CLOVER DISPLAY LTD.

LCD MODULE SPECIFICATION

Model : CG9204A - _ _ - _ _ - _ _ - _

Revision	01
Engineering	Timothy Chan
Date	19 May 2022
Our Reference	X9050

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MODE OF DISPLAY

Display mode	Display condition	Viewing direction
STN : ☐ Yellow green	☐ Reflective type	☐ 6 O' clock
☐ Grey	☐ Transflective type	☐ 12 O' clock
☐ Blue (negative)	☐ Transmissive type	☐ 3 O' clock
☐ FSTN positive	☐ Others	☐ 9 O' clock
☐ FSTN negative		

LCD MODULE NUMBER NOTATION:

CG9024A- L W - F F - W 6 – T
(1) (2) (3) (4) (5) (6) (7) (8)

*(1)---Model number of standard LCD Modules
*(2)---Backlight type
N – No backlight
E – EL backlight
L – Side-lited LED backlight
M– Array LED backlight
C – CCFL
*(3)---Backlight color
N – No backlight
A – Amber
B – Blue
O– Orange
W–White
Y – Yellow green
*(4)---Display mode
T – TN
V – TN (Negative)
S – STN Yellow green
G – STN Grey
B – STN Blue (Negative)
F – FSTN
N – FSTN (Negative)
*(5)---Rear polarizer type
R – Reflective
F – Transflective
T – Transmissive
*(6)---Temperature range
N – Normal
W– Extended
*(7)---Viewing direction
6 – 6 O'clock
2 – 12 O'clock
3 – 3 O'clock
9 – 9 O'clock
*(8)---Special code for other requirements
(Can be omitted if not used)

GENERAL DESCRIPTION

Display mode : 20 characters X 4 lines COG LCD module,

Interface : Serial
I^2C
8-bit Parallel
4-bit Parallel

Driving method : 1/33 duty, 1/6 bias

Viewing direction : 6 O' clock

Backlight : Side-lited LED / White

Controller IC : Solomon SSD1803A or equivalent
For the detailed information, please refer to the IC specifications.

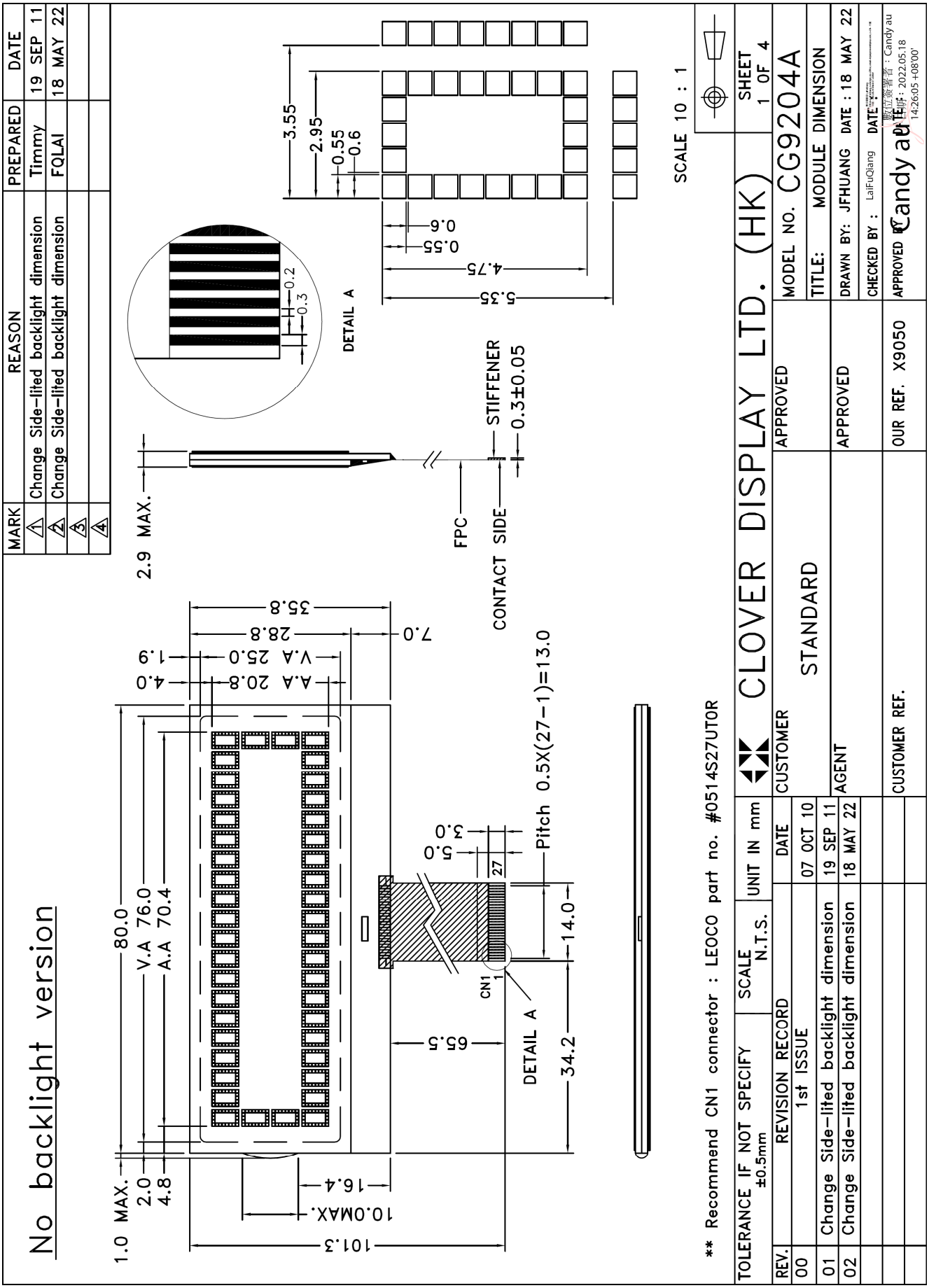
MECHANICAL DIMENSIONS

Item	Dimension	Unit	Item	Dimension	Unit
Outline Dimension		mm	Viewing Area	76.0(L)x25.0(W)	mm
No Backlight	80.0(L) x 35.8(W) x 2.9MAX.(H)	mm	Character pitch	3.55(L)x5.35(W)	mm
LED Sided Backlight	88.0(L) x 35.8(W) x 6.7MAX.(H)	mm	Character size	2.95(L)x4.75(W)	mm

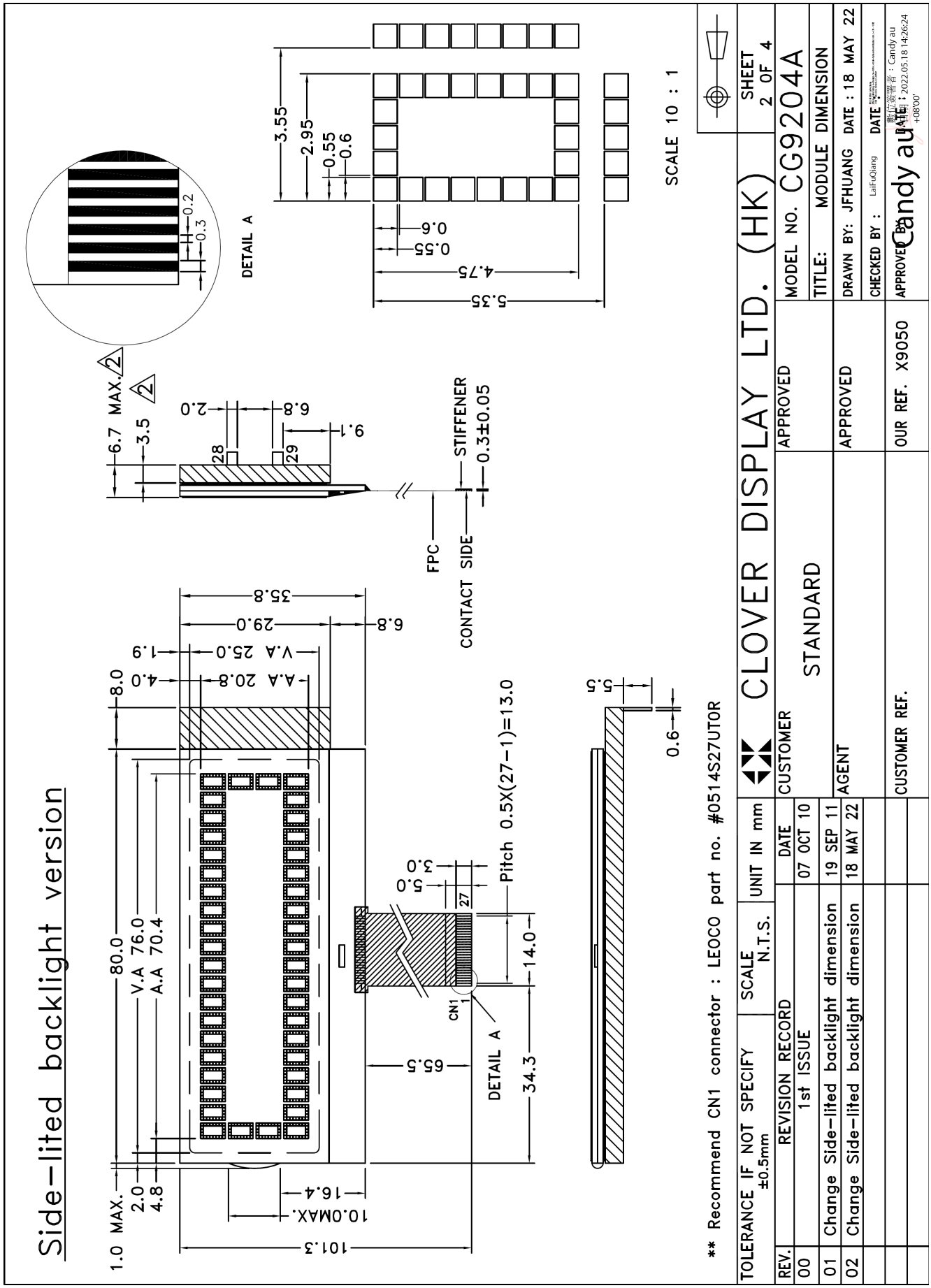
CONNECTOR PIN ASSIGNMENT

Pin No.	Symbol	Function
1	V0	External Power supply for LCD
2	V1	Bias voltage levels for LCD driving
3	V2	
4	V3	
5	V4	
6	IM2	Used to select the interface mode
7	IM1	
8	VOUT	Output of the voltage converter
9	VDD	Supply voltage for logic
10	VDDIO	Supply voltage for 5V IO application
11	ROM2	Used to select Character ROM
12	ROM1	
13	VSS	Ground
14	DB7	Support selectable 4/ 8-bit Parallel interface , Serial Peripheral interface or I2C Interface.
15	DB6	
16	DB5	
17	DB4	
18	DB3	
19	DB2/SOD/SDAout	
20	DB1/SID/SDAin	
21	DB0/SCLK/	
22	E	read / write enable signal
23	RW	Select read / write operation
24	/CS	Chip enable (Active low)
25	RS/SA0	register select / slave I2C address
26	RESET	External reset input
27	NC	No connection
*28	BL＋	Supply voltage for backlight(＋VE)
*29	BL－	Supply voltage for backlight(－VE)

