

# POWERTIP TECH. CORP.

DISPLAY DEVICES FOR BETTER ELECTRONIC DESIGN

## Specification For Approval

Customer : \_\_\_\_\_

Model Type : LCD MODULE

Sample Code : \_\_\_\_\_

Mass Production Code : PG9732LRF-DE3-H

Edition : 0

Customer Sign	Sales Sign	Checked By (QA)	Approved By	Prepared By

### Revision Record

Date(y/m/d )	Rev.	Description	Note	Page
2002/07/13	0	Revised Contents		

**Total Page : 1 ~ 21**

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# 1. SPECIFICATIONS

## 1.1 Features

Item	Standard Value
Display Type	97 * 32 dots
LCD Type	FSTN, White, Transflective, Positive, Extended Temp.
Driver Type	1/33 Duty , 1/6 Bias
Viewing Direction	6 O'clock
Backlight	Yellow-Green LED B/L
Weight	6.8g
Other	-

## 1.2 Mechanical Specifications

Item	Standard Value	Unit
Outline Dimension	42.0mm(L) * 29.9mm(w) * 5.2mm(H)(Max)	mm
Viewing Area	36.0mm(L) * 21.0mm(w)	mm
Active Area	31.0mm(L) * 13.72mm(w)	mm
Dot Size	0.28mm(L) * 0.39mm(w)	mm
Dot Pitch	0.32mm(L) * 0.43mm(w)	mm

## 1.3 Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit
Supply voltage range	$V_{DD}$	-0.3	7.0	V
		-0.3	6.0	
		-0.3	4.5	
Supply voltage range (1) ( $V_{DD}$ Level)	$V_5, V_{OUT}$	-18.0	0.3	V
Supply voltage range (2) ( $V_{DD}$ Level)	$V_1, V_2, V_3, V_4$	$V_5$	0.3	V
Input voltage range	$V_{IN}$	-0.3	$V_{DD}+0.3$	V
Output voltage range	$V_O$	-0.3	$V_{DD}+0.3$	V
Operating temperature	$T_{OPR}$	-20	70	
Storage temperature	$T_{STR}$	-30	80	
Humidity	HD	-	95	%RH



## 1.4 DC Electrical Characteristics

 $V_{DD} = 5.0 \text{ V} \pm 5\% , V_{SS} = 0\text{V} , T_a = 25^\circ\text{C}$ 

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Logic Supply Voltage	$V_{DD}$	-	2.4	-	6.0	V
“H” Input Voltage	$V_{IH}$	-	$0.8 V_{DD}$	-	$V_{DD}$	V
“L” Input Voltage	$V_{IL}$	-	$V_{SS}$	-	$0.2 V_{DD}$	V
“H” Output Voltage	$V_{OH}$	$I_{OH} = -0.5\text{mA}$	$0.8 V_{DD}$	-	$V_{DD}$	V
“L” Output Voltage	$V_{OL}$	$I_{OL} = 0.5\text{mA}$	$V_{SS}$	-	$0.2 V_{DD}$	V
Supply Current	$I_{DD}$	$V_{DD} = 5.0 \text{ V}$	-	0.2	0.5	mA
LCD Driver Voltage	$V_{OP}$	$V_{DD} - V_O (-20^\circ\text{C})$	-	-	-	V
		$V_{DD} - V_O (25^\circ\text{C})$	-	7.95	-	
		$V_{DD} - V_O (70^\circ\text{C})$	-	-	-	

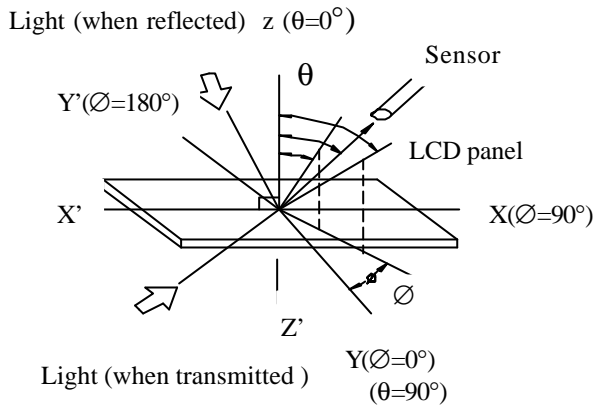
## 1.5 Optical Characteristics

 $1/33\text{Duty} , 1/6\text{Bias} , V_{OP} = 7.95\text{V} , T_a = 25^\circ\text{C}$ 

