DISPLAY Elektronik GmbH

DATA SHEET

LCD MODULE

DEM 128032A1 FGH

Product Specification ***Version: 0***

17.08.2021

GENERAL SPECIFICATION

MODULE NO. :

DEM 128032A1 SERIES

VERSION NO.	CHANGE DESCRIPTION	DATE
0	Original Version	17.08.2021

PREPARED BY: LM DATE: 17.08.2021

APPROVED BY: WH DATE: 17.08.2021

CONTENTS

DEM 128032A1 Series LCD Type :

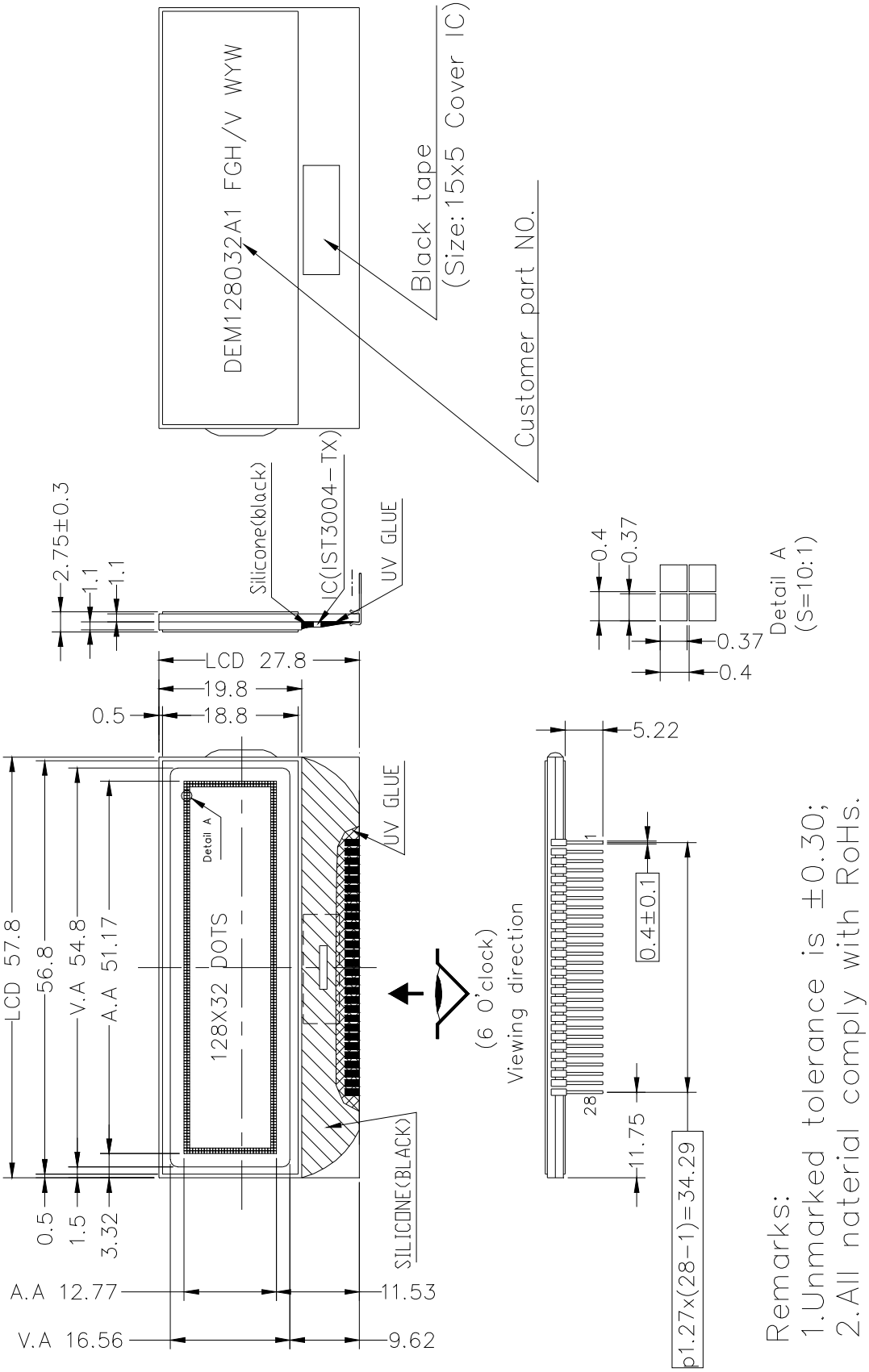
MODULE	LCD TYPE	REMARKS
DEM 128032A1 FGH	FSTN Reflective positive Mode	

- Viewing Direction : 6 O'clock
- Driving Scheme : 1/64 Duty Cycle, 1/9 Bias
- Power Supply Voltage(Typ.) : 3.0 V
- LCD Operation Voltage : 9.8 V
- Display Contents :128x32 Dots
- Driver IC : IST3004-TX
- RoHS Compliant