COUNTER DRAWING OF MODULE DIMENSION

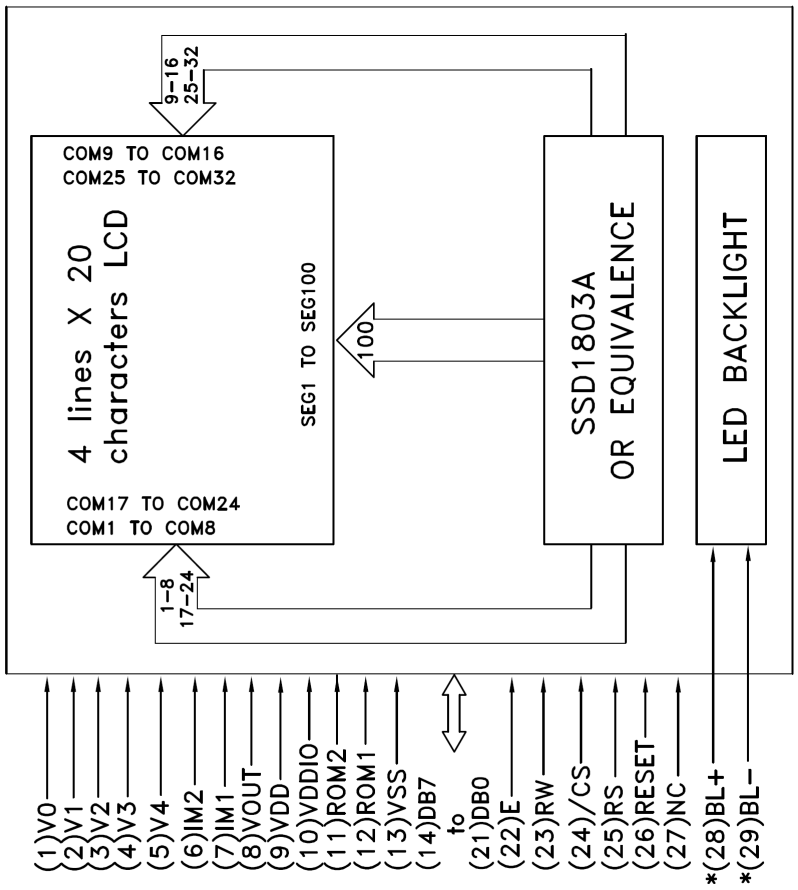


COUNTER DRAWING OF MODULE DIMENSION



COUNTER DRAWING OF PIN OUT & BLOCK DIAGRAM

PIN	DESCRIPTION	FUNCTION
1	V0	External Power supply for LCD
2	V1	
3	V2	Bias voltage levels for LCD driving
4	V3	
5	V4	
6	IM2	Used to select the interface mode
7	IM1	
8	VOUT	Output of the voltage converter
9	VDD	Supply voltage for logic
10	VDDIO	Supply Voltage for 5V IO application
11	ROM2	Used to select Character ROM
12	ROM1	
13	VSS	Ground
14	DB7	Support selectable 4/ 8-bit Parallel Interface, Serial Peripheral Interface or I2C interface.
15	DB6	
16	DB5	
17	DB4	
18	DB3	
19	DB2/SOD/SDAout	
20	DB1/SID/SDAin	
21	DB0/SCLK/SCL	
22	E	read/write enable signal
23	RW	Select read/ write operation
24	/CS	Chip enable (Active low)
25	RS/SA0	register select/slave I2C address
26	RESET	External reset input
27	NC	No connection
*28	BL+	Supply voltage for backlight(+VE)
*29	BL-	Supply voltage for backlight(-VE)



Note: Pin 28 , 29 are used for backlight versions only

TOLERANCE IF NOT SPECIFY ±0.5mm	SCALE N.T.S.	UNIT IN mm	CLOVER DISPLAY LTD. (HK)		SHEET 3 OF 4
REV.	REVISION RECORD	DATE	CUSTOMER	APPROVED	MODEL NO. CG9204A
00	1st ISSUE	07 OCT 10	STANDARD		TITLE: PIN OUT & BLOCK DIAGRAM
01	Change Side-lited backlight dimension	19 SEP 11	AGENT	APPROVED	DRAWN BY: JFHUANG DATE: 18 MAY 22
02	Change Side-lited backlight dimension	18 MAY 22			CHECKED BY : LaiFuQiang DATE:
			CUSTOMER REF.	OUR REF. X9050	APPROVED BY : Candy DATE: 數位簽署者：Candy 日期：2022.05.18 14:26:41 +08'00'

ELECTRICAL CHARACTERISTICS

Conditions: VSS=0V, Ta=25℃

Item	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage for Logic	VDD	4.8	5.0	5.2	V
Supply Current for Logic	IDD	—	0.65	0.98	mA
Operating Voltage for LCD(*)	VLCD	7.13	7.5	7.88	V
'High' Level Input Voltage	VIH	0.8VDD	—	VDD	V
'Low' Level Input Voltage	VIL	—	—	0.2VDD	V

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

Side Backlight

Constant voltage driving:

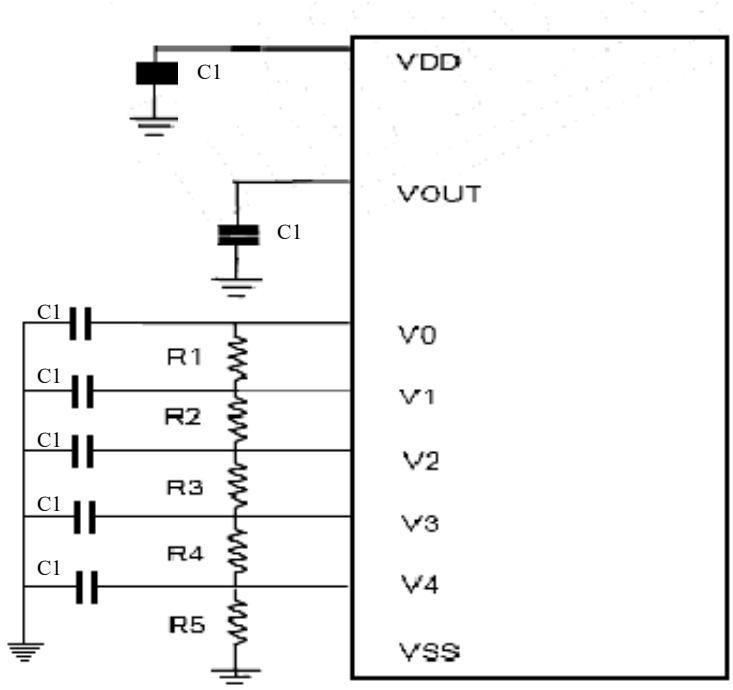
Item	Symbol	MIN.	TYP.	MAX.	Unit	Condition
White Backlight current	I_{BL}	30	35	40	mA	V_{BL} = 5.0V
Blue Backlight current	I_{BL}	30	35	40	mA	V_{BL} = 5.0V
Yellow Green Backlight current	I_{BL}	30	35	40	mA	V_{BL} = 5.0V

ABSOLUTE MAXIMUM RATINGS

Please make sure not to exceed the following maximum rating values under the worst application conditions

Item	Symbol	Rating	Unit
Supply Voltage for Logic	V_{DD}	-0.3 to 6.0	V
Input Voltage for Logic	V_{IN}	-0.3 to VDD+0.3	V
Operating Temperature	T_{opr}	-20 to 70	℃
Storage Temperature	T_{stg}	-30 to 80	℃

REFERENCE CIRCUIT EXAMPLE



R1, R2, R3, R4, R5 : 20K C1 : 1 μF

CHARACTER ROM SELECTION

Pin Name	Type	Connect To	When Not in Use	Description
ROM2, ROM1	I	VDDIO or VSS	-	This pin is used to select Character ROM:

ROM2	ROM1	ROM **
L	L	A
L	H	B
H	L	C
H	H	Invalid

INTERFACE SELECTION

IM2, IM1	I	VDDIO or VSS	-	This pin is used to select the interface mode:

IM2	IM1	Interface Mode
H	H	4-bit/8-bit bus mode
L	H	serial mode
H	L	I2C mode
L	L	I2C mode

Note (**): ROM A, B, C are attached at Page 26 ~ Page 28.

INSTRUCTIONS TABLE

Instruction	IS	RE	Instruction Code										Description
			RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
Clear display	X	X	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM. and set DDRAM address to "00H" from AC.
Return home	X	0	0	0	0	0	0	0	0	0	1	X	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.
Power down mode	X	1	0	0	0	0	0	0	0	0	1	PD	Set power down mode bit. PD = "1": power down mode set, PD = "0": power down mode disable (POR)
Entry mode set	X	0	0	0	0	0	0	0	0	1	I/D	S	Assign cursor/ blink moving direction with DDRAM address I/D = "1": cursor/ blink moves to right and DDRAM address is increased by 1 (POR) I/D = "0": cursor/ blink moves to left and DDRAM address is decreased by 1 Assign display shift with DDRAM address S = "1": make display shift of the enabled lines by the DS4 to DS1 bits in the shift enable instruction. Left/ right direction depends on I/D bit selection. S = "0": display shift disable (POR)
	X	1	0	0	0	0	0	0	0	1	BDC	BDS	Segment bi-direction function. BDS = "0": Seg100 -> Seg1, BDS = "1": Seg1 -> Seg100. Segment bi-direction function. BDC = "0": Com32 -> Com1 BDC = "1": Com1 -> Com32
Display On/Off control	X	0	0	0	0	0	0	0	1	D	C	B	Set display/cursor/blink on/off D = "1": display on, D = "0": display off (POR), C = "1": cursor on, C = "0": cursor off (POR), B = "1": blink on, B = "0": blink off (POR).
Extended function set	X	1	0	0	0	0	0	0	1	FW	B/W	NW	Assign font width, black/white inverting of cursor, and 4-line display mode control bit. FW = "1": 6-dot font width, FW = "0": 5-dot font width (POR), B/W = "1": black/white inverting of cursor enable, B/W = "0": black/white inverting of cursor disable (POR) NW = "1": 3-line or 4-line display mode, NW – "0": 1-line or 2-line display mode
Cursor or display shift	0	0	0	0	0	0	0	1	S/C	R/L	x	x	Set cursor moving and display shift control bit, and the direction, without changing DDRAM data. S/C = "1": display shift, S/C – "0": cursor shift, R/L = "1": shift to right, R/L = "0": shift to left.

*POR stands for Power On Reset Values.

Instruction	IS	RE	Instruction Code										Description
			RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
Double height(4-line)/ Bias/ Display-dot shift	**0**	**1**	0	0	0	0	0	1	UD2	UD1	BS1	DH'	UD2~1: Assign different doubt height format (POR=11) BS1:BS0 = "00": 1/5 bias (POR) BS1:BS0 = "01": 1/4 bias BS1:BS0 = "10": 1/7 bias BS1:BS0 = "11": 1/6 bias DH' = "1": display shift enable DH' = "0": dot scroll enable (POR)
Internal OSC frequency	**1**	**0**	0	0	0	0	0	1	BS0	F2	F1	F0	F2~0: adjust internal OSC frequency for FE frequency (POR: 011)
Shift enable	**1**	**1**	0	0	0	0	0	1	DS4	DS3	DS2	DS1	(when DH' = "1") POR DS4~1=1111 Determine the line for display shift. DS1 = "1/0": 1st line display shift enable/disable DS2 = "1/0": 2nd line display shift enable/disable DS3 = "1/0": 3rd line display shift enable/disable DS4 = "1/0": 4th line display shift enable/disable.
Scroll enable	**1**	**1**	0	0	0	0	0	1	HS4	HS3	HS2	HS1	(when DH' = "0") POR HS4~1=1111 Determine the line for horizontal smooth scroll. HS1 = "1/0": 1st line dot scroll enable/disable HS2 = "1/0": 2nd line dot scroll enable/disable HS3 = "1/0": 3rd line dot scroll enable/disable HS4 = "1/0": 4th line dot scroll enable/disable.
Function set	**X**	**0**	0	0	0	0	1	DL	N	DH	**RE (0)**	**IS**	Set interface data length DL = "1": 8-bit (POR), DL = "0": 4-bit Numbers of display line when NW = "0", N = "1": 2-line (NW=0)/ 4-line(NW=1), N = "0": 1-line (NW=0)/ 3-line(NW=1) Extension register, RE("0") Shift/scroll enable DH = " 1/0": Double height font control for 2-line mode enable/ disable (POR=0) Extension register, IS
	X	**1**	0	0	0	0	1	DL	N	BE	**RE (1)**	REV	Set DL, N, RE("1") CGRAM/SEGRAM blink enable BE = " 1/0": CGRAM/SEGRAM blink enable/disable (POR=0) Reverse bit REV = "1": reverse display, REV = "0": normal display (POR).
set CGRAM address	**0**	**0**	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter. (POR=00 0000)
set SEGRAM address	**1**	**0**	0	0	0	1	0	0	AC3	AC2	AC1	AC0	Set SEGRAM address in address counter. (POR=0000)
Power/ Icon control/ Contrast set	**1**	**0**	0	0	0	1	0	1	Ion	Bon	C5	C4	Ion = "1/0": ICON (SEGRAM) display on/off (POR=0) Bon = "1/0": set booster and regulator circuit on/off (POR=0) C5, C4: Contrast set for internal follower mode (POR=10)

Instruction	IS	RE	Instruction Code										Description
			RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
Follower Control	**1**	**0**	0	0	0	1	1	0	Don	Rab2	Rab1	Rab0	Don: Set divider circuit on/ off (POR=0) Rab2~0: Select Amplifier internal resistor ratio (POR=010)
Contrast Set	**1**	**0**	0	0	0	1	1	1	C3	C2	C1	C0	C3~0: Contrast set for internal follower mode (POR=0000)
set DDRAM address	**X**	**0**	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter. (POR=000 0000)
set scroll quantity	**X**	**1**	0	0	1	X	SQ5	SQ4	SQ3	SQ2	SQ1	SQ0	Set the quantity of horizontal dot scroll. (POR=00 0000)
Read busy flag and address/ part ID	**X**	**X**	0	1	BF	AC6 / ID6	AC5 / ID5	AC4 / ID4	AC3 / ID3	AC2 / ID2	AC1 / ID1	AC0 / ID0	Can be known whether during internal operation or not by reading BF. The contents of address counter or the part ID can also be read. When it is read the first time, the address counter can be read. When it is read the second time, the part ID can be read. BF = "1": busy state BF = "0": ready state
write data	**X**	**X**	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM / CGRAM / SEGRAM).
read data	**X**	**X**	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM / CGRAM / SEGRAM).

