DISPLAY Elektronik GmbH

DATA SHEET

LCD MODULE

DEM 128064U FGH-PW

Product Specification   *Version: 2*

23.10.2020

GENERAL SPECIFICATION

MODULE NO. :

DEM 128064U FGH-PW

CUSTOMER   P/N

Version No.	Change Description	Date
0	Original Version	14.10.2020
1	Change to Parallel+ SPI Interface ;Add the BL lifetime	21.10.2020
2	Correct the "FSTN Blue" to "STN Blue" on page 2; Update the LCD drawing on page 13.	23.10.2020

PREPARED BY: CC   DATE: 23.10.2020

APPROVED BY: MHI   DATE: 23.10.2020

CONTENTS

1. FUNCTIONS & FEATURES

▮ DEM 128064U Series LCD Type :

MODULE	LCD TYPE	REMARK
DEM 128064U FGH-PW	FSTN Transflective Positive Mode	

▮ Viewing Direction   : 6 O'clock
▮ Driving Scheme   : 1/64 Duty, 1/9Bias
▮ Power Supply Voltage   : 3.0V
▮ LCD Operation Voltage   : 10V
▮ Display Contents   : 128 x 64 dots
▮ Interface   : 8-bit-Parallel or SPI Interface

2. MECHANICAL SPECIFICATIONS

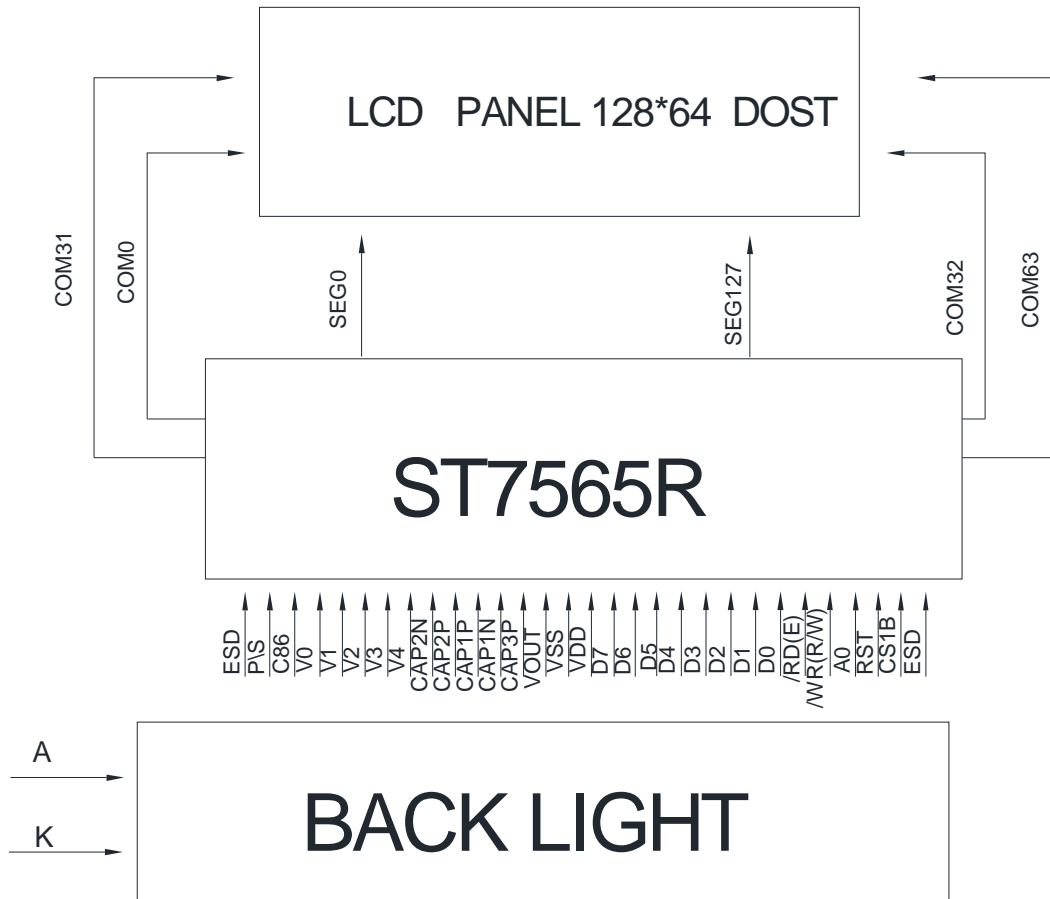▮ Module Size   : 50.00 mm x 34.00 mm x 4.50mm
▮ Viewing Area   : 44.00 mm x 23.50 mm
▮ Active Area   : 40.94 mm x 20.46 mm
▮ Dot Size   : 0.30 mm x 0.30 mm
▮ Dot Gap   : 0.02 mm