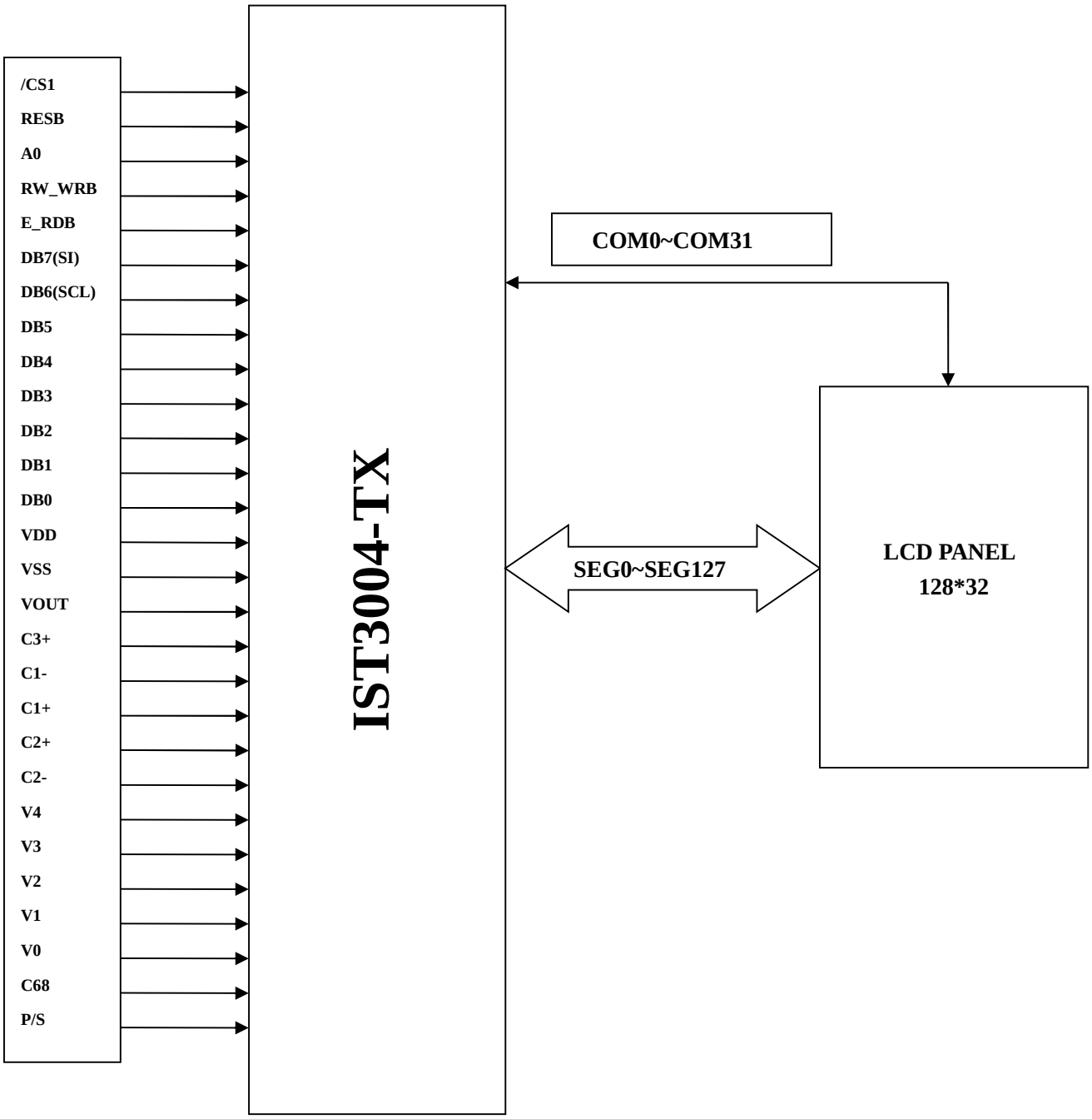
2. MECHANICAL SPECIFICATIONS

- Module Size: : 57.80 x 27.80 x 2.75 mm
- Viewing Area Size: : 54.80 x 16.56 mm
- Active Area Size : 51.17 x 12.77 mm
- Dot pitch: : 0.40 x 0.40 mm
- Dot Size: : 0.37 x 0.37 mm

3. EXTERNAL DIMENSIONS



4. BLOCK DIAGRAM



5. PIN DESCRIPTION

<table>
<tr><th>Pin No.</th><th>Name</th><th>I/O</th><th>Description</th></tr>
<tr><td>1</td><td>CS1B</td><td>I</td><td>Chip select input pins
Data / instruction I/O is enabled only when CS1B is “L” and CS2 is “H”. when chip select is non-active, DB0 to DB7 may be high impedance</td></tr>
<tr><td>2</td><td>RESB</td><td>I</td><td>Hardware Reset input pin
When RESB is “L”, initialization is executed.</td></tr>
<tr><td>3</td><td>A0</td><td>I</td><td>Register select input pin
- A0 = “H” : DB0 to DB7 are display data
- A0 = “L” : DB0 to DB7 are control data</td></tr>
<tr><td>4</td><td>RW_WRB</td><td>I</td><td>Read / Write execution control pin
<table>
<tr><th>C86</th><th>MPU Type</th><th>RW_WRB</th><th>Description</th></tr>
<tr><td>H</td><td>6800-series</td><td>WR</td><td>Read / Write control input pin
- RW = “H” : read
- RW = “L” : write</td></tr>
<tr><td>L</td><td>8080-series</td><td>/WRB</td><td>Write enable clock input pin
The data on DB0 to DB7 are latched at the rising edge of the /WRB signal.</td></tr>
</table></td></tr>
<tr><td>5</td><td>E_RDB</td><td>I</td><td>Read / Write execution control pin
<table>
<tr><th>C86</th><th>MPU Type</th><th>E_RDB</th><th>Description</th></tr>
<tr><td>H</td><td>6800-series</td><td>E</td><td>Read / Write control input pin
- RW = “H” : When E is “H”, DB0 to DB7 are in an output status.
- RW = “L” : The data on DB0 to DB7 are latched at the falling edge the E signal.</td></tr>
<tr><td>L</td><td>8080-series</td><td>/RDB</td><td>Read enable clock input pin
When / RDB is “L”, DB0 to DB7 are in an output status.</td></tr>
</table></td></tr>
<tr><td>6~13</td><td>DB7~DB0</td><td>I/O</td><td>8-bit bi-directional data bus that is connected to the standard 8-bit microprocessor data bus. When the serial interface selected (PS = “L”);
- DB0 to DB5 : high impedance
- DB6 : serial input clock (SCL)
- DB7 : serial input data (SDI)
When chip select is not active, DB0 to DB7 may be high impedance.</td></tr>
<tr><td>14</td><td>VDD</td><td>Power Supply</td><td>Power supply for logic.</td></tr>
<tr><td>15</td><td>VSS</td><td>Power Supply</td><td>Ground.</td></tr>
<tr><td>16</td><td>Vout</td><td>I/O</td><td rowspan="6">DC/DC voltage converter</td></tr>
<tr><td>17</td><td>C3+</td><td>O</td></tr>
<tr><td>18</td><td>C1-</td><td>O</td></tr>
<tr><td>19</td><td>C1+</td><td>O</td></tr>
<tr><td>20</td><td>C2+</td><td>O</td></tr>
<tr><td>21</td><td>C2-</td><td>O</td></tr>
<tr><td>22</td><td>V4</td><td rowspan="5">I/O</td><td rowspan="5">LCD driver supply voltages
The voltage determined by LCD pixel is impedance-converted by an operational amplifier for application.
Voltages should have the following relationship;
V0 ≥ V1 ≥ V2 ≥ V3 ≥ V4 ≥ VSS
When the internal power circuit is active, these voltages are generated as following as following table according to the state of LCD bias.
<table>
<tr><td>LCD bias</td><td>V1</td><td>V2</td><td>V3</td><td>V4</td></tr>
<tr><td>1/9bias</td><td>(8/9) xV0</td><td>(7/9) xV0</td><td>(2/9) xV0</td><td>(1/9) xV0</td></tr>
</table></td></tr>
<tr><td>23</td><td>V3</td></tr>
<tr><td>24</td><td>V2</td></tr>
<tr><td>25</td><td>V1</td></tr>
<tr><td>26</td><td>V0</td></tr>
<tr><td>27</td><td>C68</td><td>I</td><td>Microprocessor Interface Select input pin in parallel mode
- C68 = “H” : 6800-series MPU interface
- C68 = “L” : 8080-series MPU interface</td></tr>
<tr><td>28</td><td>P/S</td><td>I</td><td>Parallel / serial data input select input
<table>
<tr><th>PS</th><th>Interface Mode</th><th>Chip Select</th><th>Data / instruction</th><th>Data</th><th>Read / Write</th><th>Serial clock</th></tr>
<tr><td>“H”</td><td>Parallel</td><td>CS1B</td><td>A0</td><td>DB0 to DB7</td><td>E_RDB RW_WRB</td><td>--</td></tr>
<tr><td>“L”</td><td>Serial</td><td>CS1B</td><td>A0</td><td>SDI (DB7)</td><td>Write only</td><td>SCL (DB6)</td></tr>
</table>
<NOTE> In serial mode, it is impossible to read data from the on-chip RAM. And DB0 to DB5 and E_RDB and RW_WRB must be fixed to either “H” or “L”.</td></tr>
</table>

6. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Conditions	Unit
Power Supply Voltage	VDD	-0.3 ~ 7.0	V
Power Supply Voltage (VDD Standard)	V0, VOUT	-0.3 ~ 15.0	V
Power Supply Voltage (VDD Standard)	V1, V2, V3, V4	-0.3 to V0	V
Operating Temperature	TOPR	–20 to +70	°C
Storage Temperature	TSTR	–30 to +80	°C

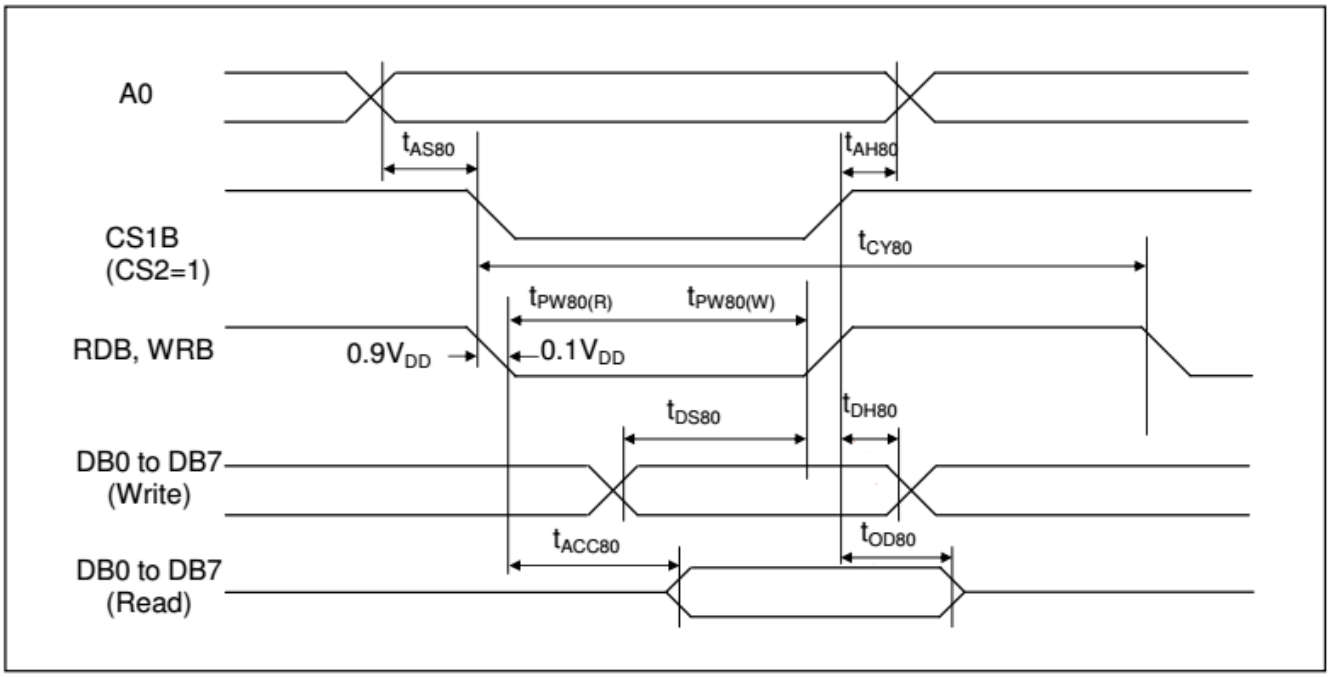
7. ELECTRICAL CHARACTERISTICS

7.1. DC CHARACTERISTICS

Item	Symbol	Condition	STANDARD VALUE			units
			Min.	Typ.	Max.	
Operating Voltage	VDD	Relative to VSS	2.7	3.0	3.3	V
LCD Driving Voltage	VLCD	Relative to VSS	9.6	9.8	10	
Consumption Current	IDD	-	-	TBD	-	mA

