Character Display Module

Part Number

C402ASBSYLY6WT55PAB

Overview

40x2(182x33.5), STN, Yellow/Green background, Yellow/Green LED, Bottom view, Wide temp, Transflective (positive), 5V LCD, 5V LED, Controller=SPLC780D, RoHS Compliant

1. Mechanical Specification

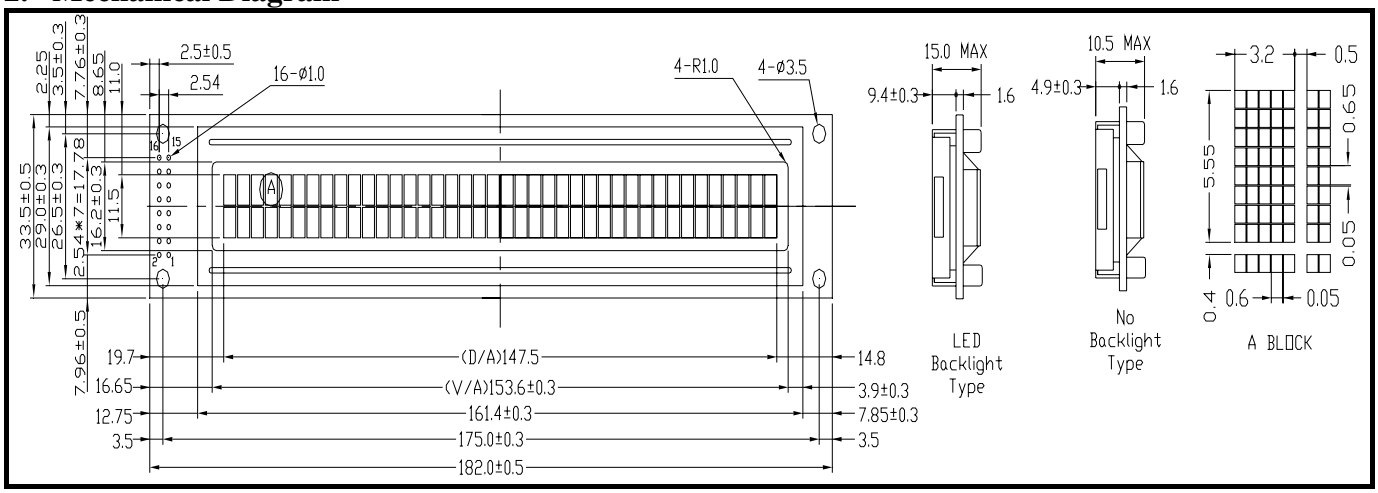
ITEM	STANDARD VALUE	UNIT
NUMBER OF CHARACTERS	40 CHARACTERS X 2 LINES	--
CHARACTER FORMAT	5 X 8 DOTS	--
MODULE DIMENSION NO BACKLIGHT	182.0 (W) X 33.5 (H) X 10.5 (T)	mm
MODULE DIMENSION ARRAY LED BACKLIGHT	182.0 (W) X 33.5 (H) X 15.0 (T)	mm
VIEWING DISPLAY AREA	153.6 (W) X 16.2 (H)	mm
ACTIVE DISPLAY AREA	147.5 (W) X 11.5 (H)	mm
CHARACTER SIZE	3.20 (W) X 5.55 (H)	mm
CHARACTER PITCH	3.70 (W) X 5.95 (H)	mm
DOT SIZE	0.60 (W) X 0.65 (H)	mm
DOT PITCH	0.65 (W) X 0.70 (H)	mm

● ARRAY LED BACKLIGHT COLOR	YELLOW GREEN OR ORANGE OR RED			
BACKLIGHT INPUT	DC +4.0V	V	250 (Type)	mA
BACKLIGHT HALF-LIFT TIME	30,000 (Ta=25℃)			HR.

LED Backlight Characteristics (without LCD) Ta=25℃

Item	Min.	Type	Max.	Unit	Condition
Forward Voltage				V	If= mA
Reverse Current	--	--		μA	If= mA
Peak Wave Length	--	--	--	nm	If= mA
Chromaticity Coordinates	X=		Y=		If= mA
Luminance		--	--	cd/m^2	If= mA

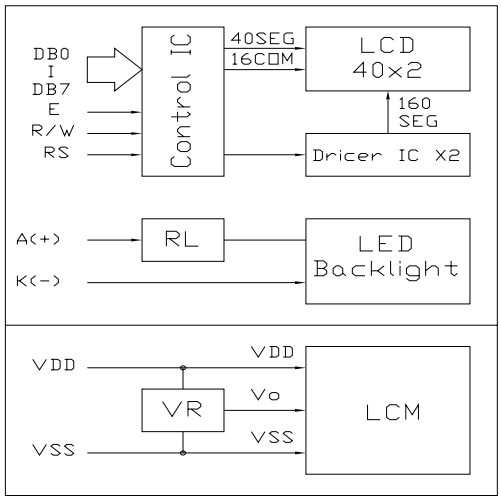
2. Mechanical Diagram



3. Interface Pin Connections

NO	SYMBOL	LEVEL	FUNCTION
1	VSS	--	GND (0V)
2	VDD	--	DC +5V
3	VO	--	Contrast Adjust
4	RS	H/L	Register select
5	R/W	H/L	Read/Write
6	E	H,H→L	Enable signal
7	DB0	H/L	Data Bit 0
8	DB1	H/L	Data Bit 1
9	DB2	H/L	Data Bit 2
10	DB3	H/L	Data Bit 3
11	DB4	H/L	Data Bit 4
12	DB5	H/L	Data Bit 5
13	DB6	H/L	Data Bit 6
14	DB7	H/L	Data Bit 7
15	A(+)	DC+5.0V	LED Backlight +
16	K(-)	0V	LED Backlight -

