received 0xF8: No relevant status information, INT_FLAG=0 Others: Reserved

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TWI Clock Register

Offset: 0x14			Register Name: TWI_CCR Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:7	/	/	/
6:3	R/W	0	CLK_M
2:0	R/W	0	CLK_N The TWI bus is sampled by the TWI at the frequency defined by F0: Fsamp = F 0 = Fin / 2^CLK_N The TWI OSCL output frequency, in master mode, is F1 / 10: F1 = F0 / (CLK_M + 1) Foscl = F1 / 10 = Fin / (2^CLK_N * (CLK_M + 1)*10) For Example： Fin = 48Mhz (APB clock input) For 400kHz full speed 2Wire, CLK_N = 2, CLK_M=2 F0 = 48M/2^2=12Mhz, F1= F0/(10*(2+1)) = 0.4Mhz For 100Khz standard speed 2Wire, CLK_N=2, CLK_M=11 F0=48M/2^2=12Mhz, F1=F0/(10*(11+1)) = 0.1Mhz

TWI Soft Reset Register

Offset: 0x18			Register Name: TWI_SRST Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:1	/	/	/
0	R/W	0	SOFT_RST Soft Reset Write ‘1’ to this bit to reset the TWI and clear to ‘0’ when completing Soft Reset operation.

TWI Enhance Feature Register

Offset: 0x1C			Register Name: TWI_EFR Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:2	/	/	/
0:1	R/W	0	DBN Data Byte number follow Read Command Control No Data Byte to be written after read command Only 1 byte data to be written after read command 2 bytes data can be written after read command 3 bytes data can be written after read command

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TWI Line Control Register

Offset: 0x20			Register Name: TWI_LCR Default Value: 0x0000_003a
Bit	Read/Write	Default/Hex	Description
31:6	/	/	/
5	R	1	SCL_STATE Current state of TWI_SCL 0 – low 1 - high
4	R	1	SDA_STATE Current state of TWI_SDA 0 – low 1 - high
3	R/W	1	SCL_CTL TWI_SCL line state control bit When line control mode is enabled (bit[2] set), value of this bit decide the output level of TWI_SCL 0 – output low level 1 – output high level
2	R/W	0	SCL_CTL_EN TWI_SCL line state control enable When this bit is set, the state of TWI_SCL is control by the value of bit[3]. 0-disable TWI_SCL line control mode 1-enable TWI_SCL line control mode
1	R/W	1	SDA_CTL TWI_SDA line state control bit When line control mode is enabled (bit[0] set), value of this bit decide the output level of TWI_SDA 0 – output low level 1 – output high level
0	R/W	0	SDA_CTL_EN TWI_SDA line state control enable When this bit is set, the state of TWI_SDA is control by the value of bit[1]. 0-disable TWI_SDA line control mode 1-enable TWI_SDA line control mode

TWI DVFS Control Register

Offset: 0x24			Register Name: TWI_DVFSCR Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:2	/	/	/
2	R/W	0	MS_PRIORITY CPU and DVFS BUSY set priority select 0: CPU has higher priority

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			1: DVFS has higher priority
1	R/W	0	CPU_BUSY_SET CPU Busy set
0	R/W	0	DVFC_BUSY_SET DVFS Busy set

Note: This register is only implemented in TWI0.

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7.2.5 TWI Controller Special Requirement

TWI Pin List

Port Name	Width	Direction	Description
TWI_SCL	1	IN/OUT	TWI Clock line
TWI_SDA	1	IN/OUT	TWI Serial Data line

TWI Controller Operation

There are four operation modes on the TWI bus which dictates the communications method. They are Master Transmit, Master Receive, Slave Transmit and Slave Receive. In general, CPU host controls TWI by writing commands and data to its registers. The TWI interrupts the CPU host for the attention each time a byte transfer is done or a START/STOP conditions is detected. The CPU host can also poll the status register for current status if the interrupt mechanism is not disabled by the CPU host.

When the CPU host wants to start a bus transfer, it initiates a bus START to enter the master mode by setting IM_STA bit in the 2WIRE_CNTR register to high (before it must be low). The TWI will assert INT line and INT_FLAG to indicate a completion for the START condition and each consequent byte transfer. At each interrupt, the micro-processor needs to check the 2WIRE_STAT register for current status. A transfer has to be concluded with STOP condition by setting M_STP bit high.

In Slave Mode, the TWI also constantly samples the bus and look for its own slave address during addressing cycles. Once a match is found, it is addressed and interrupt the CPU host with the corresponding status. Upon request, the CPU host should read the status, read/write 2WIRE_DATA data register, and set the 2WIRE_CNTR control register. After each byte transfer, a slave device always halt the operation of remote master by holding the next low pulse on SCL line until the microprocessor responds to the status of previous byte transfer or START condition.

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7.3 SPI

7.3.1 Overview

The SPI (Serial Peripheral Interface) allows rapid data communication with fewer software interrupts. The SPI module contains one 64x8 receiver buffer (RXFIFO) and one 64x8 transmit buffer (TXFIFO). It can work at two modes: Master mode and Slave mode.

It includes the following features:

- Full-duplex synchronous serial interface
- Master/Slave configurable
- Four chip selects to support multiple peripherals for SPI0 has one chip select
- 8-bit wide by 64-entry FIFO for both transmit and receive data
- Polarity and phase of the Chip Select (SPI_SS) and SPI Clock (SPI_SCLK) are configurable

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7.3.2 SPI Timing Diagram

The serial peripheral interface master uses the SPI_SCLK signal to transfer data in and out of the shift register. Data is clocked using any one of four programmable clock phase and polarity combinations.

During Phase 0, Polarity 0 and Phase 1, Polarity 1 operations, output data changes on the falling clock edge and input data is shifted in on the rising edge.
During Phase 1, Polarity 0 and Phase 0, Polarity 1 operations, output data changes on the rising edges of the clock and is shifted in on falling edges.

The POL defines the signal polarity when SPI_SCLK is in idle state. The SPI_SCLK is high level when POL is '1' and it is low level when POL is '0'. The PHA decides whether the leading edge of SPI_SCLK is used for setup or sample data. The leading edge is used for setup data when PHA is '1' and for sample data when PHA is '0'. The four modes are listed below:

SPI Mode	POL	PHA	Leading Edge	Trailing Edge
0	0	0	Rising, Sample	Falling, Setup
1	0	1	Rising, Setup	Falling, Sample
2	1	0	Falling, Sample	Rising, Setup
3	1	1	Failing, Setup	Rising, Sample

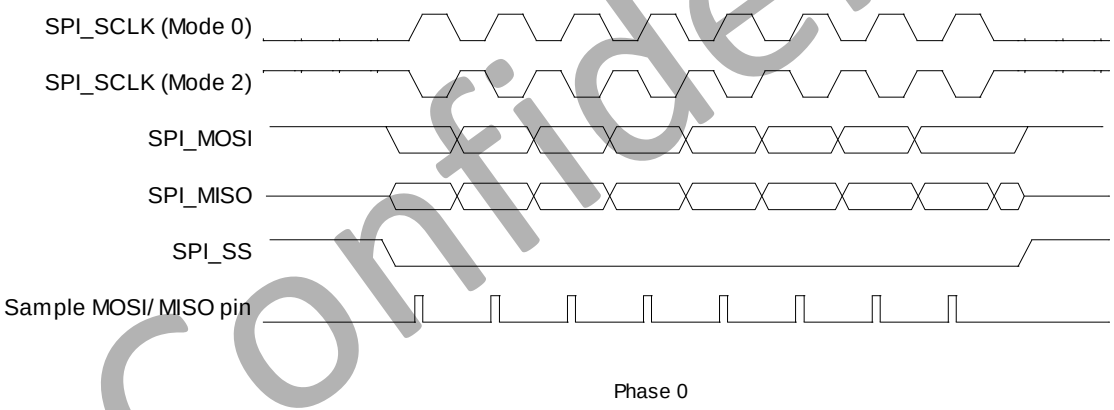

Figure 7.3-1 SPI Phase 0 Timing Diagram

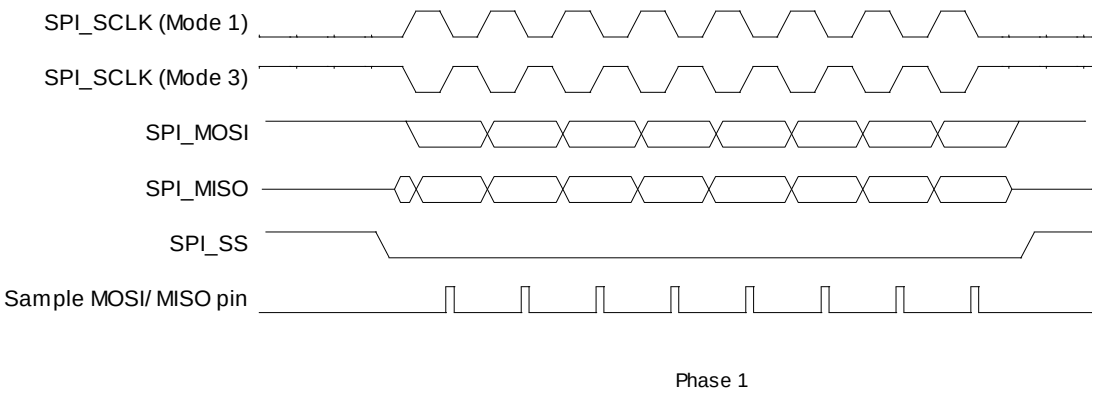

Figure 7.3-2 SPI Phase 1 Timing Diagram

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7.3.3 SPI Register List

Module Name	Base Address
SPI0	0x01C68000

Register Name	Offset	Description
/	0x00	/
SPI_GCR	0x04	SPI Global Control Register
SPI_TCR	0x08	SPI Transfer Control register
/	0x0c	reserved
SPI_IER	0x10	SPI Interrupt Control register
SPI_ISR	0x14	SPI Interrupt Status register
SPI_FCR	0x18	SPI FIFO Control register
SPI_FSR	0x1C	SPI FIFO Status register
SPI_WCR	0x20	SPI Wait Clock Counter register
SPI_CCR	0x24	SPI Clock Rate Control register
/	0x28	reserved
/	0x2c	reserved
SPI_MBC	0x30	SPI Burst Counter register
SPI_MTC	0x34	SPI Transmit Counter Register
SPI_BCC	0x38	SPI Burst Control register
SPI_TXD	0x200	SPI TX Data register
SPI_RXD	0x300	SPI RX Data register

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7.3.4 SPI Register Description

SPI Global Control Register

Offset: 0x04			Register Name: SPI_CTL Default Value: 0x0000_0080
Bit	Read/Write	Default/Hex	Description
31	R/W	0	SRST Soft reset Write '1' to this bit will clear the SPI controller, and auto clear to '0' when reset operation completes Write '0' has no effect.
30:8	/	/	/
7	R/W	1	TP_EN Transmit Pause Enable In master mode, it is used to control transmit state machine to stop smart burst sending when RX FIFO is full. 1 : stop transmit data when RXFIFO full 0 : normal operation, ignore RXFIFO status Note: Can't be written when XCH=1
6:2	/	/	/
1	R/W	0	MODE SPI Function Mode Select 0: Slave Mode 1: Master Mode Note: Can't be written when XCH=1
0	R/W	0	EN SPI Module Enable Control 0: Disable 1: Enable

SPI Transfer Control Register

Offset: 0x08			Register Name: SPI_INTCTL Default Value: 0x0000_0087
Bit	Read/Write	Default/Hex	Description
31	R/W	0	XCH Exchange Burst In master mode it is used to start SPI burst 0: Idle 1: Initiates exchange. Write "1" to this bit will start the SPI burst, and will automatically clear after finishing the bursts transfer specified by BC. Write "1" to SRST will also clear this bit. Write '0' to this bit has no effect. Note：Can't be written when XCH=1.

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30:14	R	0	Reserved.
13	R/W	0	SDM Master Sample Data Mode 1: Normal Sample Mode 0: Delay Sample Mode In Normal Sample Mode, SPI Master samples the data at the correct edge for each SPI mode. In Delay Sample Mode, SPI master samples data at the edge that is half cycle delayed by the correct edge defined in respective SPI mode.
12	R/W	0	FBS First Transmit Bit Select 0: MSB first 1: LSB first Note：Can't be written when XCH=1.
11	R/W	0	SDC Master Sample Data Control Set this bit to '1' to make the internal read sample point with a delay of half cycle of SPI_CLK. It is used in high speed read operation to reduce the error caused by the time delay of SPI_CLK propagating between master and slave. 0: normal operation, do not delay internal read sample point 1: delay internal read sample point Note：Can't be written when XCH=1.
10	R/W	0	RPSM Rapids mode select Select Rapids mode for high speed write. 0: normal write mode 1: rapids write mode Note：Can't be written when XCH=1.
9	R/W	0	DDB Dummy Burst Type 0: The bit value of dummy SPI burst is zero 1: The bit value of dummy SPI burst is one Note：Can't be written when XCH=1.
8	R/W	0	DHB Discard Hash Burst In master mode it controls whether discarding unused SPI bursts 0: Receiving all SPI bursts in BC period 1: Discard unused SPI bursts, only fetching the SPI bursts during dummy burst period. The bursts number is specified by TC. Note：Can't be written when XCH=1.

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7	R/W	1	SS_LEVEL When control SS signal manually (SPI_CTRL_REG.SS_CTRL==1), set this bit to '1' or '0' to control the level of SS signal. 0: set SS to low 1: set SS to high Note：Can't be written when XCH=1.
6	R/W	0	SS_OWNER SS Output Owner Select Usually, controller sends SS signal automatically with data together. When this bit is set to 1, software must manually write SPI_CTL_REG.SS_LEVEL to 1 or 0 to control the level of SS signal. 0: SPI controller 1: Software Note：Can't be written when XCH=1.
5:4	R/W	0	SS_SEL SPI Chip Select Select one of four external SPI Master/Slave Devices 00: SPI_SS0 will be asserted 01: SPI_SS1 will be asserted 10: SPI_SS2 will be asserted 11: SPI_SS3 will be asserted Note：Can't be written when XCH=1.
3	R/W	0	SSCTL In master mode, this bit selects the output wave form for the SPI_SSx signal. Only valid when SS_OWNER = 0. 0: SPI_SSx remains asserted between SPI bursts 1: Negate SPI_SSx between SPI bursts Note：Can't be written when XCH=1.
2	R/W	1	SPOL SPI Chip Select Signal Polarity Control 0: Active high polarity (0 = Idle) 1: Active low polarity (1 = Idle) Note：Can't be written when XCH=1.
1	R/W	1	CPOL SPI Clock Polarity Control 0: Active high polarity (0 = Idle) 1: Active low polarity (1 = Idle) Note：Can't be written when XCH=1.
0	R/W	1	CPHA SPI Clock/Data Phase Control 0: Phase 0 (Leading edge for sample data) 1: Phase 1 (Leading edge for setup data) Note：Can't be written when XCH=1.

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SPI Interrupt Control Register

Offset: 0x010			Register Name: SPI_IER Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:14	R	0	Reserved.
13	R/W	0	SS_INT_EN SSI Interrupt Enable Chip Select Signal (SSx) from valid state to invalid state 0: Disable 1: Enable
12	R/W	0	TC_INT_EN Transfer Completed Interrupt Enable 0: Disable 1: Enable
11	R/W	0	TF_UDR_INT_EN TXFIFO under run Interrupt Enable 0: Disable 1: Enable
10	R/W	0	TF_OVF_INT_EN TX FIFO Overflow Interrupt Enable 0: Disable 1: Enable
9	R/W	0	RF_UDR_INT_EN RXFIFO under run Interrupt Enable 0: Disable 1: Enable
8	R/W	0	RF_OVF_INT_EN RX FIFO Overflow Interrupt Enable 0: Disable 1: Enable
7	R	0	Reserved.
6	R/W	0	TF_FUL_INT_EN TX FIFO Full Interrupt Enable 0: Disable 1: Enable
5	R/W	0	TX_EMP_INT_EN TX FIFO Empty Interrupt Enable 0: Disable 1: Enable
4	R/W	0	TX_ERQ_INT_EN TX FIFO Empty Request Interrupt Enable 0: Disable 1: Enable
3	R	0	Reserved
2	R/W	0	RF_FUL_INT_EN RX FIFO Full Interrupt Enable

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			0: Disable 1: Enable
1	R/W	0	RX_EMP_INT_EN RX FIFO Empty Interrupt Enable 0: Disable 1: Enable
0	R/W	0	RF_RDY_INT_EN RX FIFO Ready Request Interrupt Enable 0: Disable 1: Enable

SPI Interrupt Status Register

Offset: 0x14			Register Name: SPI_INT_STA Default Value: 0x0000_0032
Bit	Read/Write	Default/Hex	Description
31:14	/	0	/
13	R/W	0	SSI SS Invalid Interrupt When SSI is 1, it indicates that SS has changed from valid state to invalid state. Writing 1 to this bit clears it.
12	R/W	0	TC Transfer Completed In master mode, it indicates that all bursts specified by BC has been exchanged. In other condition, When set, this bit indicates that all the data in TXFIFO has been loaded in the Shift register, and the Shift register has shifted out all the bits. Writing 1 to this bit clears it. 0: Busy 1: Transfer Completed
11	R/W	0	TF_UDF TXFIFO under run This bit is set when if the TXFIFO is underrun. Writing 1 to this bit clears it. 0: TXFIFO is not underrun 1: TXFIFO is underrun
10	R/W	0	TF_OVF TXFIFO Overflow This bit is set when if the TXFIFO is overflow. Writing 1 to this bit clears it. 0: TXFIFO is not overflow 1: TXFIFO is overflowed
9	R/W	0	RX_UDF RXFIFO Underrun When set, this bit indicates that RXFIFO has underrun. Writing 1 to this bit clears it.
8	R/W	0	RX_OVF

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			RXFIFO Overflow When set, this bit indicates that RXFIFO has overflowed. Writing 1 to this bit clears it. 0: RXFIFO is available. 1: RXFIFO has overflowed.
7	/	/	/
6	R/W	0	TX_FULL TXFIFO Full This bit is set when if the TXFIFO is full. Writing 1 to this bit clears it. 0: TXFIFO is not Full 1: TXFIFO is Full
5	R/W	1	TX_EMP TXFIFO Empty This bit is set if the TXFIFO is empty. Writing 1 to this bit clears it. 0: TXFIFO contains one or more words. 1: TXFIFO is empty
4	R/W	1	TX_READY TXFIFO Ready 0: TX_WL > TX_TRIG_LEVEL 1: TX_WL <= TX_TRIG_LEVEL This bit is set any time if TX_WL <= TX_TRIG_LEVEL. Writing “1” to this bit clears it. Where TX_WL is the water level of RXFIFO
3	/	/	reserved
2	R/W	0	RX_FULL RXFIFO Full This bit is set when the RXFIFO is full. Writing 1 to this bit clears it. 0: Not Full 1: Full
1	R/W	1	RX_EMP RXFIFO Empty This bit is set when the RXFIFO is empty. Writing 1 to this bit clears it. 0: Not empty 1: empty
0	R/W	0	RX_RDY RXFIFO Ready 0: RX_WL < RX_TRIG_LEVEL 1: RX_WL >= RX_TRIG_LEVEL This bit is set any time if RX_WL >= RX_TRIG_LEVEL. Writing “1” to this bit clears it. Where RX_WL is the water level of RXFIFO.

