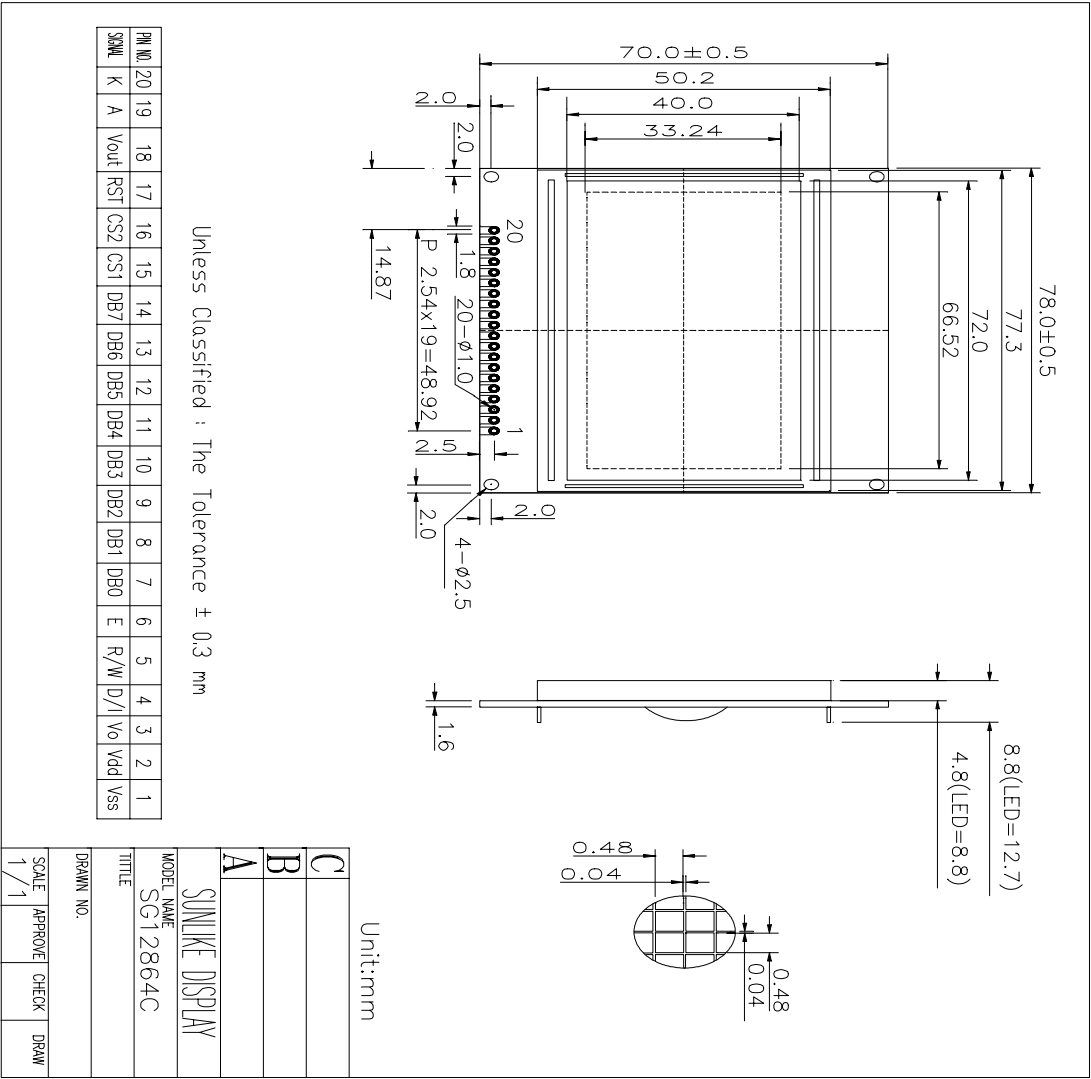


GENERAL SPECIFICATION

TIEM	DESCRIPTION					
Product No	SG12864CSLB-HS					
LCD Type	☒ STN Gray Positive		☐ STN Yellow Green Positive		☐ STN Blue Negative	
	☐ FSTN Negative White & Black			☐ FSTN Positive Black & White		
Rear Polarizer	☐ Reflective		☒ Transflective		☐ Transmissive	
Backlight Type	☐ NO B/L	☒ LED		☐ CCFL		☐ EL
Backlight Color	☒ Yellow Green	☐ Green	☐ Amber		☐ White	☐ Blue Green
View Direction	☒ 6 O'clock			☐ 12 O'clock		
Temperature Range	☐ Normal			☒ Wide		
Frame	☐ Black			☒ Silver		

TO BE VERY CAREFUL !