3. EXTERNAL DIMENSIONS

4. BLOCK DIAGRAM

5. PIN DESCRIPTION

Pin No.	Name	Description
1	ESD	Ground
2	P/S	This pin configures the interface to be parallel mode or serial mode. P/S = "H": Parallel data input/output. P/S = "L": Serial data input. The following applies depending on the P/S status: <table><tr><th>P/S</th><th>Data/Command</th><th>Data</th><th>Read/Write</th><th>4-line SPI Clock</th></tr><tr><td>"H"</td><td>A0</td><td>D0 to D7</td><td>/RD, /WR</td><td>X</td></tr><tr><td>"L"</td><td>A0</td><td>SI (D7)</td><td>Write only</td><td>SCL (D6)</td></tr></table> When P/S = "L", D0 to D5 must be fixed to "H". /RD (E) and /WR (R/W) are fixed to either "H" or "L". The serial access mode does NOT support read operation.
3	C86	This is the MPU interface selection pin. C86 = "H": 6800 Series MPU interface. C86 = "L": 8080 Series MPU interface.
4	V0	This is a multi-level power supply for the liquid crystal drive. The voltage Supply 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 Vss, and must maintain the relative magnitudes shown below. $V_0 \geqq V1 \geqq V2 \geqq V3 \geqq V4 \geqq Vss$
5	V1	
6	V2	
7	V3	
8	V4	
9	CAP2N	DC/DC voltage converter.
10	CAP2P	
11	CAP1P	
12	CAP1N	
13	CAP3P	
14	VOUT	
15	VSS	
16	VDD	Power supply
17	D7	This is an 8-bit bi-directional data bus that connects to an 8-bit or 16-bit standard MPU data bus. When the serial interface (SPI-4) is selected (P/S = "L") : D7 : serial data input (SI) ; D6 : the serial clock input (SCL). D0 to D5 should be connected to VDD or floating. When the chip select is not active, D0 to D7 are set to high impedance.
18	D6	
19	D5	
20	D4	
21	D3	
22	D2	
23	D1	
24	D0	
25	/RD(E)	When connected to 8080 series MPU, this pin is treated as the "/RD" signal of the 8080 MPU and is LOW-active. The data bus is in an output status when this signal is "L". • When connected to 6800 series MPU, this pin is treated as the "E" signal of the 6800 MPU and is HIGH-active. This is the enable clock input terminal of the 6800 Series MPU.
26	/WR(R/W)	When connected to 8080 series MPU, this pin is treated as the "/WR" signal of the 8080 MPU and is LOW-active. The signals on the data bus are latched at the rising edge of the /WR signal. • When connected to 6800 series MPU, this pin is treated as the "R/W" signal of the 6800 MPU and decides the access type : When R/W = "H": Read. When R/W = "L": Write.
27	A0	This is connect to the least significant bit of the normal MPU address bus, and it determines whether the data bits are data or command. A0 = "H": Indicates that D0 to D7 are display data. A0 = "L": Indicates that D0 to D7 are control data.
28	RST	When RST is set to "L", the register settings are initialized (cleared). The reset operation is performed by the RST signal level.

29	CS1B	This is the chip select signal. When CS1B = "L"
30	ESD	Ground.
31	A	Supply voltage for backlight LED+
32	K	Supply voltage for backlight LED-