4. Block Diagram



5. Absolute Maximum Ratings

ITEM		SYMBOL	MIN.	TYPE	MAX.	UNIT
INPUT VOLAGE		VI	VSS	—	VDD	V
SUPPLY VOLTAGE FOR LOGIC		VDD-VSS	—	5.0	6.5	V
SUPPLY VOLTAGE FOR LCD		VDD-VO	—	—	6.5	V
TN HTN	NORMAL TEMPERATURE RANGE	OPERATING	0～+50	STORAGE	-10～+60	℃
	WIDE TEMPERATURE RANGE	OPERATING	-20～+70	STORAGE	-30～+80	℃
STN FSTN	WIDE TEMPERATURE RANGE	OPERATING	-20～+70	STORAGE	-30～+80	℃
STATIC ELECTRICITY		Be sure that you are grounded when handing LCM.				

6. Electrical Characteristics

ITEM	SYN	CONDITION	MIN.	TYPE	MAX.	UNIT
SUPPLY VOLTAGE FOR LOGIC	VDD－VSS	——	4.5	5.0	5.5	V
SUPPLY VOLTAGE FOR LCD	VDD－VO	Ta＝0/-20℃	——	4.6/4.8	——	V
		Ta＝+25℃	4.1	4.3	4.5	V
		Ta＝+50/+70℃	——	4.0/3.9	——	V
INPUT HIGH VOLTAGE	VIH	——	2.5	——	VDD	V
INPUT LOW VOLTAGE	VIL	——	0	——	0.6	V
OUTPUT HIGH VOLTAGE	VOH	——	2.4	——	——	V
OUTPUT LOW VOLTAGE	VOL	——	——	——	0.4	V
SUPPLY CURRENT	IDD	VDD=+5V	——	4.0	5.5	mA

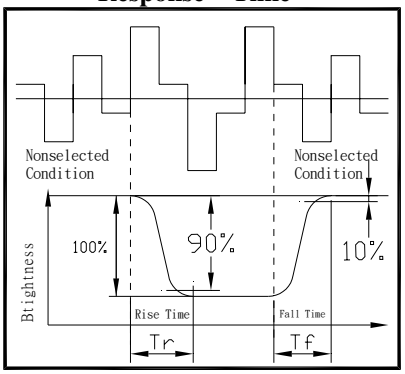
7. Optical Characteristics

Ta at 25℃

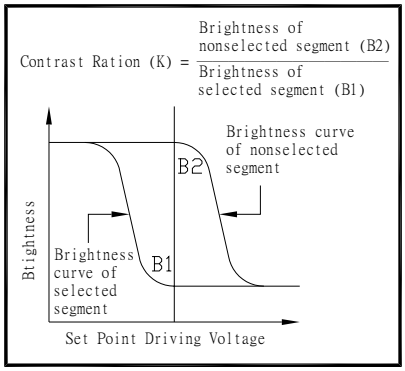
ITEM	SYM	CONDITION	MIN.	TYPE	MAX.	UNIT
VIEW ANGLE (TOP／BOTTOM)	θ2 / θ1	CR≧2	——	15° / 35°(35° / 45°)	——	deg.
VIEW ANGLE (LEFT／RIGHT)	φ1 / φ2	CR≧2	——	35° / 35°	——	deg.
CONTRAST RATIO	CR	——	——	4.5	——	——
RESPONSE TIME (RISE)	TON／Tr	——	——	170	——	mS
RESPONSE TIME (DECAY)	TOFF／Tf	——	——	220	——	mS

8. Optical Definitions

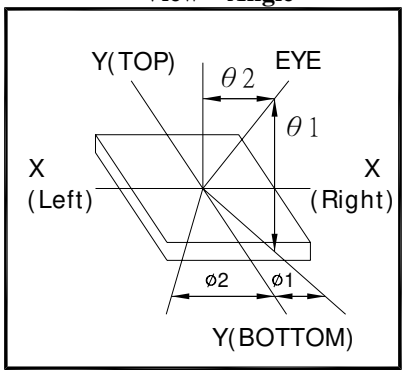
Response Time



Contrast Ration



View Angle



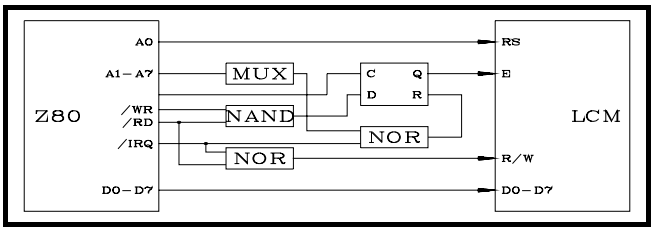
9. Display Address

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Line 1	80	81	82	83	84	85	86	87	88	89	8A	8B	8C	8D	8E	8F	90	91	92	93
Line 2	C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	CA	CB	CC	CD	CE	CF	D0	D1	D2	D3
Line 3																				
Line 4																				