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SPI FIFO Control Register

Offset: 0x18			Register Name: SPI_DMACTL Default Value: 0x0040_0001
Bit	Read/Write	Default/Hex	Description
31	R/W	0	TX_FIFO_RST TX FIFO Reset Write '1' to this bit will reset the control portion of the TX FIFO and automatically clear to '0' when completing reset operation, write to '0' has no effect.
30	R/W	0	TF_TEST_ENB TX Test Mode Enable 0: disable 1: enable Note: In normal mode, TX FIFO can only be read by SPI controller, write '1' to this bit will switch TX FIFO read and write function to AHB bus. This bit is used to test the TX FIFO, don't set in normal operation and don't set RF_TEST and TF_TEST at the same time.
29:25	/	/	/
24	R/W	0	TF_ DRQ_EN TX FIFO DMA Request Enable 0: Disable 1: Enable
23:16	R/W	40	TX_TRIG_LEVEL TX FIFO Empty Request Trigger Level
15	W/R	0	RF_RST RXFIFO Reset Write '1' to this bit will reset the control portion of the receiver FIFO, and automatically clear to '0' when completing reset operation, write '0' to this bit has no effect.
14	W/R	0	RF_TEST RX Test Mode Enable 0: Disable 1: Enable Note: In normal mode, RX FIFO can only be written by SPI controller, write '1' to this bit will switch RX FIFO read and write function to AHB bus. This bit is used to test the RX FIFO, don't set in normal operation and don't set RF_TEST and TF_TEST at the same time.
13:10	R	0	Reserved
9	W/R	0	RX_DMA_MODE SPI RX DMA Mode Control 0: Normal DMA mode 1: Dedicate DMA mode
8	R/W	0	RF_ DRQ_EN

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			RX FIFO DMA Request Enable 0: Disable 1: Enable
7:0	R/W	1	RX_TRIG_LEVEL RX FIFO Ready Request Trigger Level

SPI FIFO Status Register

Offset: 0x1c			Register Name: SPI_FSR Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31	R	0	TB_WR TX FIFO Write Buffer Write Enable
30:28	R	0	TB_CNT TX FIFO Write Buffer Counter These bits indicate the number of words in TX FIFO Write Buffer
27:24	R	0	Reserved
23:16	R	0	TF_CNT TX FIFO Counter These bits indicate the number of words in TX FIFO 0: 0 byte in TX FIFO 1: 1 byte in TX FIFO … 64: 64 bytes in TX FIFO Other: reserved
15	R	0	RB_WR RX FIFO Read Buffer Write Enable
14:12	R	0	RB_CNT RX FIFO Read Buffer Counter These bits indicate the number of words in RX FIFO Read Buffer
11:8	R	0	Reserved
7:0	R	0	RF_CNT RX FIFO Counter These bits indicate the number of words in RX FIFO 0: 0 byte in RX FIFO 1: 1 byte in RX FIFO … 64: 64 bytes in RX FIFO Other: reserved

SPI Wait Clock Register

Offset: 0x20			Register Name: SPI_WAIT Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:20	/	/	/

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19:16	R/W	0	SWC Dual mode direction switch wait clock counter (for master mode only). 0: No wait states inserted n: n SPI_SCLK wait states inserted Note: These bits control the number of wait states to be inserted before start dual data transfer in dual SPI mode. The SPI module counts SPI_SCLK by SWC for delaying next word data transfer. Note：Can't be written when XCH=1.
15:0	R/W	0	WCC Wait Clock Counter (In Master mode) These bits control the number of wait states to be inserted in data transfers. The SPI module counts SPI_SCLK by WCC for delaying next word data transfer. 0: No wait states inserted N: N SPI_SCLK wait states inserted

SPI Clock Control Register

Offset: 0x24			Register Name: SPI_CCTL Default Value: 0x0000_0002
Bit	Read/Write	Default/Hex	Description
31:13	/	/	/
12	R/W	0	DRS Divide Rate Select (Master Mode Only) 0: Select Clock Divide Rate 1 1: Select Clock Divide Rate 2
11:8	R/W	0	CDR1 Clock Divide Rate 1 (Master Mode Only) SPI_CLK = SPI0 Clock / 2^n.
7:0	R/W	0x2	CDR2 Clock Divide Rate 2 (Master Mode Only) SPI_CLK = SPI0 Clock / (2*(n + 1)).

SPI Master Burst Counter Register

Offset: 0x30			Register Name: SPI_BC Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:24	/	/	/
23:0	R/W	0	MBC Master Burst Counter In master mode, this field specifies the total burst number. 0: 0 burst 1: 1 burst …

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			N: N bursts

SPI Master Transmit Counter Register

Offset: 0x34			Register Name: SPI_TC Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:24	/	/	/
23:0	R/W	0	MWTC Master Write Transmit Counter In master mode, this field specifies the burst number that should be sent to TXFIFO before automatically sending dummy burst. For saving bus bandwidth, the dummy burst (all zero bits or all one bits) is sent by SPI Controller automatically. 0: 0 burst 1: 1 burst … N: N bursts

SPI Master Burst Control Counter Register

Offset: 0x38			Register Name: SPI_BCC Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:29	R	0x0	Reserved
28	R/W	0x0	DRM Master Dual Mode RX Enable 0: RX use single-bit mode 1: RX use dual mode Note：Can’t be written when XCH=1.
27:24	R/W	0x0	DBC Master Dummy Burst Counter In master mode, this field specifies the burst number that should be sent before receive in dual SPI mode. The data is not care by the device. 0: 0 burst 1: 1 burst … N: N bursts Note：Can’t be written when XCH=1.
23:0	R/W	0x0	STC Master Single Mode Transmit Counter In master mode, this field specifies the burst number that should be sent in single mode before automatically sending dummy burst. This is the first transmit counter in all bursts. 0: 0 burst

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			1: 1 burst … N: N bursts Note： Can’t be written when XCH=1.

SPI TX Data Register

Offset: 0x200			Register Name: SPI_TXD Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:0	W/R	0x0	TDATA Transmit Data This register can be accessed in byte, half-word or word unit by AHB. In byte accessing method, if there are rooms in RXFIFO, one burst data is written to RXFIFO and the depth is increased by 1. In half-word accessing method, two SPI burst data are written and the TXFIFO depth is increase by 2. In word accessing method, four SPI burst data are written and the TXFIFO depth is increased by 4. Note: This address is writing-only if TF_TEST is ‘0’, and if TF_TEST is set to ‘1’, this address is readable and writable to test the TX FIFO through the AHB bus.

SPI RX Data Register

Offset: 0x300			Register Name: SPI_RXD Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:0	R	0	RDATA Receive Data This register can be accessed in byte, half-word or word unit by AHB. In byte accessing method, if there are data in RXFIFO, the top word is returned and the RXFIFO depth is decreased by 1. In half-word accessing method, two SPI bursts are returned and the RXFIFO depth is decrease by 2. In word accessing method, the four SPI bursts are returned and the RXFIFO depth is decreased by 4. Note: This address is read-only if RF_TEST is ‘0’, and if RF_TEST is set to ‘1’, this address is readable and writable to test the RX FIFO through the AHB bus.

7.3.5 SPI Special Requirement

SPI Pin List

The direction of SPI pin is different in two work modes: Master Mode and Slave Mode.

Port Name	Width	Direction(M)	Direction(S)	Description
SPI_SCLK	1	OUT	IN	SPI Clock

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SPI_MOSI	1	OUT	IN	SPI Master Output Slave Input Data Signal
SPI_MISO	1	IN	OUT	SPI Master Input Slave Output Data Signal
SPI_CS0	1	OUT	IN	SPI Chip Select Signal

Note: SPI0 module has one chip select signals.

SPI Module Clock Source and Frequency

The SPI module uses two clock sources: AHB_CLK and SPI_CLK. The SPI_SCLK can in the range from 3Khz to 100 MHZ and AHB_CLK >= 2xSPI_SCLK.

Clock Name	Description	Requirement
AHB_CLK	AHB bus clock, as the clock source of SPI module	AHB_CLK >= 2xSPI_SCLK
SPI_CLK	SPI serial input clock	

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7.4 UART

7.4.1 Overview

The UART is used for serial communication with a peripheral, modem (data carrier equipment, DCE) or data set. Data is written from a master (CPU) over the APB bus to the UART and it is converted to serial form and transmitted to the destination device. Serial data is also received by the UART and stored for the master (CPU) to read back.

The UART contains registers to control the character length, baud rate, parity generation/checking, and interrupt generation. Although there is only one interrupt output signal from the UART, there are several prioritized interrupt types that can be responsible for its assertion. Each of the interrupt types can be separately enabled/disabled with the control registers.

The UART has 16450 and 16550 modes of operation, which are compatible with a range of standard software drivers. In 16550 mode, transmit and receive operations are both buffered by FIFOs. In 16450 mode, these FIFOs are disabled.

The UART supports word lengths from five to eight bits, an optional parity bit and 1, 1 ½ or 2 stop bits, and is fully programmable by an AMBA APB CPU interface. A 16-bit programmable baud rate generator and an 8-bit scratch register are included, together with separate transmit and receive FIFOs. Eight modem control lines and a diagnostic loop-back mode are provided.

Interrupts can be generated for a range of TX Buffer/FIFO, RX Buffer/FIFO, Modem Status and Line Status conditions.

For integration in systems where Infrared SIR serial data format is required, the UART can be configured to have a software-programmable IrDA SIR Mode. If this mode is not selected, only the UART (RS232 standard) serial data format is available.

The UART includes the following features:

- Compatible with industry-standard 16550 UARTs
- 64-Bytes Transmit and receive data FIFOs
- DMA controller interface
- Software/ Hardware Flow Control
- Programmable Transmit Holding Register Empty interrupt
- Support IrDa 1.0 SIR
- Interrupt support for FIFOs, Status Change

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7.4.2 UART Timing Diagram

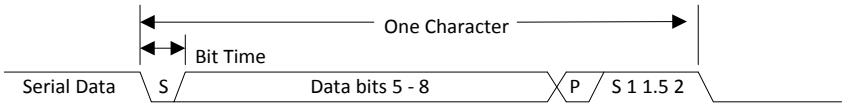

Figure 7.4-1 UART Serial Data Format

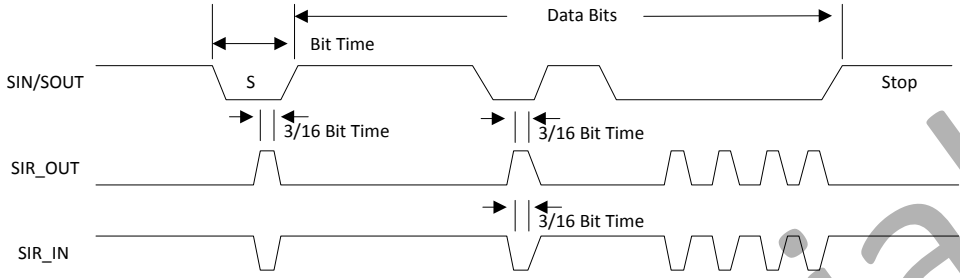

Figure 7.4-2 Serial IrDA Data Format

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7.4.3 UART Register List

There are 5 UART controllers. All UART controllers can be configured as Serial IrDA.

Module Name	Base Address
UART0	0x01C2 8000
UART1	0x01C2 8400
UART2	0x01C2 8800
UART3	0x01C2 8C00
R-UART	0x01F0 2800

Register Name	Offset	Description
UART_RBR	0x00	UART Receive Buffer Register
UART_THR	0x00	UART Transmit Holding Register
UART_DLL	0x00	UART Divisor Latch Low Register
UART_DLH	0x04	UART Divisor Latch High Register
UART_IER	0x04	UART Interrupt Enable Register
UART_IIR	0x08	UART Interrupt Identity Register
UART_FCR	0x08	UART FIFO Control Register
UART_LCR	0x0C	UART Line Control Register
UART_MCR	0x10	UART Modem Control Register
UART_LSR	0x14	UART Line Status Register
UART_MSR	0x18	UART Modem Status Register
UART_SCH	0x1C	UART Scratch Register
UART_USR	0x7C	UART Status Register
UART_TFL	0x80	UART Transmit FIFO Level
UART_RFL	0x84	UART Receiver FIFO Level
UART_HALT	0xA4	UART Halt TX Register
/	0xB0	/
/	0xB4	/

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7.4.4 UART Register Description

UART Receiver Buffer Register

Offset: 0x00			Register Name: UART_RBR Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7:0	R	0	RBR Receiver Buffer Register Data byte received on the serial input port (sin) in UART mode, or the serial infrared input (sir_in) in infrared mode. The data in this register is valid only if the Data Ready (DR) bit in the Line Status Register (LCR) is set. If in FIFO mode and FIFOs are enabled (FCR[0] set to one), this register accesses the head of the receive FIFO. If the receive FIFO is full and this register is not read before the next data character arrives, then the data already in the FIFO is preserved, but any incoming data are lost and an overrun error occurs.

UART Transmit Holding Register

Offset: 0x00			Register Name: UART_THR Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7:0	W	0	THR Transmit Holding Register Data to be transmitted on the serial output port (sout) in UART mode or the serial infrared output (sir_out_n) in infrared mode. Data should only be written to the THR when the THR Empty (THRE) bit (LSR[5]) is set. If in FIFO mode and FIFOs are enabled (FCR[0] = 1) and THRE is set, 16 number of characters of data may be written to the THR before the FIFO is full. Any attempt to write data when the FIFO is full results in the write data being lost.

UART Divisor Latch Low Register

Offset: 0x00			Register Name: UART_DLL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/

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7:0	R/W	0	DLL Divisor Latch Low Lower 8 bits of a 16-bit, read/write, Divisor Latch register that contains the baud rate divisor for the UART. This register may only be accessed when the DLAB bit (LCR[7]) is set and the UART is not busy (USR[0] is zero). The output baud rate is equal to the serial clock (sclk) frequency divided by sixteen times the value of the baud rate divisor, as follows: baud rate = (serial clock freq) / (16 * divisor). Note that with the Divisor Latch Registers (DLL and DLH) set to zero, the baud clock is disabled and no serial communications occur. Also, once the DLL is set, at least 8 clock cycles of the slowest UART clock should be allowed to pass before transmitting or receiving data.

UART Divisor Latch High Register

Offset: 0x04			Register Name: UART_DLH Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7:0	R/W	0	DLH Divisor Latch High Upper 8 bits of a 16-bit, read/write, Divisor Latch register that contains the baud rate divisor for the UART. This register may only be accessed when the DLAB bit (LCR[7]) is set and the UART is not busy (USR[0] is zero). The output baud rate is equal to the serial clock (sclk) frequency divided by sixteen times the value of the baud rate divisor, as follows: baud rate = (serial clock freq) / (16 * divisor). Note that with the Divisor Latch Registers (DLL and DLH) set to zero, the baud clock is disabled and no serial communications occur. Also, once the DLH is set, at least 8 clock cycles of the slowest UART clock should be allowed to pass before transmitting or receiving data.

UART Interrupt Enable Register

Offset: 0x04			Register Name: UART_IER Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7	R/W		PTIME Programmable THRE Interrupt Mode Enable This is used to enable/disable the generation of THRE Interrupt.

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			0: Disable 1: Enable
6:4	/	/	/
3	R/W	0	EDSSI Enable Modem Status Interrupt This is used to enable/disable the generation of Modem Status Interrupt. This is the fourth highest priority interrupt. 0: Disable 1: Enable
2	R/W	0	ELSI Enable Receiver Line Status Interrupt This is used to enable/disable the generation of Receiver Line Status Interrupt. This is the highest priority interrupt. 0: Disable 1: Enable
1	R/W	0	ETBEI Enable Transmit Holding Register Empty Interrupt This is used to enable/disable the generation of Transmitter Holding Register Empty Interrupt. This is the third highest priority interrupt. 0: Disable 1: Enable
0	R/W	0	ERBFI Enable Received Data Available Interrupt This is used to enable/disable the generation of Received Data Available Interrupt and the Character Timeout Interrupt (if in FIFO mode and FIFOs enabled). These are the second highest priority interrupts. 0: Disable 1: Enable

UART Interrupt Identity Register

Offset: 0x08			Register Name: UART_IIR Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7:6	R	0	FEFLAG FIFOs Enable Flag This is used to indicate whether the FIFOs are enabled or disabled. 00: Disable 11: Enable
5:4	/	/	/
3:0	R	1	IID Interrupt ID

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			This indicates the highest priority pending interrupt which can be one of the following types: 0000: modem status 0001: no interrupt pending 0010: THR empty 0100: received data available 0110: receiver line status 0111: busy detect 1100: character timeout Bit 3 indicates an interrupt can only occur when the FIFOs are enabled and used to distinguish a Character Timeout condition interrupt.

Interrupt ID	Priority Level	Interrupt Type	Interrupt Source	Interrupt Reset
0001	-	None	None	-
0110	Highest	Receiver line status	Overrun/parity/ framing errors or break interrupt	Reading the line status register
0100	Second	Received data available	Receiver data available (non-FIFO mode or FIFOs disabled) or RCVR FIFO trigger level reached (FIFO mode and FIFOs enabled)	Reading the receiver buffer register (non-FIFO mode or FIFOs disabled) or the FIFO drops below the trigger level (FIFO mode and FIFOs enabled)
1100	Second	Character timeout indication	No characters in or out of the RCVR FIFO during the last 4 character times and there is at least 1character in it during This time	Reading the receiver buffer register
0010	Third	Transmit holding register empty	Transmitter holding register empty (Program THRE Mode disabled) or XMIT FIFO at or below threshold (Program THRE Mode enabled)	Reading the IIR register (if source of interrupt); or, writing into THR (FIFOs or THRE Mode not selected or disabled) or XMIT FIFO above threshold (FIFOs and THRE Mode selected and enabled).
0000	Fourth	Modem status	Clear to send or data set ready or ring indicator or data carrier detect. Note that if auto flow control mode is enabled, a change in CTS (that is, DCTS set) does not cause an interrupt.	Reading the Modem status Register
0111	Fifth	Busy detect indication	UART_16550_COMPATIBLE = NO and master has tried	Reading the UART status register

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			to write to the Line Control Register while the UART is busy (USR[0] is set to one).	

UART FIFO Control Register

Offset: 0x08			Register Name: UART_FCR Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7:6	W	0	RT RCVR Trigger This is used to select the trigger level in the receiver FIFO at which the Received Data Available Interrupt is generated. In auto flow control mode it is used to determine when the rts_n signal is de-asserted. It also determines when the dma_rx_req_n signal is asserted in certain modes of operation. 00: 1 character in the FIFO 01: FIFO ¼ full 10: FIFO ½ full 11: FIFO-2 less than full
5:4	W	0	TFT TX Empty Trigger Writes have no effect when THRE_MODE_USER = Disabled. This is used to select the empty threshold level at which the THRE Interrupts are generated when the mode is active. It also determines when the dma_tx_req_n signal is asserted when in certain modes of operation. 00: FIFO empty 01: 2 characters in the FIFO 10: FIFO ¼ full 11: FIFO ½ full
3	W	0	DMAM DMA Mode 0: Mode 0 1: Mode 1
2	W	0	XFIFOR XMIT FIFO Reset This resets the control portion of the transmit FIFO and treats the FIFO as empty. This also de-asserts the DMA TX request. It is 'self-clearing'. It is not necessary to clear this bit.
1	W	0	RFIFOR RCVR FIFO Reset This resets the control portion of the receive FIFO and

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			treats the FIFO as empty. This also de-asserts the DMA RX request. It is 'self-clearing'. It is not necessary to clear this bit.
0	W	0	FIFOE Enable FIFOs This enables/disables the transmit (XMIT) and receive (RCVR) FIFOs. Whenever the value of this bit is changed both the XMIT and RCVR controller portion of FIFOs is reset.