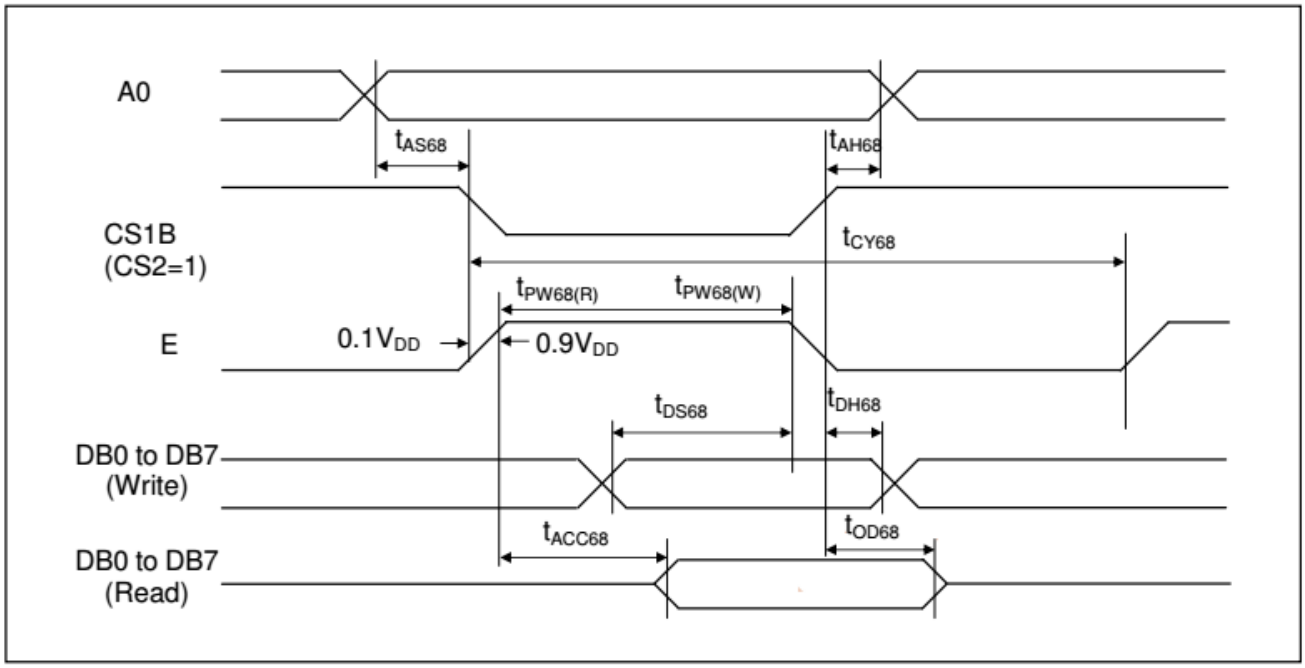
7.2. AC CHARACTERISTICS

Read / Write Characteristics (8080-series MPU)



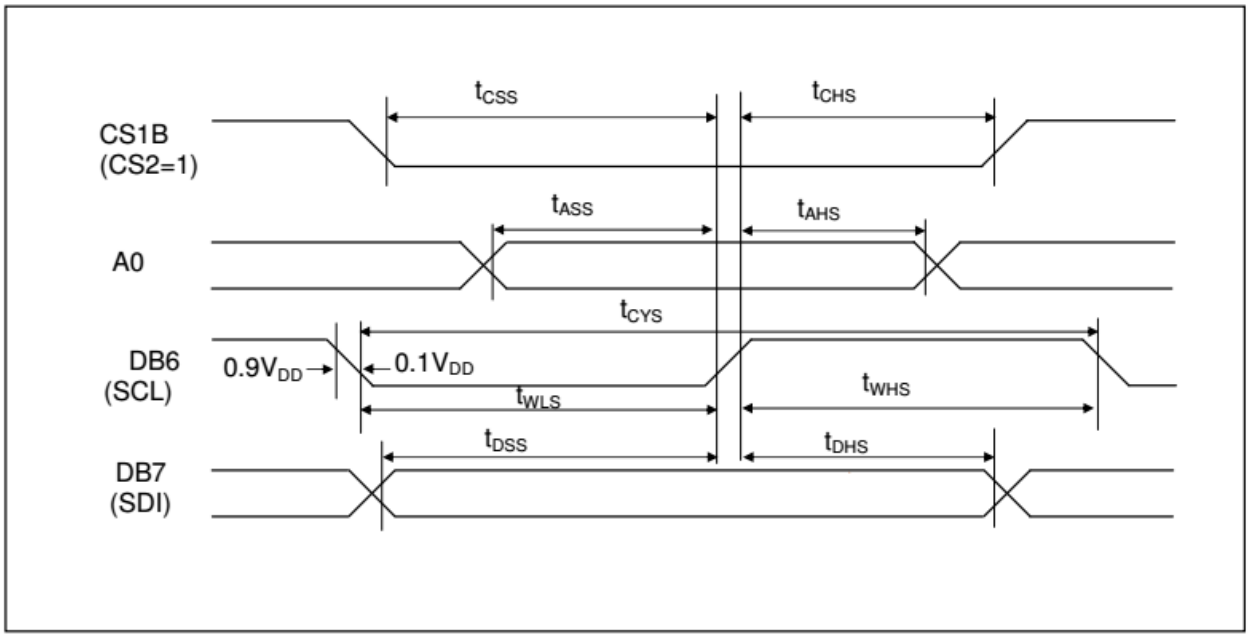
Item	Signal	Symbol	Min.	Typ.	Max.	Unit	Remark
Address setup time Address hold time	A0	t_{AS80} t_{AH80}	0 0	-	-	ns	
System cycle time		t_{CY80}	300	-	-	ns	
Pulse width (WRB)	RW_WRB	t_{PW80}(W)	150	-	-	ns	
Pulse width (RDB)	E_RDB	t_{PW80}(R)	150	-	-	ns	
Data setup time Data hold time	DB7 to DB0	t_{DS80} t_{DH80}	60 0	-	-	ns	
Read access time Output disable time		t_{ACC80} t_{OD80}	140 -	-	- 10	ns	(No load)

Read / Write Characteristics (6800-series Microprocessor)