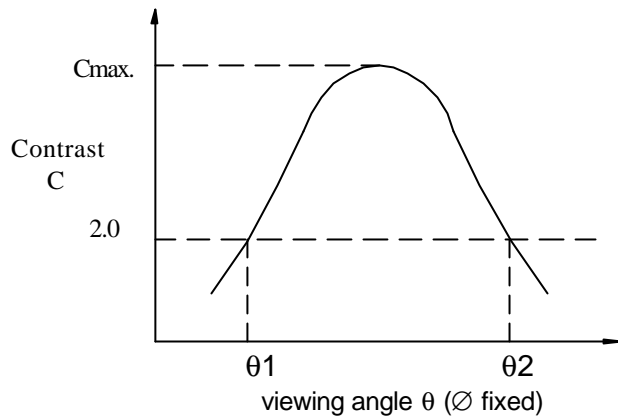
Item	Symbol	Conditions	Min.	Typ.	Max.	Reference
View Angle	$\theta$	$C \geq 2.0, \varnothing = 0^\circ$	$\pm 30^\circ$	-	-	Notes 1 & 2
Contrast Ratio	C	$\theta = 5^\circ, \varnothing = 0^\circ$	-	3	-	Note 3
Response Time(rise)	$T_r$	$\theta = 5^\circ, \varnothing = 0^\circ$	-	150 ms	300 ms	Note 4
Response Time(fall)	$T_f$	$\theta = 5^\circ, \varnothing = 0^\circ$	-	300 ms	500 ms	Note 4



Note 1: Definition of angles  $\theta$  and  $\varnothing$



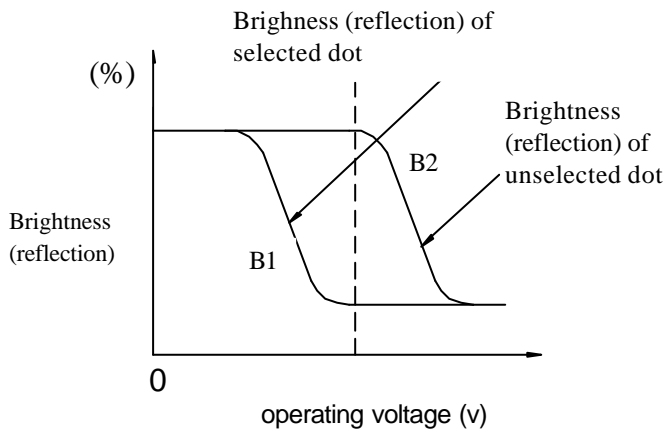
Note 2: Definition of viewing angles  $\theta_1$  and  $\theta_2$



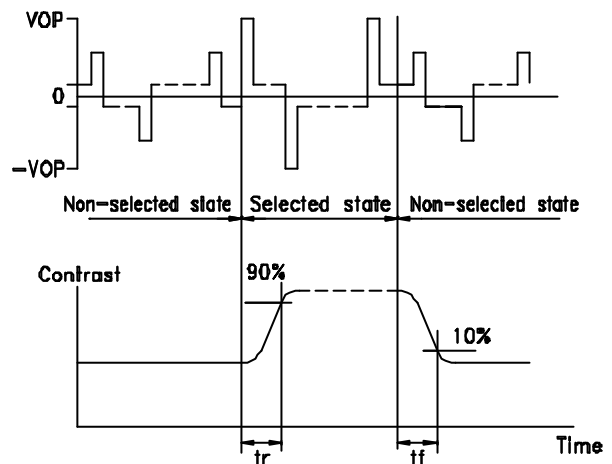
Note : Optimum viewing angle with the naked eye and viewing angle  $\theta$  at  $C_{max}$ . Above are not always the same