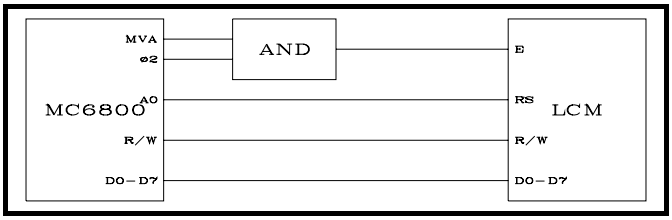
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Line 1	94	95	96	97	98	99	9A	9B	9C	9D	9E	9F	A0	A1	A2	A3	A4	A5	A6	A7
Line 2	D4	D5	D6	D7	D8	D9	DA	DB	DC	DD	DE	DF	E0	E1	E2	E3	E4	E5	E6	E7
Line 3																				
Line 4																				

10. Interface to MPU

10.1 Interface to Z-80 CPU

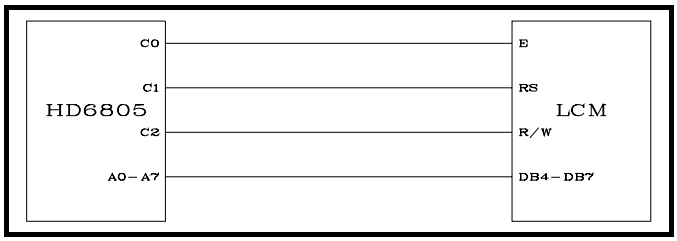


10.2 Interface to MC6800 CPU



10.3 Interface to 4-bit CPU (HMCS43C)

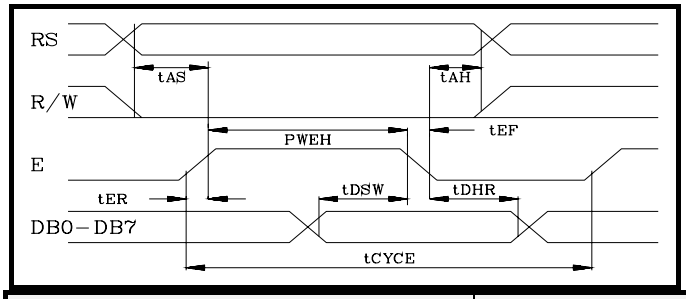
10.4 Interface to HD6805 MP



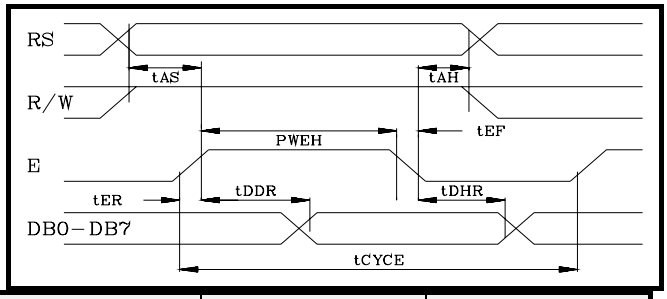
11. Timing Control

11.1 Write and Read Operation

Write Operation

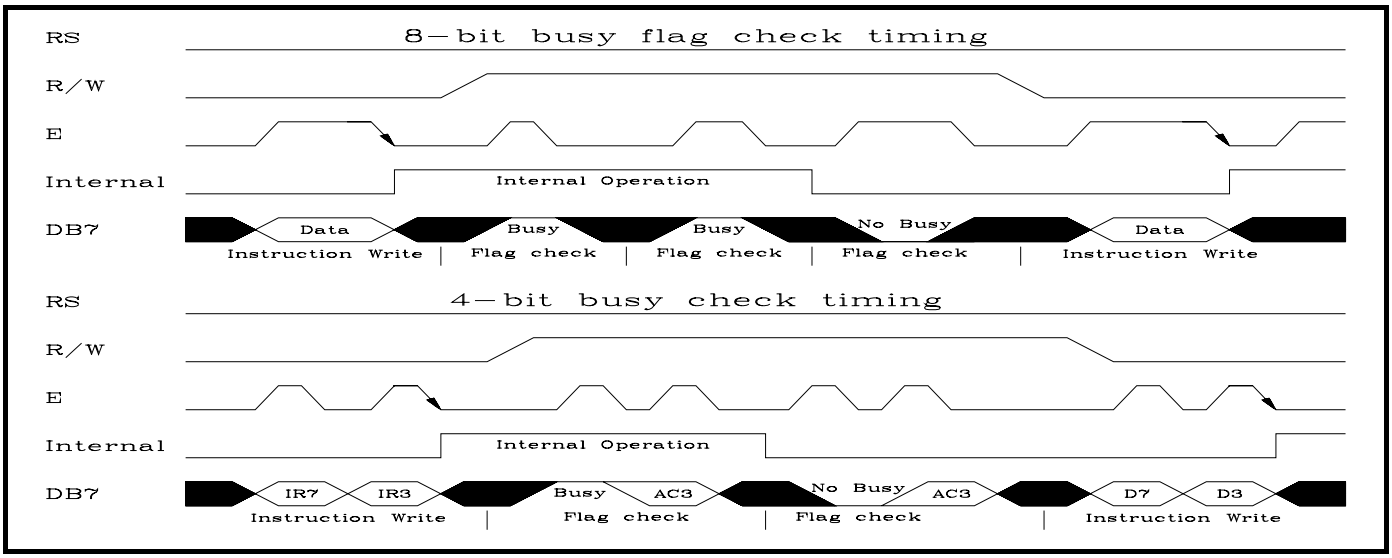


Read Operation



Item	Symbol	Limit (Min.)	Limit (Max.)	Unit
Enable Cycle Time	tCYCE	400	--	ns
Enable Pules Width (High level)	PWEH	150	--	ns
Enable Rise/Fall Time	tER,tEF	--	25	ns
Address Set-Up Time (RS,R/W,E)	tAS	30	--	ns