The LCD driver ICs are made by CMOS process, which are very easy to be damaged by static charge, make sure the user is grounded when handling the LCM.



ABSOLUTE MAXIMUM RATING**(1) Electrical Absolute Ratings**

Item	Symbol	Min.	Max.	Unit	Note
Power Supply for Logic	$V_{DD}-V_{SS}$	-0.3	7.0	Volt	
Power Supply for LCD	$V_{DD}-V_{EE}$	0	14.0	Volt	
Input Voltage	V_I	-0.3	V_{DD}	Volt	
LED Power Dissipation	P_{AD}	-	2.65	W	
LED Forward current	I_{AF}	-	660	mA	
LED Reverse Voltage	V_R		8	V	

(2) Environmental Absolute Maximum Ratings

Item	Normal Temperature				Wide Temperature			
	Operating		Storage		Operating		Storage	
	Min,	Max.	Min,	Max.	Min,	Max.	Min,	Max.
Ambient Temperature	0°C	+50°C	-20°C	+70°C	-20°C	+70°C	-30°C	+80°C
Humidity(without condensation)	Note 2,4		Note 3,5		Note 4,5		Note 4,6	

Note 2 $T_a \leq 50^\circ\text{C}$: 80% RH max

$T_a > 50^\circ\text{C}$: Absolute humidity must be lower than the humidity of 85%RH at 50°C

Note 3 T_a at -20°C will be <48hrs at 70°C will be <120hrs when humidity is higher than 75%.

Note 4 Background color changes slightly depending on ambient temperature. This phenomenon is reversible.

Note 5 $T_a \leq 70^\circ\text{C}$: 75RH max

$T_a > 70^\circ\text{C}$: absolute humidity must be lower than the humidity of 75%RH at 70°C

Note 6 T_a at -30°C will be <48hrs, at 80°C will be <120hrs when humidity is higher than 75%.

ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min.	Typ	Max.	Unit	note
Power Supply for Logic	$V_{DD}-V_{SS}$	-	4.5	5.0	5.5	Volt	
Power Supply for LCD	$V_{EE}-V_{SS}$	-	-4.3	-4.8	-5.2	Volt	
Input Voltage	V_{IL}	L level	0	-	0.6	Volt	
	V_{IH}	H level	2.2	-	V_{DD}	Volt	
	$V_{DD}-V_O$	$T_a=0^{\circ}C$	-	-	-	Volt	
		$T_a=25^{\circ}C$	7.6	8.3	9.2		
		$T_a=50^{\circ}C$	-	-	-		
Power Supply Current for LCM	I_{DD}	$V_{DD}=5.0V$ $V_{DD}-V_O=8.3V$	-	2.0	3.5	mA	
	I_{EE}		-	2.4	-		
LED Forward Voltage	V_F	$I_f=390\text{ mA}$	-	4.2	4.6	Volt	
LED Forward Current	I_F	-	-	390	-	mA	
LED Reverse Current	I_R	$V_R=8V$	-	-	0.2	mA	

OPTICAL CHARACTERISTICS

Item	Symbol	Condition	Min.	Typ	Max.	Unit	note
Viewing angle range	$\Phi f(12\text{ o'clock})$	When $Cr \geq 1.4$	-	10	-	Degree	9,10
	$\Phi b(6\text{ o'clock})$		-	30	-		
	$\Phi l(9\text{ o'clock})$		-	30	-		
	$\Phi r(3\text{ o'clock})$		-	30	-		
Rise Time	T_r	$V_{DD}-V_o=8.3V$ $T_a=25^{\circ}C$	-	200	-	ms	
Fall Time	T_f		-	250	-		
Frame frequency	Frm		-	64	-	Hz	8,10
Contrast	Cr		-	4.5	-		7
The Brightness Of Backlight	L	IF=390 mA	140	180	-	cd/m ²	
Peak Emission Wavelength	λP		-	570	576	nm	