UART Line Control Register

Offset: 0x0C			Register Name: UART_LCR Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7	R/W	0	DLAB Divisor Latch Access Bit It is writeable only when UART is not busy (USR[0] is zero) and always readable. This bit is used to enable reading and writing of the Divisor Latch register (DLL and DLH) to set the baud rate of the UART. This bit must be cleared after initial baud rate setup in order to access other registers. 0: Select RX Buffer Register (RBR) / TX Holding Register(THR) and Interrupt Enable Register (IER) 1: Select Divisor Latch LS Register (DLL) and Divisor Latch MS Register (DLM)
6	R/W	0	BC Break Control Bit This is used to cause a break condition to be transmitted to the receiving device. If set to one the serial output is forced to the spacing (logic 0) state. When not in Loopback Mode, as determined by MCR[4], the sout line is forced low until the Break bit is cleared. If SIR_MODE = Enabled and active (MCR[6] set to one) the sir_out_n line is continuously pulsed. When in Loopback Mode, the break condition is internally looped back to the receiver and the sir_out_n line is forced low.
5:4	R/W	0	EPS Even Parity Select It is writeable only when UART is not busy (USR[0] is zero) and always writable readable. This is used to select between even and odd parity, when parity is enabled (PEN set to one). Setting the LCR[5] is uset to reverse the LCR[4]. 00: Odd Parity

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			01: Even Parity 1X: Reverse LCR[4]
3	R/W	0	PEN Parity Enable It is writeable only when UART is not busy (USR[0] is zero) and always readable. This bit is used to enable and disable parity generation and detection in transmitted and received serial character respectively. 0: parity disabled 1: parity enabled
2	R/W	0	STOP Number of stop bits It is writeable only when UART is not busy (USR[0] is zero) and always readable. This is used to select the number of stop bits per character that the peripheral transmits and receives. If set to zero, one stop bit is transmitted in the serial data. If set to one and the data bits are set to 5 (LCR[1:0] set to zero) one and a half stop bits is transmitted. Otherwise, two stop bits are transmitted. Note that regardless of the number of stop bits selected, the receiver checks only the first stop bit. 0: 1 stop bit 1: 1.5 stop bits when DLS (LCR[1:0]) is zero, else 2 stop bit
1:0	R/W	0	DLS Data Length Select It is writeable only when UART is not busy (USR[0] is zero) and always readable. This is used to select the number of data bits per character that the peripheral transmits and receives. The number of bit that may be selected areas follows: 00: 5 bits 01: 6 bits 10: 7 bits 11: 8 bits

UART Modem Control Register

Offset: 0x10			Register Name: UART_MCR Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:7	/	/	/
6	R/W	0	SIRE SIR Mode Enable 0: IrDA SIR Mode disabled 1: IrDA SIR Mode enabled
5	R/W	0	AFCE

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			Auto Flow Control Enable When FIFOs are enabled and the Auto Flow Control Enable (AFCE) bit is set, Auto Flow Control features are enabled. 0: Auto Flow Control Mode disabled 1: Auto Flow Control Mode enabled
4	R/W	0	LOOP Loop Back Mode 0: Normal Mode 1: Loop Back Mode This is used to put the UART into a diagnostic mode for test purposes. If operating in UART mode (SIR_MODE != Enabled or not active, MCR[6] set to zero), data on the sout line is held high, while serial data output is looped back to the sin line, internally. In this mode all the interrupts are fully functional. Also, in loopback mode, the modem control inputs (dsr_n, cts_n, ri_n, dcd_n) are disconnected and the modem control outputs (dtr_n, rts_n, out1_n, out2_n) are looped back to the inputs, internally. If operating in infrared mode (SIR_MODE == Enabled AND active, MCR[6] set to one), data on the sir_out_n line is held low, while serial data output is inverted and looped back to the sir_in line.
3	/	/	/
2	/	/	/
1	R/W	0	RTS Request to Send This is used to directly control the Request to Send (rts_n) output. The Request To Send (rts_n) output is used to inform the modem or data set that the UART is ready to exchange data. When Auto RTS Flow Control is not enabled (MCR[5] set to zero), the rts_n signal is set low by programming MCR[1] (RTS) to a high.In Auto Flow Control, AFCE_MODE == Enabled and active (MCR[5] set to one) and FIFOs enable (FCR[0] set to one), the rts_n output is controlled in the same way, but is also gated with the receiver FIFO threshold trigger (rts_n is inactive high when above the threshold). The rts_n signal is de-asserted when MCR[1] is set low. 0: rts_n de-asserted (logic 1) 1: rts_n asserted (logic 0) Note that in Loopback mode (MCR[4] set to one), the rts_n output is held inactive high while the value of this location is internally looped back to an input.
0	R/W	0	DTR

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			Data Terminal Ready This is used to directly control the Data Terminal Ready (dtr_n) output. The value written to this location is inverted and driven out on dtr_n。 0：dtr_n de-asserted (logic 1) 1：dtr_n asserted (logic 0) The Data Terminal Ready output is used to inform the modem or data set that the UART is ready to establish communications. Note that in Loopback mode (MCR[4] set to one), the dtr_n output is held inactive high while the value of this location is internally looped back to an input.

UART Line Status Register

Offset: 0x14			Register Name: UART_LSR Default Value: 0x0000_0060
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7	R	0	FIFOERR RX Data Error in FIFO When FIFOs are disabled, this bit is always 0. When FIFOs are enabled, this bit is set to 1 when there is at least one PE, FE, or BI in the RX FIFO. It is cleared by a read from the LSR register provided there are no subsequent errors in the FIFO.
6	R	1	TEMT Transmitter Empty If the FIFOs are disabled, this bit is set to "1" whenever the TX Holding Register and the TX Shift Register are empty. If the FIFOs are enabled, this bit is set whenever the TX FIFO and the TX Shift Register are empty. In both cases, this bit is cleared when a byte is written to the TX data channel.
5	R	1	THRE TX Holding Register Empty If the FIFOs are disabled, this bit is set to "1" whenever the TX Holding Register is empty and ready to accept new data and it is cleared when the CPU writes to the TX Holding Register. If the FIFOs are enabled, this bit is set to "1" whenever the TX FIFO is empty and it is cleared when at least one byte is written to the TX FIFO.
4	R	0	BI Break Interrupt

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			This is used to indicate the detection of a break sequence on the serial input data. If in UART mode (SIR_MODE == Disabled), it is set whenever the serial input, sin, is held in a logic '0' state for longer than the sum of *start time* + *data bits* + *parity* + *stop bits*. If in infrared mode (SIR_MODE == Enabled), it is set whenever the serial input, sir_in, is continuously pulsed to logic '0' for longer than the sum of *start time* + *data bits* + *parity* + *stop bits*. A break condition on serial input causes one and only one character, consisting of all zeros, to be received by the UART. In the FIFO mode, the character associated with the break condition is carried through the FIFO and is revealed when the character is at the top of the FIFO. Reading the LSR clears the BI bit. In the non-FIFO mode, the BI indication occurs immediately and persists until the LSR is read.
3	R	0	FE Framing Error This is used to indicate the occurrence of a framing error in the receiver. A framing error occurs when the receiver does not detect a valid STOP bit in the received data. In the FIFO mode, since the framing error is associated with a character received, it is revealed when the character with the framing error is at the top of the FIFO. When a framing error occurs, the UART tries to resynchronize. It does this by assuming that the error was due to the start bit of the next character and then continues receiving the other bit i.e. data, and/or parity and stop. It should be noted that the Framing Error (FE) bit (LSR[3]) is set if a break interrupt has occurred, as indicated by Break Interrupt (BI) bit (LSR[4]). 0: no framing error 1:framing error Reading the LSR clears the FE bit.
2	R	0	PE Parity Error This is used to indicate the occurrence of a parity error in the receiver if the Parity Enable (PEN) bit (LCR[3]) is set. In the FIFO mode, since the parity error is associated with a character received, it is revealed when the character with the parity error arrives at the top of the FIFO. It should be noted that the Parity Error (PE) bit

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			(LSR[2]) is set if a break interrupt has occurred, as indicated by Break Interrupt (BI) bit (LSR[4]). 0: no parity error 1: parity error Reading the LSR clears the PE bit.
1	R	0	OE Overrun Error This occurs if a new data character was received before the previous data was read. In the non-FIFO mode, the OE bit is set when a new character arrives in the receiver before the previous character was read from the RBR. When this happens, the data in the RBR is overwritten. In the FIFO mode, an overrun error occurs when the FIFO is full and a new character arrives at the receiver. The data in the FIFO is retained and the data in the receive shift register is lost. 0: no overrun error 1: overrun error Reading the LSR clears the OE bit.
0	R	0	DR Data Ready This is used to indicate that the receiver contains at least one character in the RBR or the receiver FIFO. 0: no data ready 1: data ready This bit is cleared when the RBR is read in non-FIFO mode, or when the receiver FIFO is empty, in FIFO mode.

UART Modem Status Register

Offset: 0x18			Register Name: UART_MSR Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7	R	0	DCD Line State of Data Carrier Detect This is used to indicate the current state of the modem control line dcd_n. This bit is the complement of dcd_n. When the Data Carrier Detect input (dcd_n) is asserted it is an indication that the carrier has been detected by the modem or data set. 0: dcd_n input is de-asserted (logic 1) 1: dcd_n input is asserted (logic 0)
6	R	0	RI Line State of Ring Indicator This is used to indicate the current state of the modem control line ri_n. This bit is the complement of ri_n.

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			When the Ring Indicator input (ri_n) is asserted it is an indication that a telephone ringing signal has been received by the modem or data set. 0: ri_n input is de-asserted (logic 1) 1: ri_n input is asserted (logic 0)
5	R	0	DSR Line State of Data Set Ready This is used to indicate the current state of the modem control line dsr_n. This bit is the complement of dsr_n. When the Data Set Ready input (dsr_n) is asserted it is an indication that the modem or data set is ready to establish communications with UART. 0: dsr_n input is de-asserted (logic 1) 1: dsr_n input is asserted (logic 0) In Loopback Mode (MCR[4] set to one), DSR is the same as MCR[0] (DTR).
4	R	0	CTS Line State of Clear To Send This is used to indicate the current state of the modem control line cts_n. This bit is the complement of cts_n. When the Clear to Send input (cts_n) is asserted it is an indication that the modem or data set is ready to exchange data with UART. 0: cts_n input is de-asserted (logic 1) 1: cts_n input is asserted (logic 0) In Loopback Mode (MCR[4] = 1), CTS is the same as MCR[1] (RTS).
3	R	0	DDCD Delta Data Carrier Detect This is used to indicate that the modem control line dcd_n has changed since the last time the MSR was read. 0: no change on dcd_n since last read of MSR 1: change on dcd_n since last read of MSR Reading the MSR clears the DDCD bit. Note: Ff the DDCD bit is not set and the dcd_n signal is asserted (low) and a reset occurs (software or otherwise), then the DDCD bit is set when the reset is removed if the dcd_n signal remains asserted.
2	R	0	TERI Trailing Edge Ring Indicator This is used to indicate that a change on the input ri_n (from an active-low to an inactive-high state) has occurred since the last time the MSR was read. 0: no change on ri_n since last read of MSR 1: change on ri_n since last read of MSR

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			Reading the MSR clears the TERI bit.
1	R	0	DDSR Delta Data Set Ready This is used to indicate that the modem control line dsr_n has changed since the last time the MSR was read. 0: no change on dsr_n since last read of MSR 1: change on dsr_n since last read of MSR Reading the MSR clears the DDSR bit. In Loopback Mode (MCR[4] = 1), DDSR reflects changes on MCR[0] (DTR). Note: If the DDSR bit is not set and the dsr_n signal is asserted (low) and a reset occurs (software or otherwise), then the DDSR bit is set when the reset is removed if the dsr_n signal remains asserted.
0	R	0	DCTS Delta Clear to Send This is used to indicate that the modem control line cts_n has changed since the last time the MSR was read. 0: no change on ctsdsr_n since last read of MSR 1: change on ctsdsr_n since last read of MSR Reading the MSR clears the DCTS bit. In Loopback Mode (MCR[4] = 1), DCTS reflects changes on MCR[1] (RTS). Note: If the DCTS bit is not set and the cts_n signal is asserted (low) and a reset occurs (software or otherwise), then the DCTS bit is set when the reset isremoved if the cts_n signal remains asserted.

UART Scratch Register

Offset: 0x1C			Register Name: UART_SCH Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7:0	R/W	0	SCRATCH_REG Scratch Register This register is for programmers to use as a temporary storage space. It has no defined purpose in the UART.

UART Status Register

Offset: 0x7C			Register Name: UART_USR Default Value: 0x0000_0006
Bit	Read/Write	Default/Hex	Description
31:5	/	/	/
4	R	0	RFF Receive FIFO Full This is used to indicate that the receive FIFO is completely full. 0: Receive FIFO not full

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			1: Receive FIFO Full This bit is cleared when the RX FIFO is no longer full.
3	R	0	RFNE Receive FIFO Not Empty This is used to indicate that the receive FIFO contains one or more entries. 0: Receive FIFO is empty 1: Receive FIFO is not empty This bit is cleared when the RX FIFO is empty.
2	R	1	TFE Transmit FIFO Empty This is used to indicate that the transmit FIFO is completely empty. 0: Transmit FIFO is not empty 1: Transmit FIFO is empty This bit is cleared when the TX FIFO is no longer empty.
1	R	1	TFNF Transmit FIFO Not Full This is used to indicate that the transmit FIFO in not full. 0: Transmit FIFO is full 1: Transmit FIFO is not full This bit is cleared when the TX FIFO is full.
0	R	0	BUSY UART Busy Bit 0: Idle or inactive 1: Busy

UART Transmit FIFO Level Register

Offset: 0x80			Register Name: UART_TFL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:7	/	/	/
6:0	R	0	TFL Transmit FIFO Level This is indicates the number of data entries in the transmit FIFO.

UART Receive FIFO Level Register

Offset: 0x84			Register Name: UART_RFL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:7	/	/	/
6:0	R	0	RFL Receive FIFO Level This is indicates the number of data entries in the receive FIFO.

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UART Halt TX Register

Offset: 0xA4			Register Name: UART_HALT Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:6	/	/	/
5	R/W	0	SIR_RX_INVERT SIR Receiver Pulse Polarity Invert 0: Not invert receiver signal 1: Invert receiver signal
4	R/W	0	SIR_TX_INVERT SIR Transmit Pulse Polarity Invert 0: Not invert transmit pulse 1: Invert transmit pulse
3	/	/	/
2	R/W	0	CHANGE_UPDATE After the user using HALT[1] to change the baudrate or LCR configuration, write 1 to update the configuration and waiting this bit self clear to 0 to finish update process. Write 0 to this bit has no effect. 1: Update trigger, Self clear to 0 when finish update.
1	R/W	0	CHCFG_AT_BUSY This is an enable bit for the user to change LCR register configuration (except for the DLAB bit) and baudrate register (DLH and DLL) when the UART is busy (USB[0] is 1). 1: Enable change when busy
0	R/W	0	HALT_TX Halt TX This register is use to halt transmissions for testing, so that the transmit FIFO can be filled by the master when FIFOs are implemented and enabled. 0 : Halt TX disabled 1 : Halt TX enabled Note: If FIFOs are not enabled, the setting of the halt TX register has no effect on operation.

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7.4.5 UART Special Requirement

UART Pin List

Port Name	Width	Direction	Description
UART0_TX	1	OUT	UART Serial Bit output
UART0_RX	1	IN	UART Serial Bit input
UART1_TX	1	OUT	UART Serial Bit output
UART1_RX	1	IN	UART Serial Bit input
UART1_RTS		OUT	UART Request To Send This active low output signal informs Modem that the UART is ready to send data
UART1_CTS		IN	UART Clear To End This active low signal is an input showing when Modem is ready to accept data
UART2_TX	1	OUT	UART Serial Bit output
UART2_RX	1	IN	UART Serial Bit input
UART2_RTS	1	OUT	UART Request To Send This active low output signal informs Modem that the UART is ready to send data
UART2_CTS	1	IN	UART Clear To End This active low signal is an input showing when Modem is ready to accept data
UART3_TX	1	OUT	UART Serial Bit output
UART3_RX	1	IN	UART Serial Bit input
UART3_RTS	1	OUT	UART Request To Send This active low output signal informs Modem that the UART is ready to send data
UART3_CTS	1	IN	UART Clear To End This active low signal is an input showing when Modem is ready to accept data
S_UART_TX	1	OUT	UART Serial Bit output
S_UART_RX	1	IN	UART Serial Bit input

IrDA Inverted Signals

When the UART is working in IrDA mode (MCR[6]='1'), if HALT[4] is set to '1', the signal is inverted before transferring to pin SOUT and if HALT[5] is set to '1', the signal is inverted after receiving from pin SIN

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7.5 USB OTG

7.5.1 Overview

USB OTG ,is Dual-Role Device (DRD) controller, supports both device and host functions which can also be configured as a Host-only or Device-only controller, fully compliant with the USB 2.0 Specification. It can support high-speed (HS, 480-Mbps), full-speed (FS, 12-Mbps), and low-speed (LS, 1.5-Mbps) transfers in Host mode. It can support high-speed (HS, 480-Mbps), and full-speed (FS, 12-Mbps) in Device mode. Standard USB transceiver can be used through its UTMI+PHY Level3 interface. The UTMI+PHY interface is bidirectional with 8-bit data bus.

The USB2.0 OTG controller (SIE) includes the following features:

- Comply with USB 2.0 Specification
- Supports High-Speed (HS, 480Mbps), Full-Speed (FS, 12Mbps), and Low-Speed (LS, 1.5Mbps) in Host mode and support High-Speed (HS, 480Mbps), Full-Speed (FS, 12Mbps) in Device mode
- Supports the UTMI+ Level 3 interface. The 8-bit bidirectional data buses are used.
- 64-Byte Endpoint 0 for Control Transfer (Endpoint0)
- Supports up to 10 User-Configurable Endpoints for Bulk , Isochronous, Interrupt bi-directional transfers (Endpoint1, Endpoint2, Endpoint3, Endpoint4, Endpoint5)
- Supports up to 8128Bytes (8KB-64B) FIFO for EPs (Excluding EP0)
- Supports High-Bandwidth Isochronous & Interrupt transfers
- Automated splitting/combining of packets for Bulk transfers
- Supports point-to-point and point-to-multipoint transfer in both Host and Peripheral mode
- Includes automatic ping capabilities
- Soft connect/disconnect function
- Performs all transaction scheduling in hardware
- Power Optimization and Power Management capabilities

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7.5.2 USB_OTG Timing Diagram

Please refer to USB2.0 Specification.

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7.5.3 USB/OTG Clock Source and Frequency

There are two clocks for USB/OTG SIE module. One is from AHB bus and one is from UTMI Transceiver which is called USB/OTG PHY.

Name	Description
USB_CLK	System clock (provided by AHB bus clock). This clock needs to be >30MHz where the core is configured for an 8-bit transceiver interface and up to 180Mhz
USB_XCLK	Transceiver macrocell clock. 60MHz for an 8-bit interface

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7.6 USB Host

7.6.1 Overview

USB Host Controller is fully compliant with the USB 2.0 specification, Enhanced Host Controller Interface (EHCI) Specification, Revision 1.0, and the Open Host Controller Interface (OHCI) Specification Release 1.0a. The controller supports high-speed, 480Mbps transfers (40 times faster than USB 1.1 full-speed mode) using an EHCI Host Controller, as well as full and low speeds through one integrated OHCI Host Controllers.

The USB host controller includes the following features:

- Support industry-standard AMBA High-Performance Bus (AHB) and it is fully compliant with the AMBA Specification, Revision 2.0. Supports bus.
- Support 32-bit Little Endian AMBA AHB Slave Bus for Register Access.
- Support 32-bit Little Endian AMBA AHB Master Bus for Memory Access.
- Comply with Enhanced Host Controller Interface (EHCI) Specification, Version 1.0, and the Open Host Controller Interface (OHCI) Specification, Version 1.0a.
- Support High-Speed (HS, 480Mbps), Full-Speed (FS, 12Mbps), and Low-Speed (LS, 1.5Mbps) Device.
- Support the UTMI+ Level 3 interface. The 8-bit bidirectional data buses are used.
- Support only 1 USB Root Port shared between EHCI and OHCI.