Address Hole Time	tAH	10	--	ns
Data Set-Up Time	tDSW	40	--	ns
Data Delay Time	tDDR	--	100	ns
Data Hold Time	tDHR	20	--	ns

11.2 Busy flag check timing

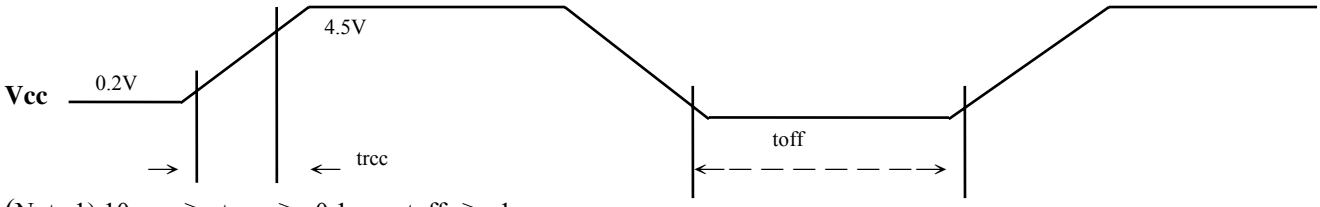


Note: IR7, IR3: Instruction 7th bit, 3rd bit; AC3: Address Counter 3rd bit.

12. Initialization of LCM

The LCM automatically initializes (reset) when power is turned on using the internal reset circuit. If the power supply conditions for correctly operating of the internal reset circuit are not met, initialization by instruction is required. Use the procedure is next page for initialization.

Internal Power Supply reset



(Note 1) 10 ms ≧ trcc ≧ 0.1 ms , toff ≧ 1 ms.
(Note 2) toff stipulates the time of power OFF for momentary power supply dip or when power supply cycles ON and OFF.

Item	Symbol	Test condition	Limit (Min.)	Limit (Max.)	Unit
Power supply rise time	trcc	--	0.1	10	ms
Power supply off time	toff	--	1	--	ms