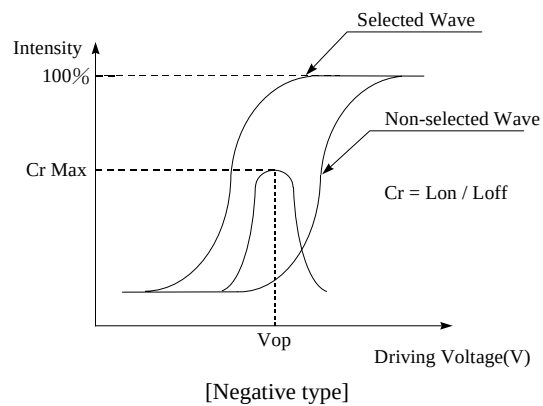
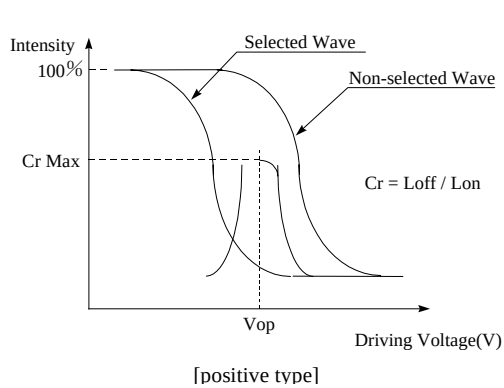
ELECTRICAL CHARACTERISTICS

ITEM	DESCRIPTION
Product No.	SG12864C
Module Size	78.0 (W)mm×70.0 (H)mm×12.7(D)mm Max
Viewing Area	72.0(W)mm × 40.0(H)mm
Dot Size	0.48(W)mm×0.48(H)mm
Dot Pitch	0.52(W)mm×0.52(H)mm
Resolution	128(W)×64(H) Dots Matrix
Controller	KS0107
DC/DC Converter	With (Optional)

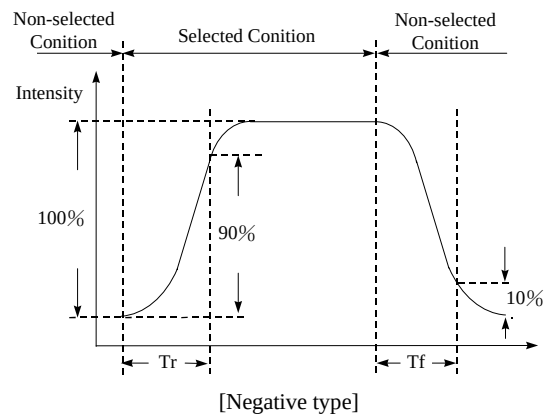
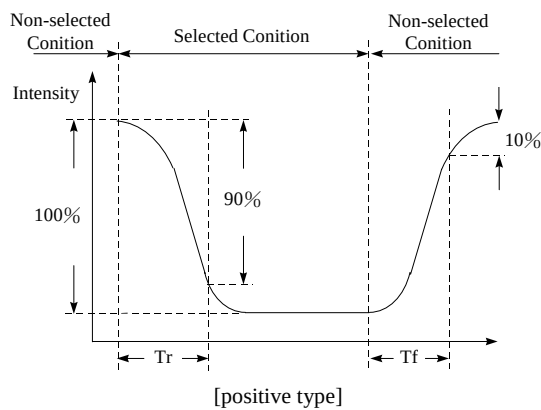
INTERFACE PIN ASSIGNMENT

PIN NO.	PIN OUT	LEVEL	FUNCTION DESCRIPTION
1	V _{SS}	0V	GND
2	V _{DD}	5V	Logic supply voltage
3	V _O	---	Contrast Adjustment voltage
4	D/I	H/L	H: Data, L: Instruction Code
5	R/W	H/L	H: Read / L: Write
6	E	H→L	Enable Signal
7	DB0	H/L	Data Bus Line
8	DB1	H/L	
9	DB2	H/L	
10	DB3	H/L	
11	DB4	H/L	
12	DB5	H/L	
13	DB6	H/L	
14	DB7	H/L	
15	CS1	H	Chip Select Signal for IC1
16	CS2	H	Chip Select Signal for IC2
17	/RES	L	Reset Signal
18	V _{out}	---	Power Supply Voltage for LCD
19	A	4.2V	LED Power (+)
20	K	0V	LED Power (-)