Table 8-2: Extended Instruction Set

Instruction	IS	RE	Instruction Code										Description
			RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
Temperature Coefficient Control	**X**	**1**	0	0	0	1	1	1	0	1	1	0	Set Temperature Coefficient TC2~0: 000: Reserved 001: Reserved 010: -0.05%/° C (POR) 011: Reserved 100: -0.10%/° C 101: Reserved 110: -0.15%/° C 111: -0.20%/° C
Temperature Coefficient Control Settings	**X**	**X**	1	0	0	0	0	0	0	TC2	TC1	TC0	

RECOMMENDED INITIAL SETTINGS

Example (8-bit Interface):

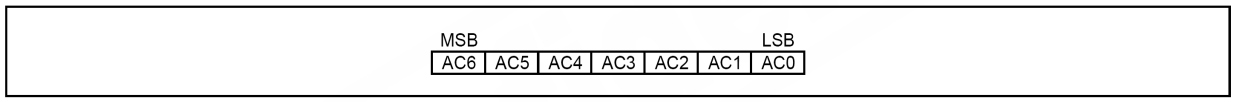
Function set：39H
Internal divider/OSC frequency：1BH
Contrast Set：78H
Power/Icon/Contrast Set：5DH
Follower Control：65H
Entry Mode Set：06H
Display ON/OFF Control：0CH
Return Home：02H
Function set：3AH
Entry Mode Set(COM32-->COM0,SEG0-->SEG100)：05H
Double height(4-line)/bias/Display-dot shift：1EH
Extended function set：09H
Clear display：01H

DISPLAY DATA RAM

7.2 Display Data Ram (DDRAM)

DDRAM stores display data of maximum 80 x 8 bits (80 characters). DDRAM address is set in the address counter (AC) as a hexadecimal number. (Refer to Figure 7-1)

Figure 7-1: DDRAM Address

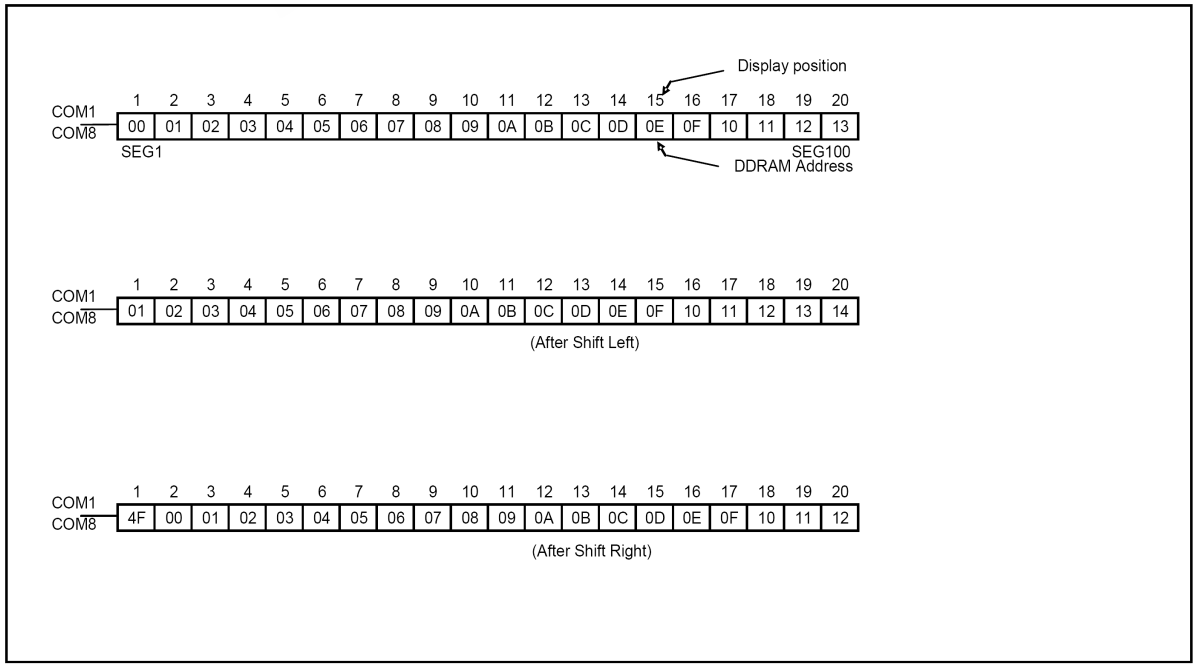


Display of 5-Dot Font Width Character

5-dot 1-line Display

In case of 1-line display with 5-dot font, the address range of DDRAM is 00H-4FH (Refer to Figure 7-2).

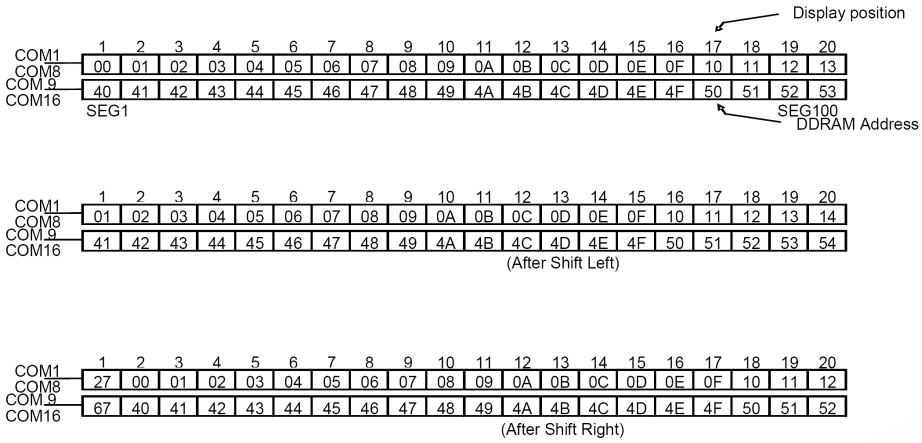
Figure 7-2: 1-line x 20ch. Display (5-dot Font Width)



5-dot 2-line Display

In case of 2-line display with 5-dot font, the address range of DDRAM is 00H-27H, 40H-67H (refer to Figure 7-3).

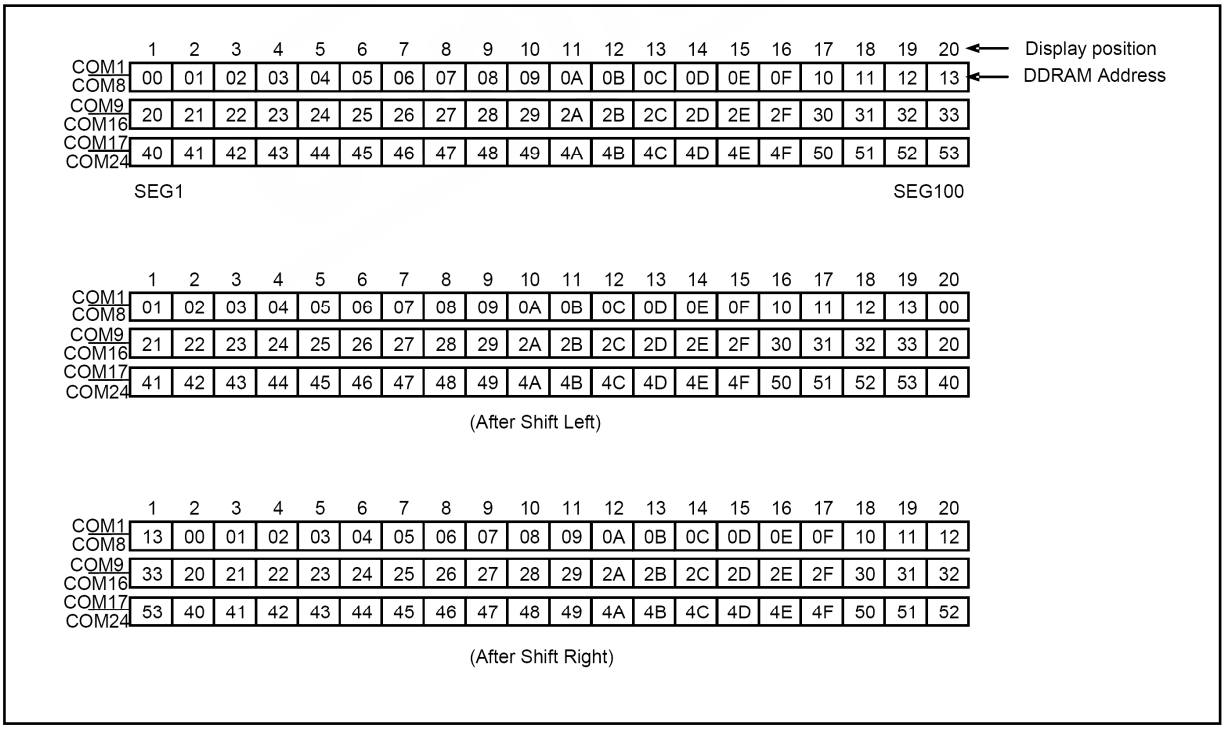
Figure 7-3: 2-line x 20ch. Display (5-dot Font Width)



5-dot 3-line Display

In case of 3-line display with 5-dot font, the address range of DDARM is 00H-13H, 20H-33H, 40H-53H (refer to Figure 7-4).

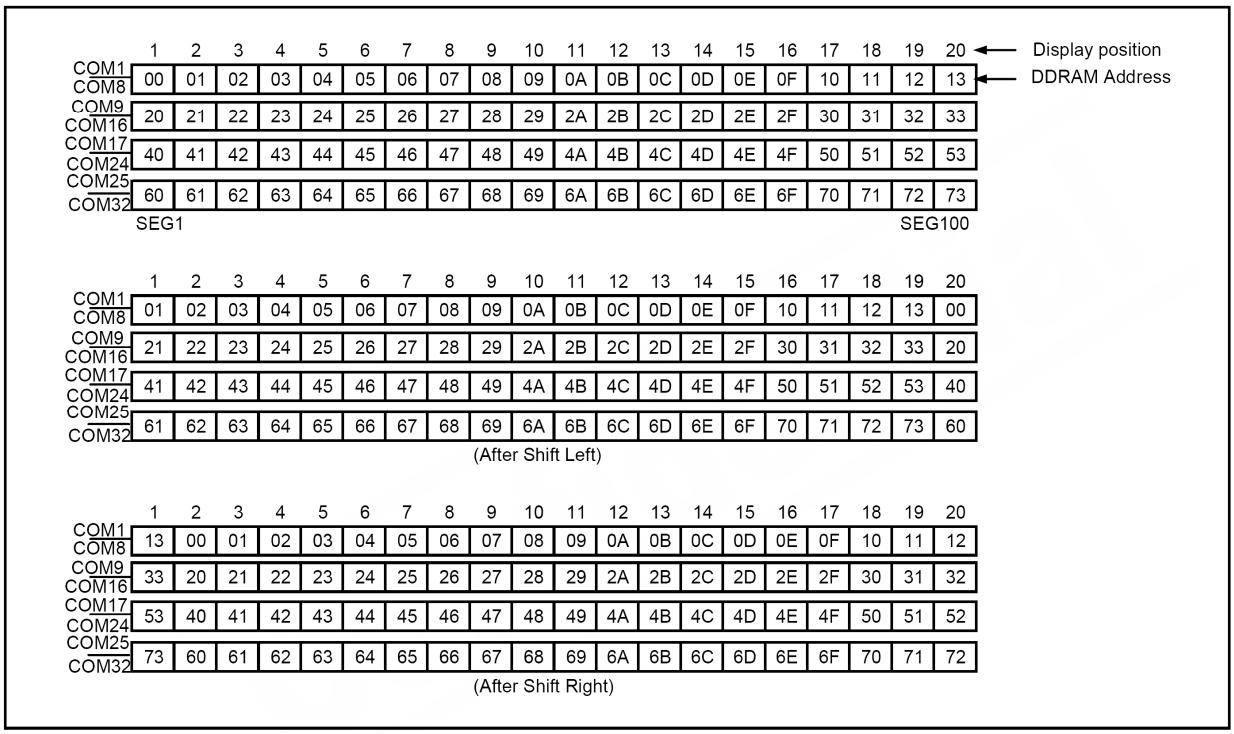
Figure 7-4: 3-line x 20ch. Display (5-dot Font Width)



5-dot 4-line Display

In case of 4-line display with 5-dot font, the address range of DDARM is 00H-13H, 20H-33H, 40H-53H, 60H-73H (refer to Figure 7-5).