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The USB host controller system-level block diagram is shown below:

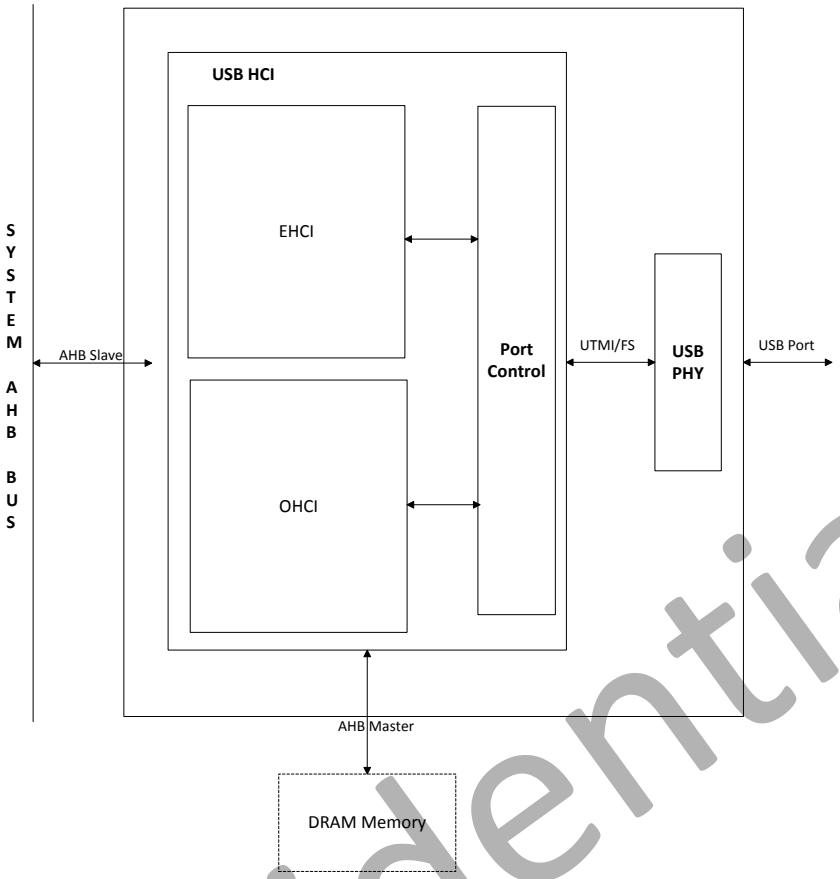

Figure 7.6-1 USB Host Control Block Diagram

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7.6.2 USB Host Timing Diagram

Please refer to USB2.0 specification, Enhanced Host Controller Interface (EHCI) Specification, Version 1.0, and the Open Host Controller Interface (OHCI) Specification, Version 1.0a.

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7.6.3 USB Host Register List

Module Name	Base Address
USB_HCI0	0x01C1A000

Register Name	Offset	Description
EHCI Capability Register		
E_CAPLENGTH	0x000	EHCI Capability register Length Register
E_HCIVERSION	0x002	EHCI Host Interface Version Number Register
E_HCSPARAMS	0x004	EHCI Host Control Structural Parameter Register
E_HCCPARAMS	0x008	EHCI Host Control Capability Parameter Register
E_HCSPPORTROUTE	0x00c	EHCI Companion Port Route Description
EHCI Operational Register		
E_USBCMD	0x010	EHCI USB Command Register
E_USBSTS	0x014	EHCI USB Status Register
E_USBINTR	0x018	EHCI USB Interrupt Enable Register
E_FRINDEX	0x01c	EHCI USB Frame Index Register
E_CTRLDSSEGMENT	0x020	EHCI 4G Segment Selector Register
E_PERIODICLISTBASE	0x024	EHCI Frame List Base Address Register
E_ASYNCLISTADDR	0x028	EHCI Next Asynchronous List Address Register
E_CONFIGFLAG	0x050	EHCI Configured Flag Register
E_PORTSC	0x054	EHCI Port Status/Control Register
OHCI Control and Status Partition Register		
O_HcRevision	0x400	OHCI Revision Register
O_HcControl	0x404	OHCI Control Register
O_HcCommandStatus	0x408	OHCI Command Status Register
O_HcInterruptStatus	0x40c	OHCI Interrupt Status Register
O_HcInterruptEnable	0x410	OHCI Interrupt Enable Register
O_HcInterruptDisable	0x414	OHCI Interrupt Disable Register
OHCI Memory Pointer Partition Register		
O_HcHCCA	0x418	OHCI HCCA Base
O_HcPeriodCurrentED	0x41c	OHCI Period Current ED Base
O_HcControlHeadED	0x420	OHCI Control Head ED Base
O_HcControlCurrentED	0x424	OHCI Control Current ED Base
O_HcBulkHeadED	0x428	OHCI Bulk Head ED Base
O_HcBulkCurrentED	0x42c	OHCI Bulk Current ED Base
O_HcDoneHead	0x430	OHCI Done Head Base
OHCI Frame Counter Partition Register		
O_HcFmInterval	0x434	OHCI Frame Interval Register
O_HcFmRemaining	0x438	OHCI Frame Remaining Register
O_HcFmNumber	0x43c	OHCI Frame Number Register
O_HcPerioddicStart	0x440	OHCI Periodic Start Register
O_HcLSThreshold	0x444	OHCI LS Threshold Register

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OHCI Root Hub Partition Register		
O_HcRhDescriptorA	0x448	OHCI Root Hub Descriptor Register A
O_HcRhDesriptorB	0x44c	OHCI Root Hub Descriptor Register B
O_HcRhStatus	0x450	OHCI Root Hub Status Register
O_HcRhPortStatus	0x454	OHCI Root Hub Port Status Register

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7.6.4 EHCI Register Description

EHCI Identification Register

Offset:0x00			Register Name: CAPLENGTH Default Value: Implementation Dependent
Bit	Read/Write	Default	Description
7:0	R	0x10	CAPLENGTH The value in these bits indicates an offset to add to register base to find the beginning of the Operational Register Space.

EHCI Host Interface Version Number Register

Offset: 0x02			Register Name: HCIVERSION Default Value:0x0100
Bit	Read/Write	Default	Description
15:0	R	0x0100	HCIVERSION This is a 16-bits register containing a BCD encoding of the EHCI revision number supported by this host controller. The most significant byte of this register represents a major revision and the least significant byte is the minor revision.

EHCI Host Control Structural Parameter Register

Offset: 0x04			Register Name: HCSPARAMS Default Value: Implementation Dependent
Bit	Read/Write	Default	Description
31:24	/	0	Reserved. These bits are reserved and should be set to zero.
23:20	R	0	/
19:16	/	0	Reserved. These bits are reserved and should be set to zero.
15:12	R	0	Number of Companion Controller (N_CC) This field indicates the number of companion controllers associated with this USB2.0 host controller. A zero in this field indicates there are no companion host controllers. And a value larger than zero in this field indicates there are companion USB1.1 host controller(s). This field will always be '0'.
11:8	R	0	Number of Port per Companion Controller(N_PCC) This field indicates the number of ports supported per companion host controller host controller. It is used to indicate the port routing configuration to system software. This field will always fix with '0'.
7	R	0	Port Routing Rules This field indicates the method used by this implementation for how all ports are mapped to companion controllers. The value of this field has the following interpretation:

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			<table><tr><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>The first N_PCC ports are routed to the lowest numbered function companion host controller, the next N_PCC port are routed to the next lowest function companion controller, and so on.</td></tr><tr><td>1</td><td>The port routing is explicitly enumerated by the first N_PORTS elements of the HCSP-PORTTOUTE array.</td></tr></table> This field will always be '0'.
6:4	/	0	Reserved. These bits are reserved and should be set to zero.
3:0	R	1	N_PORTS This field specifies the number of physical downstream ports implemented on this host controller. The value of this field determines how many port registers are addressable in the Operational Register Space. Valid values are in the range of 0x1 to 0x0f. This field is always 1.

EHCI Host Control Capability Parameter Register

Offset: 0x08			Register Name: HCCPARAMS Default Value: Implementation Dependent
Bit	Read/Write	Default	Description
31:16	/	0	Reserved These bits are reserved and should be set to zero.
15:18	R	0	EHCI Extended Capabilities Pointer (EECP) This optional field indicates the existence of a capabilities list. A value of 00b indicates no extended capabilities are implemented. A non-zero value in this register indicates the offset in PCI configuration space of the first EHCI extended capabiliby. The pointer value must be 40h or greater if implemented to maintain to consistency of the PCI header defined for this calss of device. The value of this field is always '00b'.
7:4	R		Isochronous Scheduling Threshold This field indicates, relative to the current position of the executing host controller, where software can reliably update the isochronous schedule. When bit[7] is zero, the value of the least significant 3 bits indicates the number of micro-frames a host controller can hold a set of isochronous data structures(one or more) before flushing the state. When bit[7] is a one, then host software assumes the host controller may cache an isochronous data structure for an entire frame.
3	R	0	Reserved These bits are reserved and should be set to zero.

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2	R		Asynchronous Schedule Park Capability If this bit is set to a one, then the host controller supports the park feature for high-speed queue heads in the Asynchronous Schedule. The feature can be disabled or enabled and set to a specific level by using the Asynchronous Schedule Park Mode Enable and Asynchronous Schedule Park Mode Count fields in the USBCMD register.
1	R		Programmable Frame List Flag If this bit is set to a zero, then system software must use a frame list length of 1024 elements with this host controller.The USBCMD register Frame List Size field is a read-only register and should be set to zero. If set to 1,then system software can specify and use the frame list in the USBCMD register Frame List Size field to cofigure the host controller. The frame list must always aligned on a 4K page boundary.This requirement ensures that the frame list is always physically contiguous.
0	R	0	Reserved These bits are reserved for future use and should return a value of zero when read.

EHCI Companion Port Route Description

Offset: 0x0C			Register Name: HCSP-PORTROUTE Default Value: UNDEFINED
Bit	Read/Write	Default	Description
31:0	R		HCSP-PORTROUTE This optional field is valid only if Port Routing Rules field in HCSPARAMS register is set to a one. This field is used to allow a host controller implementation to explicitly describe to which companion host controller each implemented port is mapped. This field is a 15-element nibble array (each 4 bit is one array element). Each array location corresponds one-to-one with a physical port provided by the host controller (e.g. PORTROUTE [0] corresponds to the first PORTSC port, PORTROUTE [1] to the second PORTSC port, etc.). The value of each element indicates to which of the companion host controllers this port is routed. Only the first N_PORTS elements have valid information. A value of zero indicates that the port is routed to the lowest numbered function companion host controller. A value of one indicates that the port is routed to the next lowest numbered function companion host controller, and so on.

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EHCI USB Command Register

<table>
<tr><td colspan="3">Offset: 0x10</td><td>Register Name: USBCMD
Default Value: 0x00080000(0x00080B00 if Asynchronous Schedule Park Capability is a one)</td></tr>
<tr><td>Bit</td><td>Read/Write</td><td>Default</td><td>Description</td></tr>
<tr><td>31:24</td><td>/</td><td>0</td><td>Reserved
These bits are reserved and should be set to zero.</td></tr>
<tr><td>23:16</td><td>R/W</td><td>0x08</td><td>Interrupt Threshold Control
The value in this field is used by system software to select the maximum rate at which the host controller will issue interrupts. The only valid values are defined below:
<table><tr><td>Value</td><td>Minimum Interrupt Interval</td></tr><tr><td>0x00</td><td>Reserved</td></tr><tr><td>0x01</td><td>1 micro-frame</td></tr><tr><td>0x02</td><td>2 micro-frame</td></tr><tr><td>0x04</td><td>4 micro-frame</td></tr><tr><td>0x08</td><td>8 micro-frame(default, equates to 1 ms)</td></tr><tr><td>0x10</td><td>16 micro-frame(2ms)</td></tr><tr><td>0x20</td><td>32 micro-frame(4ms)</td></tr><tr><td>0x40</td><td>64 micro-frame(8ms)</td></tr></table>Any other value in this register yields undefined results.
The default value in this field is 0x08 .
Software modifications to this bit while HC Halted bit is equal to zero results in undefined behavior.</td></tr>
<tr><td>15:12</td><td>/</td><td>0</td><td>Reserved
These bits are reserved and should be set to zero.</td></tr>
<tr><td>11</td><td>R/W or R</td><td>0</td><td>Asynchronous Schedule Park Mode Enable(OPTIONAL)
If the Asynchronous Park Capability bit in the HCCPARAMS register is a one, then this bit defaults to a 1 and is R/W. Otherwise the bit must be a zero and is Read Only. Software uses this bit to enable or disable Park mode. When this bit is one, Park mode is enabled. When this bit is zero, Park mode is disabled.</td></tr>
<tr><td>10</td><td>/</td><td>0</td><td>Reserved
These bits are reserved and should be set to zero.</td></tr>
<tr><td>9:8</td><td>R/W or R</td><td>0</td><td>Asynchronous Schedule Park Mode Count(OPTIONAL)
Asynchronous Park Capability bit in the HCCPARAMS register is a one,
Then this field defaults to 0x3 and is W/R. Otherwise it defaults to zero and is R. It contains a count of the number of successive transactions the host controller is allowed to execute from a high-speed queue head on the Asynchronous schedule before continuing traversal of the Asynchronous schedule.
Valid value are 0x1 to 0x3.Software must not write a zero to this bit when Park Mode Enable is a one as it will result in</td></tr>
</table>

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			undefined behavior.
7	R/W	0	Light Host Controller Reset(OPTIONAL) This control bit is not required. If implemented, it allows the driver to reset the EHCI controller without affecting the state of the ports or relationship to the companion host controllers. For example, the PORSTC registers should not be reset to their default values and the CF bit setting should not go to zero (retaining port ownership relationships). A host software read of this bit as zero indicates the Light Host Controller Reset has completed and it si safe for software to re-initialize the host controller. A host software read of this bit as a one indicates the Light Host
6	R/W	0	Interrupt on Async Advance Doorbell This bit is used as a doorbell by software to tell the host controller to issue an interrupt the next time it advances asynchronous schedule. Soft- Ware must write a 1 to this bit to ring the doorbell. When the host controller has evicted all appropriate cached schedule state, it sets the Interrupt on Async Advance status bit in the USBSTS. if the Interrupt on Async Advance Enable bit in the USBINTR register is a one then the host controller will assert an interrupt at the next interrupt threshold. The host controller sets this bit to a zero after it has set the Interrupt on Async Advance status bit in the USBSTS register to a one. Software should not write a one to this bit when the asynchronous schedule is disabled. Doing so will yield undefined results.
5	R/W	0	Asynchronous Schedule Enable This bit controls whether the host controller skips processing the Asynchronous Schedule. Values mean: Bit Value: 0 — Do not process the Asynchronous Schedule. Bit Value: 1 — Use the ASYNLISTADDR register to access the Asynchronous Schedule. The default value of this field is ‘0b’.
4	R/W	0	Periodic Schedule Enable This bit controls whether the host controller skips processing the Periodic Schedule. Values mean: Bit Value: 0 — Do not process the Periodic Schedule. Bit Value: 1 — Use the PERIODICLISTBASE register to access the Periodic Schedule. The default value of this field is ‘0b’.
3:2	R/W or R	0	Frame List Size

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<table>
<tr><td></td><td></td><td></td><td>This field is R/W only if Programmable Frame List Flag in the HCCPARAMS registers is set to a one. This field specifies the size of the
Frame list. The size the frame list controls which bits in the Frame Index
Register should be used for the Frame List Current index. Values mean:
<table><tr><td>Bits</td><td>Meaning</td></tr><tr><td>00b</td><td>1024 elements(4096bytes)Default value</td></tr><tr><td>01b</td><td>512 elements(2048byts)</td></tr><tr><td>10b</td><td>256 elements(1024bytes)For resource-constrained condition</td></tr><tr><td>11b</td><td>reserved</td></tr></table>The default value is ‘00b’.</td></tr>
<tr><td>1</td><td>R/W</td><td>0</td><td>Host Controller Reset
This control bit is used by software to reset the host controller. The effects of this on Root Hub registers are similar to a Chip Hardware Reset.
When software writes a one to this bit, the Host Controller resets its internal pipelines, timers, counters, state machines, etc. to their initial value. Any transaction currently in progress on USB is immediately terminated. A USB reset is not driven on downstream ports.
All operational registers, including port registers and port state machines are set to their initial values. Port ownership reverts to the companion host controller(s). Software must reinitialize the host controller as described in Section 4.1 of the CHEI Specification in order to return the host controller to an operational state.
This bit is set to zero by the Host Controller when the reset process is complete. Software cannot terminate the reset process early by writing a zero to this register.
Software should not set this bit to a one when the HC Halted bit in the USBSTS register is a zero. Attempting to reset an actively running host controller will result in undefined behaviour.</td></tr>
<tr><td>0</td><td>R/W</td><td>0</td><td>Run/Stop
When set to a 1, the Host Controller proceeds with execution of the schedule. When set to 0, the Host Controller completes the current and any actively pipelined transactions on the USB and then halts. The Host Controller must halt within 16 micro-frames after software clears this bit.
The HC Halted bit indicates when the Host Controller has finished its pending pipelined transactions and has entered the stopped state.
Software must not write a one to this field unless the Host</td></tr>
</table>

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			Controller is in the Halt State. The default value is 0x0.

EHCI USB Status Register

Offset: 0x14			Register Name: USBSTS Default Value: 0x00001000
Bit	Read/Write	Default	Description
31:16	/	0	Reserved These bits are reserved and should be set to zero.
15	R	0	Asynchronous Schedule Status The bit reports the current real status of Asynchronous Schedule. If this bit is a zero then the status of the Asynchronous Schedule is disabled. If this bit is a one then the status of the Asynchronous Schedule is enabled. The Host Controller is not required to immediately disable or enable the Asynchronous Schedule when software transitions the Asynchronous Schedule Enable bit in the USBCMD register. When this bit and the Asynchronous Schedule Enable bit are the same value, the Asynchronous Schedule is either enabled (1) or disabled (0).
14	R	0	Periodic Schedule Status The bit reports the current real status of the Periodic Schedule. If this bit is a zero then the status of the Periodic Schedule is disabled. If this bit is a one then the status of the Periodic Schedule is enabled. The Host Controller is not required to *immediately* disable or enable the Periodic Schedule when software transitions the *Periodic Schedule Enable* bit in the USBCMD register. When this bit and the *Periodic Schedule Enable* bit are the same value, the Periodic Schedule is either enabled (1) or disabled (0).
13	R	0	Reclamation This is a read-only status bit, which is used to detect an empty asynchronous schedule.
12	R	1	HC Halted This bit is a zero whenever the Run/Stop bit is a one. The Host Controller Sets this bit to one after it has stopped executing as a result of the Run/Stop bit being set to 0, either by software or by the Host Controller Hardware (e.g. internal error). The default value is '1'.
11:6	/	0	Reserved These bits are reserved and should be set to zero.
5	R/WC	0	Interrupt on Async Advance System software can force the host controller to issue an interrupt the next time the host controller advances the asynchronous schedule by writing a one to the Interrupt on Async Advance Doorbell bit in the USBCMD register. This status

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			bit indicates the assertion of that interrupt source.
4	R/WC	0	Host System Error The Host Controller set this bit to 1 when a serious error occurs during a host system access involving the Host Controller module. When this error occurs, the Host Controller clears the Run/Stop bit in the Command register to prevent further execution of the scheduled TDs.
3	R/WC	0	Frame List Rollover The Host Controller sets this bit to a one when the Frame List Index rolls over from its maximum value to zero. The exact value at which the rollover occurs depends on the frame list size. For example, if the frame list size is 1024, the Frame Index Register rolls over every time FRINDEX [13] toggles. Similarly, if the size is 512, the Host Controller sets this bit to a one every time FRINDEX [12] toggles.
2	R/WC	0	Port Change Detect The Host Controller sets this bit to a one when any port for which the Port Owner bit is set to zero has a change bit transition from a zero to a one or a Force Port Resume bit transition from a zero to a one as a result of a J-K transition detected on a suspended port. This bit will also be set as a result of the Connect Status Chang being set to a one after system software has relinquished ownership of a connected port by writing a one to a port's Port Owner bit.
1	R/WC	0	USB Error Interrupt(USBERRINT) The Host Controller sets this bit to 1 when completion of USB transaction results in an error condition(e.g. error counter underflow).If the TD on which the error interrupt occurred also had its IOC bit set, both. This bit and USBINT bit are set.
0	R/WC	0	USB Interrupt(USBINT) The Host Controller sets this bit to a one on the completion of a USB transaction, which results in the retirement of a Transfer Descriptor that had its IOC bit set. The Host Controller also sets this bit to 1 when a short packet is detected (actual number of bytes received was less than the expected number of bytes)

EHCI USB Interrupt Enable Register

Offset: 0x18			Register Name: USBINTR Default Value:0x00000000
Bit	Read/Write	Default	Description
31:6	/	0	Reserved These bits are reserved and should be zero.
5	R/W	0	Interrupt on Async Advance Enable

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			When this bit is 1, and the Interrupt on Async Advance bit in the USBSTS register is 1, the host controller will issue an interrupt at the next interrupt threshold. The interrupt is acknowledged by software clearing the Interrupt on Async Advance bit.
4	R/W	0	Host System Error Enable When this bit is 1, and the Host System Error Status bit in the USBSTS register is 1, the host controller will issue an interrupt. The interrupt is acknowledged by software clearing the Host System Error bit.
3	R/W	0	Frame List Rollover Enable When this bit is 1, and the Frame List Rollover bit in the USBSTS register is 1, the host controller will issue an interrupt. The interrupt is acknowledged by software clearing the Frame List Rollover bit.
2	R/W	0	Port Change Interrupt Enable When this bit is 1, and the Port Chang Detect bit in the USBSTS register is 1, the host controller will issue an interrupt. The interrupt is acknowledged by software clearing the Port Chang Detect bit.
1	R/W	0	USB Error Interrupt Enable When this bit is 1, and the USBERRINT bit in the USBSTS register is 1,the host controller will issue an interrupt at the next interrupt threshold. The interrupt is acknowledged by software clearing the USBERRINT bit.
0	R/W	0	USB Interrupt Enable When this bit is 1, and the USBINT bit in the USBSTS register is 1,the host controller will issue an interrupt at the next interrupt threshold. The interrupt is acknowledged by software clearing the USBINT bit

EHCI Frame Index Register

Offset: 0x1c			Register Name: FRINDEX Default Value: 0x00000000
Bit	Read/Write	Default	Description
31:14	/	0	Reserved These bits are reserved and should be zero.
13:0	R/W	0	Frame Index The value in this register increment at the end of each time frame (e.g. micro-frame).Bits[N:3] are used for the Frame List current index. It Means that each location of the frame list is accessed 8 times(frames or

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			Micro-frames) before moving to the next index. The following illustrates Values of N based on the value of the Frame List Size field in the USBCMD register. USBCMD[Frame List Size] / Number Elements / N 00b / 1024 / 12 01b / 512 / 11 10b / 256 / 10 11b / Reserved

Note: This register must be written as a DWord. Byte writes produce undefined results.