[Note 7] Definition of Operation Voltage (Vop)



[Note 8] Definition of Response Time (Tr, Tf)



Conditions:

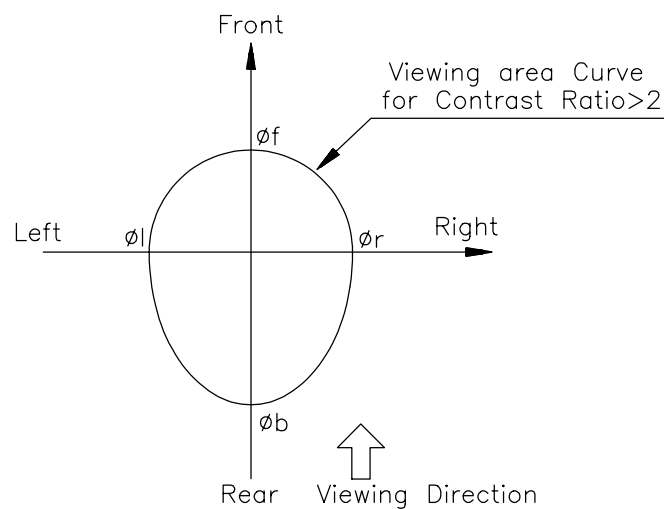
Operating Voltage : Vop

Frame Frequency : 64 Hz

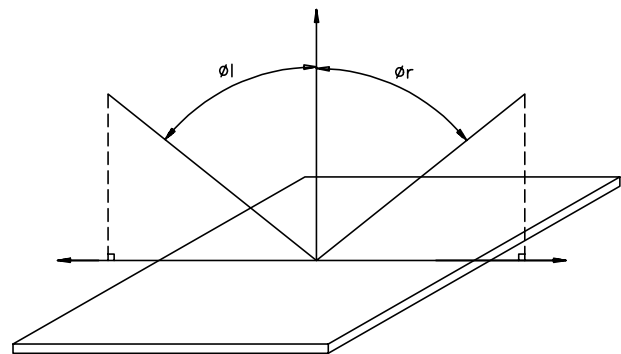
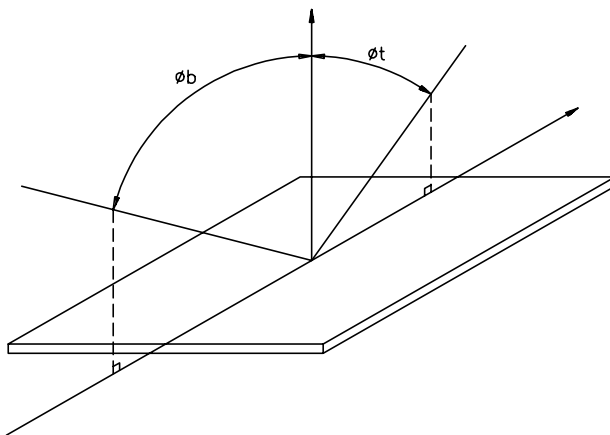
Viewing Angle(θ , φ): 0° , 0°

Driving Wave form : 1/N duty, 1/a bias

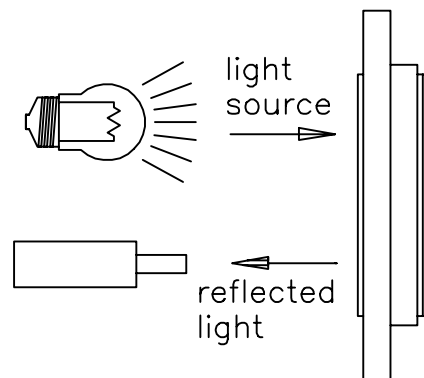
[Note 9] Definition of Viewing Direction