6. BACKLIGHT ELECTRICAL/OPTICAL SPECIFICATIONS

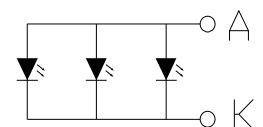| Item	Symbol	min.	typ.	max.	Unit	Condition
Forward Voltage	Vf	2.6	3	3.4	V	If= 45 mA
Power Dissipation	Pd	−	−	153	mW	If= 45 mA
Luminous Uniformity	ΔLv	70			%	MIN/MAX*100%
Luminance	Lv		800		cd/m^2	If= 45 mA T= 25°C
Color Coordinate	X	0.26		0.33		
	Y	0.23		0.30		
LED Lifetime			50000H			
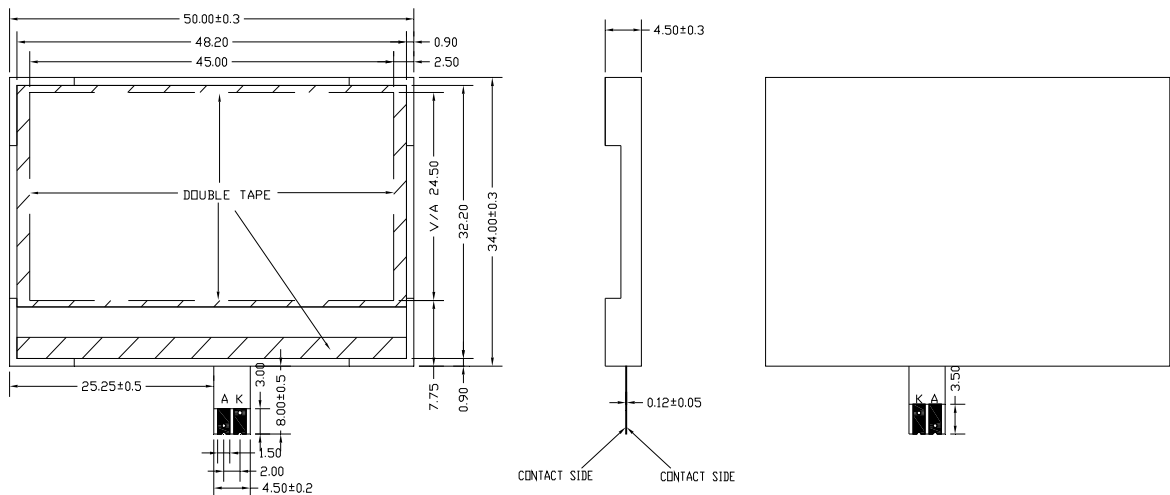
Remarks:
1.Unmarked tolerance is ±0.2
2.All materials comply with RoHs
3. ☐ ....:critical dimension.

Circuit Diagram
Color: WHITE

7. MAXIMUM ABSOLUTE LIMIT

Characteristic		Symbol	Conditions	Unit
Power Supply Voltage		VDD	-0.3 ~ 3.6	V
Power Supply Voltage (VDD standard)		VDD2	-0.3 ~ 3.6	V
Power Supply Voltage (VDD standard)		V0, VOUT	-0.3 ~ 13.5	V
Power Supply Voltage (VDD standard)		V1, V2, V3, V4	-0.3 to V0	V
Operating Temperature		TOPR	−20 to +70	°C
Storage Temperature	Bare chip	TSTR	−30 to +80	°C

8. ELECTRICAL CHARACTERISTICS

8-1. DC Characteristics

Item	Symbol	Min	Typ	Max	Condition	Unit	Remark
Operating voltage	V_{DD}	2.7	3.0	3.3		V	
LCD driving voltage	V_{LCD}	9.7	10	10.3	-	V	
Operating current	I_{DD}	---	TBD	---		mA	

8-2. AC Characteristics

System Bus Read/Write Characteristics 1 (For the 8080 Series MPU)

