Specification for
BTHQ 128064AVE-EMN-06-LEDWHITE-COG

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Specification
of
LCD Module Type
Model No.: COG-BTHQ12864-04

1. General Description

- 128 x 64 dots STN Negative Blue Transmissive Dot Matrix LCD Module.
- Viewing Angle: 6 o'clock direction.
- Driving duty: 1/65 duty, 1/7 bias.
- 'Epson' SED1565D0B (COG) Dot Matrix LCD Driver.
- 8080 Series MPU interface (default).
- 6800 Series MPU interface (Optional).
- FPC.
- White LED05 backlight.

2. Mechanical Specifications

The mechanical detail is shown in Fig. 1 and summarized in Table 1 below.

Table 1

Parameter	Specifications	Unit
Outline dimensions	89.7(W) x 49.8(H) x 6.0(D)(Exclude FPC & gate) 89.7(W) x 149.8(H) x 6.0(D)(Include FPC. Exclude gate) 89.7(W) x 150.0(H) x 6.0(D)(Include FPC and gate)	mm
View area	66.8 MIN.(W) x 35.5 MIN. (H)	mm
Active area	63.985(W) x 31.985(H)	mm
Display format	128 (W) x 64(H)	dots
Dot size	0.485(W) x 0.485(H)	mm
Dot spacing	0.015(W) x 0.015(H)	mm
Dot pitch	0.500(W) x 0.500(H)	mm
Weight:	TBD	grams