Figure 7-5: 4-line x 20ch. Display (5-dot Font Width)



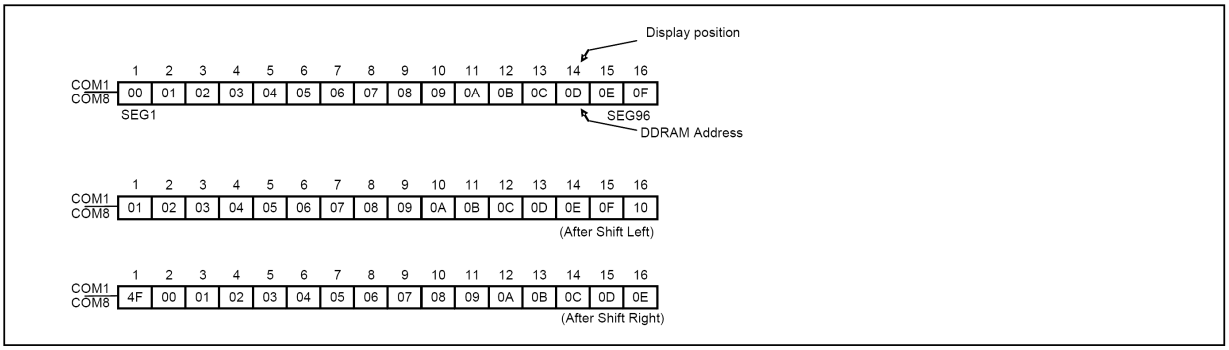
DISPLAY OF 6-DOT FONT WIDTH CHARACTER

When the device is used in 6-dot font width mode, SEG97, SEG98, SEG99 and SEG100 must be opened.

6-dot 1-line Display

In case of 1-line display with 6-dot font, the address range of DDRAM is 00H-4FH (refer to Figure 7-6).

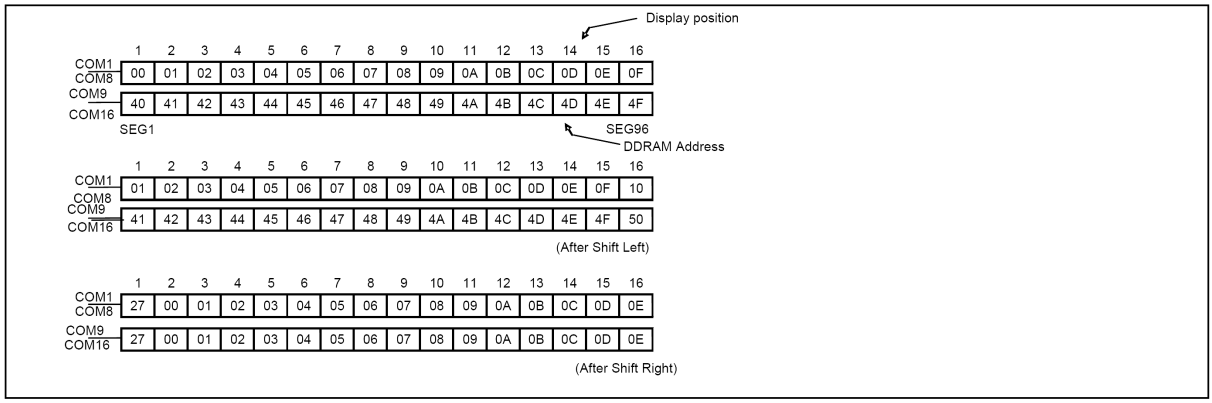
Figure 7-6: 1-line x 16ch. Display (6-dot Font Width)



6-dot 2-line Display

In case of 2-line display with 6-dot font, the address range of DDRAM is 00H-27H, 40H-67H (refer to Figure 7-7).

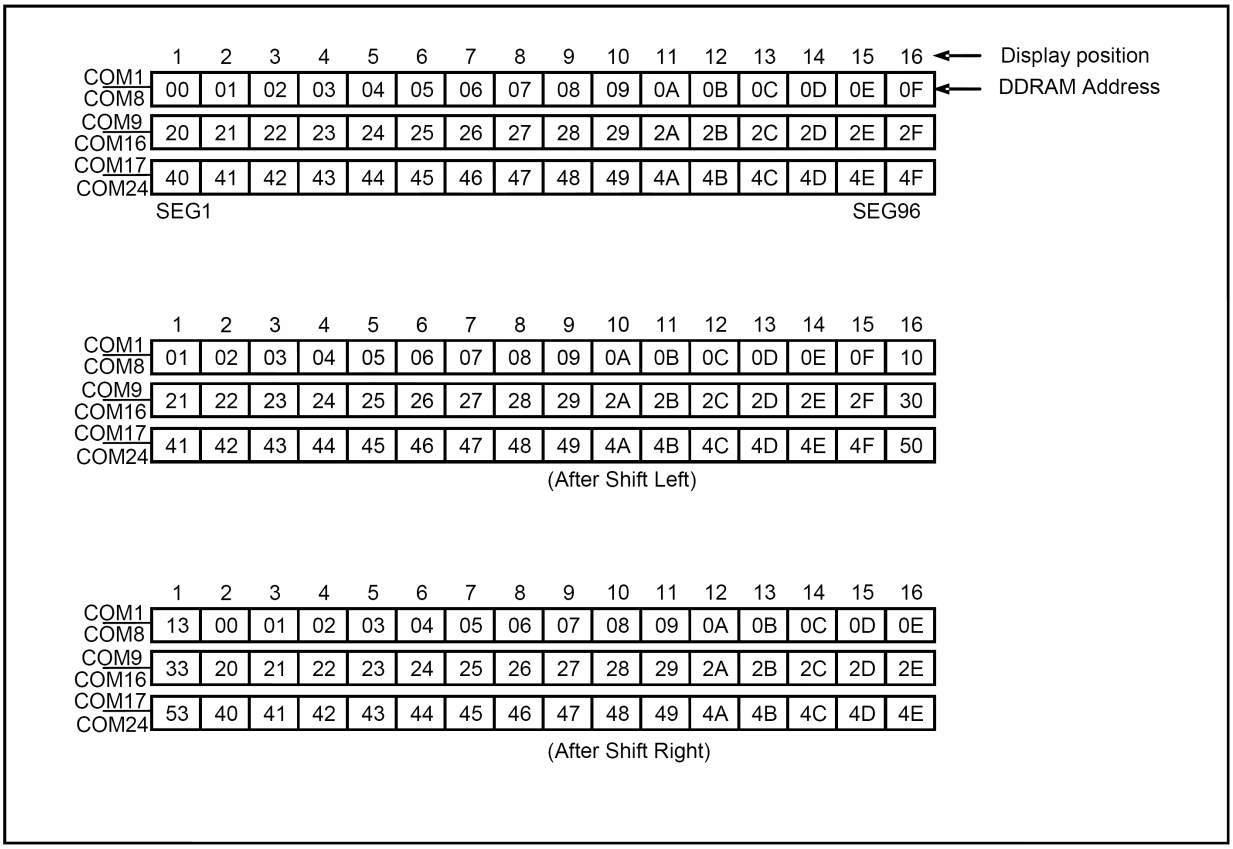
Figure 7-7: 2-line x 16ch. Display (6-dot Font Width)



6-dot 3-line Display

In case of 3-line display with 6-dot font, the address range of DDARM is 00H-13H, 20H-33H, 40H-53H (refer to Figure 7-8).

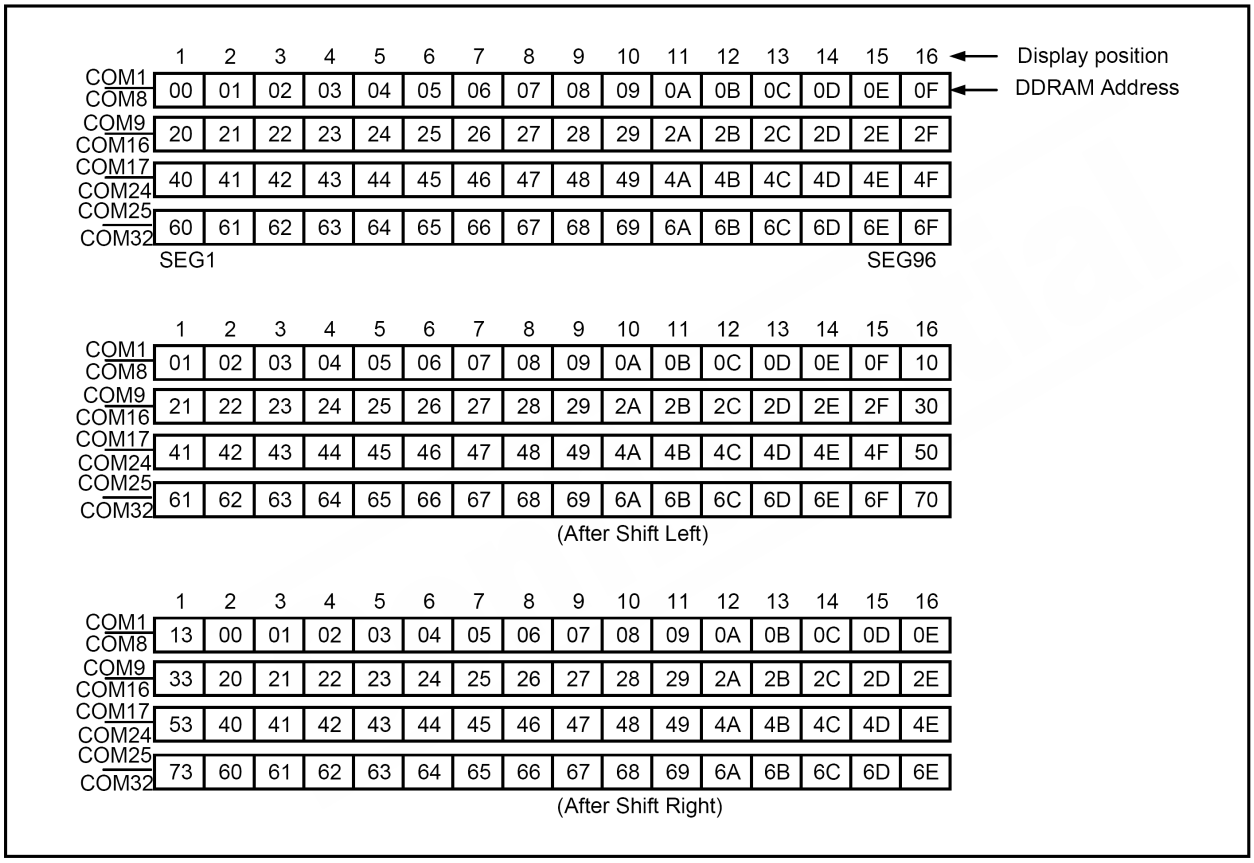
Figure 7-8 3-line x 16ch. Display (6-dot Font Width)



6-dot 4-line Display

In case of 4-line display with 6-dot font, the address range of DDARM is 00H-13H, 20H-33H, 40H-53H, 60H-73H (refer to Figure 7-9).

