Touch Screen Controller ICs

Resistive Type Touch Screen Controller ICs

BU21023GUL, BU21023MUV, BU21024FV-M

No.11105EAT01

●Description

Unlike most resistive touch screen controllers, the BU21023/ BU21024 4-wire resistive touch screen controllers enable dual-touch detection and gesture recognition. These intelligent controllers expose a set of registers to a host processor and are software configurable. The controllers can detect single point coordinates, dual coordinates, pinch, spread, rotate left and rotate right gestures, enabling pan and zoom operations in applications that previously had to rely exclusively on capacitive touch technology. Resistive touch does not require custom panel development which reduces development cost and results in faster time to market across a family of products.

●Features

1) Enables single touch, dual touch & gesture recognition using standard 4-wire resistive touch panels
2) Adjustable touch detection threshold allows fine tuning of pressure sensitivity for an application
3) Enables measurement of single point touch pressure
4) SPI and I^2C like interface for interfacing to host processor
5) Programmable interrupt polarity
6) 10-bit ADC provides sufficient resolution for finger or stylus inputs
7) Firmware for internal CPU may be downloaded from Host processor or from an EEPROM
8) Includes filtering options to eliminate false coordinates
9) Built in support for intelligent calibration
10) Easy to swap X & Y coordinates or adapt to different touch panel connections
11) Single 3V power supply
12) Available in a range of small package sizes and temperature ranges
13) Ideally suited for large volume automotive, consumer and industrial applications

●Application

- Products with a LCD that can benefit from pan and zoom operations.
- Smart phones, Digital Cameras, Video Cameras, GPS Receivers, Printers, Copiers, automotive navigation panels, touch kiosks
- Tablet PCs , Notebook computers, LCD displays (with USB interface)

●Line up matrix

Parameter	BU21023GUL	BU21023MUV	BU21024FV-M
Screen	4-wire resistive touch screen	4-wire resistive touch screen	4-wire resistive touch screens
Maximum detection point	2	2	2
Integrated Filter process	Yes	Yes	Yes
Gesture Detection	Yes	Yes	Yes
Supplied Voltage Range(V)	2.7 — 3.6	2.7 — 3.6	2.7 — 3.6
Temperature Range(℃)	-20 — 85	-20 — 85	-40 — 85
Host I/F	4-wire SPI 2-wire serial	4-wire SPI 2-wire serial	4-wire SPI 2-wire serial
PKG	VCSP50L2	VQFN028V5050	SSOP-B28

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●Absolute Maximum Ratings

Parameter		Symbol	Ratings	Unit	Condition
Power supply voltage		VDD	-0.3 ～ 4.5	V	
Input voltage		VIN	VSS-0.3 ～ VDD+0.3	V	
Power dissipation	BU21023GUL	Pd	830 *1	mW	
	BU21023MUV		704 *2	mW	
	BU21024FV-M		850 *3	mW	
Storage temperature range		Tstg	-50 ～ 125	℃	

*1 Derate by 7.04 mW /℃ centigrade when ambient temperature exceeds 25℃. Measured using Epoxy-Glass PCB measuring 50x58x1.75 mm
*2 Derate by 8.30mW /℃ centigrade when ambient temperature exceeds 25℃. Measured using Epoxy-Glass PCB measuring 50x58x1.75mm
*3 Derate by 8.50mW /℃ centigrade when ambient temperature exceeds 25℃. Measured using Epoxy-Glass PCB measuring 50x58x1.75mm

●Recommended Operating Conditions

Parameter		Symbol	Ratings			Unit	Condition
			Min.	Typ.	Max.		
Power supply voltage		VDD	2.70	3.00	3.60	V	
Digital core power supply		DVDD	1.62	1.80	1.98	V	DVDD_EXT=H
Operating temperature range	BU21023GUL BU21023MUV	Topr	-20	25	85	℃	
	BU21024FV-M		-40	25	85	℃	

Note: The BU21023/BU21024 controllers can be operated with a single 3V VDD supply.
It is also possible to supply 1.8V DVDD from an external source if the DVDD_EXT pin is connected to logic high.

●Electrical Characteristics (Ta=25℃, VDD=3.00V)

Parameter	Symbol	Limits			Unit	Condition
		Min.	Typ.	Max.		
Low-level input voltage	VIL	VSS-0.5	-	0.2×VDD	V	
High-level input voltage	VIH	0.8×VDD	-	VDD+0.5	V	
Low-level output voltage	VOL	-	-	VSS+0.4	V	
High-level output voltage	VOH	VDD-0.4	-	-	V	
Standby current	Ist	-	-	1	μA	RSTB=L
Sleep current1	Icc1	-	60	100	μA	DVDD_EXT=L
Sleep current2	Icc2	-	10	20	μA	DVDD_EXT=H
Operating current	Idd	-	4	6	mA	No load
Oscillation frequency	Freq	18	20	22	MHz	
Resolution	Ad	1024×1024			Bit	
Differential non-linearity error	DNL	-3.0	-	+3.0	LSB	
Integral non-linearity error	INL	-3.0	-	+3.0	LSB	

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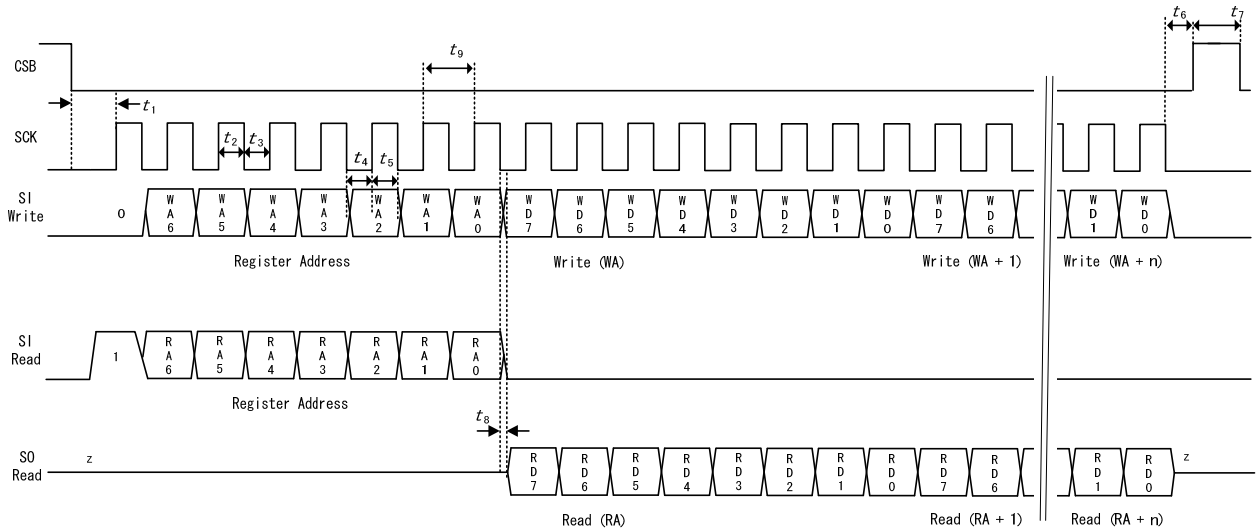
●HOST-I/F mode (4-wire SPI)

(SCK=SCL_SCK, SI=SDA_SI, CSB=SEL_CSB, SO=SO)



Condition : VDD = 3.0V Ta=25℃

Parameter	Symbol	Limits			Unit	Condition
		Min.	Typ.	Max.		
CSB setup time	t_1	30	-	-	ns	
SCK "H" level period	t_2	30	-	-	ns	
SCK "L" level period	t_3	30	-	-	ns	
SI setup time	t_4	20	-	-	ns	
SI holding time	t_5	20	-	-	ns	
CSB holding time	t_6	20	-	-	ns	
CSB "H" level time	t_7	50	-	-	ns	
Data output delay time	t_8	-	-	15	ns	
SCK frequency	t_9	-	-	15	MHz	