(a) 8-bit interface

Power ON

↓

Wait more than 15ms after V_{DD} rises to $0.9V_{DD}$

↓

Function Set

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

↓

Wait more than 4.1 ms

↓

Function Set

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

↓

Wait more than 100 μ s

↓

Function Set

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

↓

Wait more than 100 μ s or Busy Flag Check

↓

Function Set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	1	N	F	*	*

↓

Display Off

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

↓

Display Clear

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

↓

Entry Mode Set

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

↓

Write data to the DD/CG RAM and set the Instruction

(b) 4-bit interface

Power ON

↓

Wait more than 15ms after V_{DD} rises to $0.9V_{DD}$

↓

Function Set

RS	R/W	DB7	DB6	DB5	DB4
0	0	0	0	1	1

↓

Wait more than 4.1 ms

↓

Function Set

RS	R/W	DB7	DB6	DB5	DB4
0	0	0	0	1	1

↓

Wait more than 100 μ s

↓

Function Set

RS	R/W	DB7	DB6	DB5	DB4
0	0	0	0	1	1

↓

Wait more than 100 μ s or Busy Flag Check

↓

Function Set

RS	R/W	DB7	DB6	DB5	DB4
0	0	0	0	1	0

↓

Function Set

RS	R/W	DB7	DB6	DB5	DB4
0	0	0	0	1	0
0	0	N	F	*	*

↓

Display Off

RS	R/W	DB7	DB6	DB5	DB4
0	0	0	0	0	0
0	0	1	0	0	0

↓

Display Clear

RS	R/W	DB7	DB6	DB5	DB4
0	0	0	0	0	0
0	0	0	0	0	1

↓

Entry Mode Set

RS	R/W	DB7	DB6	DB5	DB4
0	0	0	0	0	0
0	0	0	1	I/D	S

↓

Write data to the DD/CG RAM and set the Instruction

13. Instruction Set

FUNCTION	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	DESCRIPTION	EXECU. TIME (270KHz)
Clear Display	0	0	0	0	0	0	0	0	0	1	Clears entire display and returns the cursor to home position (address 0).	1.52ms
Return Home	0	0	0	0	0	0	0	0	1	x	Return the cursor to the home position. Also returns the display being shifted to the original position. DD RAM contents remain unchanged.	1.52ms
Entry mode set	0	0	0	0	0	0	0	1	I/D	S	Set cursor move direct and specifies display shift. These operations are performed during data rite/read. For normal operation, set S to zero. I/D=1: increment; 0: decrement; S=1: accompanies display shift when data is written, for normal operation, set to zero.	38 μs
Display ON/OFF control	0	0	0	0	0	0	1	D	C	B	Set ON/OFF all display (D), cursor ON/OFF(C), and blink of cursor position character(B). D=1: ON display; 0:OFF display. C=1: ON cursor;0: OFF cursor. B=1: ON blink cursor; 0: OFF blink cursor.	38 μs
Cursor or Display shift	0	0	0	0	0	1	S/C	R/L	x	x	Move the cursor and shift the display without changing DD RAM contents. S/C=1: Display shift; 0:Cursor move. R/L=1: shift to right; 0: shift to left.	38 μs
Function Set	0	0	0	0	1	DL	N	F	x	x	Set the interface data length (DL). Number of display lines (N) and character font (F). DL=1: 8 bits; 0:4 bits. N=1: 2 lines; 0: 1 lines. F=1: 5x10 dots; 0: 5x7 dots.	38 μs
Set CG RAM address	0	0	0	1	ACG						Set CG RAM address. CG RAM data is sent and received after this setting.	38 μs
Set DD RAM address	0	0	1	ADD							Set DD RAM address. DD RAM data is sent and received after this setting	38 μs
Read busy flag & address	0	1	BF	AC							Reads Busy Flag (BF) indicating internal operation is being performed and reads address counter contents. BF=1: internally operating. 0: can accept instruction	--
Write Data to CG/DDRAM	1	0	WRITE DATA								Write data into DD RAM or CG RAM.	38 μs
Read Data for CG/DDRAM	1	1	READ DATA								Read data from DD RAM or CG RAM	38 μs

14. User Font Patterns (CG RAM Character)

Character Code (DD RAM data)		CG RAM Address		Character Pattern (CG RAM data)
Hi 7 6 5 4 3 2 1 0 Lo		5 4 3 2 1 0		Hi 7 6 5 4 3 2 1 0 Lo
0 0 0 0 x 0 0 0		0 0 0 0 0 1 0 1 0 0 0 0 0 1 1 1 0 0 1 0 1 1 1 0 1 1 1		x x x 1 1 1 1 0 x x x 1 0 0 0 1 x x x 1 0 0 0 1 x x x 1 1 1 1 0 x x x 1 0 1 0 0 x x x 1 0 0 1 0 x x x 1 0 0 0 1 x x x 0 0 0 0 0
0 0 0 0 x 0 0 1		0 0 0 0 0 1 0 1 0 0 0 1 0 1 1 1 0 0 1 0 1 1 1 0 1 1 1		x x x 1 0 0 0 1 x x x 0 1 0 1 0 x x x 1 1 1 1 1 x x x 0 0 1 0 0 x x x 1 1 1 1 1 x x x 0 0 1 1 0 x x x 0 0 1 0 0 x x x 0 0 0 0 0
----------		----------		----------
0 0 0 0 x 1 1 1		0 0 0 0 0 1 0 1 0 1 1 1 0 1 1 1 0 0 1 0 1 1 1 0 1 1 1		