Figure 7-9 4-line x 16ch. Display (6-dot Font Width)



SERIAL INTERFACE TIMING DIAGRAM

Figure 7-11 Timing Diagram of Serial Data Transfer

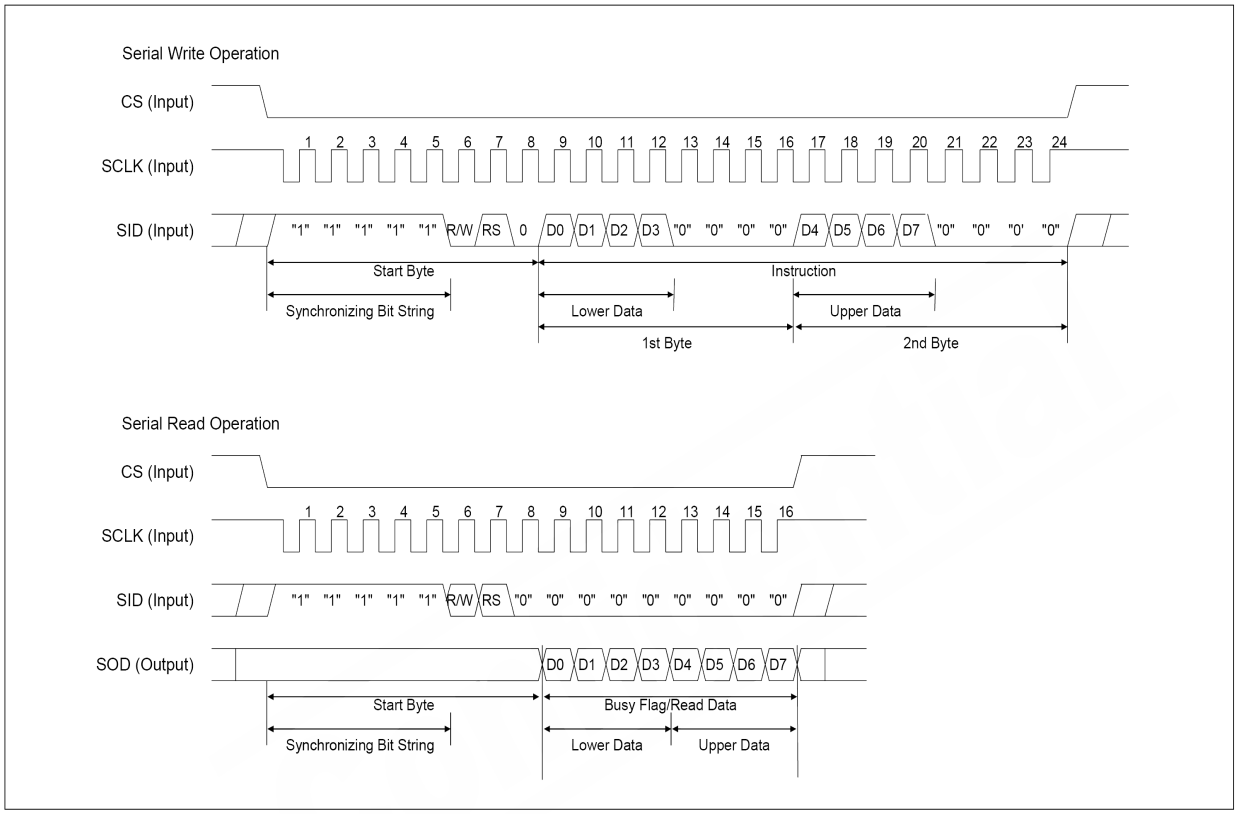
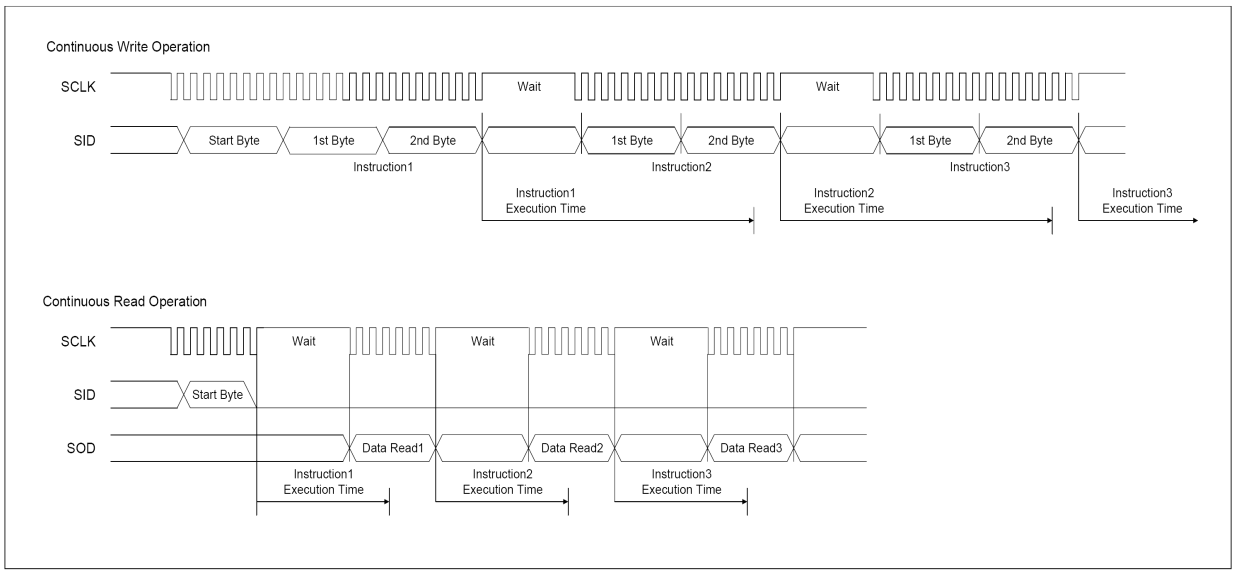


Figure 7-12 Timing Diagram of Continuous Data Transfer



SERIAL INTERFACE TIMING CHARACTERISTICS

Table 12-4 : Serial Timing Characteristics (TA = -40 to 85° C, VDDIO = 2.4-3.6/ 4.5-5.5V, VSS =0V)

Symbol	Parameter	Min	Typ	Max	Unit
t_c	Serial clock cycle time	1	-	20	us
t_r, t_f	Serial clock rise/fall time	-	-	50	ns
t_w	Serial clock width (high, low)	400	-	-	ns
t_{su1}	Chip select setup time	60	-	-	ns
t_{h1}	Chip select hold time	20	-	-	ns
t_{su2}	Serial input data setup time	200	-	-	ns
t_{h2}	Serial input data hold time	200	-	-	ns
t_D	Serial output data delay time	-	-	360	ns
t_{DH}	Serial output data hold time	5	-	-	ns

Note: All timings are based on 20% to 80% of V_{DDIO}-V_{SS}

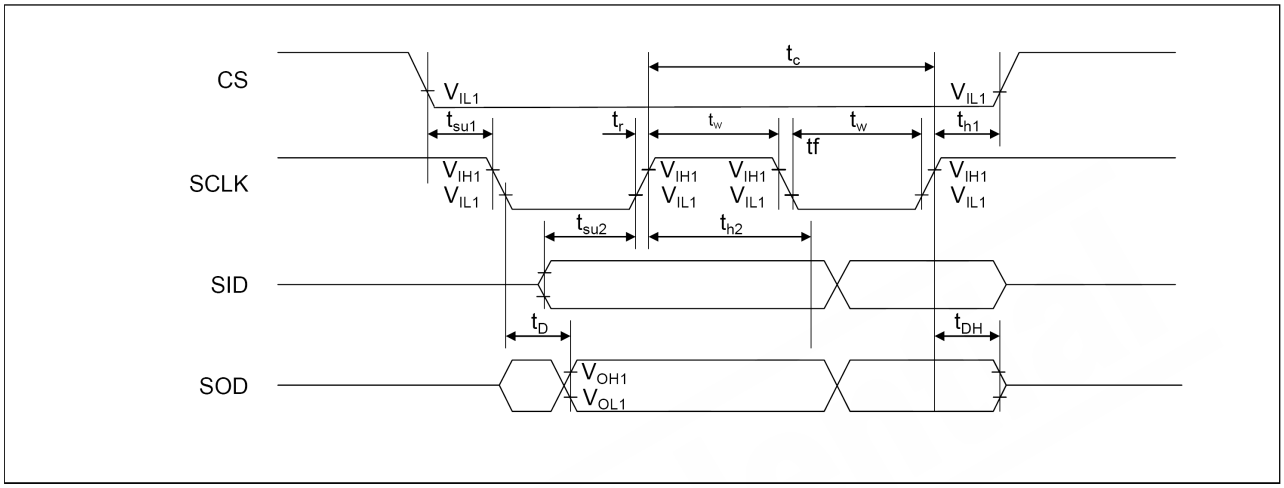


Figure 12-2 : Serial Timing Characteristics (IM2 = L, IM1 = H)

