Display Elektronik GmbH

DATA SHEET

LCD MODULE

DEM 240160C FGH-PW

Product Specification   Ver.: 0

20.11.2019

Revision Status

Version	Revise Date	Page	Content	Modified By
0	20.11.2019	**-**	First issued	

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1. FEATURES

The features of LCD are as follows

     * Display Mode   : FSTN / Transflective / Positive

     * Drive IC   : ST7529

     * Interface   : 8080 Series

     * Driving Method   : 1/160duty, 1/12bias

     * Viewing Direction   : 6 O'clock

     * Backlight   :4 LED /White

     * Sample NO.   :-

2. MECHANICAL SPECIFICATIONS

Item	Specification	Unit
Module Size	77.42 x 61.00 x 5.30	mm
Number of Dots	240 x 160 dots	-
View Display Area	73.42 x 46.50	mm
Activity Display Area	67.42 x 44.94	mm
Dot Size	0.261 x 0.261	mm
Dot Pitch	0.281 x 0.281	mm

3. ELECTRICAL SPECIFICATIONS

3-1. ABSOLUTE MAXIMUM RATINGS (Ta = 25 °C)

Item	Symbol	Standard Value			Unit
		Min.	Typ.	Max.	
Supply Voltage For Logic	V_{DD}–V_{SS}	-0.5	-	4.0	V
Supply Voltage For LCD Drive	V_{LCD}	-0.5	-	18	V
Input Voltage	Vin	-0.5	-	V_{DD}+0.5	V
Operating Temp.	Top	-20	-	+70	°C
Storage Temp.	Tst	-30	-	+80	°C

*NOTE: The response time will be extremely slow when the operating temperature is around -10℃, and the back ground will become darker at high temperature operating.

3-2. ELECTRICAL CHARACTERISTICS

Item		Symbol	Test Condition	Min.	Typ.	Max.	Unit
Logic Supply Voltage		V_{DD}-V_{SS}		2.5	3	3.3	V
LCD Drive		V_{LCD}		-	15	-	V
Input Voltage	"H" Level	V_{IH}	V_{DD} = 3V Ta= 25°C	0.7V_{DD}	-	V_{DD}	V
	"L" Level	V_{IL}		V_{SS}	-	0.3V_{DD}	V
Frame Frequency		f_{FLM}			78		Hz
Current Consumption		I_{DD}		-	TBD	-	mA

3-3 BACKLIGHT

3-3-1. Absolute Maximum Ratings

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Current	Ifm		-	-	60	mA
Reverse Voltage	Vr	Ta = 25 °C	-	-	5	V
Power Dissipation	Pd		-	-	192	mW

3-3-2. Electrical-optical Characteristics

| Item	Symbol	Condition	Min.		Typ.		Max.		Unit
Forward Voltage	Vf		2.9		3.1		3.2		V
Luminance	Lv		150		-		-		cd/m^2
LED Lifetime	-	If = 60mA Ta = 25 °C	20,000		30,000		-		hour
Color Coordinate	-		X	Y	X	Y	X	Y	-
			0.25	0.25	0.28	0.28	0.32	0.32	

*NOTE: The brightness is measured without LCD panel.