15. Software Example

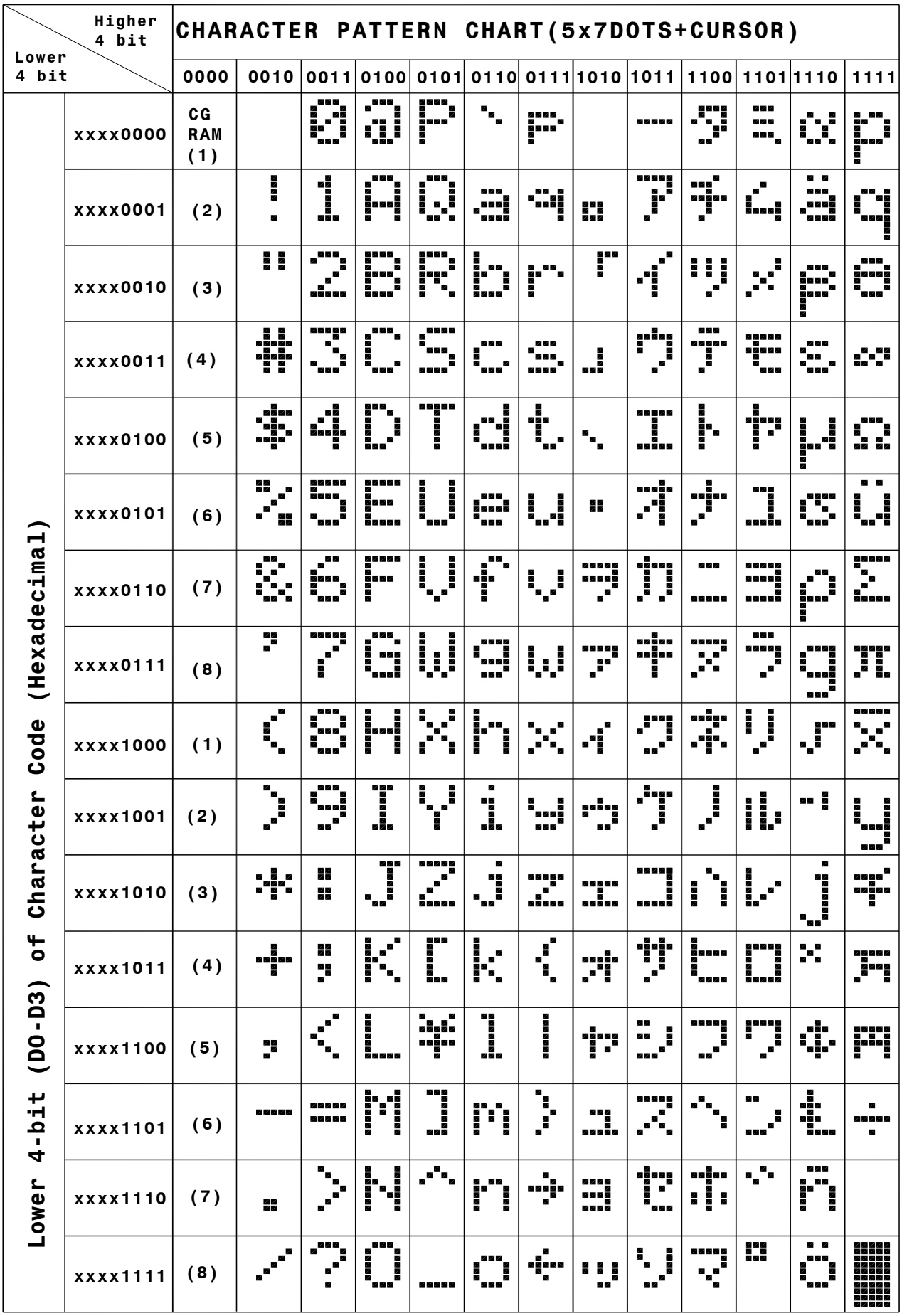
15.1 8-bit operation (8 bits 2 lines)

Function	RS	Rw	D7	D6	D5	D4	D3	D2	D1	D0	Display	Description
Power on delay												Initialization. No display appears.
Function set	0	0	0	0	1	1	1	0	x	x		Sets to 8-bit operation and selects 2-line display and 5x7 dots character font. (Note: number of display lines and character fonts cannot be changed after this.)
Display OFF	0	0	0	0	0	0	1	0	0	0		Turn off display.
Display ON	0	0	0	0	0	0	1	1	1	0	_	Turn on display and cursor
Entry Mode Set	0	0	0	0	0	0	0	1	1	0	_	Set mode to increment the address by one and to shift the cursor to the right, at the time of write, to the DD/CG RAM Display is not shifted.
Write data to CG/DD RAM	1	0	0	1	0	1	0	0	1	1	S_	Write "S". Cursor incremented by one and shift to right.
Write data to CG/DD RAM	1 1 1	0 0 0	0 0 0	1 1 1	0 0 0	0 0 0	0 0 0	1 1 0	0 0 1	0 1 1	SDEC_	Write "D", "E", and "C".
Set DD RAM	0	0	1	1	0	0	0	0	0	0	SDEC _	Set RAM address so that the cursor is propositioned at the head of the second line.
Write data to CG/DD RAM					*						SDEC CR_	Write "C" and "R".
Cursor or display shift	0	0	0	0	0	1	0	0	x	x	SDEC CR	Shift only the cursor position to the left.
Write data to CG/DD RAM					*						SDEC CO., LTD._	Write "O., LTD.".
Entry Mode Set	0	0	0	0	0	0	0	1	1	1	SDEC CO., LTD._	Set display mode shift at the time during writing operation.
Write data to CG/DD RAM	1	0	0	1	1	1	1	0	0	0	DEC O., LTD. x_	Write "x". Cursor incremented by one and shift to right. (The display move to left.)
Write data to CG/DD RAM					*							Write other characters.
Return Home	0	0	0	0	0	0	0	0	1	0	SDEC CO., LTD.	Return both display and cursor to the original position (Set address to zero).

15.2 4-bit operation (4-bit, 1 line)

Function	RS	R/W	D7	D6	D5	D4	Display	Description
Power on delay								Initialization. No display appears.
Function set	0	0	0	0	1	0		Sets to 4-bit operation. In this case, operation is handled as 8-bits by initialization, and only this instruction completes with one write.
Function set	0 0	0 0	0 0	0 0	1 x	0 x		Sets 4-bit operation and selects 1-line display and 5x7 dot character font on and resetting is needed. (Number of display lines and character fonts cannot be changed hence after).
Display ON/OFF Control	0 0	0 0	0 1	0 1	0 1	0 0	_	Turn on display and cursor.
Entry Mode Set	0 0	0 0	0 0	0 1	0 1	0 0	_	Set mode to incremented the address by one and to shift the cursor to the right, at the time of write. To the DD/CG RAM display is not shifted.
Write data to CG/DD RAM	1 1	0 0	0 0	1 0	0 1	1 1	S_	Write "S". Cursor incremented by one and shift to right.
same as 8-bit operation								