Note 3: Definition of contrast C

$$C = \frac{\text{Brightness (reflection) of unselected dot (B2)}}{\text{Brightness (reflection) of selected dot (B1)}}$$



Note 4: Definition of response time



Note: Measured with a transmissive LCD panel which is displayed 1 cm<sup>2</sup>

$V_{OPR}$  : Operating voltage  
 $t_r$  : Response time (rise)

$f_{FRM}$  : Frame frequency  
 $t_f$  : Response time (fall)



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## 1.6 Backlight Characteristics

LCD Module with LED Backlight

Maximum Ratings

Item	Symbol	Conditions	Min.	Max.	Unit
Forward Current	I <sub>F</sub>	T <sub>a</sub> =25°C	-	200	mA
Reverse Voltage	V <sub>R</sub>	T <sub>a</sub> =25°C	-	4	V
Power Dissipation	P <sub>O</sub>	T <sub>a</sub> =25°C	-	0.46	W
Operating Temperature	T <sub>OP</sub>	-	-20	70	°C
Storage Temperature	T <sub>ST</sub>	-	-40	80	°C

Electrical Ratings

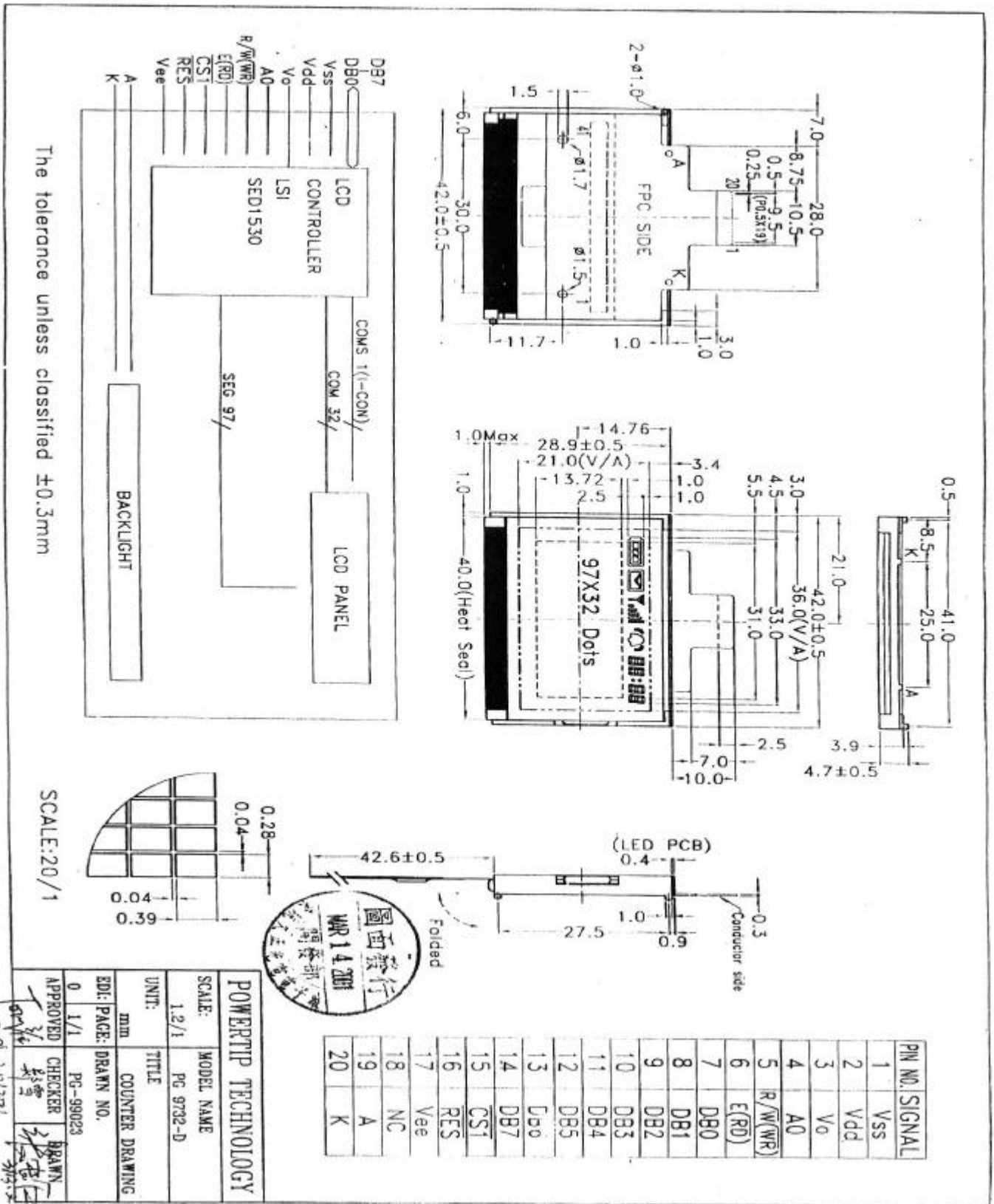
T<sub>a</sub> =25°C

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Forward Voltage	V <sub>F</sub>	I <sub>F</sub> =80 mA	-	2.1	2.3	V
Reverse Current	I <sub>R</sub>	V <sub>R</sub> =4V	-	-	0.2	mA
Luminous Intensity (with LCD, Dots Off)	I <sub>v</sub>	I <sub>F</sub> =80 mA	7.2	9.0	-	cd/m <sup>2</sup>
Wavelength	λ	I <sub>F</sub> =80 mA	571	-	576	nm
Color	Yellow-Green					



## 2. MODULE STRUCTURE

### 2.1 Counter Drawing

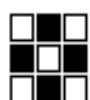
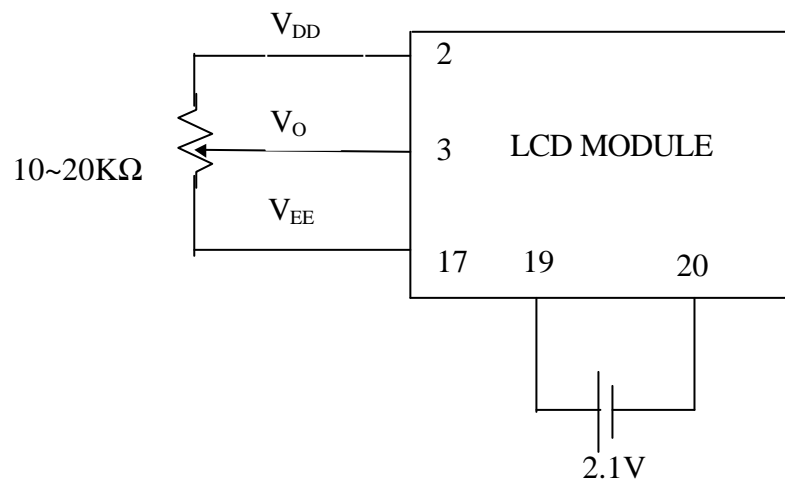