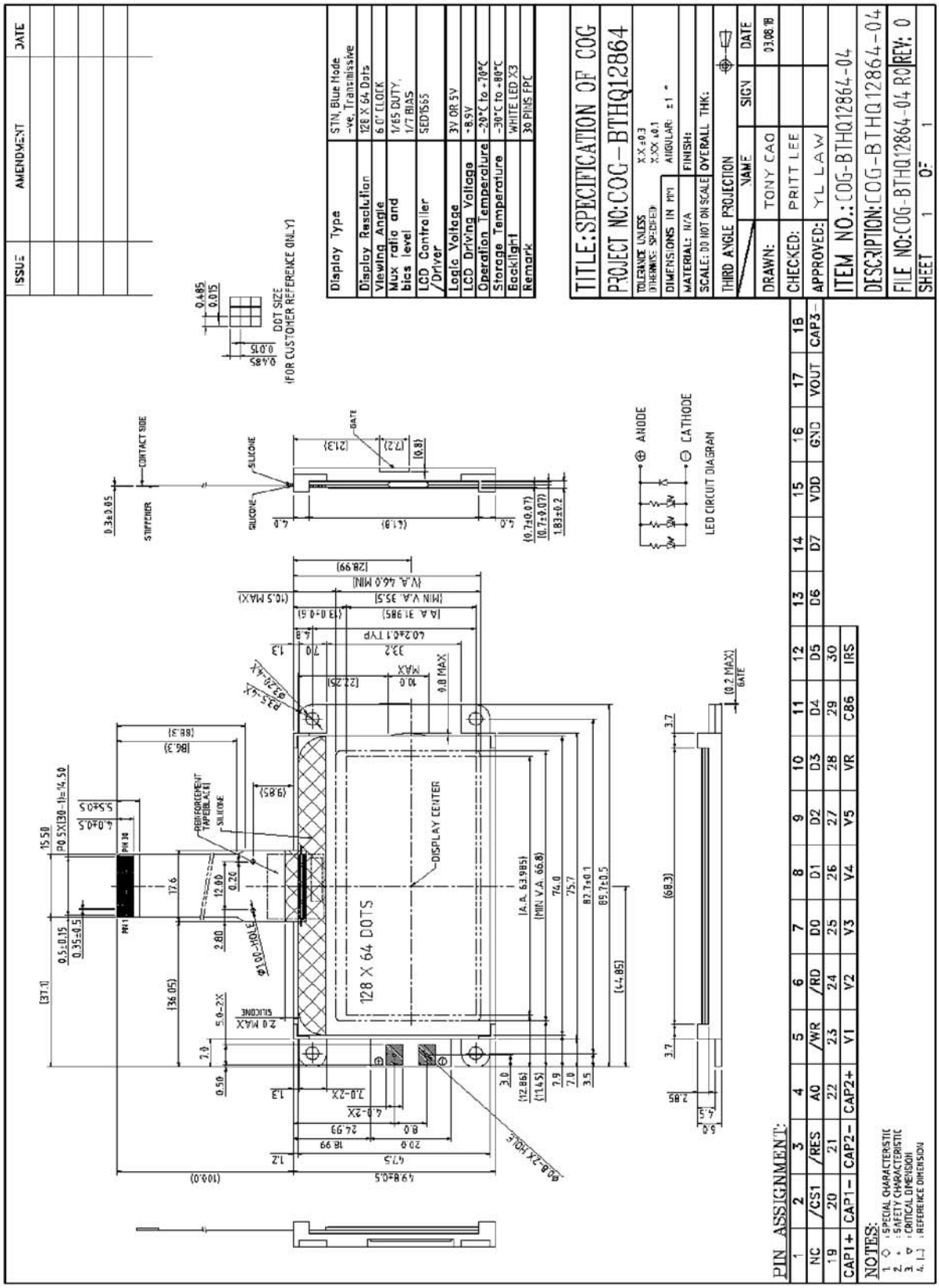


Figure 1: Module Specification

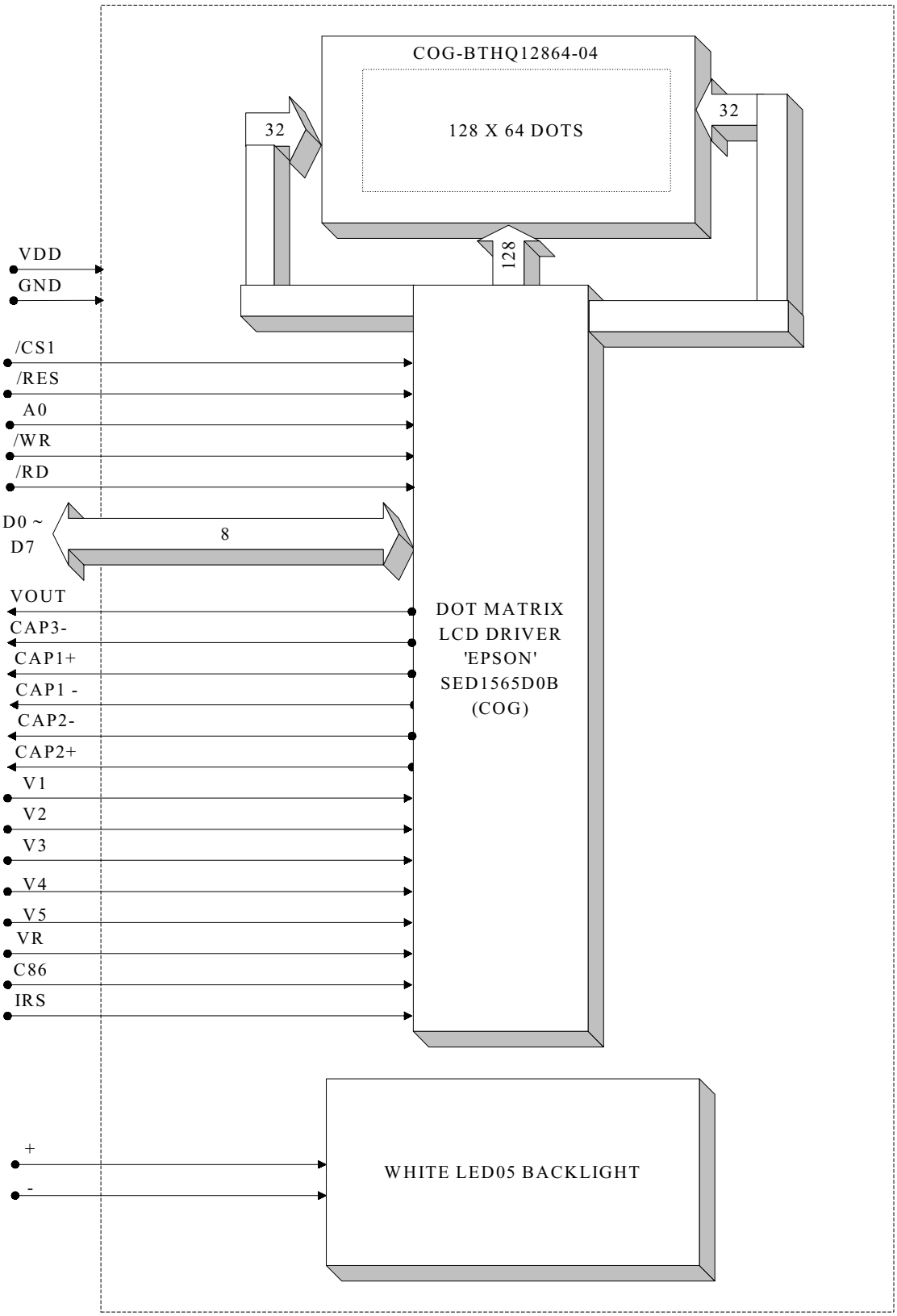


Figure 2: Block Diagram

3. Interface signals

Table 2 (a)

Pin No.	Symbol	Description
1	NC	No connection.
2	/CS1	This is the chip select signal. When /CS1 = "L", then the chip select become active, and data/command I/O is enabled.
3	/RES	When /RES is set to "L," the settings are initialized. The reset operation is performed by the /RES signal level.
4	A0	This is connected to the least significant bit of the normal MPU address bus, and it determines whether the data bits are data or a command. A0 = "H": Indicates that D0 to D7 are display data. A0 = "L": Indicates that D0 to D7 are control data.
5	/WR	When connected to an 8080 MPU, this is active LOW. This terminal connects to the 8080 MPU /WR signal. The signals on the data bus are latched at the rising edge of the /WR signal.
6	/RD	When connected to an 8080 MPU, this is active LOW. This pin is connected to the /RD signal of the 8080 MPU, and the SED1565 series data bus is in an output status when this signal is "L".
7	D0	This is an 8-bit bi-directional data bus that connects to an 8-bit or 16-bit 8 standard MPU data bus.
8	D1	
9	D2	
10	D3	
11	D4	
12	D5	
13	D6	
14	D7	
15	VDD	Power supply. Shared with the MPU power supply terminal VCC.
16	GND	Connection with ground.
17	VOUT	DC/DC voltage converter. Connect a capacitor between this terminal and GND .
18	CAP3-	DC/DC voltage converter. Connect a capacitor between this terminal and the CAP1+ terminal.
19	CAP1+	DC/DC voltage converter. Connect a capacitor between this terminal and the CAP1- terminal.
20	CAP1-	DC/DC voltage converter. Connect a capacitor between this terminal and the CAP1+ terminal.