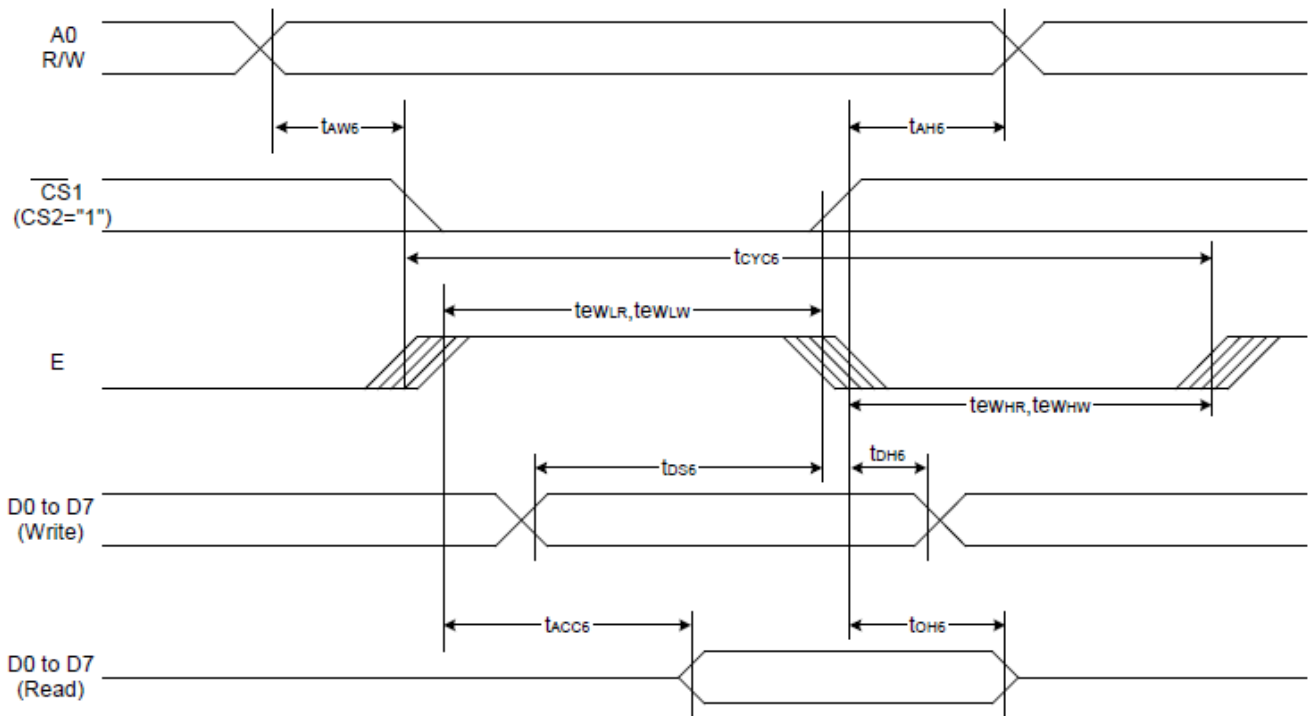| Item	Signal	Symbol	Condition	Rating Min.	Rating Max.	Units
Address hold time	A0	t_{AH8}		0	—	
Address setup time		t_{AW8}		0	—	
System cycle time		t_{CYC8}		240	—	
Enable L pulse width (WRITE)	WR	t_{CCLW}		80	—	
Enable H pulse width (WRITE)		t_{CCHW}		80	—	
Enable L pulse width (READ)	RD	t_{CCLR}		140	—	Ns
Enable H pulse width (READ)		t_{CCHR}		80	—	
WRITE Data setup time	D0 to D7	t_{DS8}		40	—	
WRITE Address hold time		t_{DH8}		0	—	
READ access time		t_{ACC8}	$C_L = 100\ pF$	—	70	
READ Output disable time		t_{OH8}	$C_L = 100\ pF$	5	50	

System Bus Read/Write Characteristics 2 (For the 6800 Series MPU)