Note: SPI interface is selected by tying IFSEL pin to logic low. IFSEL= logic high selects the 2-wire interface

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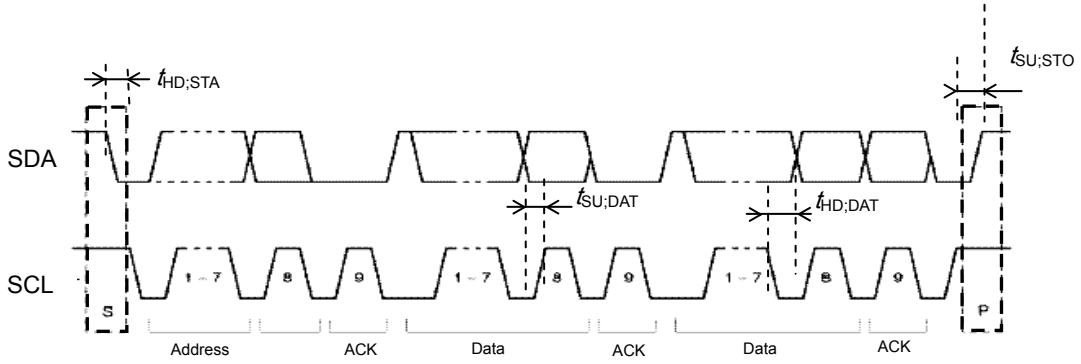
●HOST-I/F mode (2-wire serial)

(SCL=SCL_SCK, SDA=SDA_SI)

The 2-wire serial mode presents an I^2C like interface for all practical purposes, but it is not a complete implementation conforming to the I^2C specification. The BU21023MUV/ BU21023GUL / BU21024FV-M devices can co-exist with other I^2C devices on the same bus. The slave address for 2-wire serial communication is 5Ch or 5Dh. This is determined by the SEL_CSB pin.

SEL_CSB = "L" : Slave address = 5Ch
SEL_CSB = "H" : Slave address = 5Dh



Parameter	Symbol	Limits			Unit	Condition
		Min.	Typ.	Max.		
SCL clock frequency	f_{SCL}	0	-	400	kHz	
START condition hold time	$t_{HD:STA}$	0.6	-	-	μs	
SCL "L"	t_{LOW}	1.3	-	-	μs	
SCL "H"	t_{HIGH}	0.6	-	-	μs	
Data hold time	$t_{HD:DAT}$	0.1	-	-	μs	
Data setup time	$t_{SU:DAT}$	0.1	-	-	μs	
STOP condition setup time	$t_{SU:STO}$	0.6	-	-	μs	

・Write protocol

S	SLAVE ADDRESS	W	A	REGISTER ADDRESS	A	WRITE DATA	A	P
	7bit = 5Ch or 5Dh			8bit		8bit		

・Read protocol

S	SLAVE ADDRESS	W	A	REGISTER ADDRESS	A	S	SLAVE ADDRESS	R	A	READ DATA	N	P
	7bit = 5Ch or 5Dh			8bit			7bit = 5Ch or 5Dh			8bit		

	from master to slave
	from slave to master

S	= START condition
P	= STOP condition
R	= data direction READ (SDA HIGH)
W	= data direction WRITE (SDA LOW)
A	= acknowledge (SDA LOW)
N	= not acknowledge (SDA HIGH)

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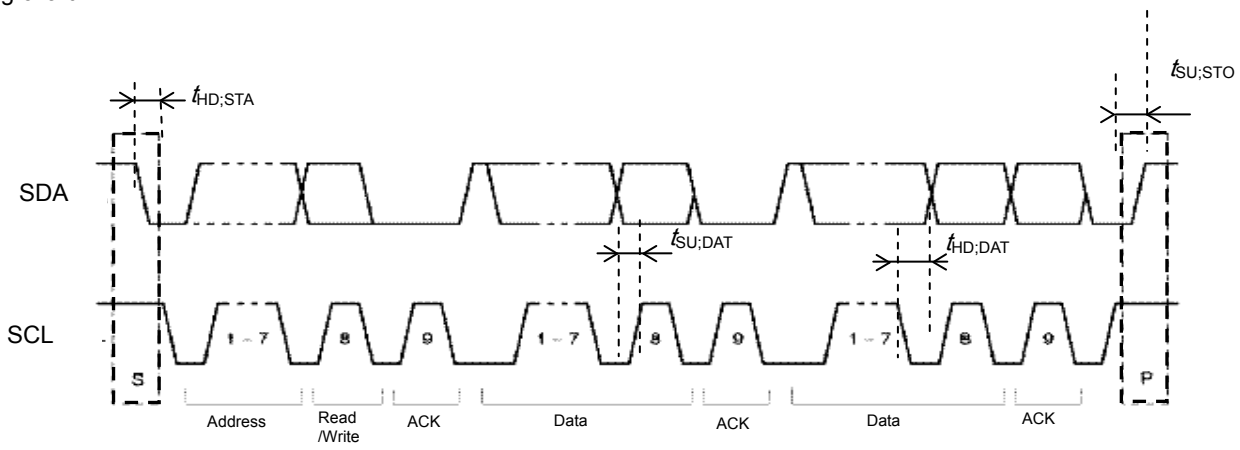
●EEPROM I/F

BU21023/BU21024 controllers include an EEPROM interface for firmware download.
Device address of EEPROM is set via register 0x51(EEPROM_ADDR).

Timing chart

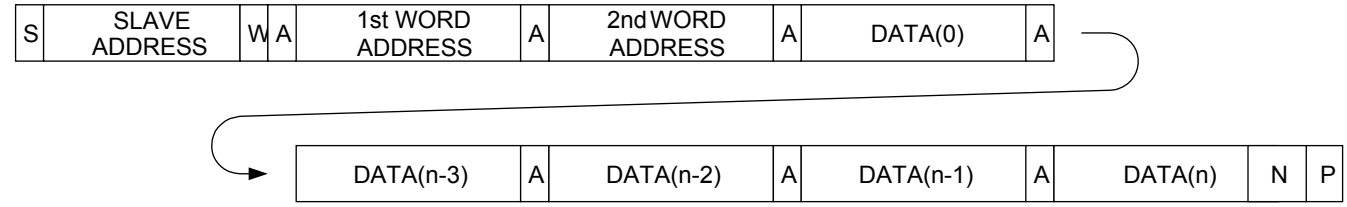


Parameter	Symbol	Limits			Unit	Condition
		Min.	Typ.	Max.		
SCL clock frequency	f_{SCL}	270	310	350	kHz	
START hold time	$t_{HD:STA}$	0.7	-	0.9	µs	
SCL ”L” width	t_{LOW}	1.4	-	1.8	µs	
SCL ”H” width	t_{HIGH}	1.4	-	1.8	µs	
Data hold time	$t_{HD:DAT}$	0.7	-	0.9	µs	
Data setup time	$t_{SU:DAT}$	0.7	-	0.9	µs	
STOP setup time	$t_{SU:STO}$	0.7	-	0.9	µs	

Protocol

*IC does not support the write command.
*IC supports the following read command.

Start



Stop

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●Background Information

A resistive touch panel is made up of a multilayer sandwich of resistive films and protective coatings all sitting on top of an LCD display. Resistive touch panels work by direct contact of a stylus or a finger flexing a pair of resistive films, hence any blunt pointing instrument or a gloved finger may be used.