21	CAP2-	DC/DC voltage converter. Connect a capacitor between this terminal and the CAP2+ terminal.
22	CAP2+	DC/DC voltage converter. Connect a capacitor between this terminal and the CAP2- terminal.

Table 2 (b)

Pin No.	Symbol	Description
23~27	V1,V2, V3,V4, V5	This is a multi-level power supply for the liquid crystal drive. The voltage applied is determined by the liquid crystal cell, and is changed through the use of a resistive voltage divided or through changing the impedance using an op. amp. Voltage levels are determined based on VDD, and must maintain the relative magnitudes shown below. VDD (= V0) ≧V1≧V2≧V3 ≧V4≧V5 Master operation: When the power supply turns ON, the internal power supply circuits produce the V1 to V4 voltages shown below. The voltage settings are selected using the LCD bias set command. For 1/7 bias: V1=(1/7)xV5, V2=(2/7)xV5, V3=(5/7)xV5, V4=(6/7)xV5.
28	VR	Output voltage regulator terminal. Provides the voltage between VDD and V5 through a resistive voltage divider. These are only enabled when the V5 voltage regulator internal resistors are not used (IRS = "L"). These cannot be used when the V5 voltage regulator internal resistors are used (IRS = "H").
29	C86	This is the MPU interface switch terminal. C86 = "H": 6800 Series MPU interface. C86 = "L": 8080 MPU interface.
30	IRS	This terminal selects the resistors for the V5 voltage level adjustment. IRS = "H": Use the internal resistors IRS = "L": Do not use the internal resistors. The V5 voltage level is regulated by an external resistive voltage divider attached to the VR terminal. This pin is enabled only when the master operation mode is selected. It is fixed to either "H" or "L" when the slave operation mode is selected.
	+	Anode of backlight
	-	Cathode of backlight.