## 2.2 Interface Pin Description

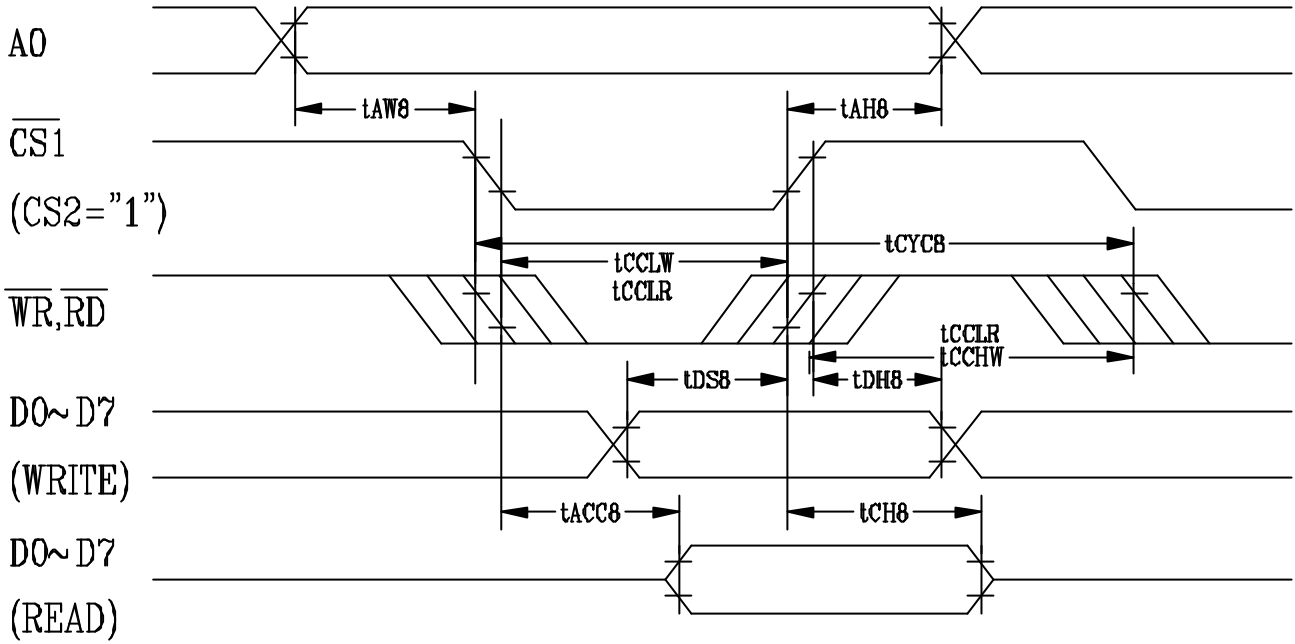
Pin No.	Symbol	Function
1	$V_{SS}$	Power Supply ( $V_{SS}=0$ )
2	$V_{DD}$	Power Supply ( $V_{DD}>V_{SS}$ )
3	$V_O$	Operating voltage for LCD (variable)
4	$A_0$	Control/Display data flag input
5	$\overline{R/W}$	R/ W signal input is used to select the read/write mode. High = Read mode, Low = Write mode
6	E	Start enable signal to read or write the data
7-14	DB0~DB7	8-bit bi-directional data bus to be connected to the standard 8-bit or 16-bit microprocessor data bus. When the serial interface selects; D7:Serial data input (SI) D6:Serial clock input (SCL)
15	$\overline{CS1}$	Chip select input.
16	$\overline{RES}$	Reset signal
17	$V_{EE}$	DC/DC converter (triple boosting) output
18	NC	No connection
19	A	Power supply for LED B / L (+ )
20	K	Power supply for LED B / L (- )