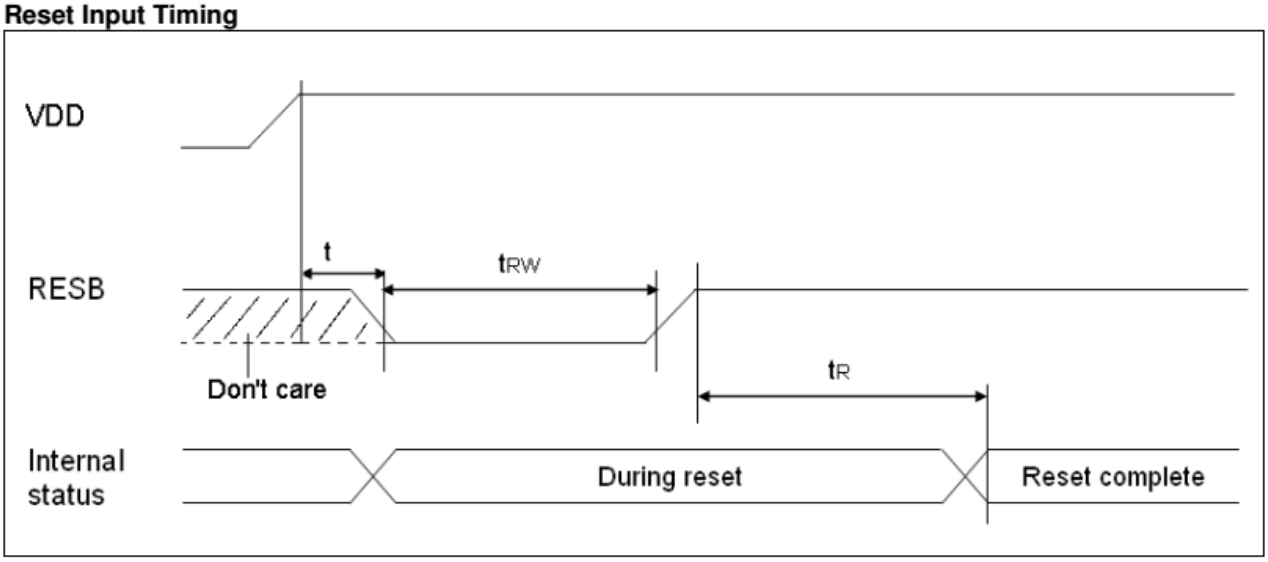
Item	Signal	Symbol	Min.	Typ.	Max.	Unit	Remark
Address setup time Address hold time	A0	t_{AH68}	0 0	-	-	ns	
System cycle time		t_{CY68}	300	-	-	ns	
Pulse width (E)	RW_WRB	t_{PW68}(W)	150	-	-	ns	
Pulse width (E)	E_RDB	t_{PW68}(R)	150	-	-	ns	
Data setup time Data hold time	DB7 to DB0	t_{DS68} t_{DH68}	60 0	-	-	ns	
Read access time Output disable time		t_{ACC68} t_{OD68}	140 -	-	- 10	ns	(No load)

Serial Interface Characteristics



Item	Signal	Symbol	Min.	Typ.	Max.	Unit	Remark
Serial clock cycle SCL high pulse width SCL low pulse width	DB6 (SCL)	tCYS tWHS tWLS	200 90 90	- - -	- - -	ns	
Address setup time Address hold time	A0	tASS tAHS	45 45	- -	- -	ns	
Data setup time Data hold time	DB7 (SDI)	tDSS tDHS	45 45	- -	- -	ns	
CS1B setup time CS1B hold time	CS1B	tCSS tCHS	90 90	- -	- -	ns	

Reset Input Timing

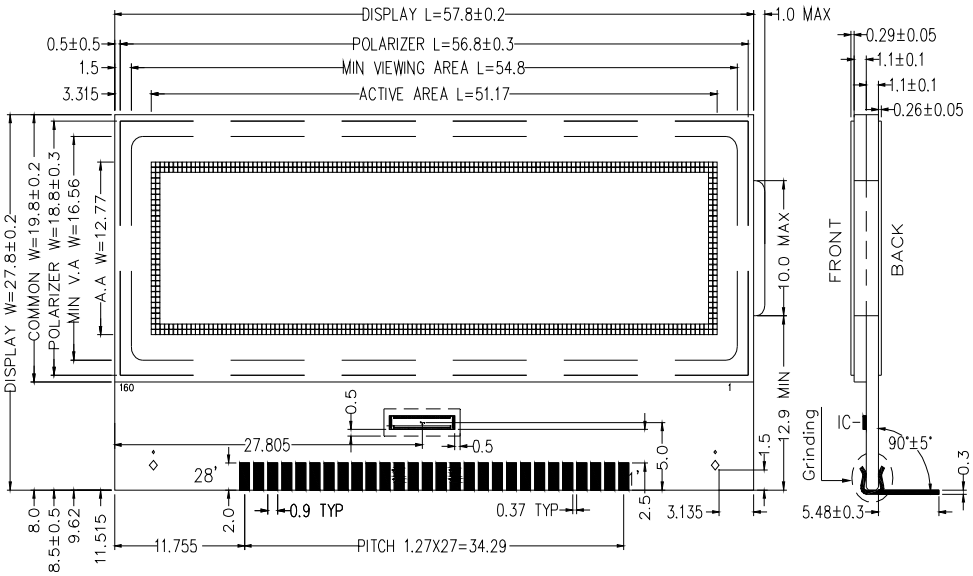


Item	Signal	Symbol	Min.	Typ.	Max.	Unit	Remark
Reset low pulse width	RESB	tRW	2	-	-	us	
Reset time	-	tR	-	-	2	us	
Reset time	RESB	t	0	-	-	us	