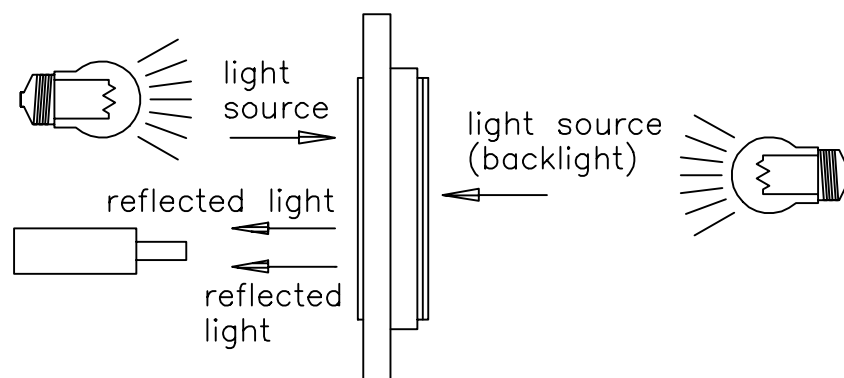
[Note 10] Definition of viewing angle



[Note 11] Description of Measuring Equipment

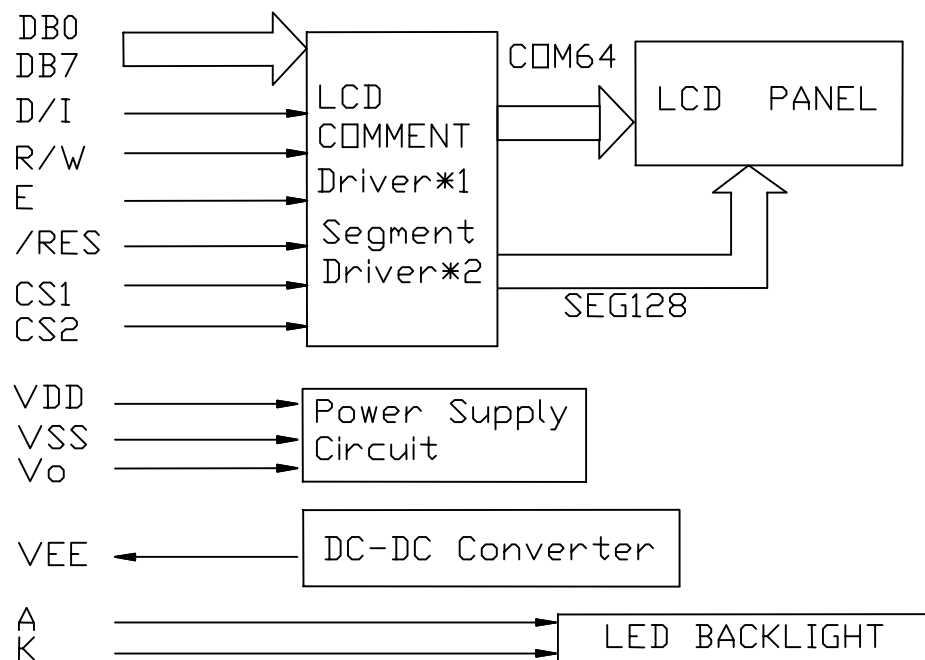


Reflective type

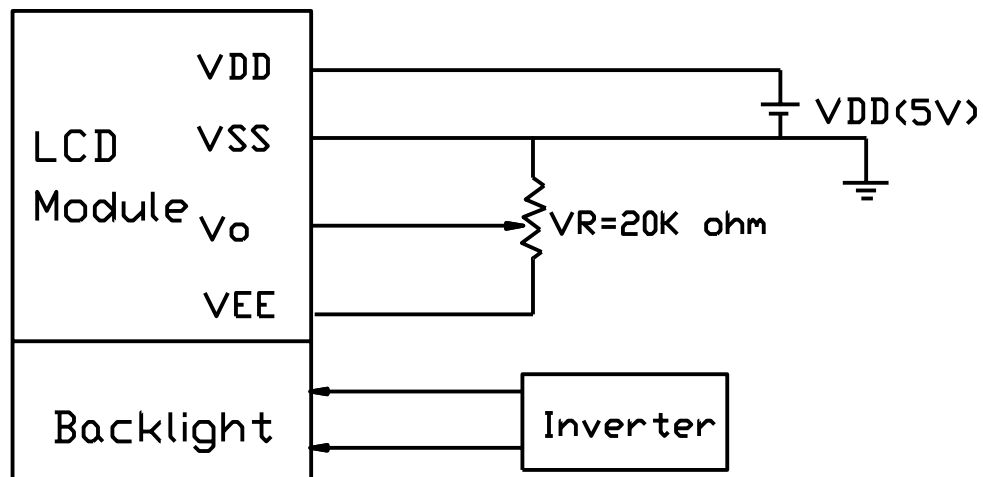


Transflective type

BLOCK DIAGRAM



POWER SUPPLY



INSTRUCTION CODE

N O	Instruction	Code										Function
		D/I	R/W	D7	D6	D5	D4	D3	D2	D1	D0	
1	Display ON / OFF	0	0	0	0	1	1	1	1	1	1/0	Controls display ON/OFF. RAM data and internal status are not affected. 1: NO , 0: OFF
2	Display Start Line	0	0	1	1	Display start line (0-63)						Specifies the RAM line displayed at the top of the screen.
3	Page Address Set	0	0	1	0	1	1	1	Page (0-7)			Sets the page (X address) of RAM at the page (X address) register.
4	Set Address	0	0	0	1	Column Address (0-63)						Sets the Column (Y address) in the Column (Y address) counter.
5	Status Read	0	1	B U S Y	0	ON / OFF	R E S E T	0	0	0	0	Reads the status. RESET 1: Reset 0: Normal ON/OFF 1: Display OFF 0: Display ON BUSY 1: Internal operation 0: Ready
6	Write Display Data	1	0	Write DATA								Write data DB0 to DB7 on the data bus into display RAM.
7	Read Display Data	1	1	Read DATA								Reads data DB0 to DB7 from the display RAM to the data bus.

* Initialization at power-on is performed not by the reset Instruction but by a reset signal applied to the RES pin.

Initialization

- (a) Display off .
- (b) Display start line register : First line .
- (c) Static drive off .
- (d) Column address counter : Address 0 .
- (e) Page address register : Page 0 .
- (f) Select duty : 1/64 duty

(1) Display On / Off

This command turns the display on and off no relation with the data in the display data RAM internal conditions.

Code	D/I	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
	0	0	0	0	1	1	1	1	1	D

D 1: Display ON
0 : Display OFF

(2) Display Start Line