Touch panel resolution

The resolution of a touch panel is typically measured in dots per inch (dpi) and is a function of the physical size of the touch panel and the ADC used in the conversion circuitry. For example, a 3”x5” panel used with the BU21023/BU21024 devices can provide a theoretical resolution of 1024 /5 = 204 dpi. In the case of resistive touch panels, the direct contact nature of its operation and finger thickness often impose an upper limit on the effective system resolution that may be achieved, regardless of the resolution of the ADC itself.

●Functional Description

The BU21023/BU21024 devices connect to a standard 4-wire resistive touch screen on one side and to a host processor on the other side. The BU21024 includes four additional sense terminals allowing it to be used with either 4-wire or 8-wire resistive touch screens. The BU21023/BU21024 include the analog and digital circuitry to process and provide dual touch coordinate data and pinch, spread, rotate-right and rotate-left gesture information to the host CPU.

The BU21023/BU21024 devices include an internal CPU and provide a high degree of programmability by exposing a set of registers that can be accessed by a host CPU through SPI or I^2C like serial interfaces. The IFSEL pin determines whether SPI or I^2C like interface is selected, The BU21023/BU21024 devices include an INT pin whose polarity can be programmed via registers. When an interrupt occurs, for example, due to touch detection, the host processor is required to read an interrupt status register to determine the cause of the interrupt and take appropriate action.

The program memory of the internal CPU may be initialized via the host interface or via an external EEPROM. This is selected by a register setting.

The BU21023/BU21024 devices support two sensing modes; continuous and interval sensing modes, that are register selectable. In the continuous sensing mode, the embedded CPU reads Z, X & Y coordinates continuously when a touch is detected. The interval sensing mode allows a delay to be inserted between each cycle. The continuous sensing mode is used more often though the interval sensing mode minimizes power consumption. The continuous sensing mode typically completes a sampling cycle consisting of Z, X & Y measurements in approximately 2.3 mS.

The BU21023/BU21024 devices enable optimization of touch detection threshold for a given panel. They also include several sophisticated calibration algorithms.

This document includes a description of the registers followed by flow charts that describe specific steps that a host processor must follow. Often, a flow chart requires other flow charts to explain the steps in finer detail.

The document also includes information on touch screen parameters that one should to look for while selecting resistive touch panels for multi-touch.

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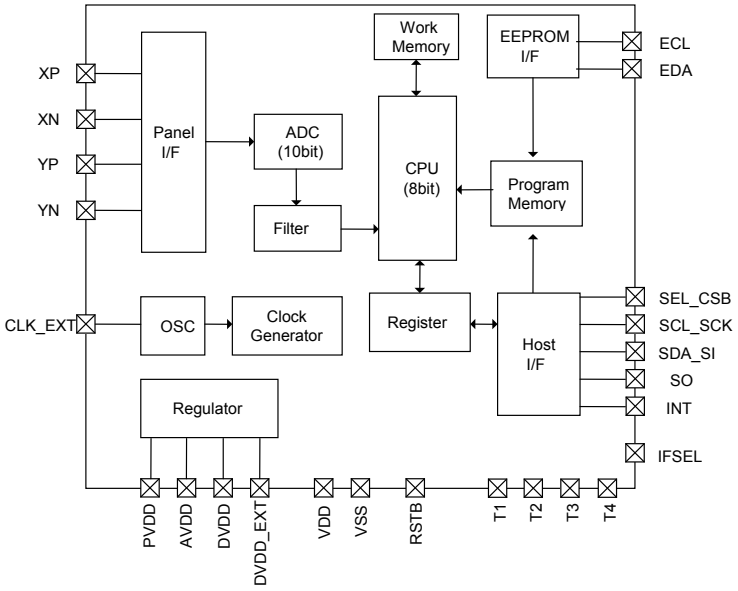
●Block Diagram / Description of each block

【BU21023GUL / BU21023MUV】



Screen I/F	4-wire resistive touch screen interface
ADC	10bit A/D converter
OSC	Internal 20MHz oscillator block with optional external clock input
Regulator	Internal regulator provides 1.8V DVDD supply. DVDD can also be supplied from an external source if DVDD_EXT pin is tied high.
Clock Generator	System clock and timing generation (10MHz CPU clock)
CPU Core	For dual touch processing, programmability and host interface
Work memory	Data memory for CPU
Program Memory	Program memory for CPU. Code can be downloaded by host processor or from an external EEPROM
EEPROM I/F	To connect to external EEPROM if downloading program memory from EEPROM. Use of external EEPROM is optional.
Host I/F	4-wire SPI or 2-wire I^2C like interface provides access to registers

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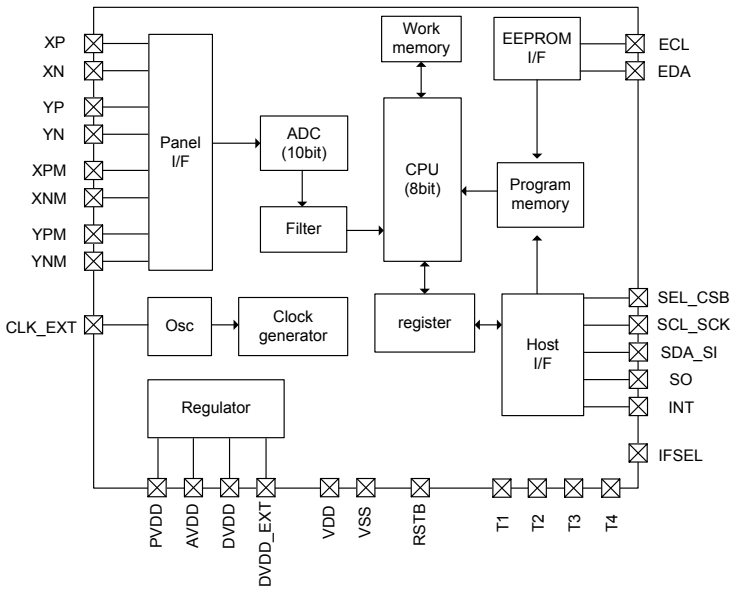
【BU21024FV-M】



Screen I/F	4-wire or 8-wire resistive touch screen interface
ADC	10bit A/D converter
OSC	Internal 20MHz oscillator block with optional external clock input
Regulator	Internal regulator provides 1.8V DVDD supply. DVDD can also be supplied from an external source if DVDD_EXT pin is tied high.
Clock Generator	System clock and timing generation (10MHz CPU clock)
CPU Core	For dual touch processing, programmability and host interface
Work memory	Data memory for CPU
Program Memory	Program memory for CPU. Code can be downloaded by host processor or from an external EEPROM
EEPROM I/F	To connect to external EEPROM if downloading program memory from EEPROM. Use of external EEPROM is optional.
Host I/F	4-wire SPI or 2-wire I^2C like interface provides access to registers

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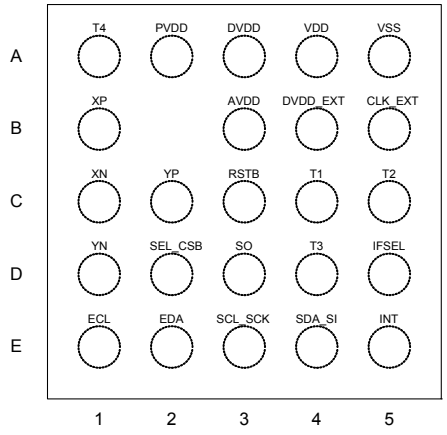
●Pin Description