I2C INTERFACE TIMING DIAGRAM

Figure 7-13: Bit transfer on the I2C-bus

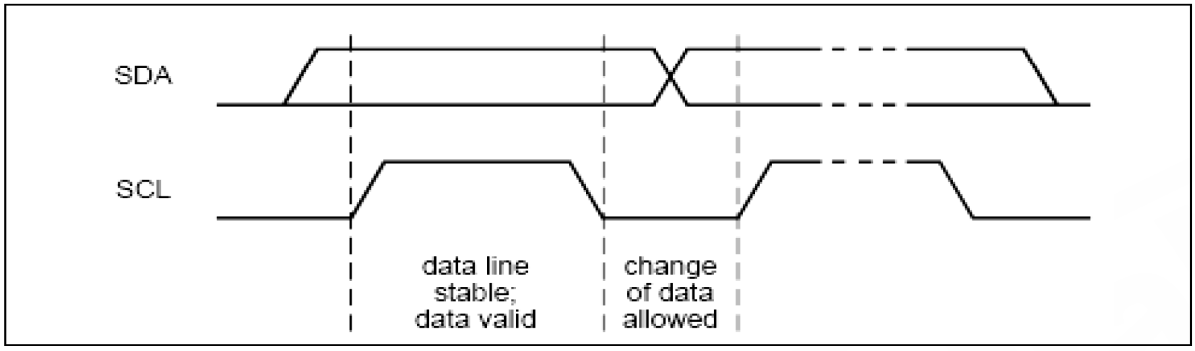


Figure 7-14: START and STOP conditions

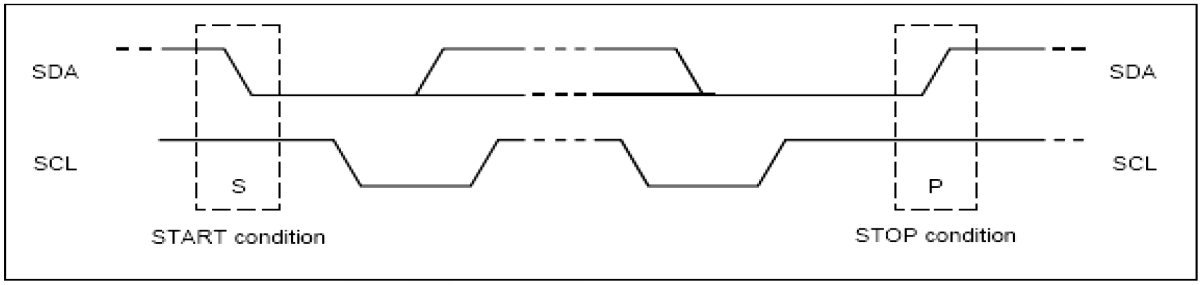


Figure 7-15: Acknowledge on the I2C bus

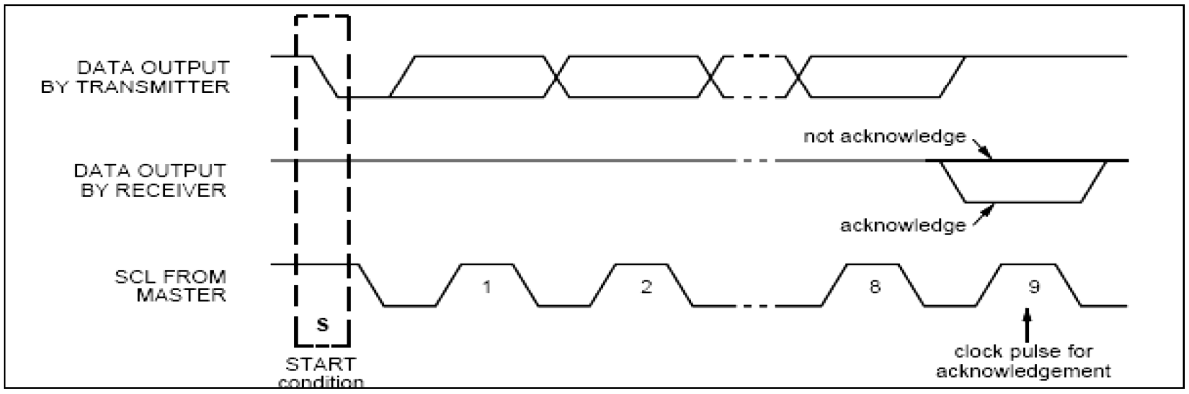


Figure 7-16: I2C write mode

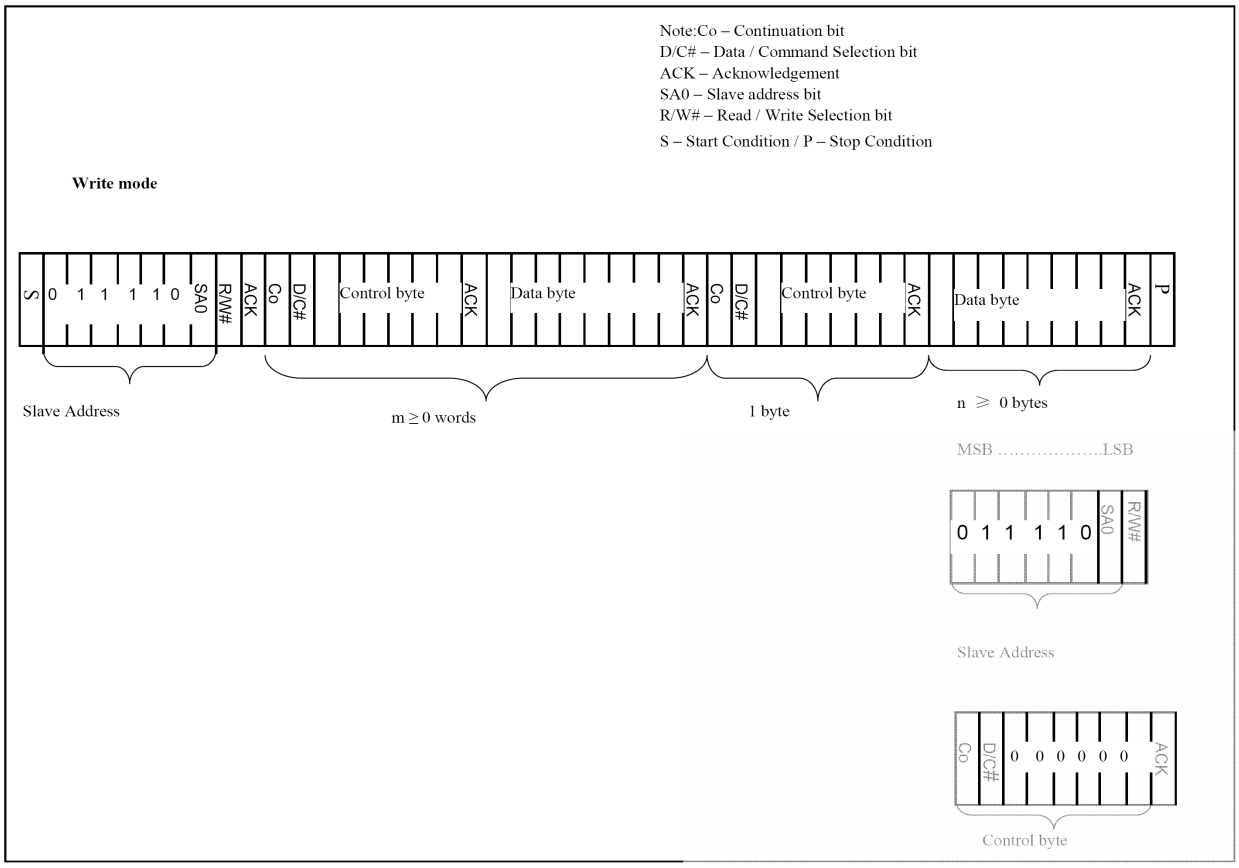
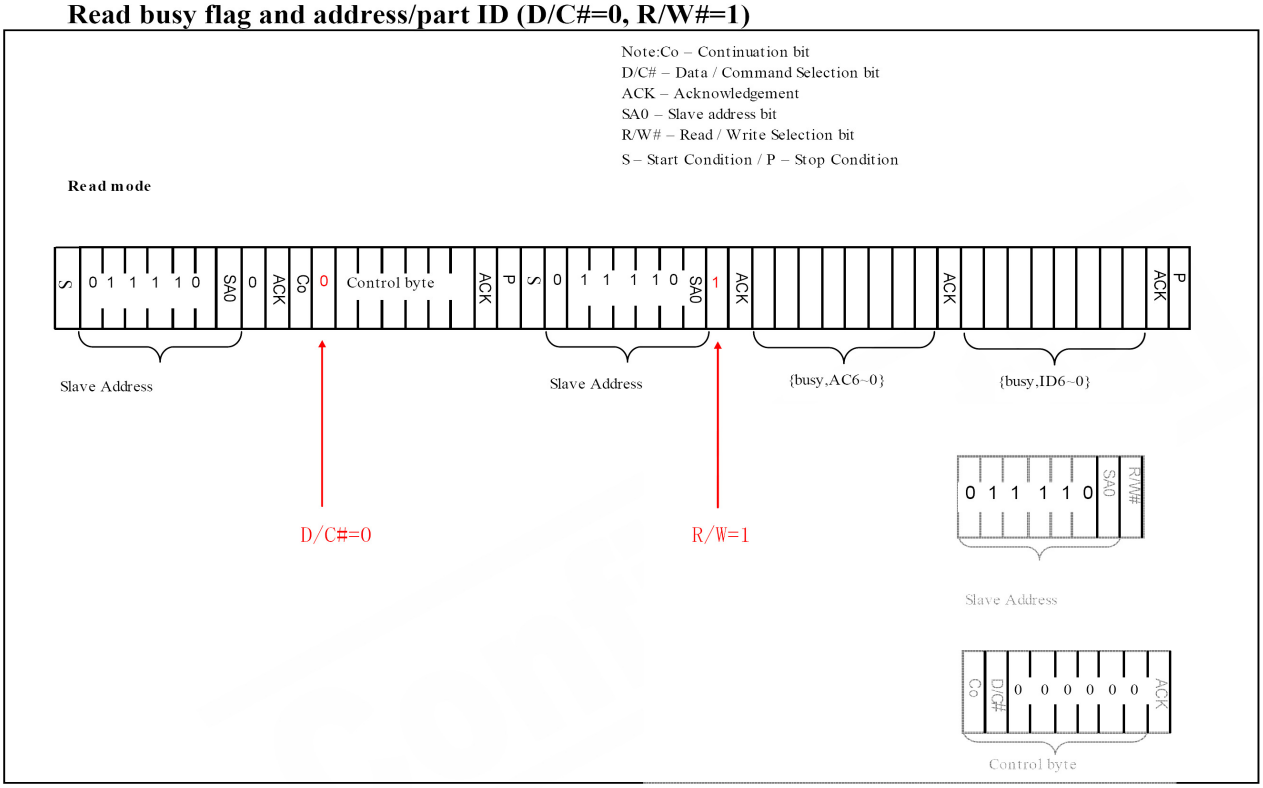


Figure 7-17: I2C read mode

Read busy flag and address/part ID (D/C#=0, R/W#=1)



Read ram (D/C#=1, R/W#=1)

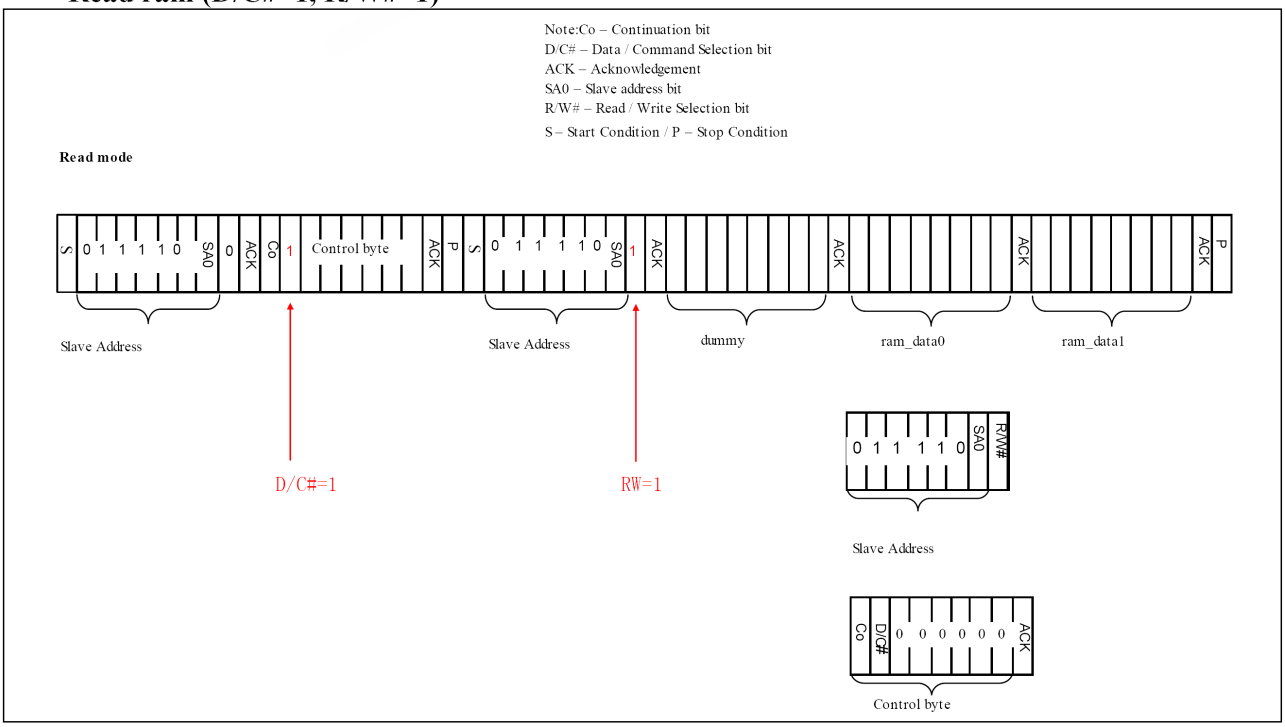
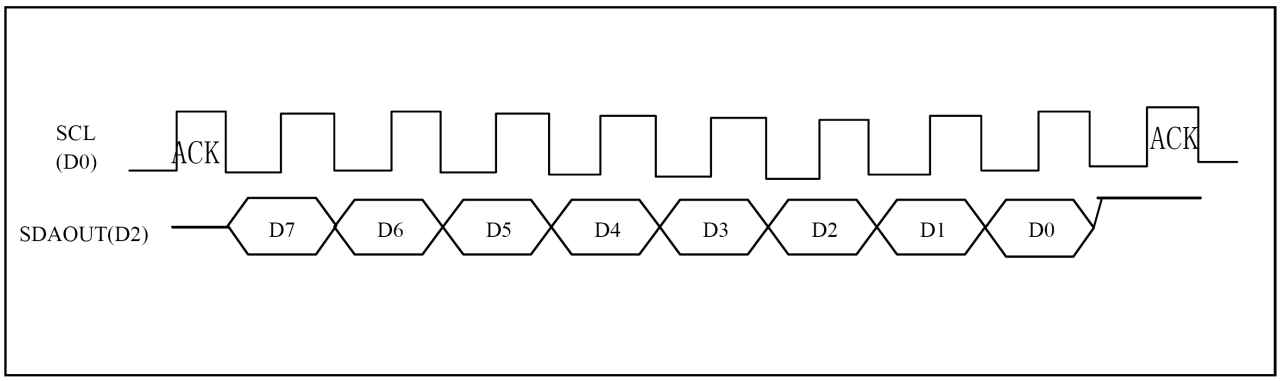


Figure 7-18: Read Timing



I2C INTERFACE TIMING CHARACTERISTICS

Table 12-5 : I2C Timing Characteristics (TA = -40 to 85° C, VDDIO = 2.4-3.6/ 4.5-5.5V, VSS =0V)

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	2.5	-	-	us
t_{HSTART}	Start condition Hold Time	0.6	-	-	us
t_{HD}	Data Hold Time (for "SDA_{OUT}" pin)	0	-	-	ns
	Data Hold Time (for "SDA_{IN}" pin)	300	-	-	ns
t_{SD}	Data Setup Time	100	-	-	ns
t_{SSTART}	Start condition Setup Time (Only relevant for a repeated Start condition)	0.6	-	-	us
t_{SSTOP}	Stop condition Setup Time	0.6	-	-	us
t_R	Rise Time for data and clock pin	-	-	300	ns
t_F	Fall Time for data and clock pin	-	-	300	ns
t_{IDLE}	Idle Time before a new transmission can start	1.3	-	-	us

Note: All timings are based on 20% to 80% of V_{DDIO}-V_{SS}

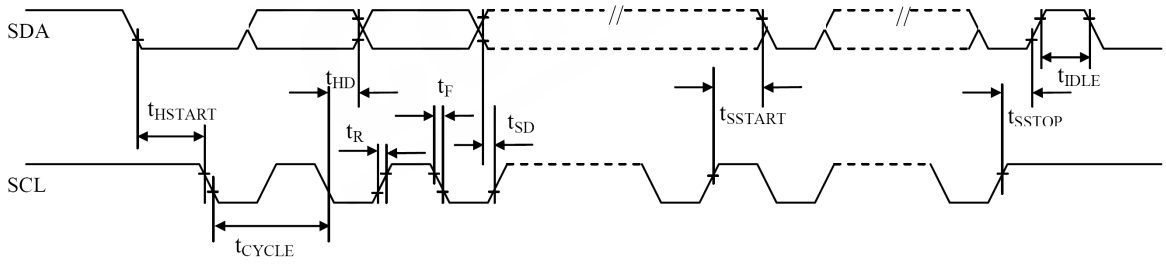


Figure 12-3 : I2C Timing Characteristics (IM2 = L, IM1 = H)