EHCI Periodic Frame List Base Address Register

Offset: 0x24			Register Name: PERIODICLISTBASE Default Value: Undefined
Bit	Read/Write	Default	Description
31:12	R/W		Base Address These bits correspond to memory address signals [31:12], respectively. This register contains the beginning address of the Periodic Frame List in the system memory. System software loads this register prior to starting the schedule execution by the Host Controller. The memory structure referenced by this physical memory pointer is assumed to be 4-K byte aligned. The contents of this register are combined with the Frame Index Register (FRINDEX) to enable the Host Controller to step through the Periodic Frame List in sequence.
11:0	/		Reserved Must be written as 0x0 during runtime, the values of these bits are undefined.

Note: Writes must be Dword Writes.

EHCI Current Asynchronous List Address Register

Offset: 0x28			Register Name: ASYNCLISTADDR Default Value: Undefined
Bit	Read/Write	Default	Description
31:5	R/W		Link Pointer (LP) This field contains the address of the next asynchronous queue head to be executed. These bits correspond to memory address signals [31:5], respectively.
4:0	/	/	Reserved These bits are reserved and their value has no effect on operation. Bits in this field cannot be modified by system software and will always return a zero when read.

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Note: Write must be DWord Writes.

EHCI Configure Flag Register

Offset: 0x50			Register Name: CONFIGFLAG Default Value: 0x00000000
Bit	Read/Write	Default	Description
31:1	/	0	Reserved These bits are reserved and should be set to zero.
0	R/W	0	Configure Flag(CF) Host software sets this bit as the last action in its process of configuring the Host Controller. This bit controls the default port-routing control logic as follow: Value: Meaning 0: Port routing control logic default-routs each port to an implementation dependent classic host controller. 1: Port routing control logic default-routs all ports to this host controller. The default value of this field is '0'.

Note: This register is not use in the normal implementation.

EHCI Port Status and Control Register

Offset: 0x54			Register Name: PORTSC Default Value: 0x00002000(w/PPC set to one);0x00003000(w/PPC set to a zero)
Bit	Read/Write	Default	Description
31:22	/	0	Reserved These bits are reserved for future use and should return a value of zero when read.
21	R/W	0	Wake on Disconnect Enable(WKDSCNNT_E) Writing this bit to a one enables the port to be sensitive to device disconnects as wake-up events. This field is zero if Port Power is zero. The default value in this field is '0'.
20	R/W	0	Wake on Connect Enable(WKCNNT_E) Writing this bit to a one enable the port to be sensitive to device connects as wake-up events. This field is zero if Port Power is zero. The default value in this field is '0'.
19:16	R/W	0	Port Test Control The value in this field specifies the test mode of the port. The encoding of the test mode bits are as follow: Bits: Test Mode 0000b: The port is NOT operating in a test mode. 0001b: Test J_STATE

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<table>
<tr><td></td><td></td><td></td><td>
<table>
<tr><td>0010b</td><td>Test K_STATE</td></tr>
<tr><td>0011b</td><td>Test SE0_NAK</td></tr>
<tr><td>0100b</td><td>Test Packet</td></tr>
<tr><td>0101b</td><td>Test FORCE_ENABLE</td></tr>
<tr><td>0110b
-
1111b</td><td>Reserved</td></tr>
</table>
The default value in this field is ‘0000b’.
</td></tr>
<tr><td>15:14</td><td>R/W</td><td>0</td><td>Reserved
These bits are reserved for future use and should return a value of zero when read.</td></tr>
<tr><td>13</td><td>R/W</td><td>1</td><td>Port Owner
This bit unconditionally goes to a 0b when the Configured bit in the CONFIGFLAG register makes a 0b to 1b transition. This bit unconditionally goes to 1b whenever the Configured bit is zero. System software uses this field to release ownership of the port to selected host controller (in the event that the attached device is not a high-speed device).Software writes a one to this bit when the attached device is not a high-speed device. A one in this bit means that a companion host controller owns and controls the port.
Default Value = 1b.</td></tr>
<tr><td>12</td><td>/</td><td>0</td><td>Reserved
These bits are reserved for future use and should return a value of zero when read.</td></tr>
<tr><td>11:10</td><td>R</td><td>0</td><td>Line Status
These bits reflect the current logical levels of the D+ (bit11) and D-(bit10) signal lines. These bits are used for detection of low-speed USB devices prior to port reset and enable sequence. This read only field is valid only when the port enable bit is zero and the current connect status bit is set to a one.
The encoding of the bits are:
<table>
<tr><td>Bit[11:10]</td><td>USB State</td><td>Interpretation</td></tr>
<tr><td>00b</td><td>SE0</td><td>Not Low-speed device, perform EHCI reset.</td></tr>
<tr><td>10b</td><td>J-state</td><td>Not Low-speed device, perform EHCI reset.</td></tr>
<tr><td>01b</td><td>K-state</td><td>Low-speed device, release ownership of port.</td></tr>
<tr><td>11b</td><td>Undefined</td><td>Not Low-speed device, perform EHCI reset.</td></tr>
</table>
This value of this field is undefined if Port Power is zero.</td></tr>
<tr><td>9</td><td>/</td><td>0</td><td>Reserved
This bit is reserved for future use, and should return a value of</td></tr>
</table>

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<table>
<tr><td></td><td></td><td></td><td>zero when read.</td></tr>
<tr><td>8</td><td>R/W</td><td>0</td><td>Port Reset
1=Port is in Reset. 0=Port is not in Reset. Default value = 0.
When software writes a one to this bit (from a zero), the bus reset sequence as defined in the USB Specification Revision 2.0 is started. Software writes a zero to this bit to terminate the bus reset sequence. Software must keep this bit at a one long enough to ensure the reset sequence, as specified in the USB Specification Revision 2.0, completes. Notes: when software writes this bit to a one , it must also write a zero to the Port Enable bit.
Note that when software writes a zero to this bit there may be a delay before the bit status changes to a zero. The bit status will not read as a zero until after the reset has completed. If the port is in high-speed mode after reset is complete, the host controller will automatically enable this port (e.g. set the Port Enable bit to a one). A host controller must terminate the reset and stabilize the state of the port within 2 milliseconds of software transitioning this bit from a one to a zero. For example: if the port detects that the attached device is high-speed during reset, then the host controller must have the port in the enabled state with 2ms of software writing this bit to a zero.
The HC Halted bit in the USBSTS register should be a zero before software attempts to use this bit. The host controller may hold Port Reset asserted to a one when the HC Halted bit is a one.
This field is zero if Port Power is zero.</td></tr>
<tr><td>7</td><td>R/W</td><td>0</td><td>Suspend
Port Enabled Bit and Suspend bit of this register define the port states as follows:
<table>
<tr><td>Bits[Port Enables, Suspend]</td><td>Port State</td></tr>
<tr><td>0x</td><td>Disable</td></tr>
<tr><td>10</td><td>Enable</td></tr>
<tr><td>11</td><td>Suspend</td></tr>
</table>
When in suspend state, downstream propagation of data is blocked on this port, except for port reset. The blocking occurs at the end of the current transaction, if a transaction was in progress when this bit was written to 1. In the suspend state, the port is sensitive to resume detection. Not that the bit status does not change until the port is suspend and that there may be a delay in suspending a port if there is a transaction currently in progress on the USB.
A write of zero to this bit is ignored by the host controller. The host controller will unconditionally set this bit to a zero when:</td></tr>
</table>

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			① Software sets the Force Port Resume bit to a zero(from a one). ② Software sets the Port Reset bit to a one(from a zero). If host software sets this bit to a one when the port is not enabled(i.e. Port enabled bit is a zero), the results are undefined. This field is zero if Port Power is zero. The default value in this field is '0'.
6	R/W	0	Force Port Resume 1 = Resume detected/driven on port. 0 = No resume (K-state) detected/ driven on port. Default value = 0. This functionality defined for manipulating this bit depends on the value of the Suspend bit. For example, if the port is not suspend and software transitions this bit to a one, then the effects on the bus are undefined. Software sets this bit to a 1 drive resume signaling. The Host Controller sets this bit to a 1 if a J-to-K transition is detected while the port is in the Suspend state. When this bit transitions to a one because a J-to-K transition is detected, the Port Change Detect bit in the USBSTS register is also set to a one. If software sets this bit to a one, the host controller must not set the Port Change Detect bit. Note that when the EHCI controller owns the port, the resume sequence follows the defined sequence documented in the USB Specification Revision 2.0. The resume signaling (Full-speed 'K') is driven on the port as long as this remains a one. Software must appropriately time the Resume and set this bit to a zero when the appropriate amount of time has elapsed. Writing a zero (from one) causes the port to return high-speed mode (forcing the bus below the port into a high-speed idle). This bit will remain a one until the port has switched to high-speed idle. The host controller must complete this transition within 2 milliseconds of software setting this bit to a zero. This field is zero if Port Power is zero.
5	R/WC	0	Over-current Change Default = 0. This bit gets set to a one when there is a change to Over-current Active. Software clears this bit by writing a one to this bit position.
4	R	0	Over-current Active 0 = This port does not have an over-current condition. 1 = This port currently has an over-current condition. This bit will automatically transition from a one to a zero when the over current condition is removed. The default value of this bit is '0'.
3	R/WC	0	Port Enable/Disable Change

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			Default = 0. 1 = Port enabled/disabled status has changed. 0 = No change. For the root hub, this bit gets set to a one only when a port is disabled due to the appropriate conditions existing at the EOF2 point (See Chapter 11 of the USB Specification for the definition of a Port Error). Software clears this bit by writing a 1 to it. This field is zero if Port Power is zero.
2	R/W	0	Port Enabled/Disabled 1=Enable, 0=Disable. Ports can only be enabled by the host controller as a part of the reset and enable. Software cannot enable a port by writing a one to this field. The host controller will only set this bit to a one when the reset sequence determines that the attached device is a high-speed device. Ports can be disabled by either a fault condition(disconnect event or other fault condition) or by host software. Note that the bit status does not change until the port state actually changes. There may be a delay in disabling or enabling a port due to other host controller and bus events. When the port is disabled, downstream propagation of data is blocked on this port except for reset. The default value of this field is '0'. This field is zero if Port Power is zero.
1	R/WC	0	Connect Status Change 1=Change in Current Connect Status, 0=No change, Default=0. Indicates a change has occurred in the port's Current Connect Status. The host controller sets this bit for all changes to the port device connect status, even if system software has not cleared an existing connect status change. For example, the insertion status changes twice before system software has cleared the changed condition, hub hardware will be "setting" an already-set bit. Software sets this bit to 0 by writing a 1 to it. This field is zero if Port Power is zero.
0	R	0	Current Connect Status Device is present on port when the value of this field is a one, and no device is present on port when the value of this field is a zero. This value reflects the current state of the port, and may not correspond directly to the event that caused the Connect Status Change(Bit 1) to be set. This field is zero if Port Power zero.

Note: This register is only reset by hardware or in response to a host controller reset.

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7.6.5 OHCI Register Description

HcRevision Register

Offset: 0x400				Register Name: HcRevision Default Value:0x10
	Read/Write			
Bit	HCD	HC	Default	Description
31:8	/	/	0x00	Reserved
7:0	R	R	0x10	Revision This read-only field contains the BCD representation of the version of the HCI specification that is implemented by this HC. For example, a value of 0x11 corresponds to version 1.1. All of the HC implementations that are compliant with this specification will have a value of 0x10.

HcControl Register

Offset: 0x404				Register Name: HcRevision Default Value:0x0
	Read/Write			Description
Bit	HCD	HC	Default	
31:11	/	/	0x00	Reserved
10	R/W	R	0x0	RemoteWakeupEnable This bit is used by HCD to enable or disable the remote wakeup feature upon the detection of upstream resume signaling. When this bit is set and the **ResumeDetected** bit in ***HcInterruptStatus*** is set, a remote wakeup is signaled to the host system. Setting this bit has no impact on the generation of hardware interrupt.
9	R/W	R/W	0x0	RemoteWakeupConnected This bit indicates whether HC supports remote wakeup signaling. If remote wakeup is supported and used by the system, it is the responsibility of system firmware to set this bit during POST. HC clear the bit upon a hardware reset but does not alter it upon a software reset. Remote wakeup signaling of the host system is host-bus-specific and is not described in this specification.
8	R/W	R	0x0	InterruptRouting This bit determines the routing of interrupts generated by events registered in HcInterruptStatus. If clear, all interrupt are routed to the normal host bus interrupt mechanism. If set interrupts are routed to the System Management Interrupt. HCD clears this bit upon a hardware reset, but it does not alter this bit upon a software reset. HCD uses this bit as a tag to indicate the ownership of HC.
7:6	R/W	R/W	0x0	HostControllerFunctionalState for USB

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				00b USBReset 01b USBResume 10b USBOperational 11b USBSuspend A transition to USBOperational from another state causes SOF generation to begin 1 ms later. HCD may determine whether HC has begun sending SOFs by reading the StartoFrame field of HcInterruptStatus. This field may be changed by HC only when in the USBSUSPEND state. HC may move from the USBSUSPEND state to the USBRESUME state after detecting the resume signal from a downstream port. HC enters USBSUSPEND after a software reset, whereas it enters USBRESET after a hardware reset. The latter also resets the Root Hub and asserts subsequent reset signal to downstream ports.
5	R/W	R	0x0	BulkListEnable This bit is set to enable the processing of the Bulk list in the next Frame. If cleared by HCD, processing of the Bulk list does not occur after the next SOF. HC checks this bit whenever it determines to process the list. When disabled, HCD may modify the list. If *HcBulkCurrentED* is pointing to an ED to be removed, HCD must advance the pointer by updating *HcBulkCurrentED* before re-enabling processing of the list.
4	R/W	R	0x0	ControlListEnable This bit is set to enable the processing of the Control list in the next Frame. If cleared by HCD, processing of the Control list does not occur after the next SOF. HC must check this bit whenever it determines to process the list. When disabled, HCD may modify the list. If *HcControlCurrentED* is pointing to an ED to be removed, HCD must advance the pointer by updating *HcControlCurrentED* before re-enabling processing of the list.
3	R/W	R	0x0	IsochronousEnable This bit is used by HCD to enable/disable processing of isochronous EDs. While processing the periodic list in a Frame, HC checks the status of this bit when it finds an Isochronous ED (F=1). If set (enabled), HC continues processing the EDs. If cleared (disabled), HC halts processing of the periodic list (which now contains only isochronous EDs) and begins processing the Bulk/Control lists. Setting this bit is guaranteed to take effect in the next Frame (not the current Frame).
2	R/W	R	0x0	PeriodicListEnable

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				This bit is set to enable the processing of periodic list in the next Frame. If cleared by HCD, processing of the periodic list does not occur after the next SOF. HC must check this bit before it starts processing the list.
1:0	R/W	R	0x0	ControlBulkServiceRatio This specifies the service ratio between Control and Bulk EDs. Before processing any of the nonperiodic lists, HC must compare the ratio specified with its internal count on how many nonempty Control EDs have been processed, in determining whether to continue serving another Control ED or switching to Bulk EDs. The internal count will be retained when crossing the frame boundary. In case of reset, HCD is responsible for restoring this value. CBSR: 0 → 1:1; 1 → 2:1; 2 → 3:1; 3 → 4:1 The default value is 0x0.

HcCommandStatus Register

Offset: 0x408				Register Name: HcCommandStatus Default Value:0x0
	Read/Write			
Bit	HCD	HC	Default	Description
31:18	/	/	0x0	Reserved
17:16	R	R/W	0x0	SchedulingOverrunCount These bits are incremented on each scheduling overrun error. It is initialized to 00b and wraps around at 11b. This will be incremented when a scheduling overrun is detected even if **SchedulingOverrun** in *HcInterruptStatus* has already been set. This is used by HCD to monitor any persistent scheduling problem.
15:4	/	/	0x0	Reserved
3	R/W	R/W	0x0	OwershipChangeRequest This bit is set by an OS HCD to request a change of control of the HC. When set HC will set the **OwnershipChange** field in *HcInterruptStatus*. After the changeover, this bit is cleared and remains so until the next request from OS HCD.
2	R/W	R/W	0x0	BulklListFilled This bit is used to indicate whether there are any TDs on the Bulk list. It is set by HCD whenever it adds a TD to an ED in the Bulk list. When HC begins to process the head of the Bulk list, it checks BLF. As long as **BulkListFilled** is 0, HC will not start processing the Bulk list. If **BulkListFilled** is 1, HC will start processing the

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				Bulk list and will set BF to 0. If HC finds a TD on the list, then HC will set **BulkListFilled** to 1 causing the Bulk list processing to continue. If no TD is found on the Bulk list, and if HCD does not set **BulkListFilled**, then **BulkListFilled** will still be 0 when HC completes processing the Bulk list and Bulk list processing will stop.
1	R/W	R/W	0x0	ControlListFilled This bit is used to indicate whether there are any TDs on the Control list. It is set by HCD whenever it adds a TD to an ED in the Control list. When HC begins to process the head of the Control list, it checks CLF. As long as **ControlListFilled** is 0, HC will not start processing the Control list. If CF is 1, HC will start processing the Control list and will set **ControlListFilled** to 0. If HC finds a TD on the list, then HC will set **ControlListFilled** to 1 causing the Control list processing to continue. If no TD is found on the Control list, and if the HCD does not set **ControlListFilled**, then **ControlListFilled** will still be 0 when HC completes processing the Control list and Control list processing will stop.
0	R/W	R/E	0x0	HostControllerReset This bit is by HCD to initiate a software reset of HC. Regardless of the functional state of HC, it moves to the USBSuspend state in which most of the operational registers are reset except those stated otherwise; e.g, the InteruptRouting field of HcControl, and no Host bus accesses are allowed. This bit is cleared by HC upon the completion of the reset operation. The reset operation must be completed within 10 ms. This bit, when set, should not cause a reset to the Root Hub and no subsequent reset signaling should be asserted to its downstream ports.