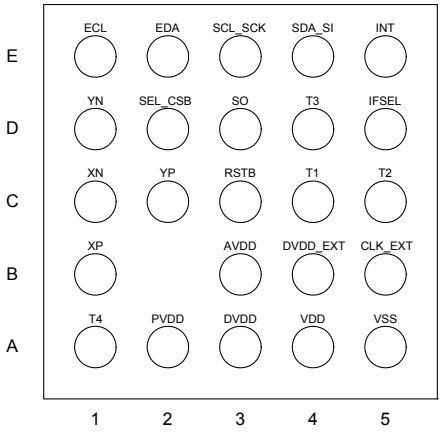
【BU21023GUL】

No.	Pin name	I/O	Function				Fig.
D1	YN	I/O	Panel interface				E
C1	XN	I/O	Panel interface				E
C2	YP	I/O	Panel interface				E
B1	XP	I/O	Panel interface				E
A1	T4	I/O	Test pin				E
A2	PVDD	O	Regulator output (for supply panel voltage)				-
B3	AVDD	O	Regulator output (for supply analog block)				-
A3	DVDD	I/O	Regulator output (for supply digital block) or supply digital voltage (DVDD_EXT="H")				-
B4	DVDD_EXT	I	Digital voltage enable (H=Hi-z , L=DVDD Enable)				E
A4	VDD	-	Supply voltage				-
A5	VSS	-	Ground				-
C3	RSTB	I	H/W reset				E
B5	CLK_EXT	I	Supply external clock for debug				A
C4	T1	I	Test pin				A
C5	T2	I	Test pin				A
D4	T3	I	Test pin				A
D5	IFSEL	I	Intereface select pin (L=SPI, H=2wire serial)				A
D3	SO	O	SPI	Serila data output	2wire	-	F
E5	INT	O	Interrupt output				C
D2	SEL_CSB	I	SPI	Chip select	2wire	Slave address select	C
E4	SDA_SI	I/O	SPI	Serial data input	2wire	Serial data in-out	C
E3	SCL_SCK	I	SPI	Serial clock input	2wire	Serial clock input	C
E2	EDA	I/O	EEPROM SDA				C
E1	ECL	O	EEPROM SCL				C

1. Please use 1.0uF capacitors between AVDD and DVDD to GND, and leave PVDD terminal open.
2. If DVDD_EXT="H ", the DVDD pin can be connected to an external 1.8V power source.
3. Please pull up the ECL, EDA, and INT pins using 10k ohm resistors as shown in the application diagram at the end of this document.
   ECL and EDA pins may be directly connected to GND if an external EEPROM is not being used. Please connect a 0.1uF capacitor between T4 and GND.
   T1, T2 & T3 pins should be connected to GND.
4. When using the 2 wire serial interface, please pull up the SCL_SCK, SDA_SI pins via 10k ohms and leave SO unconnected.
5. Please note that the values of resistors and capacitors mentioned here are only recommended values.
6. RSTB should be held low until supply voltage VDD has ramped up and has reached a stable level.
7. The polarity of INT pin is programmable via register 0x30
8. Connect CLK_EXT to GND for normal use



TOP VIEW (BALL SIDE DOWN)



BOTTOM VIEW (BALL SIDE UP)

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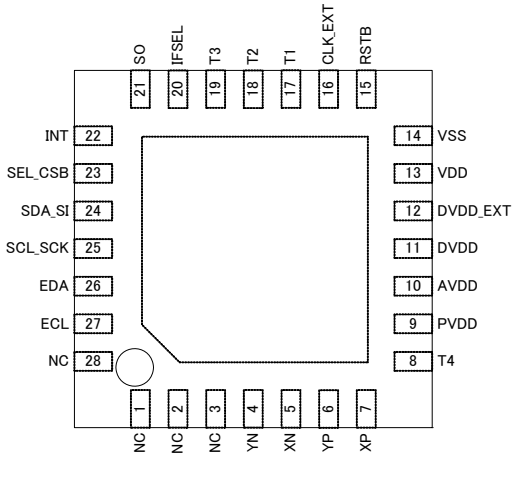
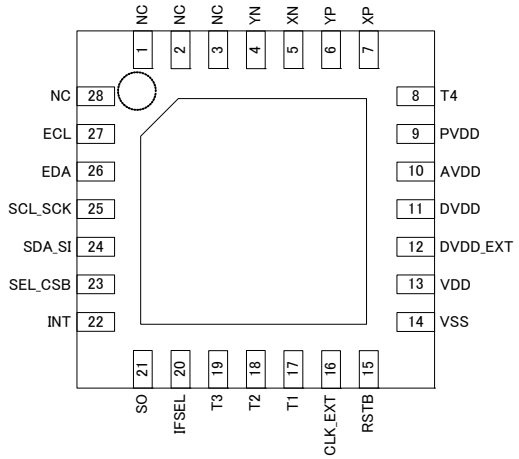
【BU21023MUV】

No.	Pin name	I/O	Function				fig
1	NC	-	-				-
2	NC	-	-				-
3	NC	-	-				-
4	YN	I/O	Panel interface				E
5	XN	I/O	Panel interface				E
6	YP	I/O	Panel interface				E
7	XP	I/O	Panel interface				E
8	T4	I/O	Test pin				E
9	PVDD	O	Regulator output (for supply panel voltage)				-
10	AVDD	O	Regulator output (for supply analog block)				-
11	DVDD	I/O	Regulator output (for supply digital block) or supply digital voltage (DVDD_EXT="H")				-
12	DVDD_EXT	I	Digital voltage enable (H=Hi-Z , L=DVDD enable)				E
13	VDD	-	Supply voltage				-
14	VSS	-	Ground				-
15	RSTB	I	H/W reset				E
16	CLK_EXT	I	Supply external clock for debug				A
17	T1	I	Test pin				A
18	T2	I	Test pin				A
19	T3	I	Test pin				A
20	IFSEL	I	Intereface select pin (L=SPI, H=2wire serial)				A
21	SO	O	SPI	Serila data output	2wire	-	F
22	INT	O	Interrupt output				C
23	SEL_CSB	I	SPI	Chip select	2wire	Slave address select	C
24	SDA_SI	I/O	SPI	Serial data input	2wire	Serial data in-out	C
25	SCL_SCK	I	SPI	Serial clock input	2wire	Serial clock input	C
26	EDA	I/O	EEPROM SDA				C
27	ECL	O	EEPROM SCL				C
28	NC	-	-				-

1. Please use 1.0uF capacitors between AVDD and DVDD to GND, and leave PVDD terminal open.
2. If DVDD_EXT="H ", the DVDD pin can be connected to an external 1.8V power source.
3. Please pull up the ECL, EDA, and INT pins using 10k ohm resistors as shown in the application diagram at the end of this document. ECL and EDA pins may be directly connected to GND if an external EEPROM is not being used. Please connect a 0.1uF capacitor between T4 and GND. T1, T2 & T3 pins should be connected to GND.
4. When using the 2 wire serial interface, please pull up the SCL_SCK, SDA_SI pins via 10k ohms and leave SO unconnected.
5. Please note that the values of resistors and capacitors mentioned here are only recommended values.
6. RSTB should be held low until supply voltage VDD has ramped up and has reached a stable level.
7. The polarity of INT pin is programmable via register 0x30
8. Connect CLK_EXT to GND for normal use



TOP VIEW (LEAD SIDE DOWN)



BOTTOM VIEW (LEAD SIDE UP)

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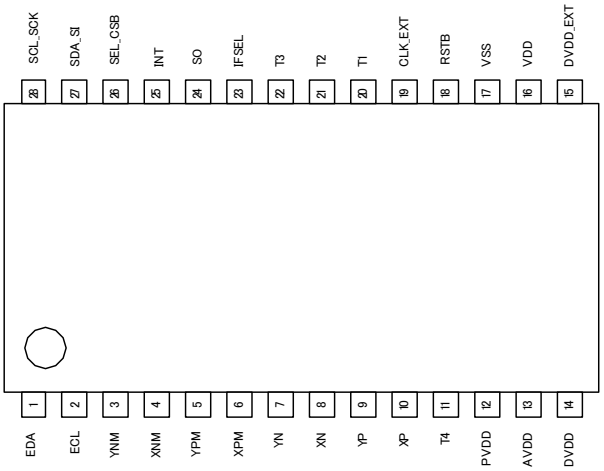
【BU21024FV-M】