4. Absolute Maximum Ratings

4.1 Electrical Maximum Ratings (Ta = 25 ºC)

Table 3

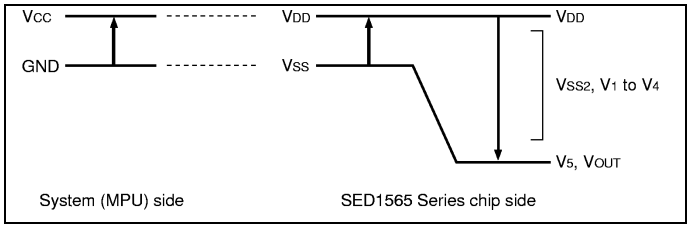
Parameter		Symbol	Min.	Max.	Unit
Power Supply voltage (Logic)		VDD-GND =VDD-VSS	-0.3	+7.0	V
Power supply voltage (VDD standard)		GND(=VSS2)	-7.0	+0.3	V
	With Triple set-up		-6.0	+0.3	V
	With Quad step-up		-4.5	+0.3	V
Power Supply voltage(V5,VOUT) (VDD standard)		V5,VOUT	-18.0	+0.3	V
Power Supply voltage(V1~V4) (VDD standard)		V1,V2,V3,V4	V5	+0.3	V
Input voltage		Vin	-0.3	VDD+0.3	V

Note: 1.)The modules may be destroyed if they are used beyond the absolute maximum ratings.

2.) Insure that the voltage levels of V1, V2, V3, and V4 are always such that

VDD ≧V1 ≧V2 ≧V3 ≧V4 ≧V5.

3.) The VSS2,V1 to V5 and VOUT are relative to VDD=0V reference.



4.2 Environmental Condition

Table 4

Item	Operating Temperature (Topr)		Storage Temperature (Tstg)		Remark
	Min.	Max.	Min.	Max.	
Ambient Temperature	-20°C	+70°C	-30°C	+80°C	Dry
Humidity	95% max. RH for Ta ≤ 40°C < 95% RH for Ta > 40°C				no condensation
Vibration (IEC 68-2-6) cells must be mounted on a suitable connector	Frequency: 10 ~ 55 Hz Amplitude: 0.75 mm Duration: 20 cycles in each direction.				3 directions
Shock (IEC 68-2-27) Half-sine pulse shape	Pulse duration: 11 ms Peak acceleration: 981 m/s^2 = 100g Number of shocks: 3 shocks in 3 mutually perpendicular axes.				3 directions

5. Electrical Specifications

5.1 Typical Electrical Characteristics

At Ta = 25 °C, VDD = 5V±5%, GND =0V.

Table 5

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply voltage (Logic)	VDD-GND		4.75	5.0	5.25	V
Supply voltage (LCD)	VLCD =VDD-V5	VDD = +5.0V, Note (1)	8.6	8.9	9.2	V
Low-level input signal voltage	V_{ILC}		GND	-	0.2xVDD	V
High-level input signal voltage	V_{IHC}		0.8xVDD	-	VDD	V
Supply Current (Logic & LCD)	IDD	VDD = 5V, Character mode	-	0.5	0.7	mA
		VDD = 5V, Checker board mode	-	1.1	1.3	mA
Supply voltage of white LED05 backlight	VLED05	Forward current =45mA Number of LED dies =1x3=3	4.8	5.0	5.2	V

Note (1): There is tolerance in optimum LCD driving voltage during production and it will be within the specified range.

5.2 Timing Specifications

Reset Timing

At Ta = -20 °C to +70 °C, VDD = +5.0V±5%, GND = 0V.

Table 6

Item	Signal	Symbol	Condition	Rating			Units
				Min	Typ	Max	
Reset time		t_R		—	—	0.5	µs
Reset "L" pulse width	RES	t_{RW}		0.5	—	—	µs

Note: All timing is specified with 20% and 80% of VDD as the standard.