PARALLEL 6800 INTERFACE TIMING DIAGRAM AND CHARACTERISTICS

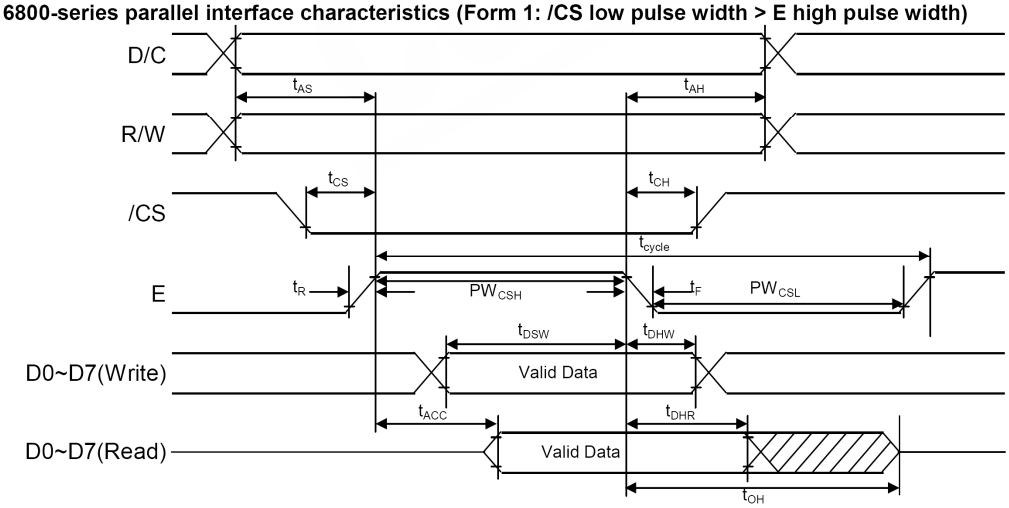
12.1.1 Parallel 6800-series Interface Timing

Table 12-3: Parallel Timing Characteristics (TA = -40 to 85° C, VDDIO = 2.4-3.6/ 4.5-5.5V, VSS =0V)

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time (write cycle)	400	-	-	ns
t_{AS}	Address Setup Time	13	-	-	ns
t_{AH}	Address Hold Time	17	-	-	ns
t_{CS}	Chip Select Time	0	-	-	ns
t_{CH}	Chip Select Hold Time	0	-	-	ns
t_{DSW}	Write Data Setup Time	35	-	-	ns
t_{DHW}	Write Data Hold Time	13	-	-	ns
t_{DHR}	Read Data Hold Time	13	-	-	ns
t_{OH}	Output Disable Time	10	-	90	ns
t_{ACC}	Access Time (RAM) Access Time (command)	-	-	125	ns ns
PW_{CSL}	Chip Select Low Pulse Width (read RAM) Chip Select Low Pulse Width (read Command) Chip Select Low Pulse Width (write)	250 250 50	- - -	- - -	ns ns ns
PW_{CSH}	Chip Select High Pulse Width (read) Chip Select High Pulse Width (write)	155 55	- -	- -	ns ns
t_R	Rise Time	-	-	15	ns
t_F	Fall Time	-	-	15	ns

Note: All timings are based on 20% to 80% of V_{DDIO}-V_{SS}

6800-series parallel interface characteristics (Form 1: /CS low pulse width > E high pulse width)



6800-series parallel interface characteristics (Form 2: /CS low pulse width < E high pulse width)

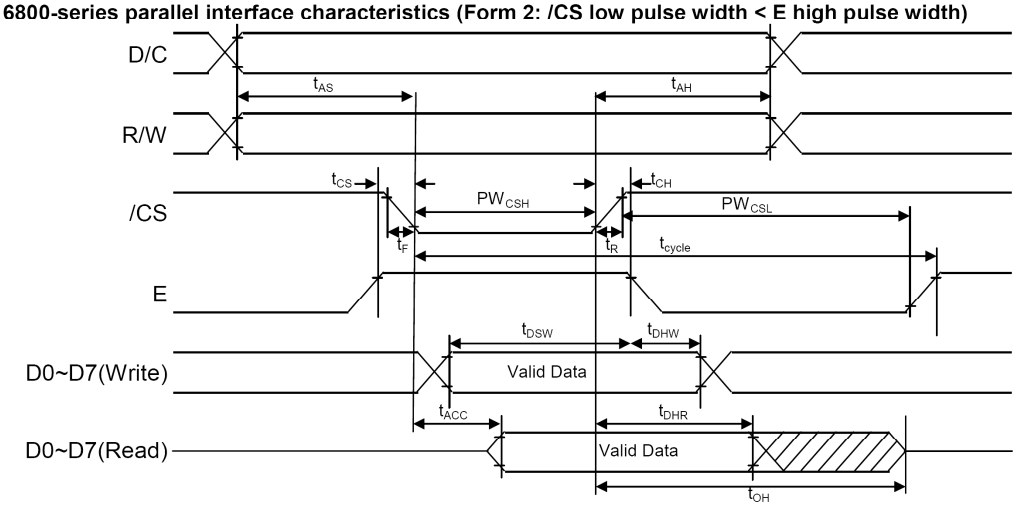


Figure 12-1 : Parallel 6800-series Interface Timing Characteristics (IM2 = H, IM1 = H)

RESET TIMING DIAGRAM

Figure 12-4 Reset Timing Diagram

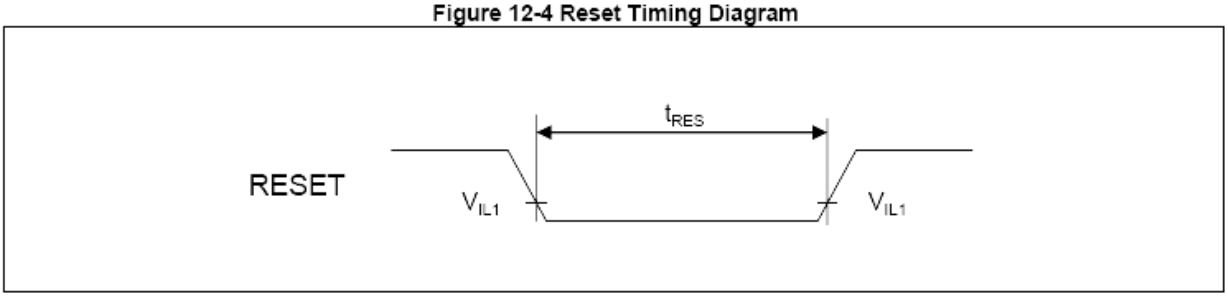


Table 12-6: Reset Timing (TA = -40 to 85° C, VDD = 2.4-3.6, VSS =0V)

Item	Symbol	Min	Typ	Max	Unit
Reset Low level (refer to figure 12-4)	t_{RES}	20	-	-	us

INITIALIZING WITHOUT THE BUILT-IN POWER SUPPLY CIRCUITS

Power ON
Wait time >5ms
After VDDIO/ VDD/VCI stable

↓

Hardware Reset

↓

Function Set									
RS	**R/W**	**DB7**	**DB6**	**DB5**	**DB4**	**DB3**	**DB2**	**DB1**	**DB0**
0	**0**	**0**	**0**	**1**	**DL**	**N**	**DH**	**RE(0)**	**IS**
		0	0	1	1	0	0	0	1

↓

Clear Display									
RS	**R/W**	**DB7**	**DB6**	**DB5**	**DB4**	**DB3**	**DB2**	**DB1**	**DB0**
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**

↓

Internal divider/ OSC frequency									
RS	**R/W**	**DB7**	**DB6**	**DB5**	**DB4**	**DB3**	**DB2**	**DB1**	**DB0**
0	**0**	**0**	**0**	**0**	**1**	**BS0**	**F2**	**F1**	**F0**
		0	0	0	1	0	0	1	1

↓

Contrast Set									
RS	**R/W**	**DB7**	**DB6**	**DB5**	**DB4**	**DB3**	**DB2**	**DB1**	**DB0**
0	**0**	**0**	**1**	**1**	**1**	**C3**	**C2**	**C1**	**C0**
		0	1	1	1	*1*	*1*	*1*	*1*

↓

Power/ Icon Control/ Contrast Set									
RS	**R/W**	**DB7**	**DB6**	**DB5**	**DB4**	**DB3**	**DB2**	**DB1**	**DB0**
0	**0**	**0**	**1**	**0**	**1**	**Ion**	**Bon**	**C5**	**C4**
		0	1	0	1	1	1	*0*	*0*

↓

Follower Control									
RS	**R/W**	**DB7**	**DB6**	**DB5**	**DB4**	**DB3**	**DB2**	**DB1**	**DB0**
0	**0**	**0**	**1**	**1**	**0**	**Don**	**Rab2**	**Rab1**	**Rab0**
		0	1	1	0	1	*1*	*1*	*0*

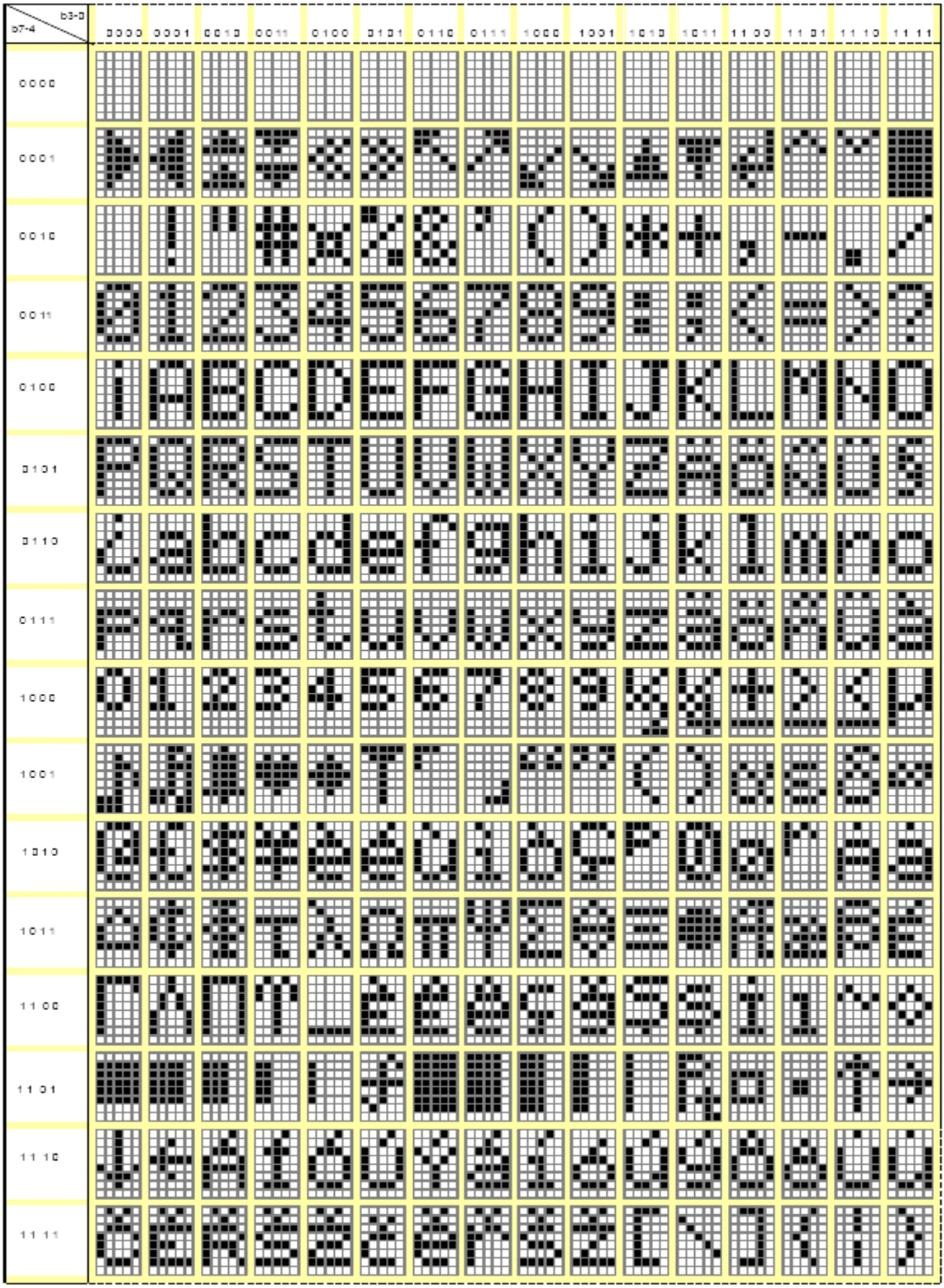
↓

Display ON/ OFF Control									
RS	**R/W**	**DB7**	**DB6**	**DB5**	**DB4**	**DB3**	**DB2**	**DB1**	**DB0**
0	**0**	**0**	**0**	**0**	**0**	**1**	**D**	**C**	**B**
		0	0	0	0	1	1	1	1