4. TERMINAL FUNCTIONS AND BLOCK DIAGRAM
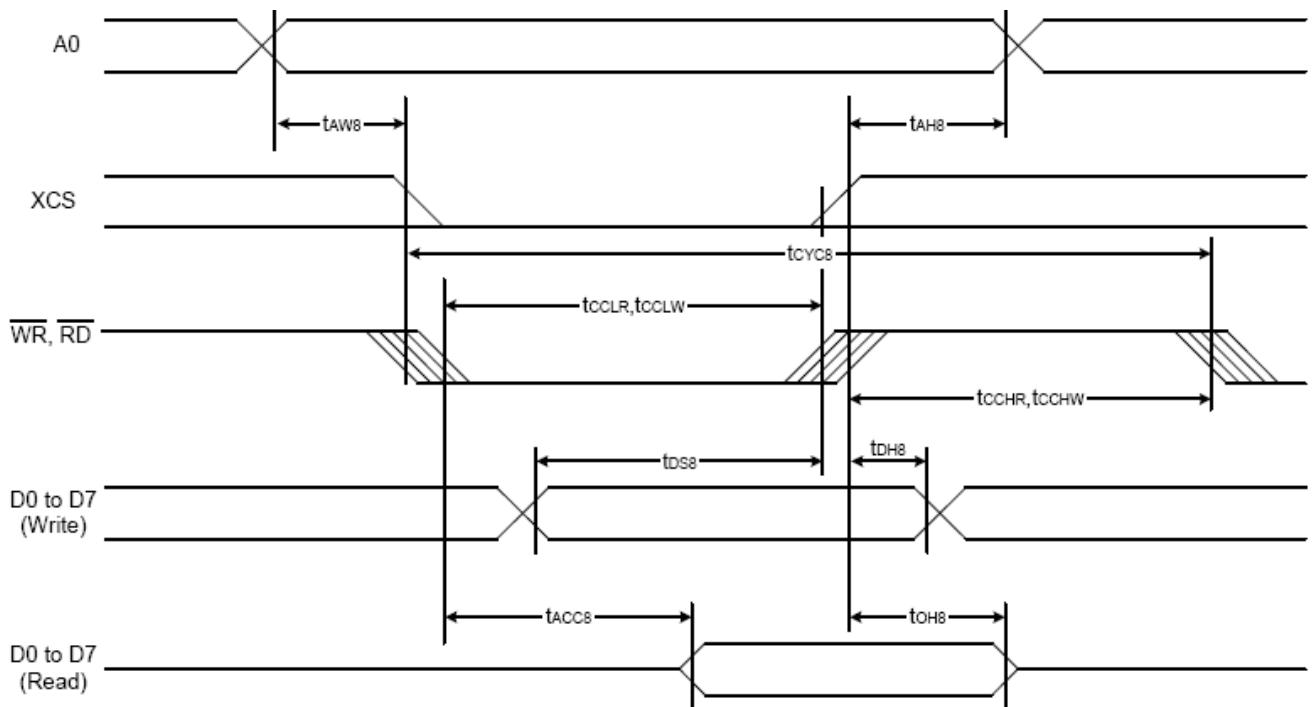
4-1. INTERFACE PIN FUNCTION DESCRIPTION

| Pin No.	Pin Name	Function
1	A0	Register selection (H : data register ; L : instruction register)
2	/WR	Write signal
3~18	DB0~DB15	Data bus
19	/RD	Read signal
20	/RES	Reset signal
21	IF3	8-bit/16-bit data bus selection
22	/CS	Chip enable
23	VDD	Power supply for logic(+3.0V)
24	VSS	Power supply (ground)
25	VDD2	Power supply for booster circuit(+3.0V)
26	C7+	Capacitor positive connection
27	C5+	Capacitor positive connection
28	C3+	Capacitor positive connection
29	C1-	Capacitor negative connection
30	C1+	Capacitor positive connection
31	C2+	Capacitor positive connection
32	C4+	Capacitor negative connection
33	C2-	Capacitor positive connection
34	C6+	Capacitor positive connection
35	Vlcd	External LCD driver voltage supply
36	V4	LCD driver supply voltage
37	V3	LCD driver supply voltage
38	V2	LCD driver supply voltage
39	V1	LCD driver supply voltage
40	V0	LCD driver supply voltage

4-2. BLOCK DIAGRAM
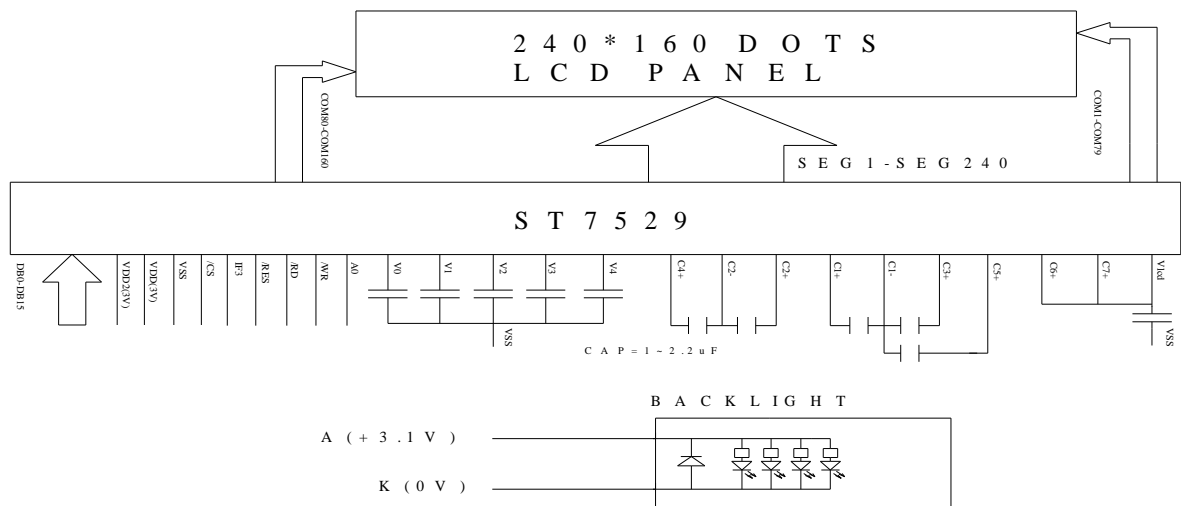
5. TIMING CHARACTERISTICS

5-1. System Bus Read/Write Characteristics (For the 8080 Series MPU)

Item	Signal	Symbol	Condition	Rating Min.	Rating Max.	Units
Address hold time	A0	tAH8	-	20	-	
Address setup time		tAW8	-	20	-	
System cycle time		tCYC8	-	200	-	
Enable L pulse width (WRITE)	WR	tCCLW	-	100	-	
Enable H pulse width (WRITE)		tCCHW	-	100	-	
Enable L pulse width (READ)	RD	tCCLR	-	100	-	ns
Enable H pulse width (READ)		tCCHR	-	100	-	
WRITE Data setup time	D0 to D7	tDS8	-	150	-	
WRITE Address hold time		tDH8	-	20	-	
READ access time		tACC8	CL = 100 pF	-	40	
READ Output disable time		tOH8	CL = 100 pF	-	30	

5-2. The Reset Timing

RST

Internal status

During reset

Reset complete

t_{RW}

t_R
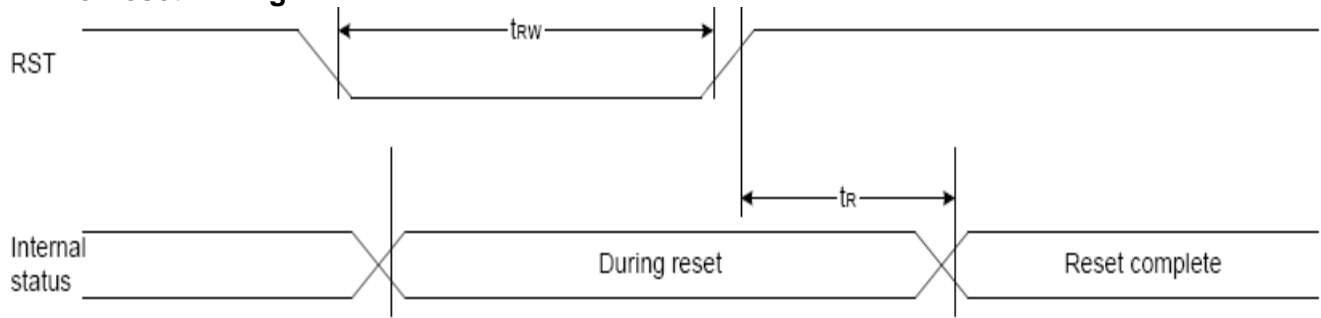
Item	Signal	Symbol	Condition	Rating			Units
				Min.	Typ.	Max.	
Reset time		tR	-	-	-	1	us
Reset "L" pulse width	RST	tRW	-	1	-	-	us