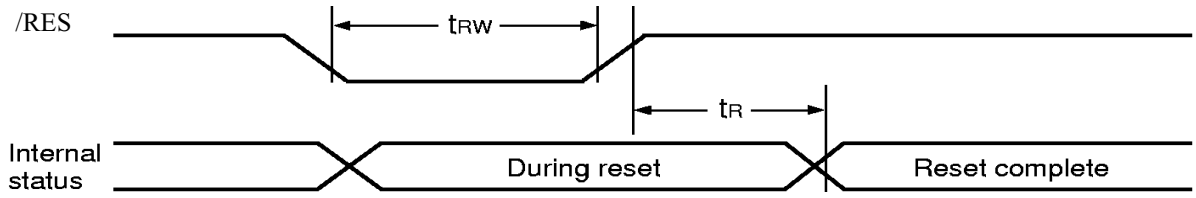


Figure 3:Reset Timing

System Bus Read/Write Characteristics (8080 Series MPU)

At Ta = -20 °C to +70 °C, VDD = +5.0V±5%, GND = 0V.

Table 7

Item	Signal	Symbol	Condition	Rating		Units
				Min	Max	
Address hold time	A0	t_{AH8}		0	—	ns
Address setup time		t_{AW8}		0	—	ns
System cycle time	A0	t_{CYC8}		166	—	ns
Control L pulse width ($\overline{WR}$)	$\overline{WR}$	t_{CCLW}		30	—	ns
Control L pulse width ($\overline{RD}$)	$\overline{RD}$	t_{CCLR}		70	—	ns
Control H pulse width ($\overline{WR}$)	$\overline{WR}$	t_{CCHW}		30	—	ns
Control H pulse width ($\overline{RD}$)	$\overline{RD}$	t_{CCHR}		30	—	ns
Data setup time	D0 to D7	t_{DS8}		30	—	ns
Address hold time		t_{DH8}		10	—	ns
$\overline{RD}$ access time		t_{ACC8}	C_L = 100 pF	—	70	ns
Output disable time		t_{OH8}		5	50	ns

*1 The input signal rise time and fall time (t_r, t_f) is specified at 15 ns or less. When the system cycle time is extremely fast, ($t_r + t_f$) ≤ ($t_{CYC8} – t_{CCLW} – t_{CCHW}$) for ($t_r + t_f$) ≤ ($t_{CYC8} – t_{CCLR} – t_{CCHR}$) are specified.
*2 All timing is specified using 20% and 80% of V_{DD} as the reference.
*3 t_{CCLW} and t_{CCLR} are specified as the overlap between $\overline{CS1}$ being "L" (CS2 = "H") and $\overline{WR}$ and $\overline{RD}$ being at the "L" level.