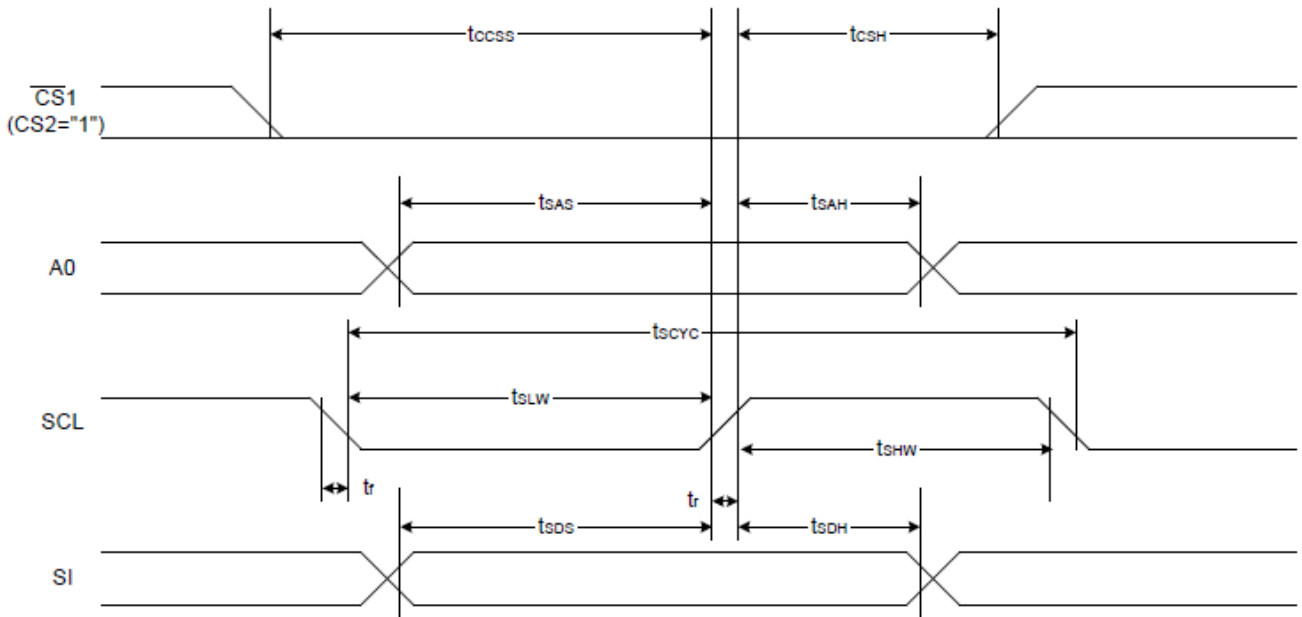| Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	t_{AH6}		0	—	ns
Address setup time		t_{AW6}		0	—	
System cycle time		t_{CYC6}		240	—	
Enable L pulse width (WRITE)	WR	t_{EWLW}		80	—	
Enable H pulse width (WRITE)		t_{EWHW}		80	—	
Enable L pulse width (READ)	RD	t_{EWLR}		80	—	
Enable H pulse width (READ)		t_{EWHR}		140	—	
WRITE Data setup time	D0 to D7	t_{DS6}		40	—	
WRITE Address hold time		t_{DH6}		0	—	
READ access time		t_{ACC6}	$C_L = 100$ pF	—	70	
READ Output disable time		t_{OH6}	$C_L = 100$ pF	5	50	

The 4-line SPI Interface

| Item	Signal	Symbol	Condition	Rating Min.	Rating Max.	Units
4-line SPI Clock Period	SCL	T_{scyc}		50	—	ns
SCL "H" pulse width		T_{shw}		25	—	
SCL "L" pulse width		T_{SLW}		25	—	
Address setup time	A0	T_{SAS}		20	—	
Address hold time		T_{sah}		10	—	
Data setup time	SI	T_{sds}		20	—	
Data hold time		T_{SDH}		10	—	
CS-SCL time	CS	T_{css}		20	—	
CS-SCL time		T_{csh}		40	—	

9. INSTRUCTION DESCRIPTION

Instruction Set

| Command	A0	/RD	/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	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 0: 1/9 bias, 1: 1/7 bias (ST7565R)
(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$_0$ 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	Set the V$_0$ output voltage electronic volume register
Electronic volume register set				0	0	Electronic volume value						
(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	0	0	0	0	0	0	Mode	Set the flashing mode
(20) Booster ratio set	0	1	0	1	1	1	1	1	0	0	0	select booster ratio 00: 2x,3x,4x 01: 5x 11: 6x
				0	0	0	0	0	0	step-up value		
(21) Power save	0	1	0									Display OFF and display all points ON compound command
(22) NOP	0	1	0	1	1	1	0	0	0	1	1	Command for non-operation
(23) Test	0	1	0	1	1	1	1	*	*	*	*	Command for IC test. Do not use this command