HcInterruptStatus Register

Offset: 0x40c				Register Name: HcInterruptStatus Default Value:0x00
	Read/Write			
Bit	HCD	HC	Default	Description
31:7	/	/	0x0	Reserved
6	R/W	R/W	0x0 0x1？	RootHubStatusChange This bit is set when the content of *HcRhStatus* or the content of any of *HcRhPortStatus*[**NumberofDownstreamPort**] has changed.
5	R/W	R/W	0x0	FrameNumberOverflow This bit is set when the MSb of *HcFmNumber* (bit 15) changes value, from 0 to 1 or from 1 to 0, and after *HccaFrameNumber* has been updated.
4	R/W	R/W	0x0	UnrecoverableError

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				This bit is set when HC detects a system error not related to USB. HC should not proceed with any processing nor signaling before the system error has been corrected. HCD clears this bit after HC has been reset.
3	R/W	R/W	0x0	ResumeDetected This bit is set when HC detects that a device on the USB is asserting resume signaling. It is the transition from no resume signaling to resume signaling causing this bit to be set. This bit is not set when HCD sets the USBRseume state.
2	R/W	R/W	0x0	StartofFrame This bit is set by HC at each start of frame and after the update of HccaFrameNumber. HC also generates a SOF token at the same time.
1	R/W	R/W	0x0	WritebackDoneHead This bit is set immediately after HC has written *HcDoneHead* to *HccaDoneHead*. Further updates of the *HccaDoneHead* will not occur until this bit has been cleared. HCD should only clear this bit after it has saved the content of *HccaDoneHead*.
0	R/W	R/W	0x0	SchedulingOverrun This bit is set when the USB schedule for the current Frame overruns and after the update of *HccaFrameNumber*. A scheduling overrun will also cause the **SchedulingOverrunCount** of *HcCommandStatus* to be Incremented.

HcInterruptEnable Register

Offset: 0x410				Register Name: HcInterruptEnable Register Default Value: 0x0
	Read/Write			
Bit	HCD	HC	Default	Description
31	R/W	R	0x0	MasterInterruptEnable A '0' writtern to this field is ignored by HC. A '1' written to this field enables interrupt generation due to events specified in the other bits of this register. This is used by HCD as Master Interrupt Enable.
30:7	/	/	0x0	Reserved
6	R/W	R	0x0	RootHubStatusChange Interrupt Enable 0 Ignore; 1 Enable interrupt generation due to Root Hub Status Change;
5	R/W	R	0x0	FrameNumberOverflow Interrupt Enable 0 Ignore; 1 Enable interrupt generation due to Frame Number Over Flow;
4	R/W	R	0x0	UnrecoverableError Interrupt Enable

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				0 Ignore; 1 Enable interrupt generation due to Unrecoverable Error;
3	R/W	R	0x0	ResumeDetected Interrupt Enable 0 Ignore; 1 Enable interrupt generation due to Resume Detected;
2	R/W	R	0x0	StartofFrame Interrupt Enable 0 Ignore; 1 Enable interrupt generation due to Start of Flame;
1	R/W	R	0x0	WritebackDoneHead Interrupt Enable 0 Ignore; 1 Enable interrupt generation due to Write back Done Head;
0	R/W	R	0x0	SchedulingOverrun Interrupt Enable 0 Ignore; 1 Enable interrupt generation due to Scheduling Overrun;

HcInterruptDisable Register

Offset: 0x414				Register Name: HcInterruptDisable Register Default Value: 0x0
	Read/Write			
Bit	HCD	HC	Default	Description
31	R/W	R	0x0	MasterInterruptEnable A written '0' to this field is ignored by HC. A '1' written to this field disables interrupt generation due events specified in the other bits of this register. This field is set after a hardware or software reset.
30:7	/	/	0x00	Reserved
6	R/W	R	0x0	RootHubStatusChange Interrupt Disable 0 Ignore; 1 Disable interrupt generation due to Root Hub Status Change;
5	R/W	R	0x0	FrameNumberOverflow Interrupt Disable 0 Ignore; 1 Disable interrupt generation due to Frame Number Over Flow;
4	R/W	R	0x0	UnrecoverableError Interrupt Disable 0 Ignore; 1 Disable interrupt generation due to Unrecoverable Error;
3	R/W	R	0x0	ResumeDetected Interrupt Disable 0 Ignore; 1 Disable interrupt generation due to Resume Detected;

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2	R/W	R	0x0	StartofFrame Interrupt Disable 0 Ignore; 1 Disable interrupt generation due to Start of Flame;
1	R/W	R	0x0	WritebackDoneHead Interrupt Disable 0 Ignore; 1 Disable interrupt generation due to Write back Done Head;
0	R/w	R	0x0	SchedulingOverrun Interrupt Disable 0 Ignore; 1 Disable interrupt generation due to Scheduling Overrun;

HcHCCA Register

Offset: 0x418				Register Name: HcHCCA Default Value:0x0
	Read/Write			
Bit	HCD	HC	Default	Description
31:8	R/W	R	0x0	HCCA[31:8] This is the base address of the Host Controller Communication Area. This area is used to hold the control structures and the Interrupt table that are accessed by both the Host Controller and the Host Controller Driver.
7:0	R	R	0x0	HCCA[7:0] The alignment restriction in HcHCCA register is evaluated by examining the number of zeros in the lower order bits. The minimum alignment is 256 bytes, therefore, bits 0 through 7 must always return 0 when read.

HcPeriodCurrentED Register

Offset: 0x41c				Register Name: HcPeriodCurrentED(PCED) Default Value: 0x0
	Read/Write			
Bit	HCD	HC	Default	Description
31:4	R	R/W	0x0	PCED[31:4] This is used by HC to point to the head of one of the Periodec list which will be processed in the current Frame. The content of this register is updated by HC after a periodic ED has been processed. HCD may read the content in determining which ED is currently being processed at the time of reading.
3:0	R	R	0x0	PCED[3:0] Because the general TD length is 16 bytes, the memory structure for the TD must be aligned to a 16-byte boundary. So the lower bits in the PCED, through bit 0 to bit 3 must be zero in this field.

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HcControlHeadED Register

Offset: 0x420				Register Name: HcControlHeadED[CHED] Default Value: 0x0
	Read/Write			
Bit	HCD	HC	Default	Description
31:4	R/W	R	0x0	EHCD[31:4] The HcControlHeadED register contains the physical address of the first Endpoint Descriptor of the Control list. HC traverse the Control list starting with the HcControlHeadED pointer. The content is loaded from HCCA during the initialization of HC.
3:0	R	R	0x0	EHCD[3:0] Because the general TD length is 16 bytes, the memory structure for the TD must be aligned to a 16-byte boundary. So the lower bits in the PCED, through bit 0 to bit 3 must be zero in this field.

HcControlCurrentED Register

Offset: 0x424				Register Name: HcControlCurrentED[CCED] Default Value: 0x0
	Read/Write			
Bit	HCD	HC	Default	Description
31:4	R/W	R/W	0x0	CCED[31:4] The pointer is advanced to the next ED after serving the present one. HC will continue processing the list from where it left off in the last Frame. When it reaches the end of the Control list, HC checks the ControlListFilled of in HcCommandStatus. If set, it copies the content of HcControlHeadED to HcControlCurrentED and clears the bit. If not set, it does nothing. HCD is allowed to modify this register only when the ControlListEnable of HcControl is cleared. When set, HCD only reads the instantaneous value of this register. Initially, this is set to zero to indicate the end of the Control list.
3:0	R	R	0x0	CCED[3:0] Because the general TD length is 16 bytes, the memory structure for the TD must be aligned to a 16-byte boundary. So the lower bits in the PCED, through bit 0 to bit 3 must be zero in this field.

HcBulkHeadED Register

Offset: 0x428				Register Name: HcBulkHeadED[BHED] Default Value: 0x0
	Read/Write			
Bit	HCD	HC	Default	Description
31:4	R/W	R	0x0	BHED[31:4]

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				The HcBulkHeadED register contains the physical address of the first Endpoint Descriptor of the Bulk list. HC traverses the Bulk list starting with the HcBulkHeadED pointer. The content is loaded from HCCA during the initialization of HC.
3:0	R	R	0x0	BHED[3:0] Because the general TD length is 16 bytes, the memory structure for the TD must be aligned to a 16-byte boundary. So the lower bits in the PCED, through bit 0 to bit 3 must be zero in this field.

HcBulkCurrentED Register

Offset: 0x42c				Register Name: HcBulkCurrentED [BCED] Default Value: 0x00
	Read/Write			
Bit	HCD	HC	Default	Description
31:4	R/W	R/W	0x0	BulkCurrentED[31:4] This is advanced to the next ED after the HC has served the present one. HC continues processing the list from where it left off in the last Frame. When it reaches the end of the Bulk list, HC checks the **ControlListFilled** of HcControl. If set, it copies the content of *HcBulkHeadED* to *HcBulkCurrentED* and clears the bit. If it is not set, it does nothing. HCD is only allowed to modify this register when the **BulkListEnable** of *HcControl* is cleared. When set, the HCD only reads the instantaneous value of this register. This is initially set to zero to indicate the end of the Bulk list.
3:0	R	R	0x0	BulkCurrentED [3:0] Because the general TD length is 16 bytes, the memory structure for the TD must be aligned to a 16-byte boundary. So the lower bits in the PCED, through bit 0 to bit 3 must be zero in this field.

HcDoneHead Register

Offset: 0x430				Register Name: HcDoneHead Default Value: 0x00
	Read/Write			
Bit	HCD	HC	Default	Description
31:4	R	R/W	0x0	HcDoneHead[31:4] When a TD is completed, HC writes the content of *HcDoneHead* to the NextTD field of the TD. HC then overwrites the content of *HcDoneHead* with the address of this TD. This is set to zero whenever HC writes the content of this register to HCCA. It also sets the **WritebackDoneHead** of *HcInterruptStatus*.
3:0	R	R	0x0	HcDoneHead[3:0] Because the general TD length is 16 bytes, the memory

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				structure for the TD must be aligned to a 16-byte boundary. So the lower bits in the PCED, through bit 0 to bit 3 must be zero in this field.

HcFmInterval Register

Offset: 0x434				Register Name: HcFmInterval Register Default Value: 0x2EDF
	Read/Write			
Bit	HCD	HC	Default	Description
31	R/W	R	0x0	FrameIntervalToggler HCD toggles this bit whenever it loads a new value to **FrameInterval**.
30:16	R/W	R	0x0	FSLargestDataPacket This field specifies a value which is loaded into the Largest Data Packet Counter at the beginning of each frame. The counter value represents the largest amount of data in bits which can be sent or received by the HC in a single transaction at any given time without causing scheduling overrun. The field value is calculated by the HCD.
15:14	/	/	0x0	Reserved
13:0	R/W	R	0x2edf	FrameInterval This specifies the interval between two consecutive SOFs in bit times. The nominal value is set to be 11,999. HCD should store the current value of this field before resetting HC. By setting the **HostControllerReset** field of *HcCommandStatus* as this will cause the HC to reset this field to its nominal value. HCD may choose to restore the stored value upon the completion of the Reset sequence.

HcFmRemaining Register

Offset: 0x438				Register Name: HcFmRemaining Default Value: 0x0
	Read/Write			
Bit	HCD	HC	Default	Description
31	R	R/W	0x0	FrameRemaining Toggle This bit is loaded from the **FrameIntervalToggle** field of *HcFmInterval* whenever **FrameRemaining** reaches 0. This bit is used by HCD for the synchronization between **FrameInterval** and **FrameRemaining**.
30:14	/	/	0x0	Reserved
13:0	R	RW	0x0	FramRemaining This counter is decremented at each bit time. When it reaches zero, it is reset by loading the FrameInterval value specified in *HcFmInterval* at the next bit time boundary. When entering the USBOPERATIONAL state, HC re-loads the content with the FrameInterval of *HcFmInterval* and uses the updated value

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				from the next SOF.

HcFmNumber Register

Offset: 0x43c				Register Name: HcFmNumber Default Value:0x0
	Read/Write			
Bit	HCD	HC	Default	Description
31:16				Reserved
15:0	R	R/W	0x0	FrameNumber This is incremented when *HcFmRemaining* is re-loaded. It will be rolled over to 0x0 after 0x0ffff. When entering the USBOPERATIONAL state, this will be incremented automatically. The content will be written to HCCA after HC has incremented the **FrameNumber** at each frame boundary and sent a SOF but before HC reads the first ED in that Frame. After writing to HCCA, HC will set the **StartofFrame** in *HcInterruptStatus.*

HcPeriodicStart Register

Offset: 0x440				Register Name: HcPeriodicStatus Default Value: 0x0
	Read/Write			
Bit	HCD	HC	Default	Description
31:14				Reserved
13:0	R/W	R	0x0	PeriodicStart After a hardware reset, this field is cleared. This is then set by HCD during the HC initialization. The value is calculated roughly as 10% off from *HcFmInterval*. A typical value will be 0x2A3F (0x3e67??). When *HcFmRemaining* reaches the value specified, processing of the periodic lists will have priority over Control/Bulk processing. HC will therefore start processing the Interrupt list after completing the current Control or Bulk transaction that is in progress.

HcLSThreshold Register

Offset: 0x444				Register Name: HcLSThreshold Default Value: 0x0628
	Read/Write			
Bit	HCD	HC	Default	Description
31:12				Reserved
11:0	R/W	R	0x0628	LSThreshold This field contains a value which is compared to the **FrameRemaining** field prior to initiating a Low Speed transaction. The transaction is started only if **FrameRemaining**

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				[3] this field. The value is calculated by HCD with the consideration of transmission and setup overhead.

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HcRhDescriptorA Register

Offset: 0x448				Register Name: HcRhDescriptorA Default Value:
	Read/Write			
Bit	HCD	HC	Default	Description
31:24	R/W	R	0x2	PowerOnToPowerGoodTime[POTPGT] This byte specifies the duration HCD has to wait before accessing a powered-on port of the Root Hub. It is implementation-specific. The unit of time is 2 ms. The duration is calculated as POTPGT * 2ms.
23:13				Reserved
12	R/W	R	1	NoOverCurrentProtection This bit describes how the overcurrent status for the Root Hub ports are reported. When this bit is cleared, the **OverCurrentProtectionMode** field specifies global or per-port reporting. 0 Over-current status is reported collectively for all downstream ports. 1 No overcurrent protection supported.
11	R/W	R	0	OverCurrentProtectionMode This bit describes how the overcurrent status for the Root Hub ports are reported. At reset, these fields should reflect the same mode as **PowerSwitchingMode**. This field is valid only if the **NoOverCurrentProtection** field is cleared. 0 Over-current status is reported collectively for all downstream ports. 1 Over-current status is reported on per-port basis.
10	R	R	0x0	Device Type This bit specifies that the Root Hub is not a compound device. The Root Hub is not permitted to be a compound device. This field should always read/write 0.
9	R/W	R	1	PowerSwitchingMode This bit is used to specify how the power switching of the Root Hub ports is controlled. It is implementation-specific. This field is only valid if the **NoPowerSwitching** field is cleared. 0 All ports are powered at the same time. 1 Each port is powered individually. This mode allows port power to be controlled by either the global switch or per-port switching. If the **PortPowerControlMask** bit is set, the port responds only to port power commands (**Set/ClearPortPower**). If the port mask is cleared, then the port is controlled only by the global power switch (**Set/ClearGlobalPower**).

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8	R/W	R	0	NoPowerSwithcing These bits are used to specify whether power switching is supported or ports are always powered. It is implementation-specific. When this bit is cleared, the **PowerSwitchingMode** specifies global or per-port switching. 0 Ports are power switched. 1 Ports are always powered on when the HC is powered on.
7:0	R	R	0x01	NumberDownstreamPorts These bits specify the number of downstream ports supported by the Root Hub. It is implementation-specific. The minimum number of ports is 1. The maximum number of ports supported.

HcRhDescriptorB Register

Offset: 0x44c				Register Name: HcRhDescriptorB Register Default Value:
	Read/Write			
Bit	HCD	HC	Default	Description
31:16	R/W	R	0x0	PortPowerControlMask Each bit indicates if a port is affected by a global power control command when **PowerSwitchingMode** is set. When set, the port's power state is only affected by per-port power control (**Set/ClearPortPower**). When cleared, the port is controlled by the global power switch (**Set/ClearGlobalPower**). If the device is configured to global switching mode (**PowerSwitchingMode** = 0), this field is not valid. Bit0 Reserved Bit1 Ganged-power mask on Port #1. Bit2 Ganged-power mask on Port #2. … Bit15 Ganged-power mask on Port #15.
15:0	R/W	R	0x0	DeviceRemovable Each bit is dedicated to a port of the Root Hub. When cleared, the attached device is removable. When set, the attached device is not removable. Bit0 Reserved Bit1 Device attached to Port #1. Bit2 Device attached to Port #2. … Bit15 Device attached to Port #15.

HcRhStatus Register

Offset: 0x450	Register Name: HcRhStatus Register Default Value:

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Bit	Read/Write HCD	Read/Write HC	Default	Description
31	W	R	0	(write)ClearRemoteWakeupEnable Write a '1' clears **DeviceRemoteWakeupEnable.** Write a '0' has no effect.
30:18	/	/	0x0	Reserved
17	R/W	R	0	OverCurrentIndicatorChang This bit is set by hardware when a change has occurred to the **OverCurrentIndicator** field of this register. The HCD clears this bit by writing a '1'.Writing a '0' has no effect.
16	R/W	R	0x0	(read)LocalPowerStartusChange The Root Hub does not support the local power status features, thus, this bit is always read as '0'. (write)SetGlobalPower In global power mode (**PowerSwitchingMode**=0), This bit is written to '1' to turn on power to all ports (clear **PortPowerStatus**). In per-port power mode, it sets **PortPowerStatus** only on ports whose **PortPowerControlMask** bit is not set. Writing a '0' has no effect.
15	R/W	R	0x0	(read)DeviceRemoteWakeupEnable This bit enables a **ConnectStatusChange** bit as a resume event, causing a USBSUSPEND to USBRESUME state transition and setting the **ResumeDetected** interrupt. 0 **ConnectStatusChange** is not a remote wakeup event. 1 **ConnectStatusChange** is a remote wakeup event. (write)SetRemoteWakeupEnable Writing a '1' sets DeviceRemoveWakeupEnable. Writing a '0' has no effect.
14:2				Reserved
1	R	R/W	0x0	OverCurrentIndicator This bit reports overcurrent conditions when the global reporting is implemented. When set, an overcurrent condition exists. When cleared, all power operations are normal. If per-port overcurrent protection is implemented this bit is always '0'
0	R/W	R	0x0	(Read)LocalPowerStatus When read, this bit returns the LocalPowerStatus of the Root Hub. The Root Hub does not support the local power status feature; thus, this bit is always read as '0'. (Write)ClearGlobalPower When write, this bit is operated as the ClearGlobalPower. In global power mode (**PowerSwitchingMode**=0), This bit is written to '1' to turn off power to all ports (clear **PortPowerStatus**). In per-port power mode, it clears **PortPowerStatus** only on ports whose **PortPowerControlMask**

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				bit is not set. Writing a '0' has no effect.