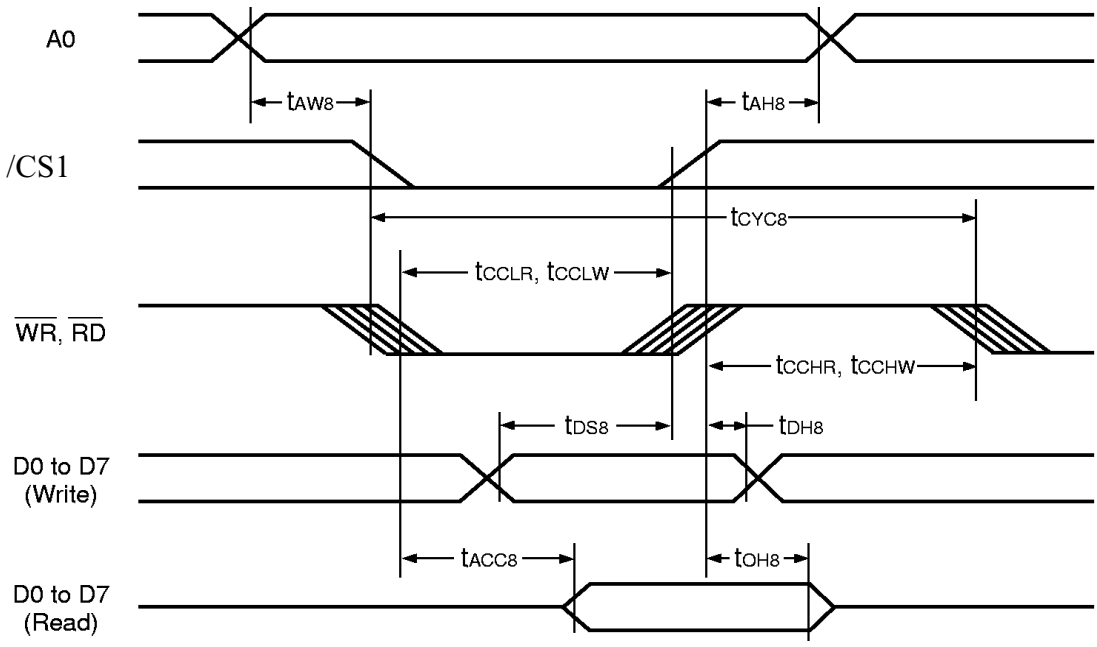


Figure 4: MPU bus read / write timing diagram (80 family MPU)

System Bus Read/Write Characteristics (6800 Series MPU)

At Ta = -20 °C to +70 °C, VDD = +5.0V±5%, VSS = 0V.

Table 8

Item		Signal	Symbol	Condition	Rating		Units
					Min	Max	
Address hold time Address setup time		A0	t_{AH6} t_{AW6}		0 0	— —	ns ns
System cycle time		A0	t_{CYC6}		166	—	ns
Data setup time Data hold time		D0 to D7	t_{DS6} t_{DH6}		30 10	— —	ns ns
Access time Output disable time			t_{ACC6} t_{OH6}	C_L = 100 pF	— 10	70 50	ns ns
Enable H pulse time	Read Write	E	t_{EWHR} t_{EWHW}		70 30	— —	ns ns
Enable L pulse time	Read Write	E	t_{EWLR} t_{EWLW}		30 30	— —	ns ns

*1 The input signal rise time and fall time (t_r, t_f) is specified at 15 ns or less. When the system cycle time is extremely fast, $(t_r + t_f) \leq (t_{CYC6} - t_{EWLW} - t_{EWHW})$ for $(t_r + t_f) \leq (t_{CYC6} - t_{EWLR} - t_{EWHR})$ are specified.
*2 All timing is specified using 20% and 80% of V_{DD} as the reference.
*3 t_{EWLW} and t_{EWLR} are specified as the overlap between $\overline{CS1}$ being "L" (CS2 = "H") and E.