6. INSTRUCTION SET

6-1. Command

Ext=0 or Ext=1

Index	Command	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0	Function	Hex	Parameter
1	Ext In	0	1	0	0	0	1	1	0	0	0	0	Ext=0 Set	30	None
2	Ext Out	0	1	0	0	0	1	1	0	0	0	1	Ext=1 Set	31	None

Ext=0

Index	Command	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0	Function	Hex	Parameter
1	DISON	0	1	0	1	0	1	0	1	1	1	1	Display On	AF	None
2	DISOFF	0	1	0	1	0	1	0	1	1	1	0	Display Off	AE	None
3	DISNOR	0	1	0	1	0	1	0	0	1	1	0	Normal Display	A6	None
4	DISINV	0	1	0	1	0	1	0	0	1	1	1	Inverse Display	A7	None
5	COMSCN	0	1	0	1	0	1	1	1	0	1	1	COM Scan Direction	BB	1 byte
6	DISCTRL	0	1	0	1	1	0	0	1	0	1	0	Display Control	CA	3 bytes
7	SLPIN	0	1	0	1	0	0	1	0	1	0	1	Sleep In	95	None
8	SLPOUT	0	1	0	1	0	0	1	0	1	0	0	Sleep Out	94	None
9	LASET	0	1	0	0	1	1	1	0	1	0	1	Line Address Set	75	2 bytes
10	CASET	0	1	0	0	0	0	1	0	1	0	1	Column Address Set	15	2 bytes
11	DATSDR	0	1	0	1	0	1	1	1	1	0	0	Data Scan Direction	BC	3 bytes
12	RAMWR	0	1	0	0	1	0	1	1	1	0	0	Writing to Memory	5C	Data
13	RAMRD	0	1	0	0	1	0	1	1	1	0	1	Reading from Memory	5D	Data
14	PTLIN	0	1	0	1	0	1	0	1	0	0	0	Partial display in	A8	2 bytes
15	PTLOUT	0	1	0	1	0	1	0	1	0	0	1	Partial display out	A9	None
16	RMWIN	0	1	0	1	1	1	0	0	0	0	0	Read and Modify Write	E0	None
17	RMWOUT	0	1	0	1	1	1	0	1	1	1	0	RMW end	EE	None
18	ASCSET	0	1	0	1	0	1	0	1	0	1	0	Area Scroll Set	AA	4 bytes
19	SCSTART	0	1	0	1	0	1	0	1	0	1	1	Scroll Start Set	AB	1 byte
20	OSCON	0	1	0	1	1	0	1	0	0	0	1	Internal OSC on	D1	None
21	OSCOFF	0	1	0	1	1	0	1	0	0	1	0	Internal OSC off	D2	None
22	PWRCTRL	0	1	0	0	0	1	0	0	0	0	0	Power Control	20	1 byte
23	VOLCTRL	0	1	0	1	0	0	0	0	0	0	1	EC control	81	2 bytes
24	VOLUP	0	1	0	1	1	0	1	0	1	1	0	EC increase 1	D6	None
25	VOLDOWN	0	1	0	1	1	0	1	0	1	1	1	EC decrease 1	D7	None
26	RESERVED	0	1	0	1	0	0	0	0	0	1	0	Not Use	82	0

27	EPSRRD1	0	1	0	0	1	1	1	1	1	0	0	READ Register1	7C	None
28	EPSRRD2	0	1	0	0	1	1	1	1	1	0	1	READ Register2	7D	None
29	NOP	0	1	0	0	0	1	0	0	1	0	1	NOP Instruction	25	None
30	STREAD	0	0	1	Read Data								Status Read		
31	EPINT	0	1	0	0	0	0	0	0	1	1	1	Initial code(1)	07	1 byte

Ext=1

Index	Command	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0	Function	Hex	Parameter
1	Gray 1 Set	0	1	0	0	0	1	0	0	0	0	0	FRAME 1 Gray PWM Set	20	16 bytes
2	Gray 2 Set	0	1	0	0	0	1	0	0	0	0	1	FRAME 2 Gray PWM Set	21	16 bytes
3	ANASET	0	1	0	0	0	1	1	0	0	1	0	Analog Circuit Set	32	3 bytes
4	SWINT	0	1	0	0	0	1	1	0	1	0	0	Software Initial	34	None
5	EPCTIN	0	1	0	1	1	0	0	1	1	0	1	Control EEPROM	CD	1 byte
6	EPCOUT	0	1	0	1	1	0	0	1	1	0	0	Cancel EEPROM	CC	None
7	EPMWR	0	1	0	1	1	1	1	1	1	0	0	Write to EEPROM	FC	None
8	EPMRD	0	1	0	1	1	1	1	1	1	0	1	Read from EEPROM	FD	None

Note: The table above is for 8-bit interface. For the application of 16-bit interface, fill D15~8 with 0, and other bits are just the same with the table above.