16. Character Generator ROM Map



17. Functional Test & Inspection Criteria

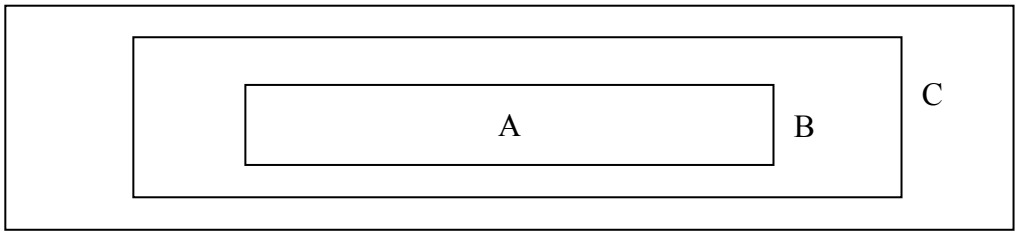
17.1 Sample plan

Sample plan according to MIL-STD-105D level 2, and acceptance/rejection criteria is.
Base on: Major defect: AQL 0.65 Minor defect: AQL 2.5

17.2 Inspection condition

Viewing distance for cosmetic inspection is 30cm with bare eyes, and under an environment of 800 lus (20W) light intensity. All direction for inspecting the sample should be within 45° against perpendicular line.

17.3 Definition of Inspection Zone in LCD



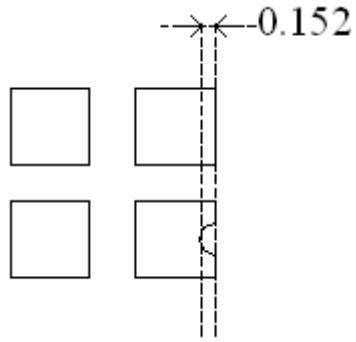
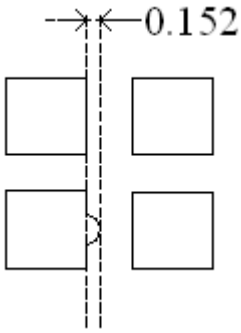
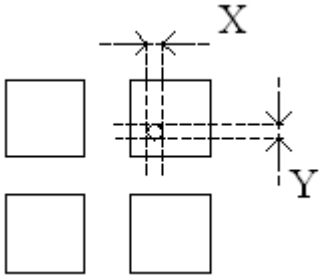
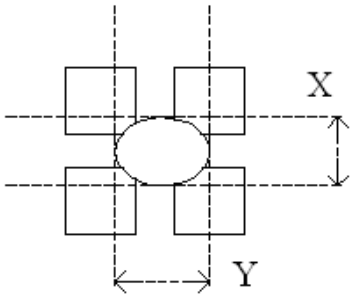
Zone A: Character / Digit area
Zone B: Viewing area except Zone A (Zone A + Zone B = minimum Viewing area)
Zone C: Outside viewing area (invisible area after assembly in customer's product)
Note: As a general rule, visual defects in Zone C are permissible, when it is no trouble for quality and assembly of customer's product.

17.4 Major Defect

All functional defects such as open (or missing segment), short, contrast differential, excess power consumption, smearing, leakage, etc. and overall outline dimension beyond the drawing. Are classified as major defects.

17.5 Inspection Parameters And Glass Pixel

<table>
<tr><th>No</th><th>Polarizer)</th><th>Criteria</th></tr>
<tr><td>1</td><td>Black or White spots
and Piercing</td><td>
<table>
<tr><th colspan="2">Zone
Dimension (mm)</th><th colspan="3">Acceptable number</th></tr>
<tr><th colspan="2"></th><th>A</th><th>B</th><th>C</th></tr>
<tr><td colspan="2">D ≦ 0.15</td><td>*</td><td>*</td><td>*</td></tr>
<tr><td colspan="2">0.15 < D ≦ 0.2</td><td>4</td><td>6</td><td>*</td></tr>
<tr><td colspan="2">0.2 < D ≦ 0.3</td><td>2</td><td>2</td><td>*</td></tr>
<tr><td colspan="2">0.3 < D</td><td>0</td><td>0</td><td>*</td></tr>
<tr><td colspan="5">D=(Length+Width/2 ＊：Disregard</td></tr>
</table>
</td></tr>
<tr><td>2</td><td>Scratch</td><td>
<table>
<tr><th>Zone
X(mm)</th><th>Zone
Y(mm)</th><th colspan="3">Acceptable number</th></tr>
<tr><th></th><th></th><th>A</th><th>B</th><th>C</th></tr>
<tr><td>*</td><td>0.04≧W</td><td>*</td><td>*</td><td>*</td></tr>
<tr><td>3.0≧L</td><td>0.06≧W</td><td>4</td><td>4</td><td>*</td></tr>
<tr><td>2.0≧L</td><td>0.08≧W</td><td>2</td><td>2</td><td>*</td></tr>
<tr><td>--</td><td>0.10≧W</td><td>0</td><td>0</td><td>*</td></tr>
<tr><td colspan="5">X：LengthY：Width ＊：Disregard</td></tr>
</table>
</td></tr>
<tr><td>3</td><td>Air Bubbles
(between glass & polarizer)</td><td>
<table>
<tr><th colspan="2">Zone
Dimension (mm)</th><th colspan="3">Acceptable number</th></tr>
<tr><th colspan="2"></th><th>A</th><th>B</th><th>C</th></tr>
<tr><td colspan="2">D ≦ 0.20</td><td>*</td><td>*</td><td>*</td></tr>
<tr><td colspan="2">0.20 < D ≦ 0.50</td><td>2</td><td>2</td><td>*</td></tr>
<tr><td colspan="2">0.50 < D</td><td>0</td><td>0</td><td>*</td></tr>
<tr><td colspan="5">＊：Disregard</td></tr>
</table>
</td></tr>
</table>