No.	Pin name	I/O	Function				fig
1	EDA	I/O	EEPROM SDA				C
2	ECL	O	EEPROM SCL				C
3	YNM	I/O	Panel interface (Test input)				E
4	XNM	I/O	Panel interface (Test input)				E
5	YPM	I/O	Panel interface (Test input)				E
6	XPM	I/O	Panel interface (Test input)				E
7	YN	I/O	Panel interface				E
8	XN	I/O	Panel interface				E
9	YP	I/O	Panel interface				E
10	XP	I/O	Panel interface				E
11	T4	I/O	Test pin				E
12	PVDD	O	Regulator output (for supply panel voltage)				-
13	AVDD	O	Regulator output (for supply analog block)				-
14	DVDD	I/O	Regulator output (for supply digital block) or supply digital voltage (DVDD_EXT="H")				-
15	DVDD_EXT	I	Digital voltage enable (H=Hi-Z , L=DVDD enable)				E
16	VDD	-	Supply voltage				-
17	VSS	-	Ground				-
18	RSTB	I	H/W reset				E
19	CLK_EXT	I	Supply external clock for debug				A
20	T1	I	Test pin				A
21	T2	I	Test pin				A
22	T3	I	Test pin				A
23	IFSEL	I	Intereface select pin (L=SPI, H=2wire serial)				A
24	SO	O	SPI	Serila data output	2wire	-	F
25	INT	O	Interrupt output				C
26	SEL_CSB	I	SPI	Chip select	2wire	Slave address select	C
27	SDA_SI	I/O	SPI	Serial data input	2wire	Serial data in-out	C
28	SCL_SCK	I	SPI	Serial clock input	2wire	Serial clock input	C

1. Please use 1.0uF capacitors between AVDD and DVDD to GND, and leave PVDD terminal open.
2. If DVDD_EXT="H ", the DVDD pin can be connected to an external 1.8V power source.
3. Please pull up the ECL, EDA, and INT pins using 10k ohm resistors as shown in the application diagram at the end of this document. ECL and EDA pins may be directly connected to GND if an external EEPROM is not being used. Please connect a 0.1uF capacitor between T4 and GND. T1, T2 & T3 pins should be connected to GND.
4. When using the 2 wire serial interface, please pull up the SCL_SCK, SDA_SI pins via 10k ohms and leave SO unconnected.
5. Please note that the values of resistors and capacitors mentioned here are only recommended values.
6. RSTB should be held low until supply voltage VDD has ramped up and has reached a stable level.
7. The polarity of INT pin is programmable via register 0x30
8. Connect CLK_EXT to GND for normal use
9. Please leave the XPM, XNM, YPM, YNM terminals open if using a 4-wire touch screen. These pins should be connected to the reference leads of an 8-wire touch screen if one is being used.



TOP VIEW

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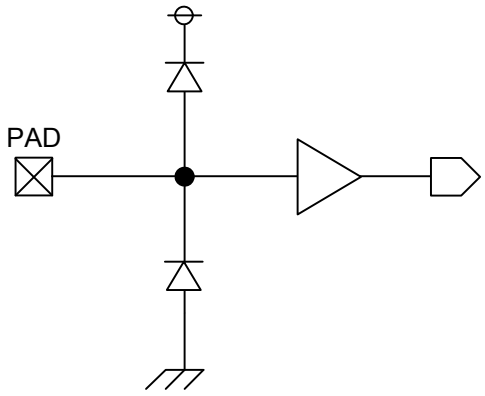