This instruction set the line address as shown Fig 1. The selected line the display data RAM correspond to the COM0 which display at the top of LCD panel . The display area is set automatically from the selected line to the line which increased the number of duty ratio . Therefore , the smooth scroll for vertical direction by changing the start line address one by one or page switching are available by this instruction .

Code	D/I	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
	0	0	1	1	A5	A4	A3	A2	A1	A0

A5	A4	A3	A2	A1	A0	Line Address
0	0	0	0	0	0	0
					1	1
				1		2
1	1	1	1	1	0	3E
1	1	1	1	1	1	3F

(3) Page Address Set

When MPU access the Display Data RAM , the page address corresponded to the row address must be selected . The access in the Display Data RAM is available by setting the page and column address . (Refer the Fig . 1) The display is no change when the page address is changed .

Code	D/I	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
	0	0	1	0	1	1	1	A2	A1	A0

A2	A1	A0	Page
0	0	0	0
0	0	1	1
1	1	0	6
1	1	1	7

(4) Column Address Set

This instruction set the column address in the display Data RAM . (see Fig . 1)

When the MPU access the Display Data RAM continuously , the column address increase “1” automatically , therefore , the MPU can access the data only without address setting . The increment of the column address is stopped by the address of 50H automatically , but the page address is no change even if the column address increase to 50H and stop .

Code	D/I	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
	0	0	0	A6	A5	A4	A3	A2	A1	A0

A6	A5	A4	A3	A2	A1	A0	Column Address
0	0	0	0	0	0	0	0
						1	1
					1		2
1	1	1	1	1	1	0	3E
1	1	1	1	1	1	1	3F

(5) Status Read

This instruction read out internal status.

Code	D/I	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
	0	1	Busy	0	on/off	Reset	0	0	0	0

Busy : Busy =1 : indicate the operating or the Reser cycle . The instruction can be input after the Busy status change to “0” .

On/Off : Indicate the whole display On/Off status .

0 : Whole display “On”

1 : Whole display “Off”

(Note) The data “0=On” and “1=Off” of Display On/Off status read out is inverted with the Display On/Off instruction data of “1=On” and “0=Off” .