6-2. Initialization Sequence
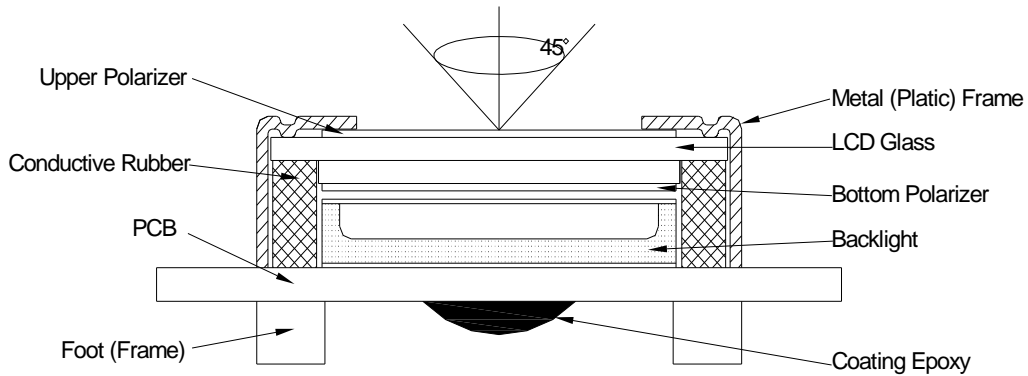### 6-2-1. Initializing with the Built-in Power Supply Circuits

```
┌─────────────────────────────────────────────┐
│        User System Setup by External Pins    │
└─────────────────────────────────────────────┘
                      ↓
      ┌───────────────────────────────────┐
      │        Start of Initialization     │
      └───────────────────────────────────┘
                      ↓
   ┌──────────────────────────────────────────┐
   │   Power On and Keeping the /RES Pin="L"   │
   └──────────────────────────────────────────┘
                      ↓
   ┌──────────────────────────────────────────┐
   │      Waiting for Stabilizing the Power     │
   └──────────────────────────────────────────┘
                      ↓
   ┌──────────────────────────────────────────┐
   │      /RES Pin="H" and wait time > 1.8 us   │
   └──────────────────────────────────────────┘
                      ↓
        ┌─────────────────────────────────┐
        │            Initial Code          │
        └─────────────────────────────────┘
                      ↓
        ┌─────────────────────────────────┐
        │        End of Initialization     │
        └─────────────────────────────────┘
```
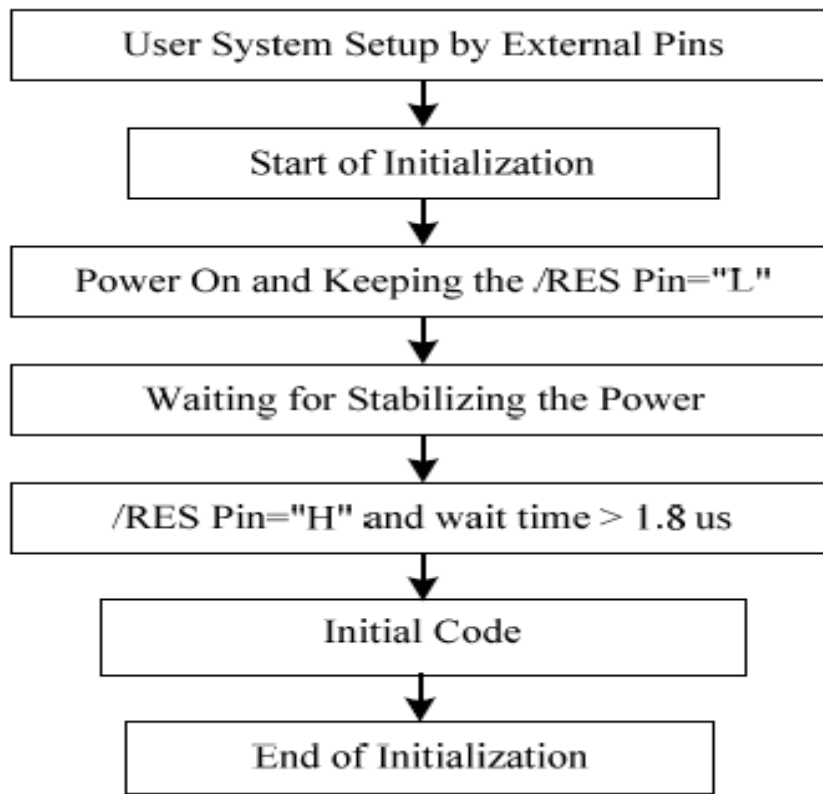
When Power-ON (VDD/VDD2 goes from low to high), please follow the sequence shown below. If not, some unpredictable result may occur.
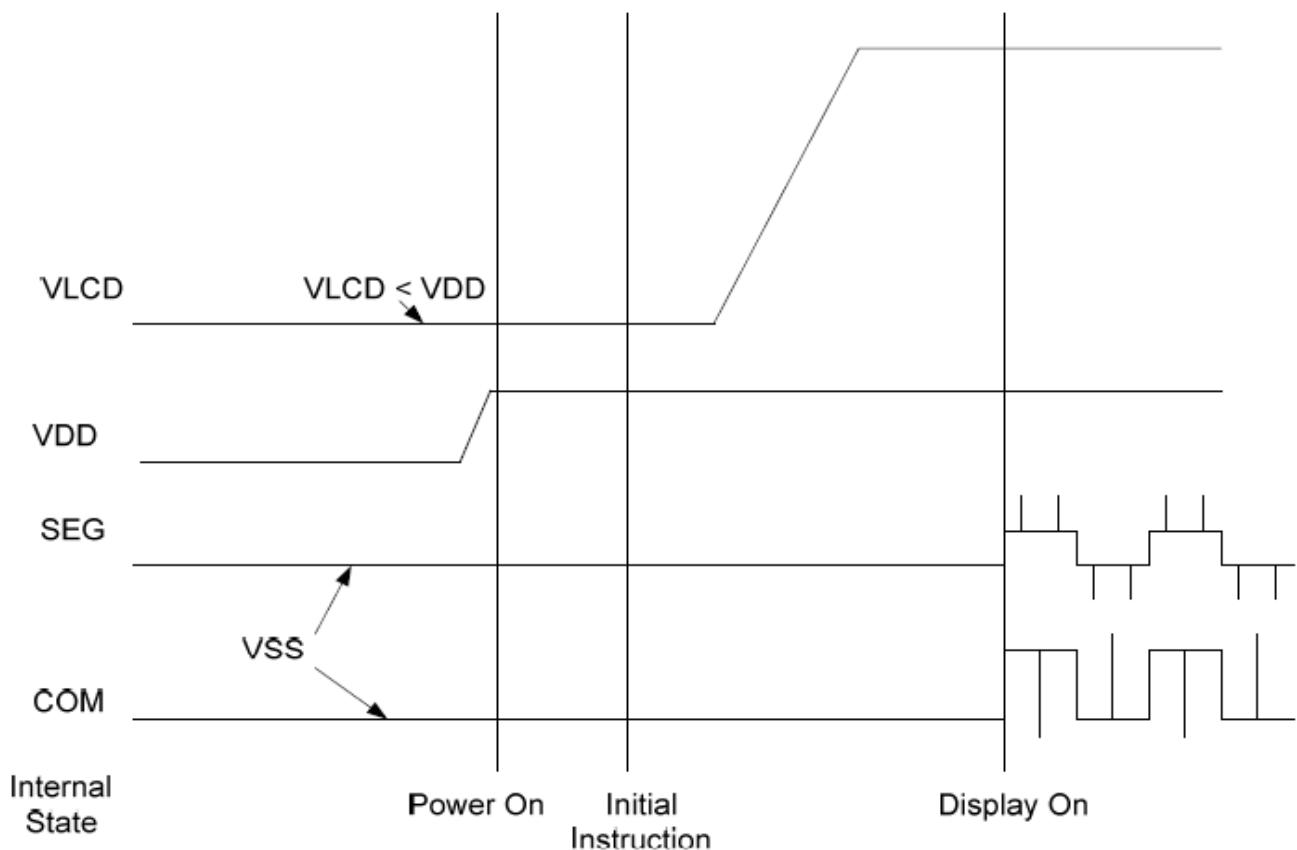
7. QUALITY SPECIFICATIONS