Fig. A

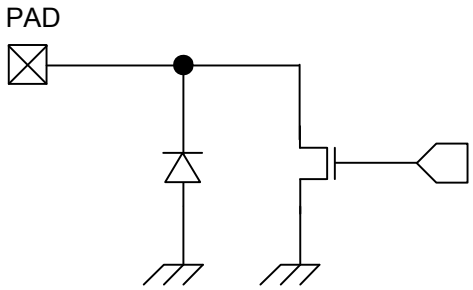

Fig. B

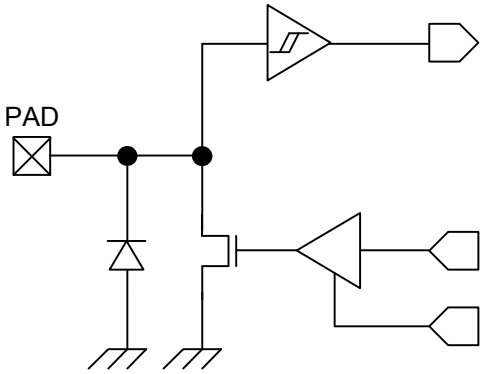

Fig. C

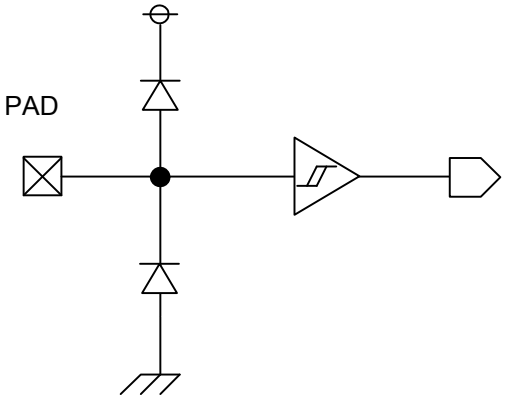

Fig. D

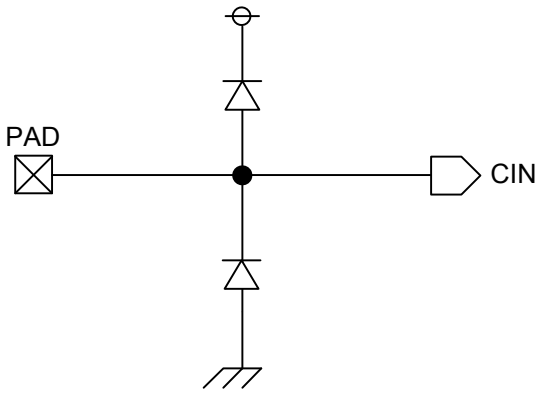

Fig. E

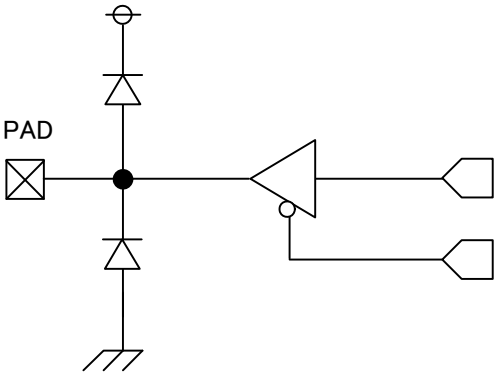

Fig. F

●Fig. BU21023GUL / BU21023MUV / BU21024FV-M I/O equivalent circuit

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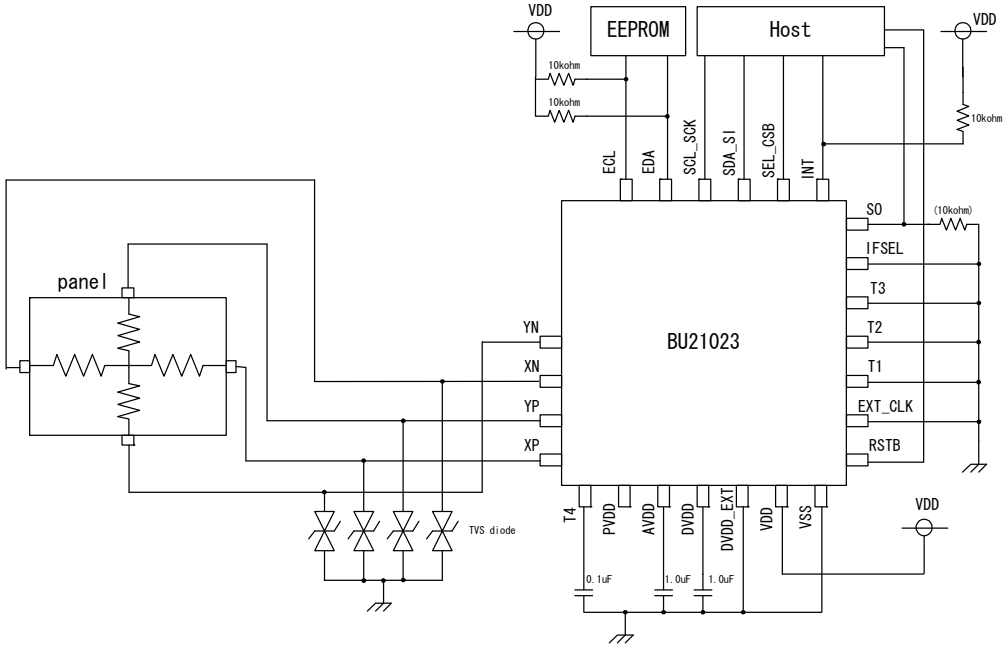
●Application Circuit

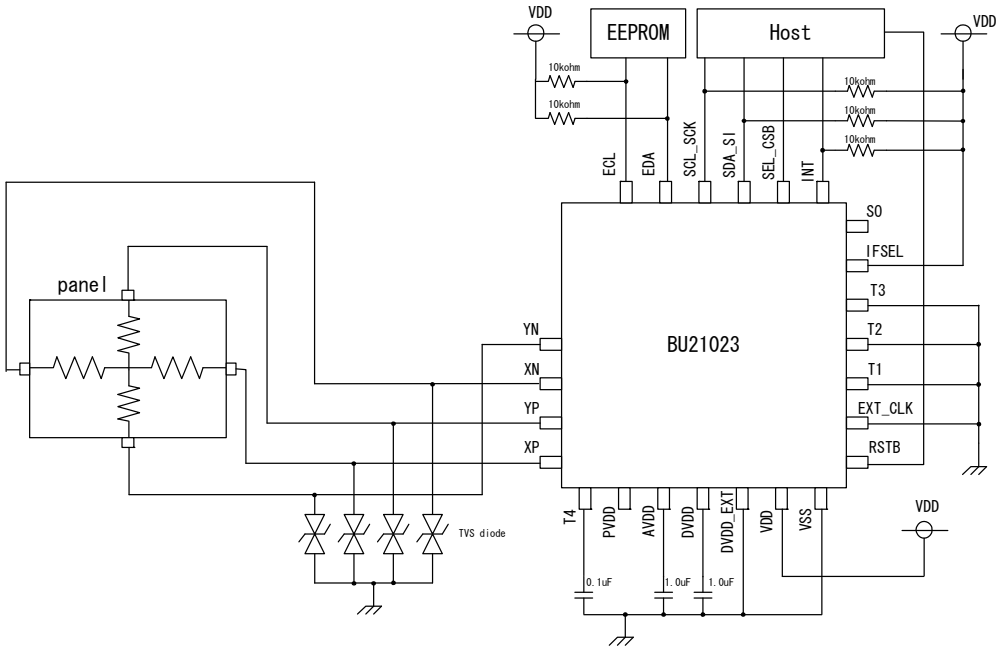
【BU21023GUL/BU21023MUV】
BU21023GUL/MUV support 2 host interfaces (4-wire SPI and 2-wire serial bus).
The figures below are shown application circuit when each interface is used.
(Although BU21023GUL is CSP package, it is shown in similar figure for comparing.)

*Please connect the terminal of ECL/EDA with VSS, when firmware is download form HOST.
*Please insert TVS diode each sensor line from the perspective that enhances resistance to ESD.
*In 4-wire SPI using case, pull up INT terminal to VDD or host IO voltage (max4.5V).
If no using, connect to GND.



Example 1 : BU21023GUL/MUV application circuit(4-wireSPI)

In 2-wire serial interface using case,
please pull up INT, SCL_SCK, SDA_SI terminal to VDD or host IO voltage(max4.5V).



Example 2 : BU21023GUL/MUV application circuit(2-wire Serial bus)

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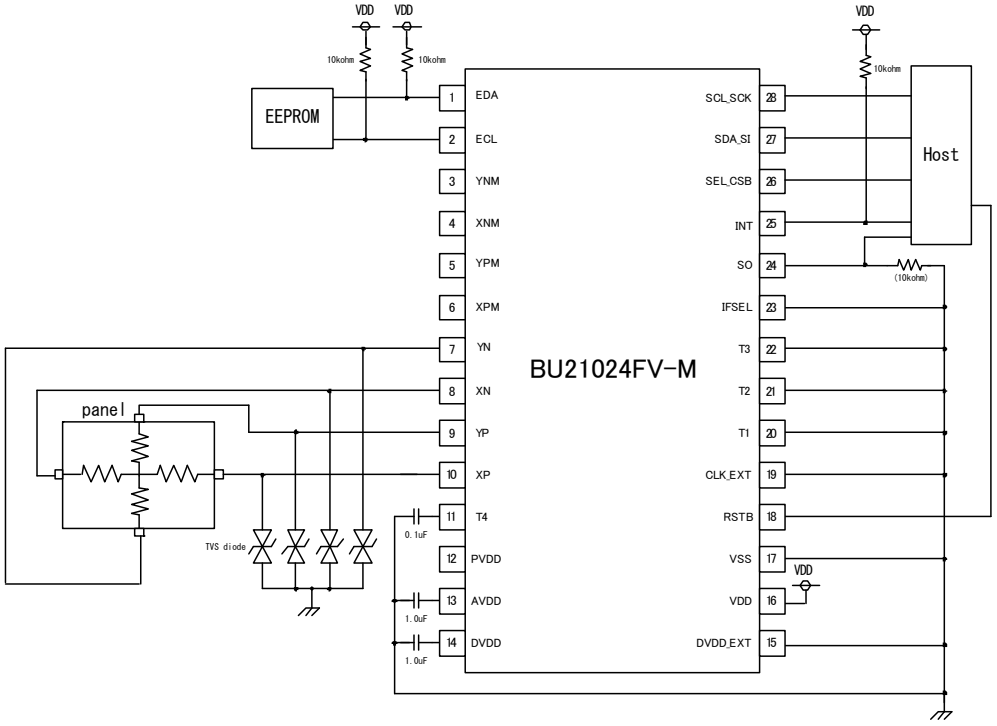
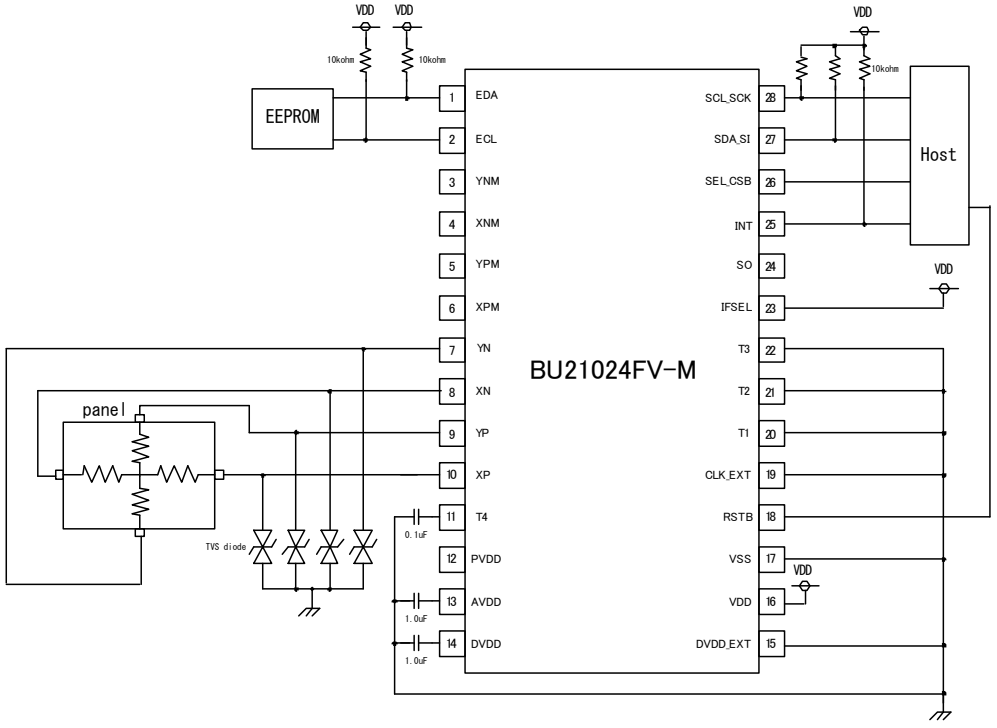
【BU21024FV-M】
BU21024FV-M support 2 host interfaces (4-wire SPI and 2-wire serial bus).
The figures below are shown Application Circuit when each interface is used.
(Although BU21023GUL is CSP package, it is shown in similar figure for comparing.)