Reset : Indicate the initialization period by /RST signal or reset instruction .

0 : ---

1 : Initialization period .

(6) Write Display Data

This instruction writes the 8-bits data on the data bus into the Display Data RAM . The column (segment) address increase “1” automatically when writing , therefore , the MPU can write the 8-bit data into Display Data RAM without address setting .

Code	D/I	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
	1	0	Write Data							

(7) Read Display Data

This instruction read out the 8-bits data from Display Data RAM which addressed by the column and page address . in case of the Read Modify Write Mode is off , the column address increase “1” automatically after each read out , therefore , the MPU can read out 8-bit data from the Display Data RAM continuously without address setting . One time dummy read be required after column address set as explain in (4-3) .

Code	D/I	WR	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
	1	1	Read Data							

Display Data Ram Addressing

Page Addrees cs1,cs2	Data	Display Pattern								Line Address
B8	D0	■				■				C0
	D1	■				■				C1
	D2	■	■			■				C2
	D3	■		■		■			0 Page	C3
	D4	■			■	■				C4
	D5	■				■				C5
	D6	■				■				C6
	D7									C7
B9	D0									C8
	D1									C9
	D2									CA
	D3								1 Page	CB
	D4									CC
	D5									CD
	D6									CE
	D7									CF
BA	D0									D0
	D1								2 Page	D1
	D2									D2
	D3									D3
	D4									D4
	D5									D5
	D6								6 Page	F6
	D7									F7
BF	D0									F8
	D1									F9
	D2									FA
	D3								7 Page	FB
	D4									FC
	D5									FD
	D6									FE
	D7									FF
Column address		40	41	42	43	44	45	46	7E	7F
Segment Term		1	2	3	4	5	6	7	63	64

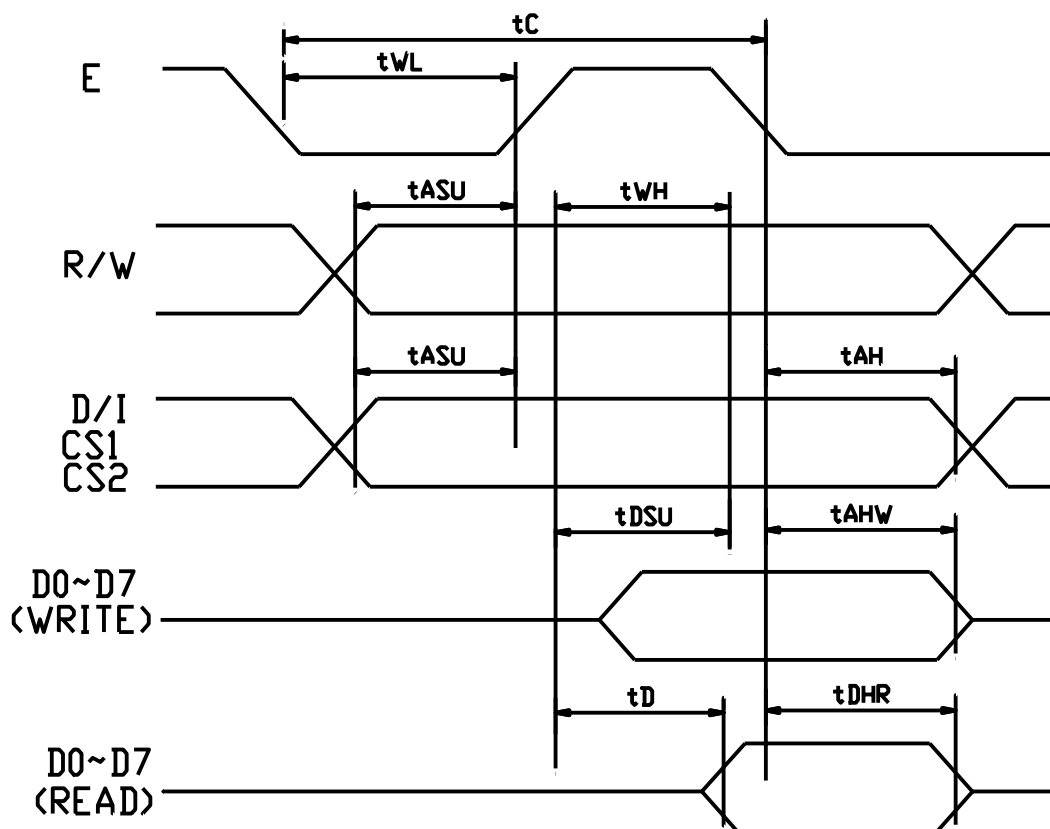
Fig.1Correspondence with display data RAM and address (For example the display start line is 10th and 1/64 duty)