7-1. LCM Appearance and Electric inspection Condition

1. Inspection will be done by placing LCM 30cm away from inspector's eyeballs under normal illumination.

Upper Polarizer · Metal (Platic) Frame · LCD Glass · Conductive Rubber · Bottom Polarizer · PCB · Backlight · Foot (Frame) · Coating Epoxy · 45°

2. View Angle: with in 45°around perpendicular line.

7-2. Definition

1. COB

PCB · Metal (Plastic) Frame · LCD

2. Heat Seal

LCD

Heat Seal

3. TAB and COG

LCD Glass · ITO Terminal Pad · IC

TAB

LCD Glass · IC · Pin
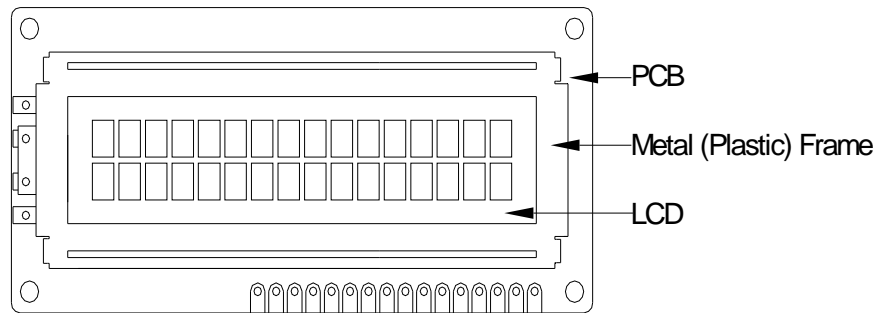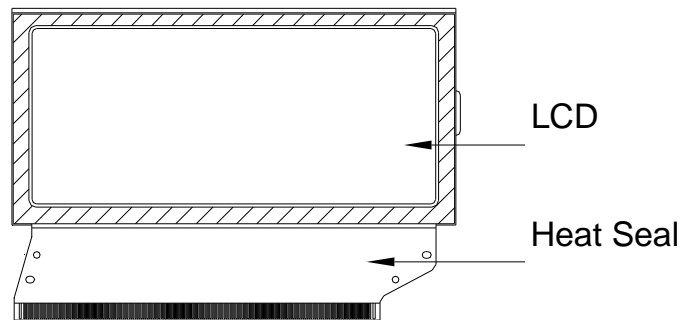
COG
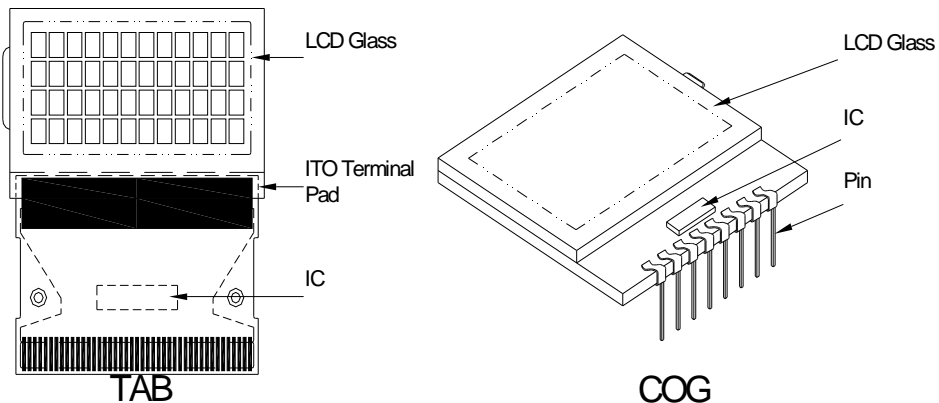
7-3. Sampling Plan and Acceptance

1. Sampling Plan

   MIL - STD - 105E (□) ordinary single inspection is used.