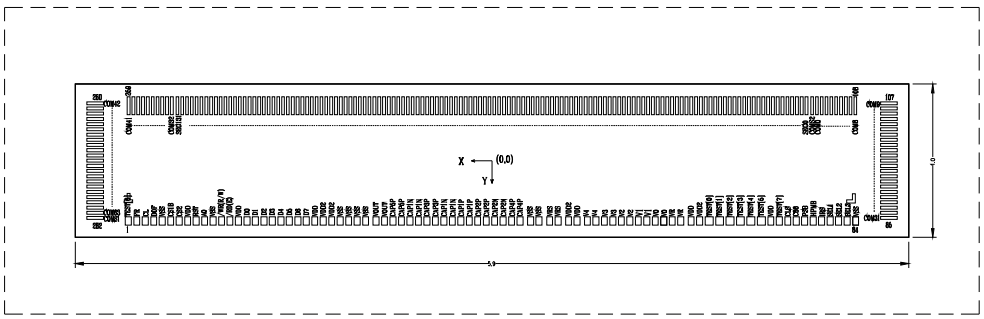
8. INSTRUCTION DESCRIPTION

INSTRUCTION	A0	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description
Display ON / OFF	0	0	1	0	1	0	1	1	1	DON	LCD display On/Off control DON = 0 : display OFF DON = 1 : display On
Display starting line	0	0	0	1	ST5	ST4	ST3	ST2	ST1	ST0	Specify the line address for the first COM output
page address	0	0	1	0	1	1	P3	P2	P1	P0	Set page address
Set column address MSB	0	0	0	0	0	1	Y7	Y6	Y5	Y4	Set column address MSB
Set column address LSB	0	0	0	0	0	0	Y3	Y2	Y1	Y0	Set column address LSB
Read status	0	1	BUSY	ADC	ON/OFF	RESB	0	0	0	0	Read the internal status
Write display data	1	0	Write data								Write data into Display RAM
Read display data	1	1	Read data								Read data from Display RAM
ADC select	0	0	1	0	1	0	0	0	0	ADC	SEG output direction select ADC = 0 : SEG0 → SEG131 ADC = 1 : SEG131 → SEG0
Reverse display ON / OFF	0	0	1	0	1	0	0	1	1	REV	Normal / Reverse display select REV = 0 : Reverse display off REV = 1 : Reverse display on
Entire display ON / OFF	0	0	1	0	1	0	0	1	0	EON	Entire display On/Off control EON = 0 : Entire display off EON = 1 : Entire display on
LCD bias select	0	0	1	0	1	0	0	0	1	BS	Select LCD bias
Set Read-modify-write (RMW)	0	0	1	1	1	0	0	0	0	0	Set Read-modify-write mode
Clear RMW	0	0	1	1	1	0	1	1	1	0	Clear Read-modify-write mode
S/W Reset	0	0	1	1	1	0	0	0	1	0	S/W Reset
SHL select	0	0	1	1	0	0	SHL	×	×	×	COM output direction select SHL = 0 : COM0 → COM63 SHL = 1 : COM63 → COM0
Power control	0	0	0	0	1	0	1	VC	VR	VF	Control power circuit operation
Regulator resistor select	0	0	0	0	1	0	0	R2	R1	R0	Select internal resistance ratio of the regulator resistor
Set reference voltage mode	0	0	1	0	0	0	0	0	0	1	Set reference voltage mode (double byte command)
Set reference voltage register	0	0	×	×	SV5	SV4	SV3	SV2	SV1	SV0	Set reference voltage register
Set static indicator mode	0	0	1	0	1	0	1	1	0	SM	Set static indicator mode (double byte command)
Set static indicator register	0	0	×	×	×	×	×	×	S1	S0	Set static indicator register
Power save	-	-	-	-	-	-	-	-	-	-	Compound Instruction of display OFF and entire display ON
NOP	0	0	1	1	1	0	0	0	1	1	No operation (dummy command)
Set Booster Ratio select mode	0	0	1	1	1	1	1	0	0	0	Set Booster ration select mode (double byte command)
Set Booster Ratio register	0	0	x	x	x	x	x	x	BT1	BT0	Set Booster ration BT[1:0] = 00 : x2, x3, x4 BT[1:0] = 01 : x5 BT[1:0] = 11 : x6 BT[1:0] = 10 : (don't use)
Test Instruction	0	0	1	0	0	0	1	0	0	0	Test command (don't use)