4	Glass of Pixel	(1)Pixel shape (with Dent)  ●Less than 0.152 mm is no counted (0.152mm) (2)Pixel shape (with Projection)/  Should not be connected next pixel (3)Deformation  (X + Y) / 2 ≦ 0.15mm ●Less than 0.1 mm is no counted (0.15mm) (4) Deformation  (X + Y) / 2 ≦ 0.3mm ●Less than 0.3 mm is no counted (0.3mm)

18. Reliability Test – Normal Temperature

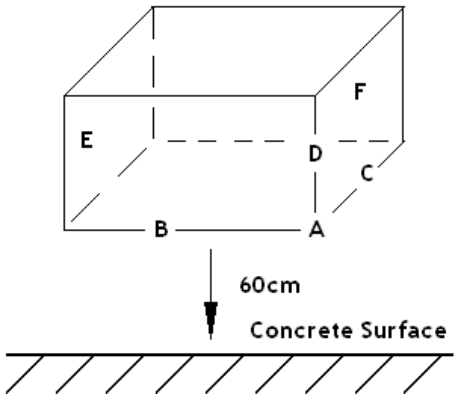
No change no display and in operation under the following text condition.

Conditions ： Unless otherwise specified, test will be conducted under the following condition.

Temperature ： 20±5 ℃ Humidity： 40±5%RH

Tests will be not conducted under functioning state.

20±5 ℃：40±5%RH

NO	Parameter	Conditions	Notes
1	High Temperature Operating	50°C ± 2°C, 96 hrs (operation state)	
2	Low Temperature Operating	0°C ± 2°C, 96 hrs (operation state)	1
3	High Temperature Storage	60°C ± 2°C, 96 hrs	2
4	Low Temperature Storage	- 10℃±2 ℃ , 96 hrs	1 , 2
5	Damp Proof Test	40℃±2 ℃ , 85 ~ 90%RH , 96hr	1 , 2
6	Vibration Test	Total fixed amplitude: 1.5 mm Vibration Frequency： 10 ～ 55 Hz One cycle 60 seconds to 3 directions of X , Y , Z for each 15 minutes	3
7	Shock Test	To be measured after dropping from 60cm high on the concrete surface in packing state.  Dropping method comer dropping A comer：once Edge dropping B , C , D edge : once Face dropping E , F , G face : once	

Note 1：No dew condensation to be observed. Note 2：The function test shall be conducted after 4 hours storage at the normal

Temperature and humidity after removed from the test chamber

(Temp：25℃ ，Humidity：45%RH)

Note 3：Vibration test will be conducted to the product itself without putting it in a container.

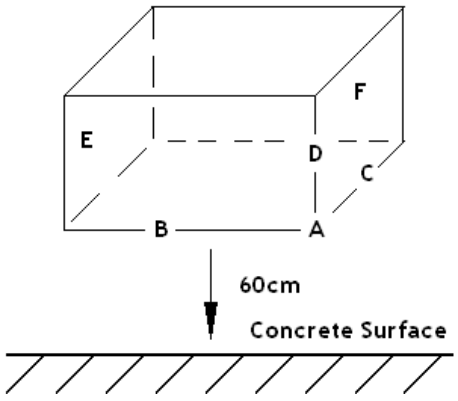
19. Reliability Test – Wide Temperature

No change no display and in operation under the following text condition.

Conditions ： Unless otherwise specified, test will be conducted under the following condition.

Temperature ： 20±5 ℃ Humidity： 40±5%RH

Tests will be not conducted under functioning state.

NO	Parameter	Conditions	Notes
1	High Temperature Operating	70℃±2 ℃ , 96 hrs (operation state)	
2	Low Temperature Operating	- 20℃±2 ℃ , 96 hrs (operation state)	1
3	High Temperature Storage	80℃±2 ℃ , 96 hrs	2
4	Low Temperature Storage	- 30℃±2 ℃ , 96 hrs	1 , 2
5	Damp Proof Test	40℃±2 ℃ , 85 ~ 90%RH , 96hr	1 , 2
6	Vibration Test	Total fixed amplitude ： 1.5 mm Vibration Frequency ： 10 ～ 55 Hz One cycle 60 seconds to 3 directions of X , Y , Z for each 15 minutes	3
7	Shock Test	To be measured after dropping from 60cm high on the concrete surface in packing state.  Dropping method comer dropping A comer：once Edge dropping B , C , D edge : once Face dropping E , F , G face : once	

Note 1：No dew condensation to be observed.

Note 2：The function test shall be conducted after 4 hours storage at the normal Temperature and humidity after removed from the test chamber (25℃：45%RH)，

Note 3：Vibration test will be conducted to the product itself without putting it in a container.