2. Acceptance

   Major defect: AQL = 0.25%
   Minor defect: AQL = 0.65%
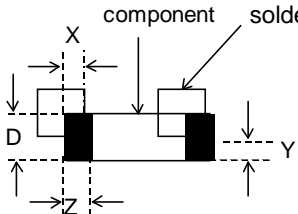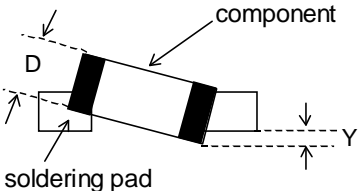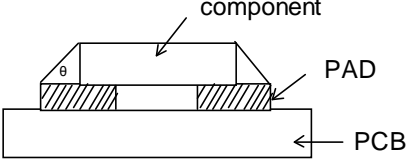
7-4. Criteria

1. COB

Defect	Inspection Item	Inspection Standards	
Major	PCB copper flakes peeling off	Any copper flake in viewing Area should be greater than 1.0mm^2	Reject
Major	Height of coating epoxy	Exceed the dimension of drawing	Reject
Major	Void or hole of coating epoxy	Expose bonding wire or IC	Reject
Major	PCB cutting defect	Exceed the dimension of drawing	Reject
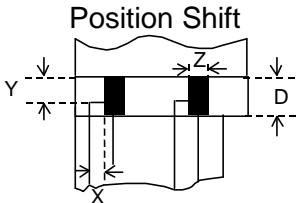
2. SMT

Defect	Inspection Item	Inspection Standards	
Minor	Component marking not readable		Reject
Minor	Component height	Exceed the dimension Of drawing	Reject
Major	Component solder defect (missing , extra, wrong component or wrong orientation		Reject
Minor	Component position shift	$X < 3/4Z$ $Y > 1/3D$	Reject Reject
Minor	Component tilt	$Y > 1/3D$	Reject
Minor	Insufficient solder	$\theta \leq 20°$	Reject

3. Metal (Plastic) Frame

Defect	Inspection Item	Inspection Standards		
Major	Crack / Breakage	Anywhere		Reject
Minor	Frame Scratch	W	L	Acceptable of Scratch
		w<0.1mm	Any	Ignore
		0.1≤w<0.2mm	L≤5.0mm	2
		0.2≤w<0.3mm	L≤3.0mm	1
		w≥0.3mm	Any	0
		Note : 1. Above criteria applicable to scratch lines with distance greater than 5mm.　2. Scratch on the back side of frame (not visible) can be ignored .		
Minor	Frame Dent , Prick $$\Phi = \frac{L+W}{2}$$			Acceptable of Dents / Pricks
		$\Phi \leq 1.0$mm		2
		$1.0 < \Phi \leq 1.5$mm		1
		1.5mm$< \Phi$		0
		Note : 1. Above criteria applicable to any two dents / pricks with distance greater than 5mm　2. Dent / prick on the back side of frame (not visible) can be ignored		
Minor	Frame Deformation	Exceed the dimension of drawing		
Minor	Metal Frame Oxidation	Any rust		
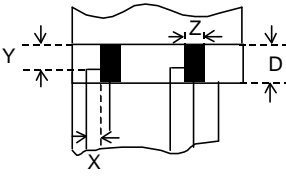
4. Flexible Film Connector (FFC)

Defect	Inspection Item	Inspection Standards	
Minor	Tilted Soldering	Within the angle +5°	Acceptable
Minor	Uneven Solder Joint / Bump		Reject
Minor	Hole $\Phi = \dfrac{L+W}{2}$	Expose the conductive line	Reject
		$\Phi > 1.0$mm	Reject
Minor	Position Shift	Y > 1/3D	Reject
		X > 1/2Z	Reject

5. Screw

Defect	Inspection Item	Inspection Standards	
Major	Screw Missing / Loosen		Reject
Minor	Screw Oxidation	Any Rust	Reject
Minor	Screw Deformation	Difficult to accept Screw Driver	Reject

6. Heatseal, TCP, FPC

Defect	Inspection Item	Inspection Standards	
Major	Scratch Expose Conductive Layer		Reject
Minor	HS Hole $\Phi = \dfrac{L + W}{2}$	$\Phi > 0.5mm$	Reject
Major	Adhesion Strength	Less than the specification	Reject
Minor	Position Shift	$Y > 1/3D$	Reject
		$X > 1/2Z$	Reject
Major	Conductive Line Break		Reject
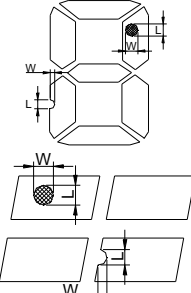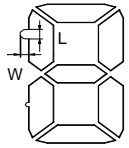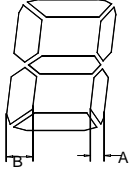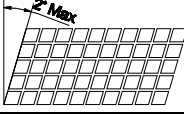
7. LED Backing Protective Film and Others

Defect	Inspection Item	Inspection Standards	
Minor	LED Dirty, Prick	Acceptable number of units	
		$\Phi \leq 0.10mm$	Ignore
		$0.10 < \Phi \leq 0.15mm$	2
		$0.15 < \Phi \leq 0.2mm$	1
		$\Phi > 0.2mm$	0
		The distance between any two spots should be $\geq 5mm$ Any spot/dot/void outside of viewing area is acceptable	
Minor	Protective Film Tilt	Not fully cover LCD	Reject
Major	COG Coating	Not fully cover ITO circuit	Reject

8. Electric Inspection

Defect	Inspection Item	Inspection Standards	
Major	Short		Reject
Major	Open		Reject

9. Inspection Specification of LCD

Defect	Inspect Item	Inspection Standards			
Minor	Linear Defect * Glass Scratch * Polarizer Scratch * Fiber and Linear material	W	W$\leq$0.03	0.03<W$\leq$0.05	W>0.05
		L	L<5	L<3	Any
		ACC. NO.	1	1	Reject
		Note	L is the length and W is the width of the defect		

Minor	Black Spot and Polarizer Pricked * Foreign material between glass and polarizer or glass and glass * Polarizer hole or protuberance by external force	Φ	Φ$\leq$0.1	0.1<Φ$\leq$0.15	0.15<Φ$\leq$0.2	Φ>0.2
		ACC. NO.	3EA / 100mm^2	2	1	0
		Note	Φ is the average diameter of the defect. Distance between two defects > 10mm.			