9. LCD ARTWORK

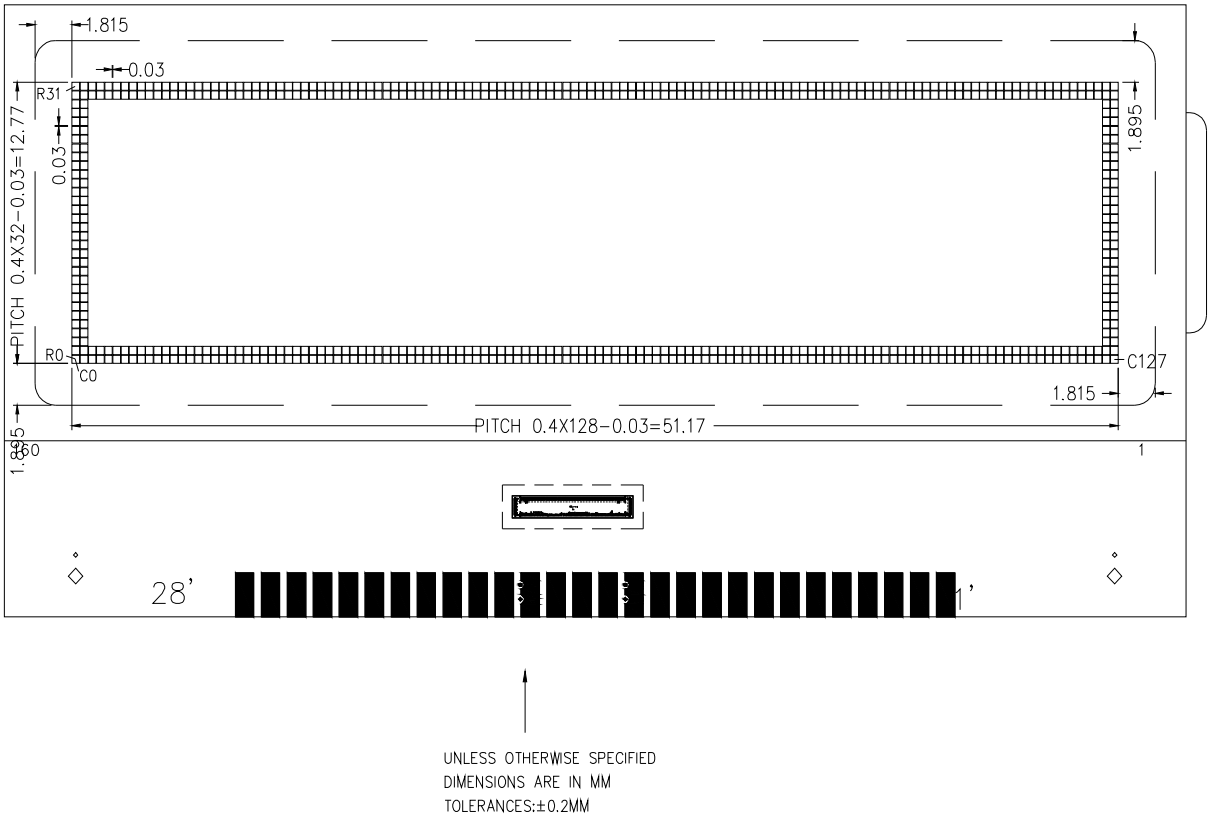


10.PAD CONFIGURATION

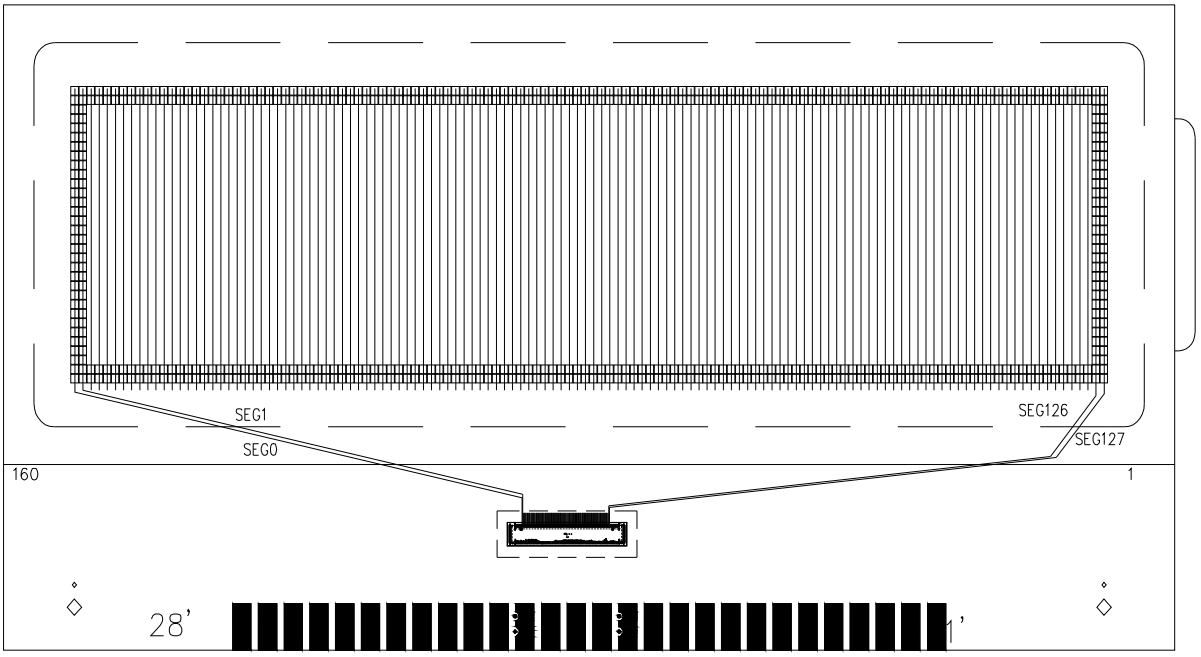


PAD NO.	PAD CONFIGURATION	PAD NO.	PAD CONFIGURATION
1'	CS1B	15'	VSS,SEL3,SEL2,SEL1,HPMB
2'	RST	16'	VOUT
3'	A0	17'	CAP3P
4'	/WR(R/W)	18'	CAP1N
5'	/RD(E)	19'	CAL1P
6'	D0	20'	CAP2P
7'	D1	21'	CAP2N
8'	D2	22'	V4
9'	D3	23'	V3
10'	D4	24'	V2
11'	D5	25'	V1
12'	D6	26'	V0
13'	D7	27'	C86
14'	VDD,VDD2	28'	PSB