HcRhPortStatus Register

Offset: 0x454				Register Name: HcRhPortStatus Default Value: 0x100
	Read/Write			
Bit	HCD	HC	Default	Description
31:21	/	/	0x0	Reserved
20	R/W	R/W	0x0	PortResetStatusChange This bit is set at the end of the 10-ms port reset signal. The HCD writes a '1' to clear this bit. Writing a '0' has no effect. 0 port reset is not complete 1 port reset is complete
19	R/W	R/W	0x0	PortOverCurrentIndicatorChange This bit is valid only if overcurrent conditions are reported on a per-port basis. This bit is set when Root Hub changes the **PortOverCurrentIndicator** bit. The HCD writes a '1' to clear this bit. Writing a '0' has no effect. 0 no change in PortOverCurrentIndicator 1 PortOverCurrentIndicator has changed
18	R/W	R/W	0x0	PortSuspendStatusChange This bit is set when the full resume sequence has been completed. This sequence includes the 20-s resume pulse, LS EOP, and 3-ms resychronization delay. The HCD writes a '1' to clear this bit. Writing a '0' has no effect. This bit is also cleared when **ResetStatusChange** is set. 0 resume is not completed 1 resume completed
17	R/W	R/W	0x0	PortEnableStatusChange This bit is set when hardware events cause the **PortEnableStatus** bit to be cleared. Changes from HCD writes do not set this bit. The HCD writes a '1' to clear this bit. Writing a '0' has no effect. 0 no change in PortEnableStatus 1 change in PortEnableStatus
16	R/W	R/W	0x0	ConnectStatusChange This bit is set whenever a connect or disconnect event occurs. The HCD writes a '1' to clear this bit. Writing a '0' has no effect. If **CurrentConnectStatus** is cleared when a **SetPortReset,SetPortEnable**, or **SetPortSuspend** write occurs, this bit is set to force the driver to re-evaluate the connection status since these writes should not occur if the port is disconnected.

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				0 no change in PortEnableStatus 1 change in PortEnableStatus Note: If the **DeviceRemovable[NDP]** bit is set, this bit is set only after a Root Hub reset to inform the system that the device is attached.
15:10	/	/	0x0	Reserved
9	R/W	R/W	-	(read)LowSpeedDeviceAttached This bit indicates the speed of the device attached to this port. When set, a Low Speed device is attached to this port. When clear, a Full Speed device is attached to this port. This field is valid only when the **CurrentConnectStatus** is set. 0 full speed device attached 1 low speed device attached (write)ClearPortPower The HCD clears the **PortPowerStatus** bit by writing a '1' to this bit. Writing a '0' has no effect.
8	R/W	R/W	0x1	(read)PortPowerStatus This bit reflects the port's power status, regardless of the type of power switching implemented. This bit is cleared if an overcurrent condition is detected. HCD sets this bit by writing **SetPortPower** or **SetGlobalPower**. HCD clears this bit by writing **ClearPortPower** or **ClearGlobalPower**. Which power control switches are enabled is determined by **PowerSwitchingMode** and **PortPortControlMask[**NumberDownstreamPort**]**. In global switching mode(**PowerSwitchingMode**=0), only **Set/ClearGlobalPower** controls this bit. In per-port power switching (**PowerSwitchingMode**=1), if the **PortPowerControlMask[NDP]** bit for the port is set, only **Set/ClearPortPower** commands are enabled. If the mask is not set, only **Set/ClearGlobalPower** commands are enabled. When port power is disabled, **CurrentConnectStatus**, **PortEnableStatus**, **PortSuspendStatus**, and **PortResetStatus** should be reset. 0 port power is off 1 port power is on (write)SetPortPower The HCD writes a '1' to set the **PortPowerStatus** bit. Writing a '0' has no effect. Note: This bit is always reads '1b' if power switching is not

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<table>
<tr><td></td><td></td><td></td><td></td><td>supported.</td></tr>
<tr><td>7:5</td><td>/</td><td>/</td><td>0x0</td><td>Reserved</td></tr>
<tr><td>4</td><td>R/W</td><td>R/W</td><td>0x0</td><td>(read)PortResetStatus
When this bit is set by a write to SetPortReset, port reset signaling is asserted. When reset is completed, this bit is cleared when PortResetStatusChange is set. This bit cannot be set if
CurrentConnectStatus is cleared.
<table><tr><td>0</td><td>port reset signal is not active</td></tr><tr><td>1</td><td>port reset signal is active</td></tr></table>
(write)SetPortReset
The HCD sets the port reset signaling by writing a ‘1’ to this bit. Writing a ‘0’ has no effect. If CurrentConnectStatus is cleared, this write does not set PortResetStatus, but instead sets ConnectStatusChange. This informs the driver that it attempted to reset a disconnected port.</td></tr>
<tr><td>3</td><td>R/W</td><td>R/W</td><td>0x0</td><td>(read)PortOverCurrentIndicator
This bit is only valid when the Root Hub is configured in such a way that overcurrent conditions are reported on a per-port basis. If per-port overcurrent reporting is not supported, this bit is set to 0. If cleared, all power operations are normal for this port. If set, an overcurrent condition exists on this port. This bit always reflects the overcurrent input signal.
<table><tr><td>0</td><td>no overcurrent condition.</td></tr><tr><td>1</td><td>overcurrent condition detected.</td></tr></table>
(write)ClearSuspendStatus
The HCD writes a ‘1’ to initiate a resume. Writing a ‘0’ has no effect. A resume is initiated only if PortSuspendStatus is set.</td></tr>
<tr><td>2</td><td>R/W</td><td>R/W</td><td>0x0</td><td>(read)PortSuspendStatus
This bit indicates the port is suspended or in the resume sequence. It is set by a SetSuspendState write and cleared when
PortSuspendStatusChange is set at the end of the resume interval. This bit cannot be set if CurrentConnectStatus is cleared. This bit is also cleared when PortResetStatusChange is set at the end of the port reset or when the HC is placed in the USBRESUME state. If an upstream resume is in progress, it should propagate to the HC.
<table><tr><td>0</td><td>port is not suspended</td></tr><tr><td>1</td><td>port is suspended</td></tr></table>
(write)SetPortSuspend
The HCD sets the PortSuspendStatus bit by writing a ‘1’ to this bit. Writing a ‘0’ has no effect. If CurrentConnectStatus is</td></tr>
</table>

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				cleared, this write does not set **PortSuspendStatus**; instead it sets **ConnectStatusChange**. This informs the driver that it attempted to suspend a disconnected port.
1	R/W	R/W	0x0	(read)PortEnableStatus This bit indicates whether the port is enabled or disabled. The Root Hub may clear this bit when an overcurrent condition, disconnect event, switched-off power, or operational bus error such as babble is detected. This change also causes **PortEnabledStatusChange** to be set. HCD sets this bit by writing **SetPortEnable** and clears it by writing **ClearPortEnable**. This bit cannot be set when **CurrentConnectStatus** is cleared. This bit is also set, if not already, at the completion of a port reset when **ResetStatusChange** is set or port suspend when SuspendStatusChange is set. 0 port is disabled 1 port is enabled (write)SetPortEnable The HCD sets **PortEnableStatus** by writing a '1'. Writing a '0' has no effect. If **CurrentConnectStatus** is cleared, this write does not set **PortEnableStatus**, but instead sets **ConnectStatusChange**. This informs the driver that it attempted to enable a disconnected Port.
0	R/W	R/W	0x0	(read)CurrentConnectStatus This bit reflects the current state of the downstream port. 0 No device connected 1 Device connected (write)ClearPortEnable The HCD writes a '1' to clear the PortEnableStatus bit. Writing '0' has no effect. The CurrentConnectStatus is not affected by any write. Note: This bit is always read '1' when the attached device is nonremovalble(DviceRemoveable[NumberDownstreamPor**t**]).

USB Host Clock Requirement

Name	Description
HCLK	System clock (provided by AHB bus clock). This clock needs to be >30MHz.
CLK60M	Clock from PHY for HS SIE, is constant to be 60MHz.
CLK48M	Clock from PLL for FS/LS SIE, is constant to be 48MHz.

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7.7 Digital Audio Interface

7.7.1 Overview

The Digital Audio Interface can be configured as I2S interface or PCM interface.

When configured as I2S interface, it can support the industry standard format for I2S, left-justified, or right-justified. PCM is a standard method used to digital audio for transmission over digital communication channels.

It supports linear 8 or 16-bits linear, or 8-bit u-law or A-law companded sample formats at 8K samples/s and can receive and transmit on any selection of four of the first four slots following PCM_SYNC.

It includes the following features:

- I2S or PCM configured by software
- Full-duplex synchronous serial interface
- Master / Slave Mode operation configured by software
- Audio data resolutions of 16, 20, 24
- I2S audio data sample rate from 8KHz to 192KHz
- I2S Data format for standard I2S, Left Justified and Right Justified
- I2S supports 2-channel output and 2-channel input
- PCM supports linear sample (8-bits or 16-bits), 8-bits u-law and A-law companded sample
- One 128x24-bits FIFO for data transmit, one 64x24-bits FIFO for data receive
- Programmable FIFO thresholds
- Interrupt and DMA support
- Two 32-bits counters for A/V sync application
- Loopback mode for test
- 2 sets of digital audio interface

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7.7.2 Block Diagram

The digital audio interface block diagram is shown below:

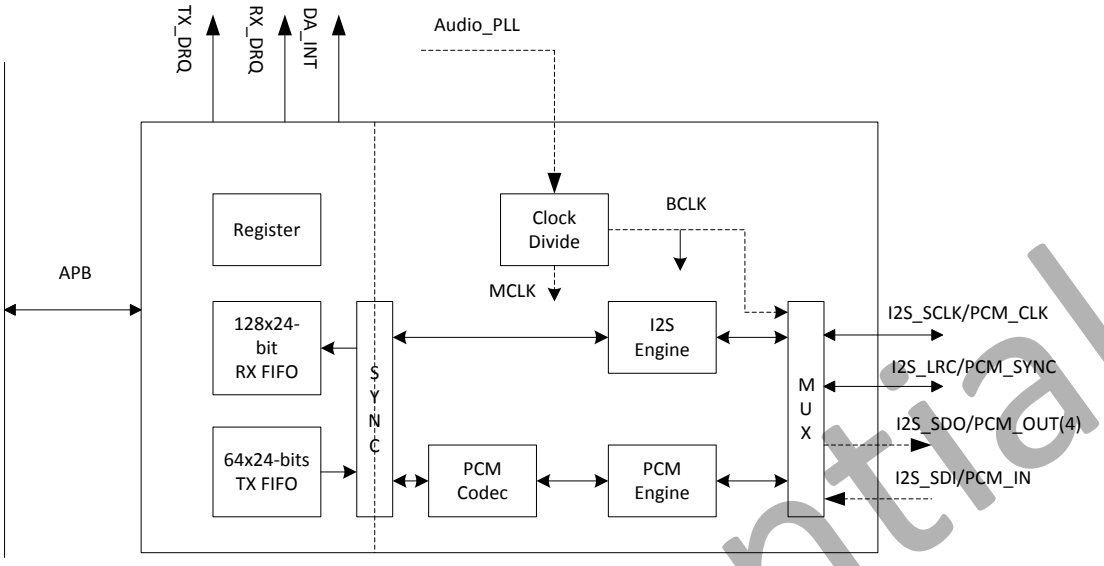

Figure 7.7-1 Digital Audio Block Diagram

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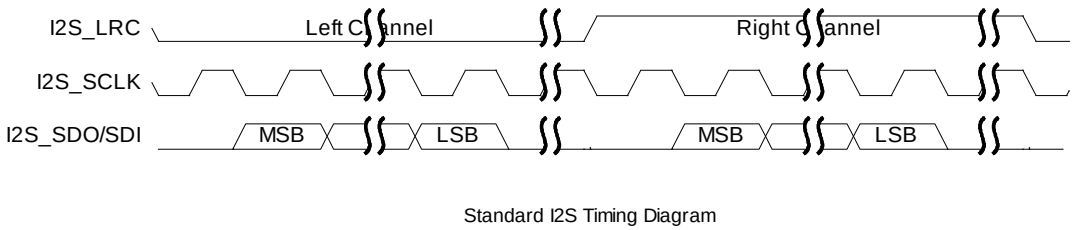
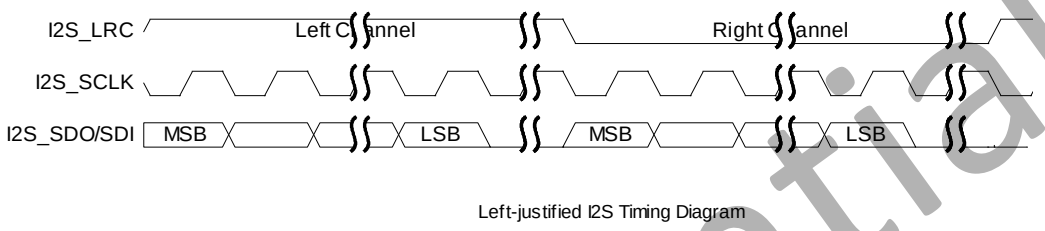
7.7.3 Digital Audio Interface Timing Diagram



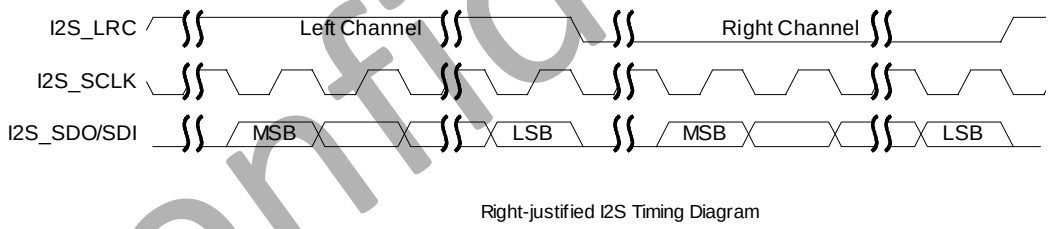
Standard I2S Timing Diagram

Figure 7.7-2 Standard I2S Timing Diagram



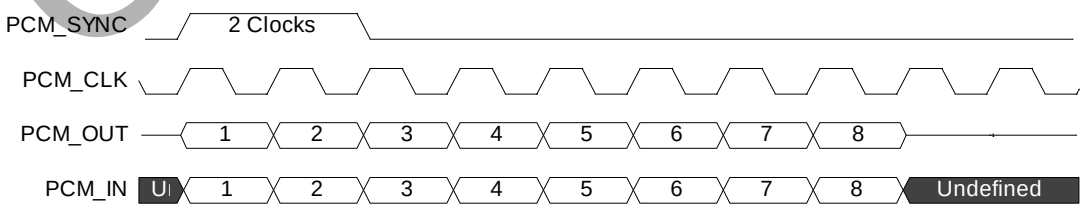
Left-justified I2S Timing Diagram

Figure 7.7-3 Left-justified I2S Timing Diagram



Right-justified I2S Timing Diagram

Figure 7.7-4 Right-justified I2S Timing Diagram



PCM Long Frame SYNC Timing Diagram (8-bits Companded Sample Example)

Figure 7.7-5 PCM Long Frame SYNC Timing Diagram

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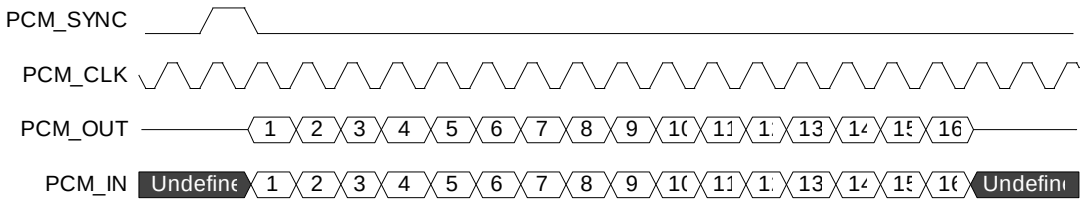

PCM Short Frame SYNC Timing Diagram (16-bits sample example)

Figure 7.7-6 PCM Short Frame SYNC Timing Diagram

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7.7.4 Digital Audio Interface Register List

Module Name	Base Address
DA0	0x01C22000
DA1	0x01C22400

Register Name	Offset	Description
DA_CTL	0x00	Digital Audio Control Register
DA_FAT0	0x04	Digital Audio Format Register 0
DA_FAT1	0x08	Digital Audio Format Register 1
DA_TXFIFO	0x0C	Digital Audio TX FIFO Register
DA_RXFIFO	0x10	Digital Audio RX FIFO Register
DA_FCTL	0x14	Digital Audio FIFO Control Register
DA_FSTA	0x18	Digital Audio FIFO Status Register
DA_INT	0x1C	Digital Audio Interrupt Control Register
DA_ISTA	0x20	Digital Audio Interrupt Status Register
DA_CLKD	0x24	Digital Audio Clock Divide Register
DA_TXCNT	0x28	Digital Audio RX Sample Counter Register
DA_RXCNT	0x2C	Digital Audio TX Sample Counter Register
DA_TXCHSEL	0x30	Digital Audio TX Channel Select register
DA_TXCHMAP	0x34	Digital Audio TX Channel Mapping Register
DA_RXCHSEL	0x38	Digital Audio RX Channel Select register
DA_RXCHMAP	0x3C	Digital Audio RX Channel Mapping Register

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7.7.5 Digital Audio Interface Register Description

Digital Audio Control Register

Offset: 0x00			Register Name: DA_CTL Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:9	/	/	/
8	R/W	0	SDO_EN 0: Disable 1: Enable
7	/	/	/
6	R/W	0	ASS Audio sample select when TX FIFO under run 0: Sending zero 1: Sending last audio sample
5	R/W	0	MS Master Slave Select 0: Master 1: Slave
4	R/W	0	PCM 0: I2S Interface 1: PCM Interface
3	R/W	0	LOOP Loop back test 0: Normal mode 1: Loop back test When set '1', connecting the SDO with the SDI in Master mode.
2	R/W	0	TXEN Transmitter Block Enable 0: Disable 1: Enable
1	R/W	0	RXEN Receiver Block Enable 0: Disable 1: Enable
0	R/W	0	GEN Globe Enable A disable on this bit overrides any other block or channel enables. 0: Disable 1: Enable

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Digital Audio Format Register 0

Offset: 0x04			Register Name: DA_FAT0 Default Value: 0x0000_000C
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7	R/W	0	LRCP Left/ Right Clock Parity 0: Normal 1: Inverted In DSP/ PCM mode 0: MSB is available on 2nd BCLK rising edge after LRC rising edge 1: MSB is available on 1st BCLK rising edge after LRC rising edge
6	R/W	0	BCP BCLK Parity 0: Normal 1: Inverted
5:4	R/W	0	SR Sample Resolution 00: 16-bits 01: 20-bits 10: 24-bits 11: Reserved
3:2	R/W	3	WSS Word Select Size 00: 16 BCLK 01: 20 BCLK 10: 24 BCLK 11: 32 BCLK
1:0	R/W	0	FMT Serial Data Format 00: Standard I2S Format 01: Left Justified Format 10: Right Justified Format 11: Reserved

Digital Audio Format Register 1

Offset: 0x08			Register Name: DA_FAT1 Default Value: 0x0000_4020
Bit	Read/Write	Default/Hex	Description
31:15	/	/	/
14:12	R/W	4	PCM_SYNC_PERIOD PCM SYNC Period Clock Number 000: 16 BCLK period

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			001: 32 BCLK period 010: 64 BCLK period 011: 128 BCLK period 100: 256 BCLK period Others : Reserved
11	R/W	0	PCM_SYNC_OUT PCM Sync Out 0: Enable PCM_SYNC output in Master mode 1: Suppress PCM_SYNC whilst keeping PCM_CLK running. Some Codec utilize this to enter a low power state.
10	R/W	0	PCM Out Mute Write 1 force PCM_OUT to 0
9	R/W	0	MLS MSB / LSB First Select 0: MSB First 1: LSB First
8	R/W	0	SEXT Sign Extend (only for 16 bits slot) 0: Zeros or audio gain padding at LSB position 1: Sign extension at MSB position When writing the bit is 0, the unused bits are audio gain for 13-bit linear sample and zeros padding for 8-bit companding sample. When writing the bit is 1, the unused bits are both sign extension.
7:6	R/W	0	SI Slot Index 00: the 1st slot 01: the 2nd slot 10: the 3rd slot 11: the 4th slot
5	R/W	1	SW Slot Width 0: 8 clocks width 1: 16 clocks width Notes: For A-law or u-law PCM sample, if this bit is set to 1, eight zero bits are following with PCM sample.
4	R/W	0	SSYNC Short Sync Select 0: Long Frame Sync 1: Short Frame Sync It should be set '1' for 8 clocks width slot.
3:2	R/W	0	RX_PDM PCM Data Mode 00: 16-bits Linear PCM 01: 8-bits Linear PCM

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			10: 8-bits u-law 11: 8-bits A-law
1:0	R/W	0	TX_PDM PCM Data Mode 00: 16-bits Linear PCM 01: 8-bits Linear PCM 10: 8-bits u-law 11: 8-bits A-law

Digital Audio TX FIFO register

Offset: 0x0C			Register Name: DA_TXFIFO Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:0	W	0	TX_DATA TX Sample Transmitting left, right channel sample data should be written this register one by one. The left channel sample data is first and then the right channel sample.