BUS TIMING CHARACTERISTICS

1. Read/Write operation sequence (68 type MPU)

(VDD=5.0V±10%, VSS=0V, Ta=-20~+75°C)

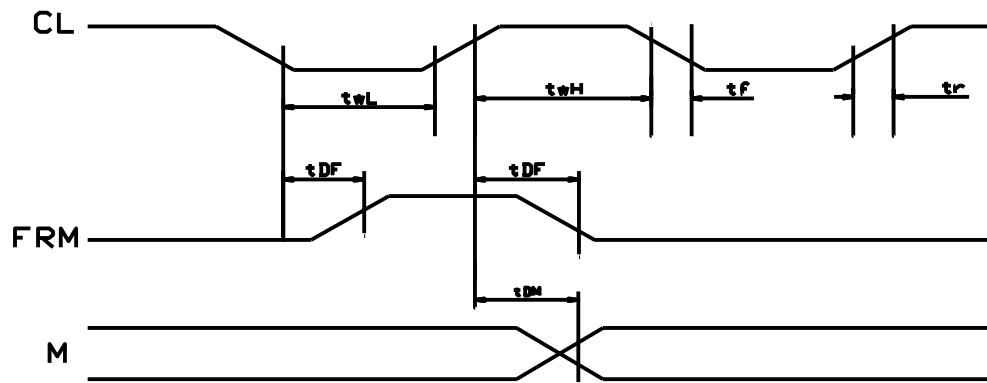
Parameter			Symbol	min	max	Condition	Unit
Address set up time	D/I,R/W Terminals		t _{ASU}	140	----	----	ns
Address hold time			t _{AH}	10	----		
System cycle time			t _C	1000	----		
Enable	Low	E Terminal	t _{WL}	450	----		
Pulse write	High		t _{WH}	450	----		
Data set up time	D0~D7 Terminals		t _{DSU}	200	----		
Data hold time			t _{DHW}	10	----		
Access time			t _D	----	320		
Output disable time			t _{DHR}	20	----		



2.Display control timing characteristics (68 type MPU)

(VDD=5.0V±10%,VSS=0V,Ta=-20~+75℃)

Parameter	Symbol	min	typ	max	Condition	Unit
“L” level pulse write	t _{WL}	35				us
“H” level pulse write	t _{WH}	35				
Ruse time	t _r		30	150		ns
Fall time	t _f		30	150		
FRM delay time	t _{DF}	-2.0		2.0		us
M delay time	t _{DM}	-2.0		2.0		



OPERATING PRINCIPLES & METHODS

1.Output register

Output register stores the data temporarily from display data RAM when CS1,CS2 is in active mode and R/W and D/I=H, stored data in display data RAM is latched in output register. When CS1,CS2 is in active mode and R/W=H,D/I=L, status data (busy check) can read out.

To read the contents of display data RAM, twice access of read instruction is needed. In first access, data in display data RAM is latched into output register. In second access, MPU can read data which is latched. That is, to read the data in display data RAM, it needs dummy read. But status read is not needed dummy read.

D/I	R/W	FUNCTION
L	L	Instruction
	H	Status read (busy check)
H	L	Data write (from input register to display data RAM)
	H	Data read (from display data RAM to output register)

2.Reset

Reset can be initialized system by setting RES terminal at low level when turning power on. receiving instruction from MPU. When RES become low, following procedure is occurred.

1.Display OFF

2.Display start line register become set by 0.

While RES is low, any instruction except status read can be accepted. Reset status appears at DB4. After DB4 is low, any instruction can be accepted.

The conditions of power supply at initial power up are shown in table 1.

Table 1. Power Supply Initial Conditions

Item	Symbol	Min	Typ	Max	Unit
Reset Time	t _{RS}	1.0	--	--	us
Rise Time	t _R	--	--	200	ns