*Please connect the terminal of ECL/EDA with VSS, when Firmware is download form HOST.
*Please insert TVS diode each sensor line from the perspective that enhances resistance to ESD.
*In 4-wire SPI using case, pull up INT terminal to VDD or host IO voltage(max4.5V).
If no using, connect to GND.



Example 3 : BU21024FV-M Application Circuit(4-wireSPI)



Example 4 : BU21024FV-M Application Circuit(2-wire Serial bus)

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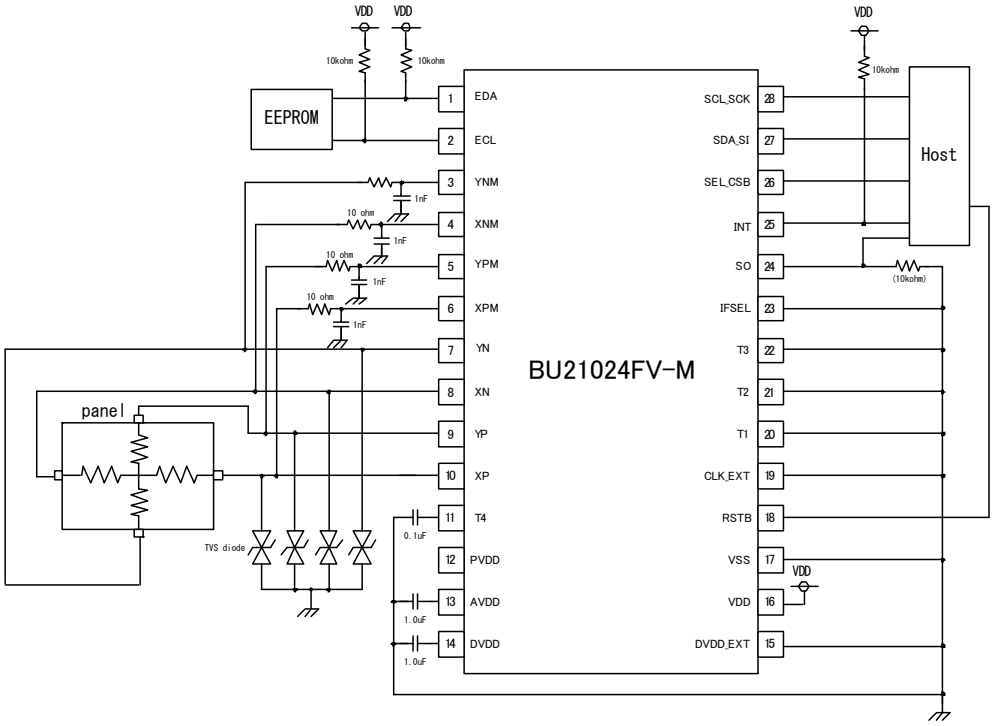
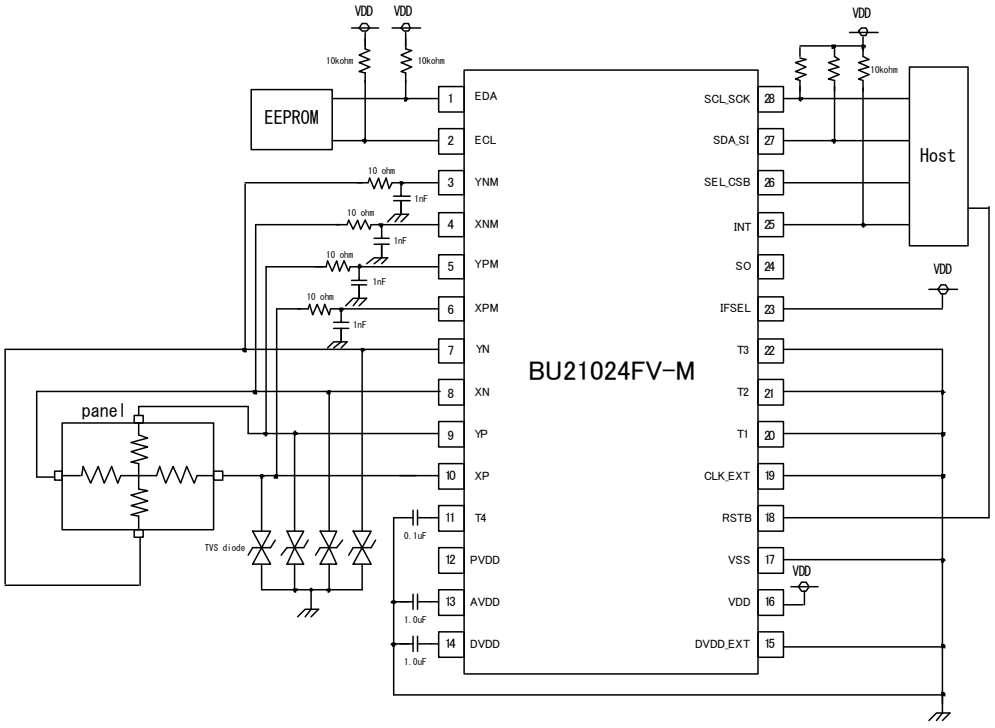
BU21024FV-M has the other pins for debug except for 4-wire resistive touch screen interface (XP, YP, XN, YN).
When debug, there are 4 monitor pins corresponding to four past terminals.
(In 4-wire, supply and detect voltage of screen on 4 pins. When debug, if this function is enable,
it is possible to supply voltage on past 4pins and detect voltage on 4 pins with **M separately.)
To remove the noise of Screen itself, the filter is composed of discrete circuit.
It is possible to ease the decrease of screen voltage's dynamic range, which is caused by wiring resistance on the PCB.

Note: These debug terminals are only for debug. So, please don't use them in normal application using.