Minor	White Spot and Bubble in polarizer * Unobvious transparant foreign material between glass and glass or glass and polarizer * Air protuberance between polarizer and glass	Φ	Φ$\leq$0.3	0.3<Φ$\leq$0.5	0.5<Φ
		ACC. NO.	3EA / 100mm^2	1	0
		Note	Φ is the average diameter of the defect. Distance between two defects > 10mm.		

Minor	Segment Defect	Φ	Φ$\leq$0.10	0.10<Φ$\leq$0.20	0.20<Φ$\leq$0.25	Φ>0.25
		ACC. NO.	3EA / 100mm^2	2	1	0
		Note	W is more than 1/2 segment width			Reject
			$\Phi = \dfrac{L+W}{2}$ Distance between two defect is 10mm			

Minor	Protuberant Segment $\Phi = (L + W) / 2$	Φ	Φ$\leq$0.10	0.10<Φ$\leq$0.20	0.20<Φ$\leq$0.25	Φ>0.25
		W	Glue	W$\leq$1/2 Seg W$\leq$0.2	W$\leq$1/2 Seg W$\leq$0.2	Ignore
		ACC. NO.	3EA / 100mm^2	2	1	0

Minor	Assembly Mis-alignment	1. Segment			
		B	B$\leq$0.4mm	0.4<B$\leq$1.0mm	B>1.0mm
		B-A	B-A<1/2B	B-A<0.2	B-A<0.25
		Judge	Acceptable	Acceptable	Acceptable
		2. Dot Matrix			
		Deformation>2°			Reject

Minor	Stain on LCD Panel Surface	Accept when stains can be wiped lightly with a soft cloth or a similar one. Otherwise, judged according to the above items: "Black spot" and "White Spot"

8. RELIABILITY

No	Item	Condition	Quantity	Criteria
1	High Temperature Operating	70°C, 96Hrs	2	GB/T2423.2 -2008
2	Low Temperature Operating	-20°C, 96Hrs	2	GB/T2423.1 -2008
3	High Humidity	60°C, 90%RH, 96Hrs	2	GB/T2423.3 -2016
4	High Temperature Storage	80°C, 96Hrs	2	GB/T2423.2 -2008
5	Low Temperature Storage	-30°C, 96Hrs	2	GB/T2423.1 -2008
6	Thermal Cycling Test	-20°C, 60min~70°C, 60min, 20 cycles.	2	GB/T2423.22 -2012
7	Packing vibration	Frequency range:10Hz~50Hz Acceleration of gravity:5G X,Y,Z 30 min for each direction.	2	GB/T5170.14 -2009
8	Electrical Static Discharge	Air:±8kV 150pF/330Ω 5 times Contact:±4kV 150pF/330Ω 5 times	2	GB/T17626.2 -2018
9	Drop Test(Packaged)	Height:80 cm,1 corner, 3 edges, 6 surfaces.	2	GB/T2423.8 -1995

*NOTE:1) Above conditions are suitable for standard products.
2) For restrict products, the test conditions listed as above must be revised.

9. HANDLING PRECAUTION

(1) Mounting Method
The panel of the LCD Module consists of two thin glass plates with polarizers which easily get damaged since the Module is fixed by utilizing fitting holes in the printed circuit board. Extreme care should be taken when handling the LCD Modules.

(2) Caution of LCD handling & cleaning
When cleaning the display surface, use soft cloth with solvent (recommended below) and wipe lightly.
- Isopropyl alcohol
- Ethyl alcohol
- Trichloro thane
Do not wipe the display surface with dry or hard materials that will damage the polarizer surface.
Do not use the following solvent:
- Water
- Ketone
- Aromatics

(3) Caution against static charge
The LCD Module use C-MOS LSI drivers, so we recommend that you connect any unused input terminal to VDD or VSS, do not input any signals before power is turned on. And ground your body, Work/assembly table. And assembly equipment to protect against static electricity.

(4) Packaging
- Modules use LCD elements, and must be treated as such. Avoid intense shock and falls from a height.
- To prevent modules from degradation. Do not operate or store them exposed directly to sunshine or high temperature/humidity.

(5) Caution for operation
- It is indispensable to drive LCD's within the specified voltage limit since the higher voltage than the limit shorten LCD life. An electrochemical reaction due to direct current causes LCD deterioration, Avoid the use of direct current drive.
- Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them.However those phenomena do not mean malfunction or out of order with LCD's. Which will come back in the specified operating temperature range.
- If the display area is pushed hard during operation, some font will be abnormally displayed but it resumes normal condition after turning off once.
- A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit.
Usage under the relative condition of 40°C, 50%RH or less is required.