10 LCD LAYOUT

10-1. ARTWORK
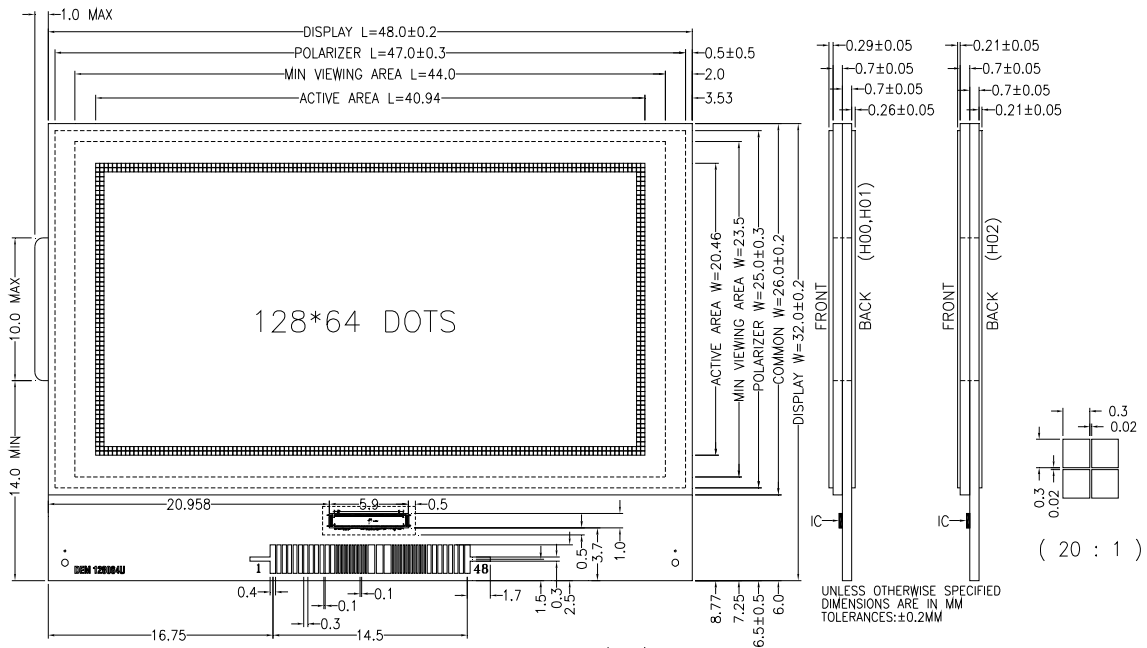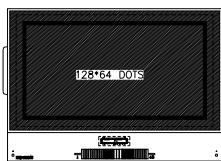
Pin Interface(LCD)

PIN	1	2~12	13	14	15	16	17	18
NAME	ESD	NC	PSB	C86	V0	V1	V2	V3
PIN	19	20	21	22	23	24	25	26
NAME	V4	CAP2N	CAP2P	CAP1P	CAP1N	CAP3P	VOUT	VSS
PIN	27	28	29	30	31	32	33	34
NAME	VDD	D7	D6	D5	D4	D3	D2	D1
PIN	35	36	37	38	39	40	41~47	48
NAME	D0	/RD(E)	/WR(R/W)	A0	RST	CS1B	NC	ESD

10-3. SEG&COM LAYOUT
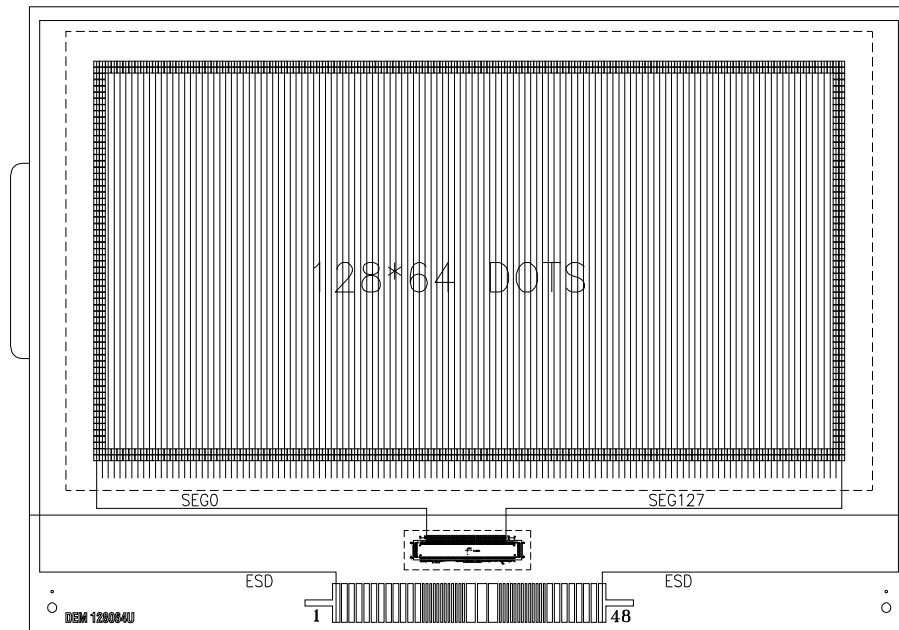
SEG LAYOUT
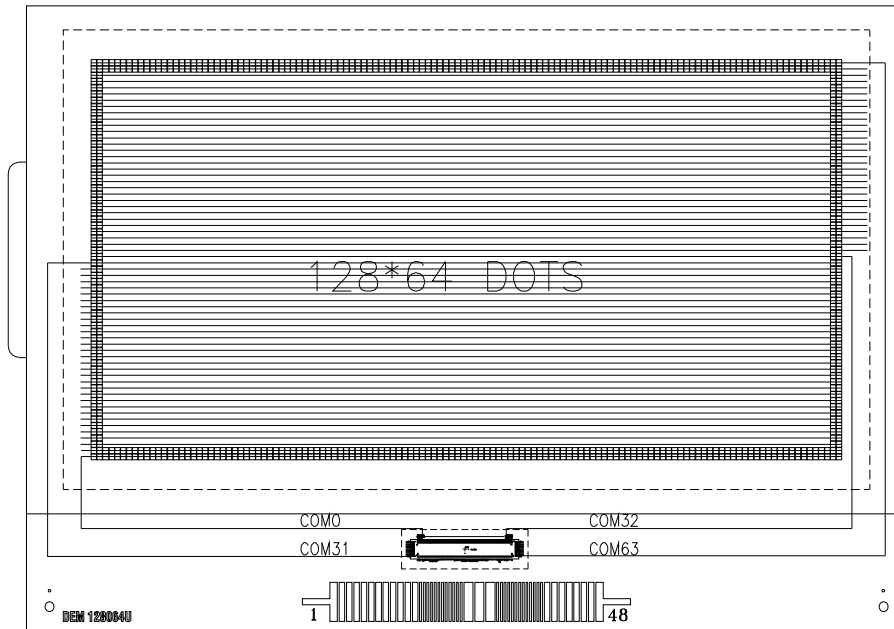
COM LAYOUT