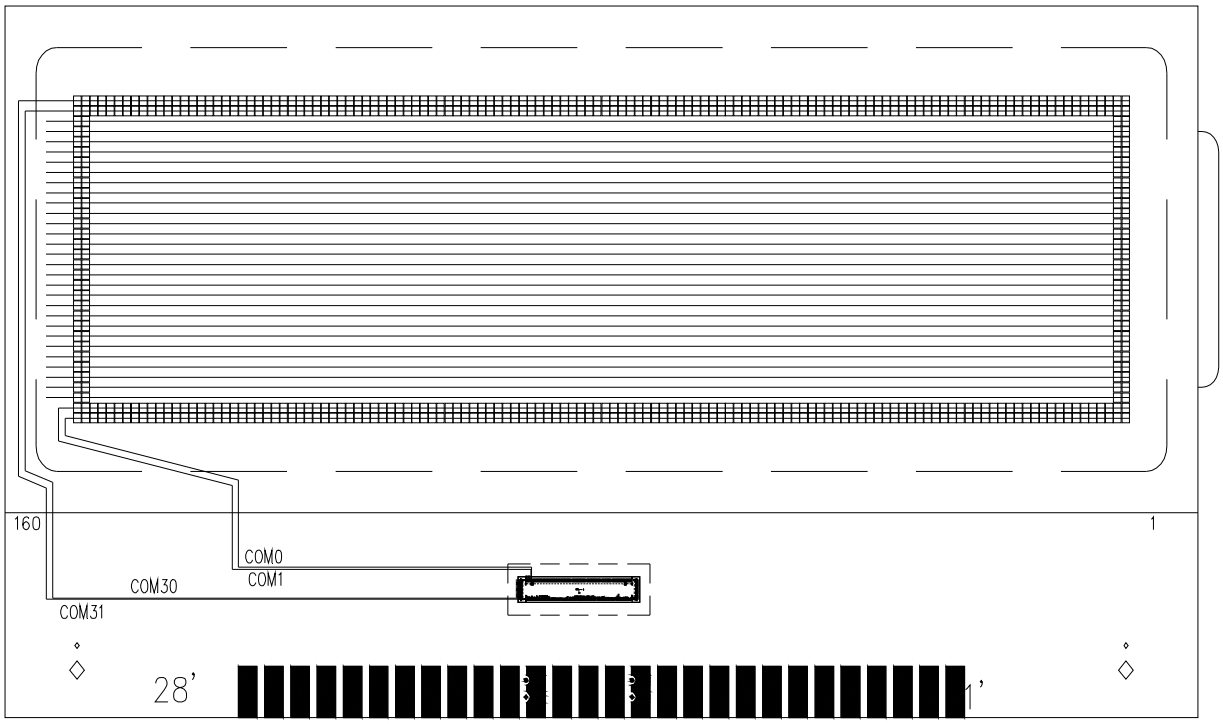
11. LCD LABELING



12. SEG LAYOUT

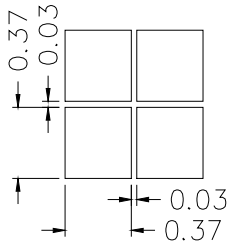


13.COM LAYOUT



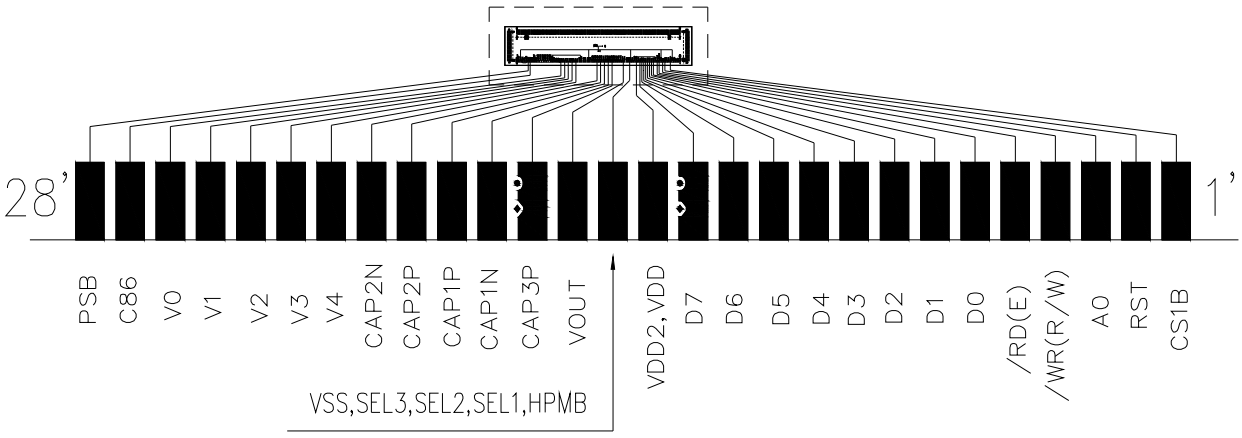
14. PAD CONFIGURATION GRAPHIC DIMENSION

IC NO.	PAD CONFIGURATION
COM31	COM31[R31(C0-C127)]
COM30	COM30[R30(C0-C127)]
COM1	COM1[R1(C0-C127)]
COM0	COM0[R0(C0-C127)]
SEG0	SEG0[C0(R0-R31)]
SEG1	SEG1[C1(R0-R31)]
SEG126	SEG126[C126(R0-R31)]
SEG127	SEG127[C127(R0-R31)]



UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MM
TOLERANCES:±0.1MM

15. IC LAYOUT



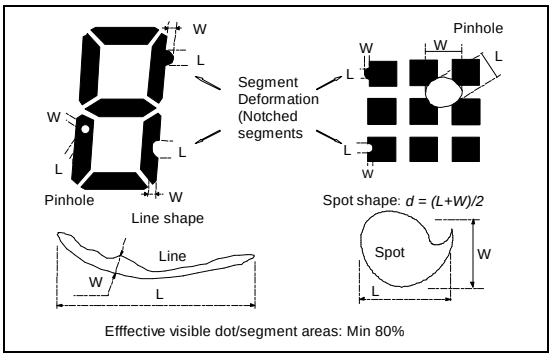
16. QUALITY DESCRIPTION

DEFECT SPECIFICATION:

Specific type-related items are covered in this sheet.

a: Table for Cosmetic defects
(Note: nc = not counted).
Sizes and number of defects
(Max. Qty)

Defect Type	Max. defect size [µm] d or L	W	Max. Quantity.
Black or White Spots	d ≤ 150		nc
	150< d ≤ 300		5
Black or White Lines	--	W ≤ 10	nc
	L ≤ 5000	W ≤ 30	3
	L ≤ 2000	W ≤ 50	2
Pinhole	d ≤ 150 150< d ≤ 300		nc 1/segment
(Total defects)			(5)
Segment Deformation		W ≤ 100	nc
Bubble (e.g. under pola)	d ≤ 150		nc
	200< d ≤ 400		3
	400< d ≤ 600		1

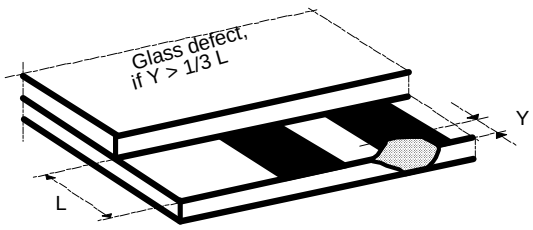


Examples/ Shapes

b: Glass defects

b1:Glass defects at contact ledge

b2:Glass chipping in other areas shall not be in conflict with the product's function.



17. MODULE ACCEPTS QUALITY LEVEL (AQL).

17.1. AQL standard value: Fatal defect =0.1, Major defect=0.65; Minor defect =2.5.
17.2. Inspection Plan: ANSI Z-1.4, Normal Inspection Level II, Single Sampling Plan.

18. RELIABILITY TEST

Operating life time: Longer than 50000 hours (at room temperature without direct irradiation of sunlight)
Reliability characteristics shall meet following requirements.

TEMPERATURE TESTS	NORMAL GRADE
High Temperature Storage	+80°C * 96HR
Low Temperature Storage	-30°C * 96HR
High Temperature Operation	+70°C * 96HR
Low Temperature Operation	-20°C * 96HR
High Temperature, High Humidity	+60°C 90%RH 96HR
Thermal Shock	-20°C * 30 min 10s ↓ 5Cycles 70°C * 30 min
Vibration Test	Frequency * Swing * Time 40Hz * 4mm * 4hrs
Drop Test	Drop height * Times 1.0m * 6 times

19. LCD MODULES HANDLING PRECAUTIONS

- The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
- If the display panel is damaged and the liquid crystal substance inside it leaks out, do not get any in your mouth. If the substance come into contact with your skin or clothes promptly wash it off using soap and water.
- Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarize carefully.
- To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
  -Be sure to ground the body when handling the LCD module.
  -Tools required for assembly, such as soldering irons, must be properly grounded.
  -To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.
  -The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.
- Storage precautions
  When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps. Keep the modules in bags designed to prevent static electricity charging under low temperature / normal humidity conditions (avoid high temperature / high humidity and low temperatures below -20℃). Whenever possible, the LCD modules should be stored in the same conditions in which they were shipped from our company.

20. OTHERS

- Liquid crystals solidify at low temperature (below the storage temperature range) leading to defective orientation of liquid crystal or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subjected to a strong shock at a low temperature.
- If the LCD modules have been operating for a long time showing the same display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. Abnormal operating status can be resumed to be normal condition by suspending use for some time. It should be noted that this phenomena does not adversely affect performance reliability.
- To minimize the performance degradation of the LCD modules resulting from caused by static electricity, etc. exercise care to avoid holding the following sections when handling the modules:
  - Exposed area of the printed circuit board
  - Terminal electrode sections

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