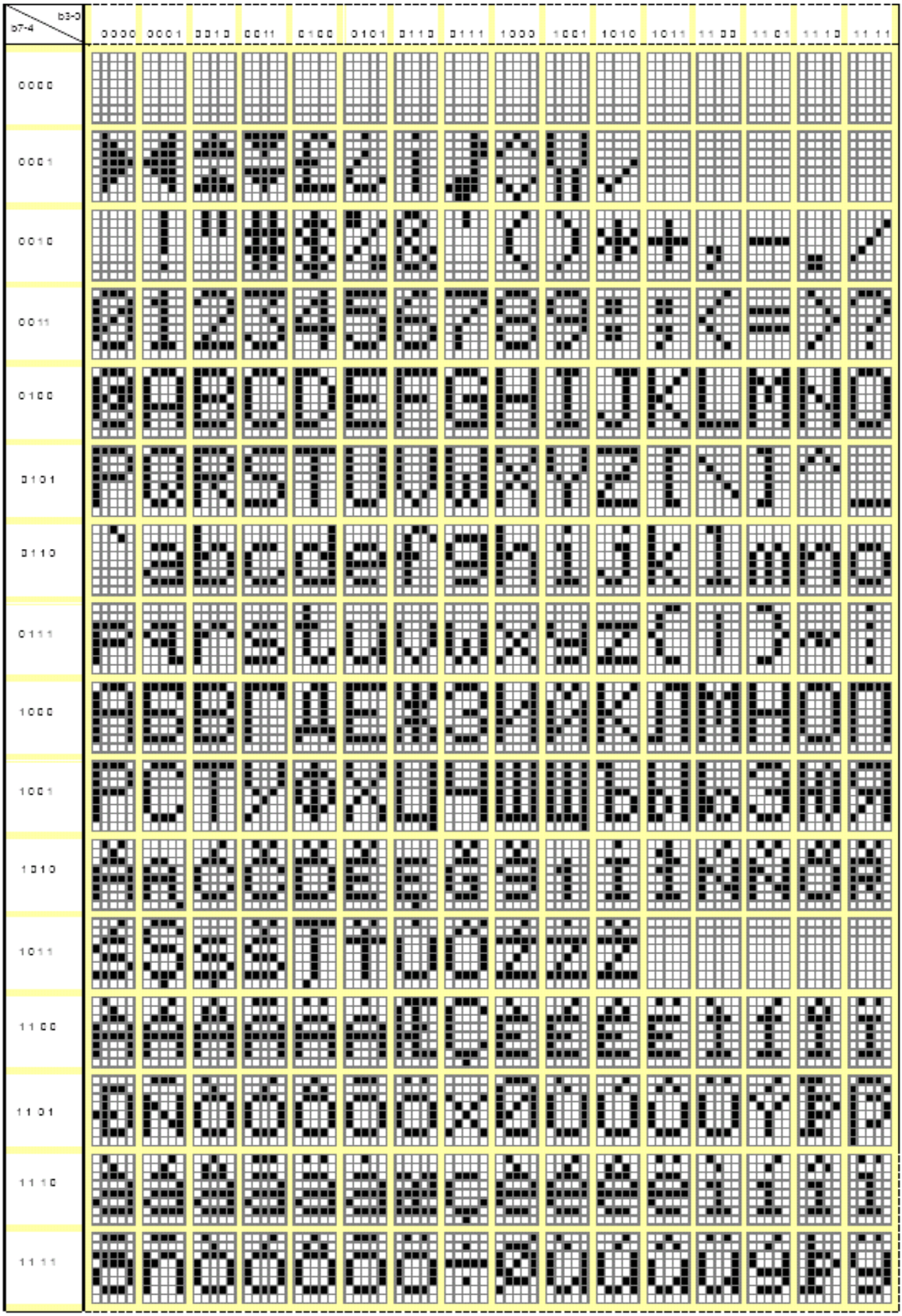
*C5~0 and Rab2~0 setting depends on actual panel loadings and application

CHARACTER CODES AND CHARACTER PATTERN

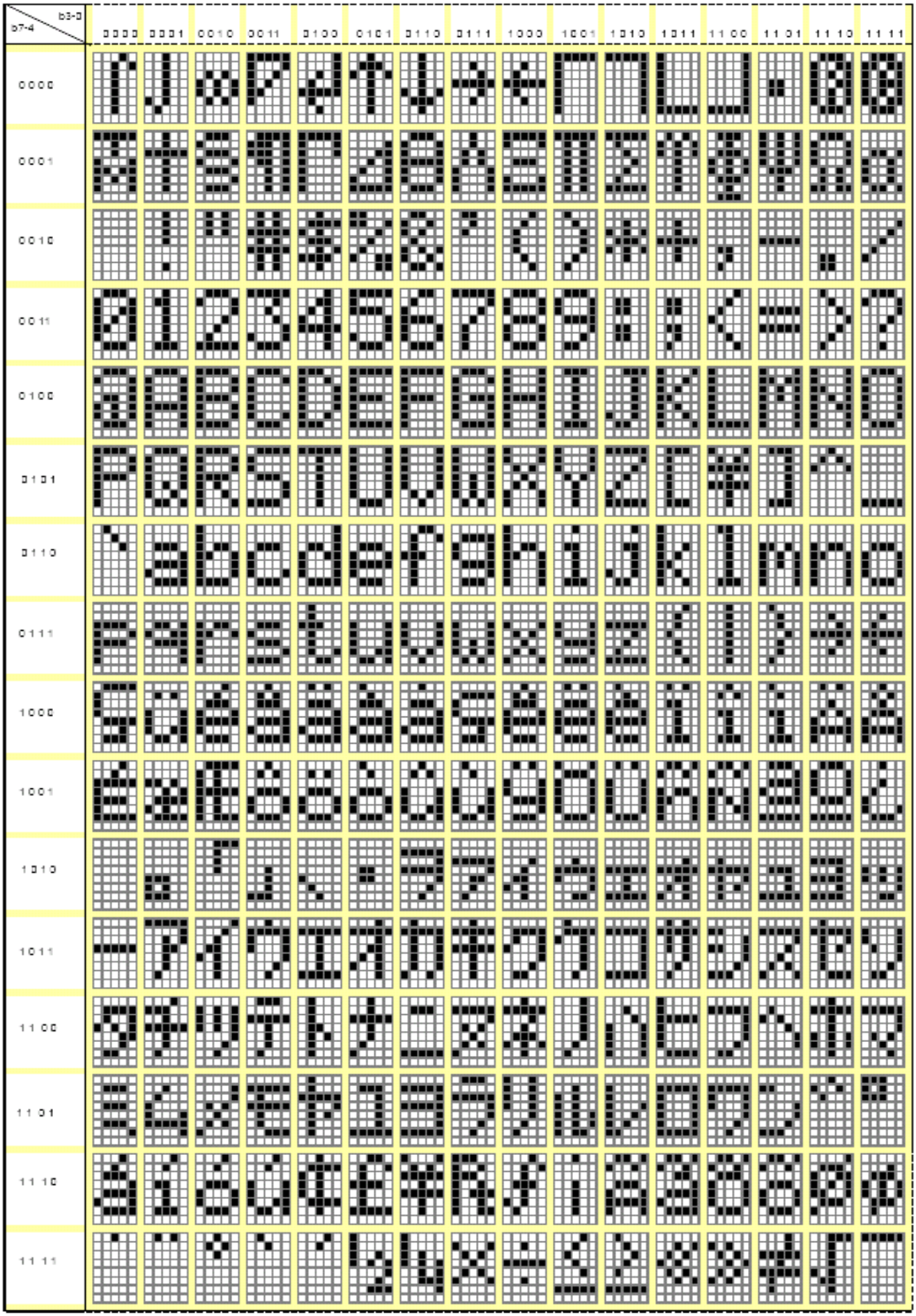
ROM A



ROM B


b3-0
b7-4
0000 0001 0010 0011 0100 0101 0110 0111 1000 1001 1010 1011 1100 1101 1110 1111

ROM C



ELECTRO-OPTICAL CHARACTERISTICS

MEASURING CONDITION: POWER SUPPLY = V_{OP} / 64 Hz
TEMPERATURE = 23 ± 5 °C
RELATIVE HUMIDITY = 60 ± 20 %

ITEM	SYMBOL	UNIT	TYP.
RESPONSE TIME	Ton	ms	180
	Toff	ms	240
CONTRAST RATIO	Cr	-	15
VIEWING ANGLE (Cr ≥ 2)	$V_{3:00}$	°	40
	$V_{6:00}$	°	70
	$V_{9:00}$	°	40
	$V_{12:00}$	°	50

THE ELECTRO-OPTICAL CHARACTERISTICS ARE MEASURED VALUE BUT NOT GUARANTEED ONES.

RELIABILITY OF LCD MODULE

ITEM	TEST CONDITION FOR NORMAL TEMPERATURE	TEST CONDITION FOR WIDE TEMPERATURE	TIME
High temperature operating	50°C	70°C	240 hours
Low temperature operating	0°C	-20°C	240 hours
High temperature storage	60°C	80°C	240 hours
Low temperature storage	-10°C	-30°C	240 hours
Temperature-humidity storage(*)	40°C 90% R.H.	60°C 90% R.H.	96 hours
Temperature cycling	-10°C to 60°C 30 Min Dwell	-30°C to 80°C 30 Min Dwell	5 cycle
Vibration Test at LCM Level	Freq 10-55 Hz Sweep rate: 10-55-10 at 1 min Sweep mode Linear Displacement: 2 mm p-p 1 Hour each for X, Y, Z	Freq 10-55 Hz Sweep rate: 10-55-10 at 1 min Sweep mode Linear Displacement: 2 mm p-p 1 Hour each for X, Y, Z	—

QUALITY STANDARD OF LCD MODULE

1.0	**Sampling Method**		
	Sampling Plan : MIL STD 105 E Class of AQL : Level II/Single Sampling Critical : 0.25% Major 0.65% Minor 1.5%		
2.0	**Defect Group**	**Failure Category**	**Failure Reasons**
	Critical Defect 0.25%(AQL)	Malfunction	Open Short Burnt or dead component Missing part/improper part P.C.B. Broken
	Major Defect 0.65%(AQL)	Poor Insulation	Potential short High current Component damage or scratched or Lying too close improper coating
		Poor Conduction	Damage joint Wrong polarity Wrong spec. part Uneven/intermittent contact Loose part Copper peeling Rust or corrosion or dirt‘s
	Minor Defect 1.5%(AQL)	Cosmetic Defect	Minor scratch Flux residue Thin solder Poor plating Poor marking Crack solder Poor bending Poor packing Wrong size

HANDLING PRECAUTIONS

(1) CAUTION OF LCD HANDLING & CLEANING

The polarizing plate on the surface of the panel is made from organic substances. Be very careful for chemicals not to touch the plate or it leads the polarizing plate to deteriorate.

If the use of a chemical is unavoidable, wipe the panel lightly with soft materials, such as gauze and absorbent cotton, soaked in a solvent.

*Usable solvent: Alcohol (ethanol, IPA and the like)
*Appropriate solvent: Ketones, ethyl alcohol

Avoid wiping with a dry cloth, since it could damage the surface of the polarizing plate and others.
Do not expose to direct sunlight or fluorescent light for a long time

(2) CAUTION AGAINST STATIC CHARGE

The LCD modules use CMOS LSI drivers, so customers are recommended that any unused input terminal would be connected to V_{DD} or V_{SS}, do not input any signals before power is turned on, and ground your body, work/assembly areas, assembly equipment to protect against static electricity.

(3) ESD PRECAUTION

Inputs and outputs are protected against electrostatic discharge in normal handling. However, to be totally safe, it is recommended to take normal precautions appropriate to handling LCM module. For example: product surface grounding. Always take ESD precaution when handling the *LCD Module*. Components are exposed for direct finger touches and can be damaged unless ESD precaution is taken.

(4) PACKAGING

Avoid intense shock and falls from a height and do not operate or store them exposed to direct sunshine or high temperature/humidity for long periods.

(5) CAUTION FOR OPERATION

The viewing angle can be adjusted by varying the LCD driving voltage VO.

Driving voltage should be kept within specified range, excess voltage shortens display life.

Response time increases with decrease in temperature.

Display may turn black or dark Blue at temperature above its operational range; this is however not destructive and the display will return to normal once the temperature falls back to range.

Mechanical disturbance during operation (such as pressing on the viewing area) may cause the segments to appear “fractured”. They will recover once the display is turned off.

Condensation at terminals will cause malfunction and possible electrochemical reaction. Relative humidity of the environment should therefore be kept below 60%.

(6) SAFETY

Liquid crystal may leak out of a damaged LCD, it is recommended to wash off the liquid crystal by using solvents such as acetone or ethanol and should be burned up later.

If any liquid leak out of a damaged glass cell comes in contact with your hands, wash it off with soap and water immediately.

WARRANTY

CLOVER will replace or repair any of her LCD module in accordance with her LCD specification for a period of one year from date of shipment. The warranty liability of Clover is limited to repair and/or replacement. Clover will not be responsible for any subsequent or consequential event.