(6) Storage
In the case of storing for a long period of time (for instance.) For years) for the purpose or replacement use, The following ways are recommended.
- Storage in a polyethylene bag with sealed so as not to enter fresh air outside in it, And with no desiccant.
- Placing in a dark place where neither exposure to direct sunlight nor light is. Keeping temperature in the specified storage temperature range.
- Storing with no touch on polarizer surface by the anything else. (It is recommended to store them as they have been contained in the inner container at the time of delivery)
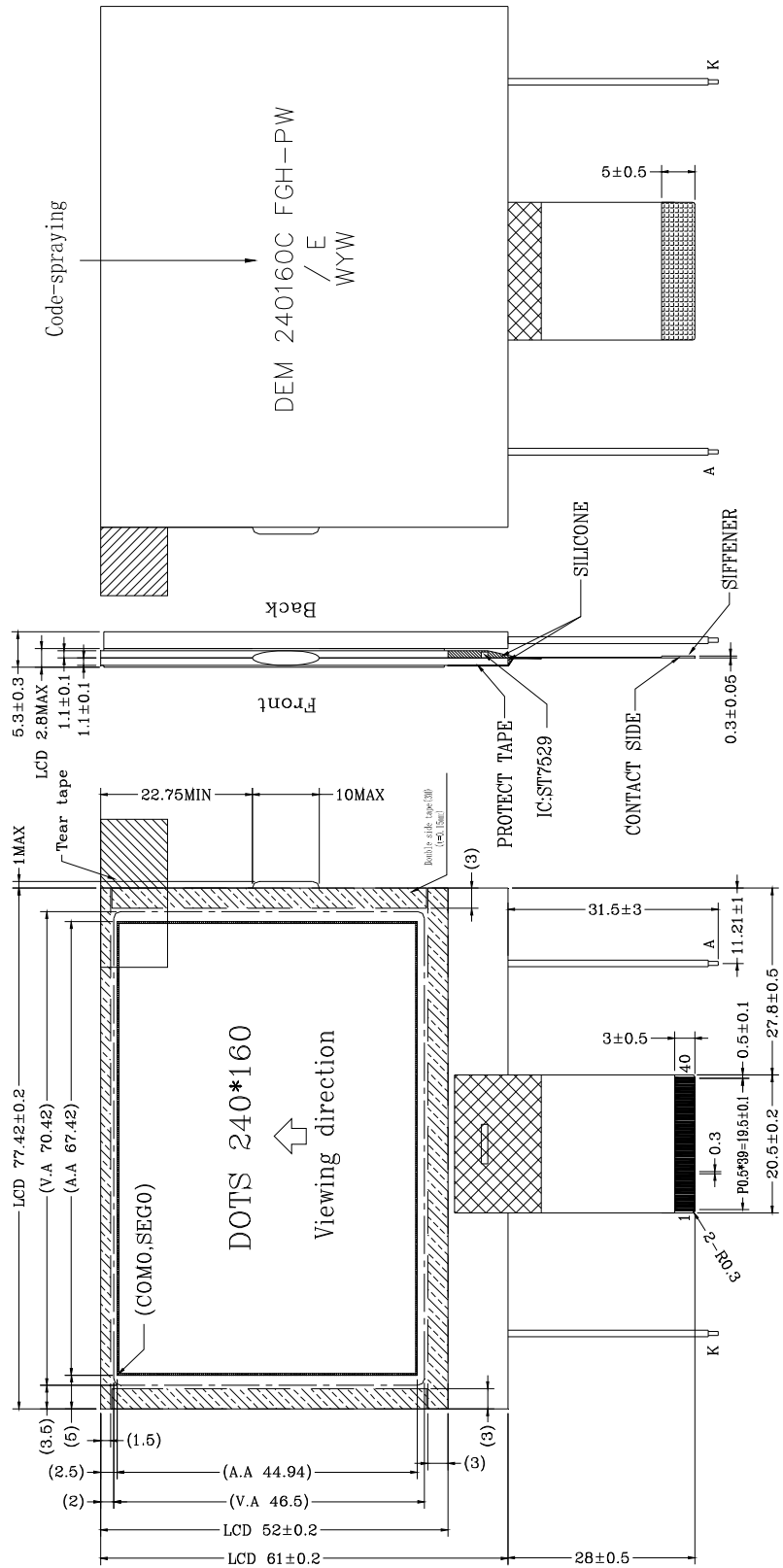
(7) Safety
- It is recommendable to crash damaged or unnecessary LCD into pieces and wash off liquid crystal by using solvents such as acetone and ethanol.Which should be burned up later.
When any liquid crystal leaked out of a damaged glass cell comes in contact with your hands, please wash it off well with soap and water.
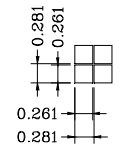
(8) Limited Warranty
- Our warranty liability is limited to repair and/or replacement. We will not be responsible for any consequential loss.
- If possible, we suggest customer to use up all modules in six months. If the module storage time over twelve months, we suggest that recheck it before the module be used
- After the product shipped, any product quality issues must be feedback within three months, otherwise, we will not be responsible for the subsequent or consequential events.

10. OUTLINE DIMENSION

Pin assignment

NO	Symbol	NO	Symbol
1	A0	21	IP3
2	/WR	22	/CS
3	DB0	23	VDD
4	DB1	24	VSS
5	DB2	25	VDD2
6	DB3	26	C7+
7	DB4	27	C5+
8	DB5	28	C3+
9	DB6	29	C1−
10	DB7	30	C1+
11	DB8	31	C2+
12	DB9	32	C4+
13	DB10	33	C6+
14	DB11	34	C8−
15	DB12	35	VLCD
16	DB13	36	V4
17	DB14	37	V3
18	DB15	38	V2
19	/RD	39	V1
20	/RBS	40	V0

NOTES:
1. Display type:FSTN
2. Viewing direction:6 O'CLOCK
3. Drive method:1/160 DUTY 1/12 BIAS
4. Polarizer mode:Transflective/Positive
5. LCD drive voltage:15.0V(Refer.)
6. Operation temperature:−20°C~+70°C
7. Storage temperature:−30~+80°C
8. Driver/Controller IC:ST7529
9. Logic power supply voltage:3.0V
10. Backlight:4 LED/Side White/If=60mA VF=2.9(min)~3.1(typ)~3.2(max)V
    LED life time:20,000 Hrs(min.)~30,000 Hrs(typ.)
11. ROHS must be complied

*NOTE: The dimension with"( )" is reference.