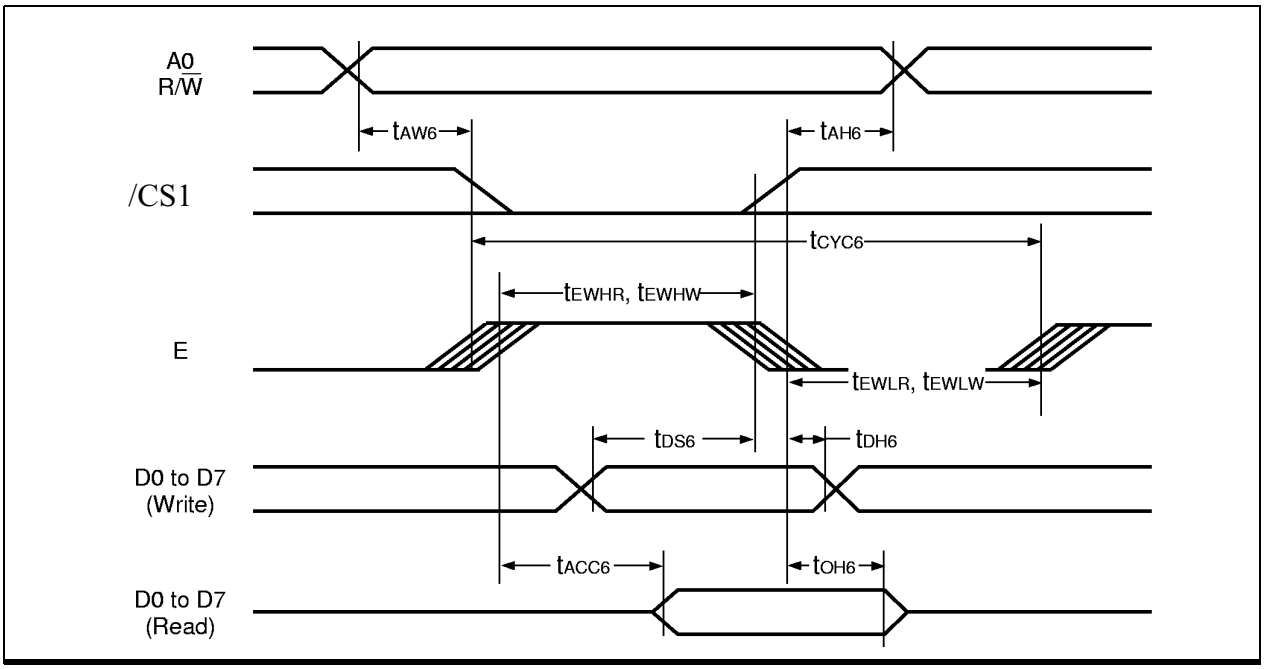


Figure 5: MPU bus read / write timing diagram (68 family MPU)

5.3 Instruction Set

Table 8

	Command	Command Code A0	$\overline{RD}$	$\overline{WR}$	D7	D6	D5	D4	D3	D2	D1	D0	Function
(1)	Display ON/OFF	0	1	0	1	0	1	0	1	1	1	0 1	LCD display ON/OFF 0: OFF, 1: ON
(2)	Display start line set	0	1	0	0	1	Display start address						Sets the display RAM display start line address
(3)	Page address set	0	1	0	1	0	1	1	Page address				Sets the display RAM page address
(4)	Column address set upper bit	0	1	0	0	0	0	1	Most significant column address				Sets the most significant 4 bits of the display RAM column address.
	Column address set lower bit	0	1	0	0	0	0	0	Least significant column address				Sets the least significant 4 bits of the display RAM column address.
(5)	Status read	0	0	1	Status				0	0	0	0	Reads the status data
(6)	Display data write	1	1	0	Write data								Writes to the display RAM
(7)	Display data read	1	0	1	Read data								Reads from the display RAM
(8)	ADC select	0	1	0	1	0	1	0	0	0	0	0 1	Sets the display RAM address SEG output correspondence 0: normal, 1: reverse
(9)	Display normal/ reverse	0	1	0	1	0	1	0	0	1	1	0 1	Sets the LCD display normal/ reverse 0: normal, 1: reverse
(10)	Display all points ON/OFF	0	1	0	1	0	1	0	0	1	0	0 1	Display all points 0: normal display 1: all points ON
(11)	LCD bias set	0	1	0	1	0	1	0	0	0	1	0 1	Sets the LCD drive voltage bias ratio SED1565*** ..... 0: 1/9, 1: 1/7 SED1566*** /SED1568*** /SED1569*** ..... 0: 1/8, 1: 1/6 SED1567*** 0: 1/6, 1: 1/5
(12)	Read/modify/write	0	1	0	1	1	1	0	0	0	0	0	Column address increment At write: +1 At read: 0
(13)	End	0	1	0	1	1	1	0	1	1	1	0	Clear read/modify/write
(14)	Reset	0	1	0	1	1	1	0	0	0	1	0	Internal reset
(15)	Common output mode select	0	1	0	1	1	0	0	0 1	*	*	*	Select COM output scan direction 0: normal direction, 1: reverse direction
(16)	Power control set	0	1	0	0	0	1	0	1	Operating mode			Select internal power supply operating mode
(17)	V_5 voltage regulator internal resistor ratio set	0	1	0	0	0	1	0	0	Resistor ratio			Select internal resistor ratio (Rb/Ra) mode
(18)	Electronic volume mode set	0	1	0	1	0	0	0	0	0	0	1	
	Electronic volume register set	0	1	0	*	*	Electronic volume value						Set the V_5 output voltage electronic volume register
(19)	Static indicator ON/OFF	0	1	0	1	0	1	0	1	1	0	0 1	0: OFF, 1: ON
	Static indicator register set	0	1	0	*	*	*	*	*	*	Mode		Set the flashing mode
(20)	Power saver												Display OFF and display all points ON compound command
(21)	NOP	0	1	0	1	1	1	0	0	0	1	1	Command for non-operation
(22)	Test	0	1	0	1	1	1	1	*	*	*	*	Command for IC test. Do not use this command

(Note) *: disabled data

6. Reference Application Circuit (8080) Example