12. IC LAYOUT

IC LAYOUT (10 : 1)

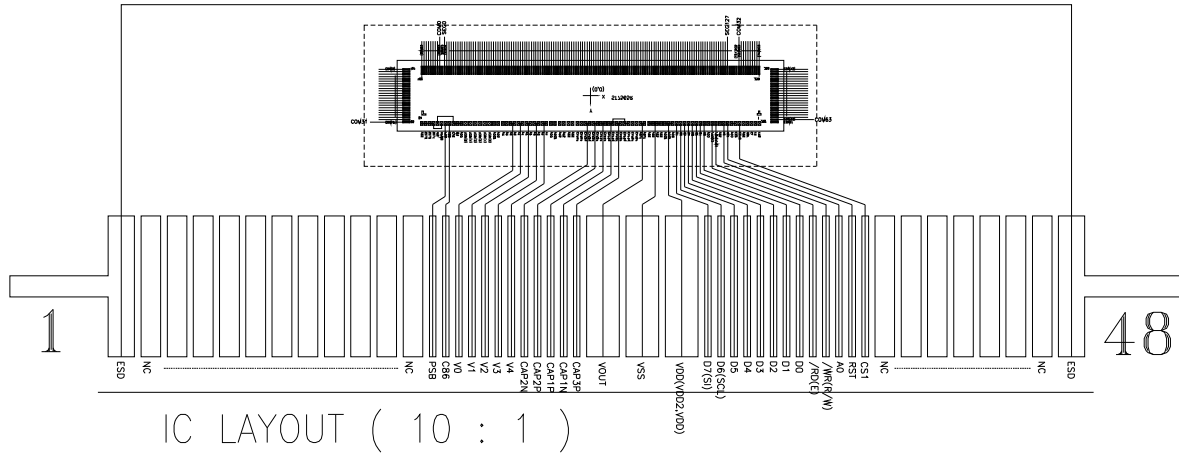## 14. MODULE ACCEPT QUALITY LEVEL (AQL)

Inspection Plan: ANSI Z-1.4, Normal Inspection Level II, Single Sampling Plan.

15. 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 x 96hrs
Low Temperature Storage	-30°C x 96hrs
High Temperature Operation	+70°C x 96hrs
Low Temperature Operation	-20°C x 96hrs
High Temperature, High Humidity	+60°C x 90%RH x 96hrs (Without Polarizer)
Thermal Shock	-20°C x 30min 10s 5Cycles +70°C x 30min.
Vibration Test	Frequency xSwing x Time 40Hz x 4mm x 4hrs
Drop Test	Drop height x Times 1.0m x 6times

16. 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 0℃).Whenever possible, the LCD modules should be stored in the same conditions in which they were shipped from our company.

17. 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