Digital Audio RX FIFO register

Offset: 0x10			Register Name: DA_RXFIFO Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:0	R	0	RX_DATA RX Sample Host can get one sample by reading this register. The left channel sample data is first and then the right channel sample.

Digital Audio FIFO Control Register

Offset: 0x14			Register Name: DA_FCTL Default Value: 0x0004_00F0
Bit	Read/Write	Default/Hex	Description
31	R/W	0	FIFOSRC TX FIFO source select 0: APB bus 1: Analog Audio Codec
30:26	/	/	/
25	R/W	0	FTX Write '1' to flush TX FIFO, self clear to '0'.
24	R/W	0	FRX Write '1' to flush RX FIFO, self clear to '0'.
23:19	/	/	/
18:12	R/W	40	TXTL TX FIFO Empty Trigger Level Interrupt and DMA request trigger level for TXFIFO

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			normal condition Trigger Level = TXTL
11:10	/	/	/
9:4	R/W	F	RXTL RX FIFO Trigger Level Interrupt and DMA request trigger level for RXFIFO normal condition Trigger Level = RXTL + 1
3	/	/	/
2	R/W	0	TXIM TX FIFO Input Mode (Mode 0, 1) 0: Valid data at the MSB of TXFIFO register 1: Valid data at the LSB of TXFIFO register Example for 20-bits transmitted audio sample: Mode 0: FIFO_I[23:0] = {4'h0, TXFIFO[31:12]} Mode 1: FIFO_I[23:0] = {4'h0, TXFIFO[19:0]}
1:0	R/W	0	RXOM RX FIFO Output Mode (Mode 0, 1, 2, 3) 00: Expanding '0' at LSB of DA_RXFIFO register. 01: Expanding received sample sign bit at MSB of DA_RXFIFO register. 10: Truncating received samples at high half-word of DA_RXFIFO register and low half-word of DA_RXFIFO register is filled by '0'. 11: Truncating received samples at low half-word of DA_RXFIFO register and high half-word of DA_RXFIFO register is expanded by its sign bit. Example for 20-bits received audio sample: Mode 0: RXFIFO[31:0] = {FIFO_O[19:0], 12'h0} Mode 1: RXFIFO[31:0] = {12{FIFO_O[19]}, FIFO_O[19:0]} Mode 2: RXFIFO[31:0] = {FIFO_O[19:4], 16'h0} Mode 3: RXFIFO[31:0] = {16{FIFO_O[19], FIFO_O[19:4]}

Digital Audio FIFO Status Register

Offset: 0x18			Register Name: DA_FSTA Default Value: 0x1080_0000
Bit	Read/Write	Default/Hex	Description
31:29	/	/	/
28	R	1	TXE TX FIFO Empty 0: No room for new sample in TX FIFO 1: More than one room for new sample in TX FIFO (>= 1 word)
27:24	/	/	/
23:16	R	80	TXE_CNT TX FIFO Empty Space Word Counter

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15:9	/	/	/
8	R	0	RXA RX FIFO Available 0: No available data in RX FIFO 1: More than one sample in RX FIFO (>= 1 word)
7	/	/	/
6:0	R	0	RXA_CNT RX FIFO Available Sample Word Counter

Digital Audio DMA & Interrupt Control Register

Offset: 0x1C			Register Name: DA_INT Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7	R/W	0	TX_DRQ TX FIFO Empty DRQ Enable 0: Disable 1: Enable
6	R/W	0	TXUI_EN TX FIFO Under run Interrupt Enable 0: Disable 1: Enable
5	R/W	0	TXOI_EN TX FIFO Overrun Interrupt Enable 0: Disable 1: Enable When set to '1', an interrupt happens when writing new audio data if TX FIFO is full.
4	R/W	0	TXEI_EN TX FIFO Empty Interrupt Enable 0: Disable 1: Enable
3	R/W	0	RX_DRQ RX FIFO Data Available DRQ Enable 0: Disable 1: Enable When set to '1', RXFIFO DMA Request line is asserted if Data is available in RX FIFO.
2	R/W	0	RXUI_EN RX FIFO Under run Interrupt Enable 0: Disable 1: Enable
1	R/W	0	RXOI_EN RX FIFO Overrun Interrupt Enable 0: Disable 1: Enable

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0	R/W	0	RXAI_EN RX FIFO Data Available Interrupt Enable 0: Disable 1: Enable

Digital Audio Interrupt Status Register

Offset: 0x20			Register Name: DA_ISTA Default Value: 0x0000_0010
Bit	Read/Write	Default/Hex	Description
31:7	/	/	/
6	R/W	0	TXU_INT TX FIFO Under run Pending Interrupt 0: No Pending Interrupt 1: FIFO Under run Pending Interrupt
5	R/W	0	TXO_INT TX FIFO Overrun Pending Interrupt 0: No Pending Interrupt 1: FIFO Overrun Pending Interrupt Write '1' to clear this interrupt
4	R/W	1	TXE_INT TX FIFO Empty Pending Interrupt 0: No Pending IRQ 1: FIFO Empty Pending Interrupt Write '1' to clear this interrupt or automatic clear if interrupt condition fails.
3:2	/	/	/
2	R/W	0	RXU_INT RX FIFO Under run Pending Interrupt 0: No Pending Interrupt 1:FIFO Under run Pending Interrupt Write 1 to clear this interrupt
1	R/W	0	RXO_INT RX FIFO Overrun Pending Interrupt 0: No Pending IRQ 1: FIFO Overrun Pending IRQ Write '1' to clear this interrupt
0	R/W	0	RXA_INT RX FIFO Data Available Pending Interrupt 0: No Pending IRQ 1: Data Available Pending IRQ Write '1' to clear this interrupt or automatic clear if interrupt condition fails.

Digital Audio Clock Divide Register

Offset: 0x24	Register Name: DA_CLKD Default Value: 0x0000_0000

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Bit	Read/Write	Default/Hex	Description
31:8	/	/	/
7	R/W	0	MCLKO_EN 0: Disable MCLK Output 1: Enable MCLK Output Notes: Whether in Slave or Master mode, when this bit is set to 1, MCLK should be output.
6:4	R/W	0	BCLKDIV BCLK Divide Ratio from MCLK 000: Divide by 2 (BCLK = MCLK/2) 001: Divide by 4 010: Divide by 6 011: Divide by 8 100: Divide by 12 101: Divide by 16 110: Divide by 32 111: Divide by 64
3:0	R/W	0	MCLKDIV MCLK Divide Ratio from Audio PLL Output 0000: Divide by 1 0001: Divide by 2 0010: Divide by 4 0011: Divide by 6 0100: Divide by 8 0101: Divide by 12 0110: Divide by 16 0111: Divide by 24 1000: Divide by 32 1001: Divide by 48 1010: Divide by 64 Others : Reserved

Digital Audio TX Counter register

Offset: 0x28			Register Name: DA_TXCNT Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0	TX_CNT TX Sample Counter The audio sample number of sending into TXFIFO. When one sample is put into TXFIFO by DMA or by host IO, the TX sample counter register increases by one. The TX sample counter register can be set to any initial valve at any time. After been updated by the initial value, the counter register should count on base of this initial value.

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Digital Audio RX Counter register

Offset: 0x2C			Register Name: DA_RXCNT Default Value: 0x0000_0000
Bit	Read/Write	Default/Hex	Description
31:0	R/W	0	RX_CNT RX Sample Counter The audio sample number of writing into RXFIFO. When one sample is written by Digital Audio Engine, the RX sample counter register increases by one. The RX sample counter register can be set to any initial valve at any time. After been updated by the initial value, the counter register should count on base of this initial value.

Digital Audio TX Channel Select register

Offset: 0x30			Register Name: DA_TXCHSEL Default Value: 0x0000_0001
Bit	Read/Write	Default/Hex	Description
31:3	/	/	/
2:0	R/W	1	TX_CHSEL TX Channel Select 0: 1-ch 1: 2-ch 2: 3-ch 3: 4-ch

Digital Audio TX Channel Mapping Register

Offset: 0x34			Register Name: DA_TXCHMAP Default Value: 0x7654_3210
Bit	Read/Write	Default/Hex	Description
31:15	/	/	/
14:12	R/W	3	TX_CH3_MAP TX Channel3 Mapping 000: 1st sample 001: 2nd sample 010: 3rd sample 011: 4th sample 100: 5th sample 101: 6th sample 110: 7th sample 111: 8th sample
11	/	/	/
10:8	R/W	2	TX_CH2_MAP TX Channel2 Mapping 000: 1st sample 001: 2nd sample 010: 3rd sample

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			011: 4th sample 100: 5th sample 101: 6th sample 110: 7th sample 111: 8th sample
7	/	/	/
6:4	R/W	1	TX_CH1_MAP TX Channel1 Mapping 000: 1st sample 001: 2nd sample 010: 3rd sample 011: 4th sample 100: 5th sample 101: 6th sample 110: 7th sample 111: 8th sample
3	/	/	/
2:0	R/W	0	TX_CH0_MAP TX Channel0 Mapping 000: 1st sample 001: 2nd sample 010: 3rd sample 011: 4th sample 100: 5th sample 101: 6th sample 110: 7th sample 111: 8th sample

Digital Audio RX Channel Select register

Offset: 0x38			Register Name: DA_RXCHSEL Default Value: 0x0000_0001
Bit	Read/Write	Default/Hex	Description
31:3	/	/	/
2:0	R/W	1	RX_CHSEL RX Channel Select 0: 1-ch 1: 2-ch 2: 3-ch 3: 4-ch Others: Reserved

Digital Audio RX Channel Mapping Register

Offset: 0x3C			Register Name: DA_RXCHMAP Default Value: 0x0000_3210
Bit	Read/Write	Default/Hex	Description
31:15	/	/	/

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14:12	R/W	3	RX_CH3_MAP RX Channel3 Mapping 000: 1st sample 001: 2nd sample 010: 3rd sample 011: 4th sample Others: Reserved
11	/	/	/
10:8	R/W	2	RX_CH2_MAP RX Channel2 Mapping 000: 1st sample 001: 2nd sample 010: 3rd sample 011: 4th sample Others: Reserved
7	/	/	/
6:4	R/W	1	RX_CH1_MAP RX Channel1 Mapping 000: 1st sample 001: 2nd sample 010: 3rd sample 011: 4th sample Others: Reserved
3	/	/	/
2:0	R/W	0	RX_CH0_MAP RX Channel0 Mapping 000: 1st sample 001: 2nd sample 010: 3rd sample 011: 4th sample Others: Reserved

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7.7.6 Digital Audio Interface Special Requirement

Digital Audio Interface Pin List

Port Name	Width	Direction(M)	Description
DA_BCLK	1	IN/OUT	Digital Audio Serial Clock
DA_LRC	1	IN/OUT	Digital Audio Sample Rate Clock/ Sync
DA_SDO	1	OUT	Digital Audio Serial Data Output
DA_SDI	1	IN	Digital Audio Serial Data Input

Digital Audio Interface MCLK and BCLK

The Digital Audio Interface can support sampling rates from 128fs to 768fs, where fs is the audio sampling frequency typically 32kHz, 44.1kHz, 48kHz or 96kHz. For different sampling frequency, the tables list the coefficient value of MCLKDIV and BCLKDIV.

Sampling Rate(kHz)	128fs	192fs	256fs	384fs	512fs	768fs
8	24	16	12	8	6	4
16	12	8	6	4	X	2
32	6	4	X	2	X	1
64	X	2	X	1	X	X
128	X	1	X	X	X	X
12	16	X	8	X	4	X
24	8	X	4	X	2	X
48	4	X	2	X	1	X
96	2	X	1	X	X	X
192	1	X	X	X	X	X

MCLKDIV value for 24.576MHz Audio Serial Frequency

Sampling Rate (kHz)	128fs	192fs	256fs	384fs	512fs	768fs
11.025	16	X	8	X	4	X
22.05	8	X	4	X	2	X
44.1	4	X	2	X	1	X
88.2	2	X	1	X	X	X
176.4	1	X	X	X	X	X

MCLKDIV value for 22.5792 MHz Audio Serial Frequency

Word Select Size	128fs	192fs	256fs	384fs	512fs	768fs
16	4	6	8	12	16	X
24	X	4	X	8	X	16
32	2	X	4	6	8	12

BCLKDIV value for Different Word Select Size

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Digital Audio Interface Clock Source and Frequency

There are two clocks for Digital Audio Interface. One is from APB bus and one is from Audio PLL.

Name	Description
Audio_PLL	24.576Mhz or 22.528Mhz generated by Audio PLL
APB_CLK	APB bus system clock. In I2S mode, it is requested >= 0.25 BCLK. In PCM mode, it is requested >= 0.5 BCLK.

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7.8 Reduced Serial Bus

7.8.1 Overview

The RSB™ (Reduced Serial Bus) is a push-pull two wire bus developed by Allwinner Technology that supports multiple devices. It supports speed up to 20MHz.

It features:

- Support industry-standard AMBA Peripheral Bus (APB) and it is fully compliant with the AMBA Specification, Revision 2.0.
- Support speed up to 20MHz with lower power consumption
- Support Push-Pull bus
- Support Host mode
- Support multiple devices
- Support programmable output delay of CD signal
- Support parity check for address and data transmission

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7.8.2 RSB Bus Topology

The bus topology is shown below.

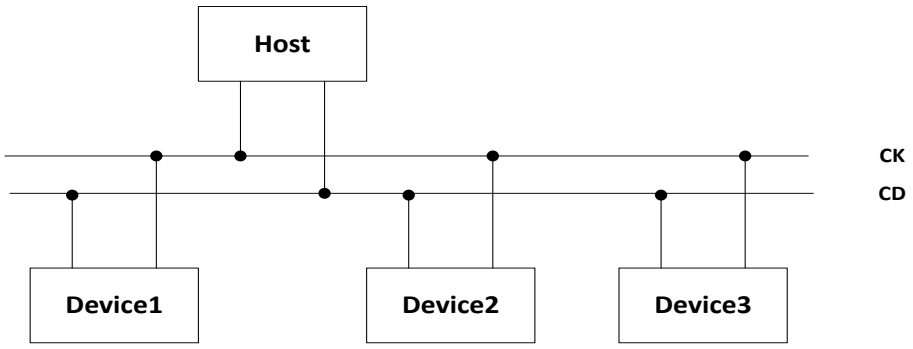

Figure 7.8-1 RSB Bus Topology

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7.8.3 Glossary

A

AES	Advanced Encryption Standard	A specification for the encryption of electronic data established by the U.S. National Institute of Standards and Technology (NIST) in 2001
AGC	Automatic Gain Control	An adaptive system found in electronic devices that automatically controls the gain of a signal: the average output signal level is fed back to adjust the gain to an appropriate level for a range of input signal levels.
AHB	AMBA High-speed Bus	A bus protocol introduced in Advanced Microcontroller Bus Architecture version 2 published by ARM Ltd company
APB	Advanced Peripheral Bus	APB is designed for low bandwidth control accesses, which has an address and data phase similar to AHB, but a much reduced, low complexity signal list (for example no bursts).
AVS	Audio Video Standard	A compression standard for digital audio and video

C

CIR	Consumer IR	The CIR (Consumer IR) interface is used for remote control through infra-red light
CRC	Cyclic Redundancy Check	A type of hash function used to produce a checksum in order to detect errors in data storage or transmission
CSI	CMOS Sensor Interface	The hardware block that interfaces with different image sensor interfaces and provides a standard output that can be used for subsequent image processing

D

DES	Data Encryption Standard	A previously predominant algorithm for the encryption of electronic data

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DEU	Detail Enhancement Unit	A unit used for display engine frontend data post-processing
DLL	Delay-Locked Loop	A digital circuit similar to a phase-locked loop (PLL), with the main difference being the absence of an internal voltage-controlled oscillator, replaced by a delay line
DRC	Dynamic Range Compression	It reduces the volume of loud sounds or amplifies quiet sounds by narrowing or "compressing" an audio signal's dynamic range.
DVFS	Dynamic Voltage and Frequency Scaling	Dynamic voltage scaling is a power management technique where the voltage used in a component is increased or decreased, depending on circumstances. Dynamic frequency scaling is a technique whereby the frequency of a microprocessor can be automatically adjusted on the fly so that the power consumption or heat generated by the chip can be reduced. These two are often used together to save power in mobile devices.
E		
EHCI	Enhanced Host Controller Interface	The register-level interface for a Host Controller for the USB Revision 2.0.
eMMC	Embedded Multi-Media Card	An architecture consisting of an embedded storage solution with MMC interface, flash memory and controller, all in a small BGA package
F		
FBGA	Fine Ball Grid Array	FBGA is based on BGA technology, but comes with thinner contacts and is mainly used in SoC design
G		
GIC	Generic Interrupt Controller	A centralized resource for supporting and managing interrupts in a system that includes at least one processor
I		

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IEP	Image Enhancement Processor	A unit used for the improvement of digital image quality, including DEU, DRC, SAT.
I2S	IIS	An electrical serial bus interface standard used for connecting digital audio devices together
L		
LSB	Least Significant Bit	The bit position in a binary integer giving the units value, that is, determining whether the number is even or odd. It is sometimes referred to as the right-most bit, due to the convention in positional notation of writing less significant digits further to the right.
KEYADC	Low Resolution Analog to Digital Converter	A module which can transfer analog signals to digital signals
M		
MIPI DSI	MIPI Display Serial Interface	A specification by the Mobile Industry Processor Interface (MIPI) Alliance aimed at reducing the cost of display sub-systems in a mobile device
MSB	Most Significant Bit	The bit position in a binary number having the greatest value, which is sometimes referred to as the left-most bit due to the convention in positional notation of writing more significant digits further to the left
N		
NTSC	National Television System Committee	An analog television system that is used in most of North America, and many other countries
O		
OHCI	Open Host Controller Interface	A register-level interface that enables a host controller for USB or FireWire hardware to communicate with a host controller driver in software

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OSD	On-Screen Display	A feature of visual devices like VCRs and DVD players that displays program, position, and setting data on a connected TV or computer display
P		
PAL	Phase Alternating Line	An analogue television color encoding system used in broadcast television systems in many countries
PCM	Pulse Code Modulation	A method used to digitally represent sampled analog signals
PID	Packet Identifier	Each table or elementary stream in a transport stream is identified by a 13-bit packet ID (PID). A demultiplexer extracts elementary streams from the transport stream in part by looking for packets identified by the same PID.
R		
RSB	Reduced Serial Bus	A push-pull two wire bus invented by Allwinner Technology that supports speed up to 20MHz.
S		
SPI	Synchronous Peripheral Interface	A synchronous serial data link standard named by Motorola that operates in full duplex mode. Devices communicate in master/slave mode where the master device initiates the data frame
T		
TP	Touch Panel	A human-machine interactive interface
TS	Transport Stream	A data stream defined by ISO13818-1, which consists of one or more programs with video and audio data.
U		

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USB OTG	Universal Serial Bus On-The-Go	A dual-role controller, which supports both Host and Device functions and is fully compliant with the On-The-Go Supplement to the USB 2.0 Specification, Revision 1.0a

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How To Reach Us

Allwinner Website
www.allwinnertech.com

For Service:
service@allwinnertech.com

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