Example 5 : BU21024FV-M Application Circuit(4-wireSPI with RC filter)



Example 6 : BU21024FV-M Application Circuit(2-wire Serial bus with RC filter)

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●Notes for use

(1) Absolute Maximum Ratings
An excess in the absolute maximum ratings, such as supply voltage, temperature range of operating conditions, etc., can break down devices thus making impossible to identify breaking mode such as a short circuit or an open circuit. If any special mode exceeding the absolute maximum ratings is assumed, consideration should be given to take physical safety measures including the use of fuses, etc.

(2) Operating conditions
These conditions represent a range within which characteristics can be provided approximately as expected. The electrical characteristics are guaranteed under the conditions of each parameter.

(3) Reverse connection of power supply connector
The reverse connection of power supply connector can break down ICs. Take protective measures against the breakdown due to the reverse connection, such as mounting an external diode between the power supply and the IC's power supply terminal.

(4) Power supply line
Design PCB pattern to provide low impedance for the wiring between the power supply and the GND lines. In this regard, for the digital block power supply and the analog block power supply, even though these power supplies has the same level of potential, separate the power supply pattern for the digital block from that for the analog block, thus suppressing the diffraction of digital noises to the analog block power supply resulting from impedance common to the wiring patterns. For the GND line, give consideration to design the patterns in a similar manner. Furthermore, for all power supply terminals to ICs, mount a capacitor between the power supply and the GND terminal. At the same time, in order to use an electrolytic capacitor, thoroughly check to be sure the characteristics of the capacitor to be used present no problem including the occurrence of capacity dropout at a low temperature, thus determining the constant.

(5) GND voltage
Make setting of the potential of the GND terminal so that it will be maintained at the minimum in any operating state. Furthermore, check to be sure no terminals are at a potential lower than the GND voltage including an actual electric transient.

(6) Short circuit between terminals and erroneous mounting
In order to mount ICs on a set PCB, pay thorough attention to the direction and offset of the ICs. Erroneous mounting can break down the ICs. Furthermore, if a short circuit occurs due to foreign matters entering between terminals or between the terminal and the power supply or the GND terminal, the ICs can break down.

(7) Operation in strong electromagnetic field
Be noted that using ICs in the strong electromagnetic field can malfunction them.

(8) Inspection with set PCB
On the inspection with the set PCB, if a capacitor is connected to a low-impedance IC terminal, the IC can suffer stress. Therefore, be sure to discharge from the set PCB by each process. Furthermore, in order to mount or dismount the set PCB to/from the jig for the inspection process, be sure to turn OFF the power supply and then mount the set PCB to the jig. After the completion of the inspection, be sure to turn OFF the power supply and then dismount it from the jig. In addition, for protection against static electricity, establish a ground for the assembly process and pay thorough attention to the transportation and the storage of the set PCB.

(9) Input terminals
In terms of the construction of IC, parasitic elements are inevitably formed in relation to potential. The operation of the parasitic element can cause interference with circuit operation, thus resulting in a malfunction and then breakdown of the input terminal. Therefore, pay thorough attention not to handle the input terminals, such as to apply to the input terminals a voltage lower than the GND respectively, so that any parasitic element will operate. Furthermore, do not apply a voltage to the input terminals when no power supply voltage is applied to the IC. In addition, even if the power supply voltage is applied, apply to the input terminals a voltage lower than the power supply voltage or within the guaranteed value of electrical characteristics.

(10) Ground wiring pattern
If small-signal GND and large-current GND are provided, It will be recommended to separate the large-current GND pattern from the small-signal GND pattern and establish a single ground at the reference point of the set PCB so that resistance to the wiring pattern and voltage fluctuations due to a large current will cause no fluctuations in voltages of the small-signal GND. Pay attention not to cause fluctuations in the GND wiring pattern of external parts as well.

(11) External capacitor
In order to use a ceramic capacitor as the external capacitor, determine the constant with consideration given to a degradation in the nominal capacitance due to DC bias and changes in the capacitance due to temperature, etc.

(12) Rush current
The IC with some power supplies has a capable of rush current due to procedure and delay at power-on. Pay attention to the capacitance of the coupling condensers and the wiring pattern width and routing of the power supply and the GND lines.

(13) Others
In case of use this LSI, please peruse some other detail documents, we called, Technical note, Functional description, Application note.

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●Ordering part number

B	U	2	1	0	2	4	F	V	-	M	E	2

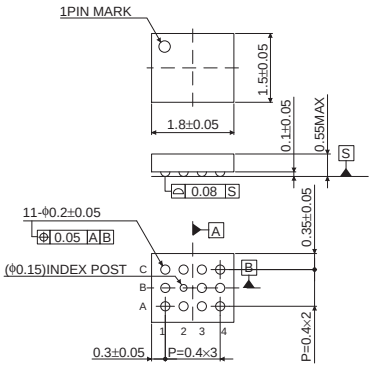
Part No.

Part No.
21023
21024

Package
GUL : VCSP50L2
MUV: VQFN028V5050
FV : SSOP-B28

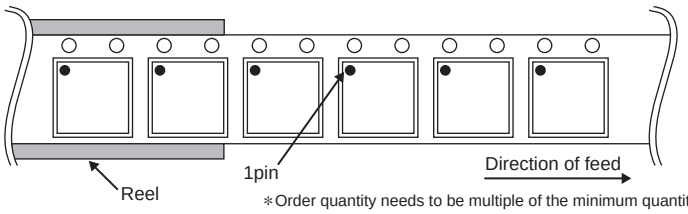
Packaging and forming specification
E2: Embossed tape and reel

UCSP50L1 (BD82103GWL)



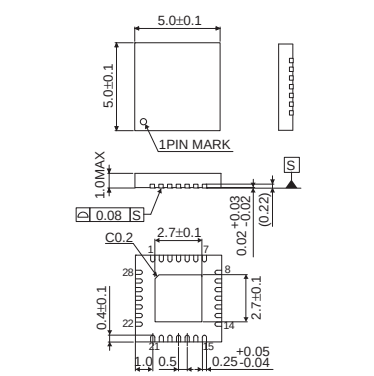
<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	3000pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)



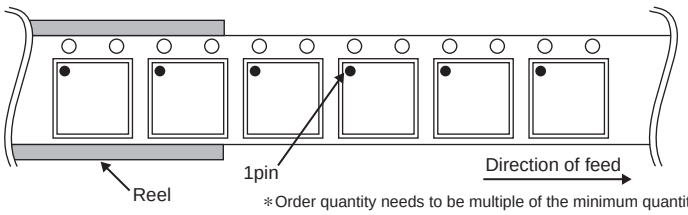
∗Order quantity needs to be multiple of the minimum quantity.

VQFN028V5050



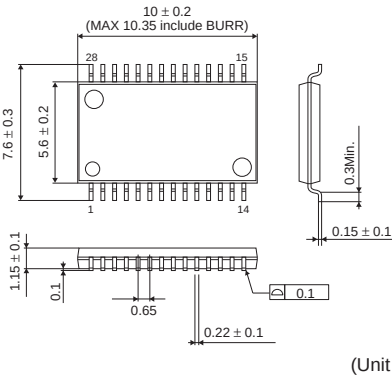
<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	2500pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)



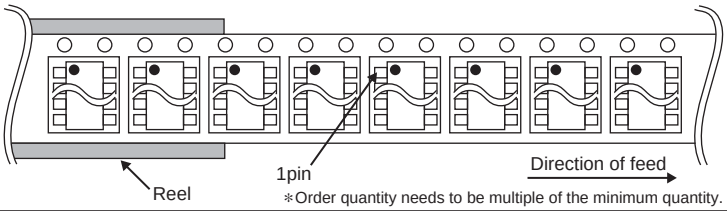
∗Order quantity needs to be multiple of the minimum quantity.

SSOP-B28



<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	2000pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)



∗Order quantity needs to be multiple of the minimum quantity.

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