Contrast Adjust

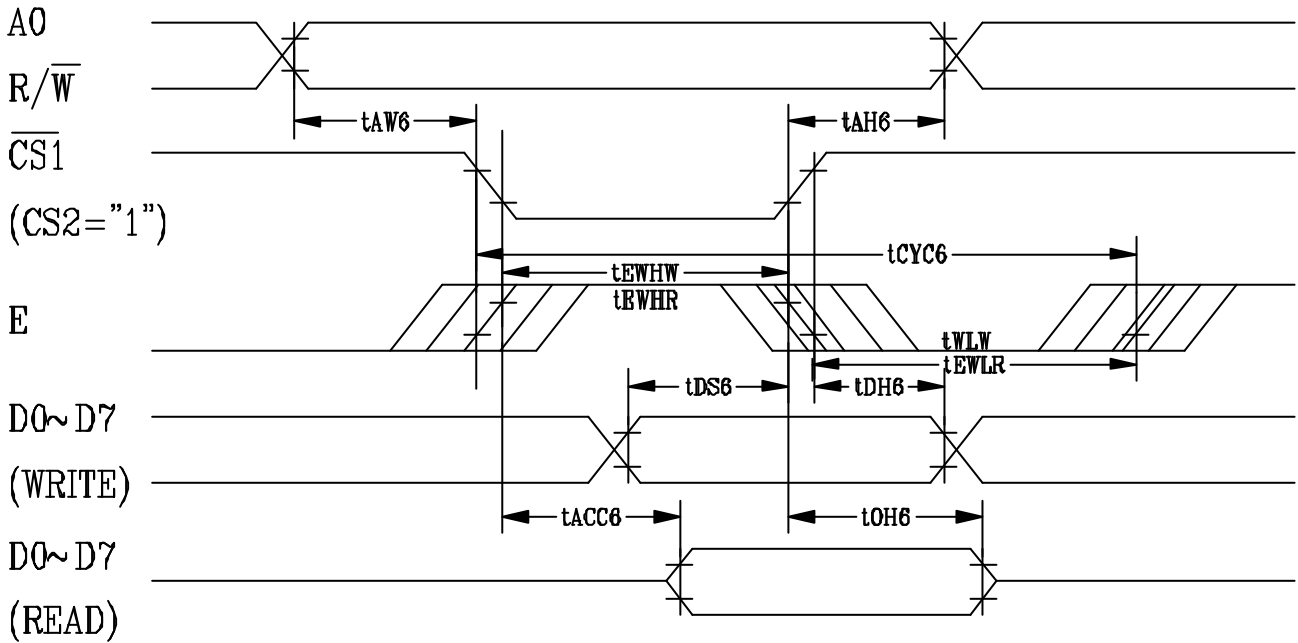


### 2.3 Timing Characteristics

- MPU Bus Read/Write I (8080-series microprocessor)



- MPU Bus Read/Write II (6800-series microprocessor)



## •MPU Bus Read/Write I (8080-series microprocessor)

VDD=2.7V to 4.5V, Ta=-40 to 85°C

Item	Symbol	Conditions	Min.	Max.	Unit	Signal
Address hold time	t <sub>AH8</sub>	-	19	-	ns	A0
Address setup time	t <sub>AW8</sub>	-	15	-	ns	
System cycle time	t <sub>CYC8</sub>	-	450	-	ns	
Control L pulse width	t <sub>CCLW</sub>	-	60	-	ns	$\overline{\text{WR}}$
Control L pulse width	t <sub>CCLR</sub>	-	140	-	ns	$\overline{\text{RD}}$
Control H pulse width	t <sub>CCHW</sub>	-	200	-	ns	$\overline{\text{WR}}$
Control H pulse width	t <sub>CCHR</sub>	-	140	-	ns	$\overline{\text{RD}}$
Data setup time	t <sub>DS8</sub>	-	40	-	ns	D0 to D7
Data hold time	t <sub>DH8</sub>	-	15	-	ns	
RD access time	t <sub>ACC8</sub>	CL=100 PF	-	140	ns	
Output disable time	t <sub>CH8</sub>		10	100	ns	
Rise and fall time	t <sub>r</sub> ,t <sub>f</sub>		-	-	15	

## •MPU Bus Read/Write II (6800-series microprocessor)

VDD=2.7V to 4.5V Ta=-40 to 85°C

Item	Symbol	Conditions	Min.	Max.	Unit	Signal
System cycle time	t <sub>CYC6</sub>	-	450	-	ns	
Address setup time	t <sub>AW6</sub>	-	15	-	ns	A0
Address hold time	t <sub>AH6</sub>	-	19	-	ns	W/R
Data hold time	t <sub>DS6</sub>	-	40	-	ns	D0 to D7
Data hold time	t <sub>DH6</sub>	-	15	-	ns	
Output disable time	t <sub>OH6</sub>	CL=100 PF	10	100	ns	
Access time	t <sub>ACC6</sub>		-	140	ns	
Enable L pulse width	Read	t <sub>EWHR</sub>	-	140	ns	E
	Write	t <sub>EWHW</sub>	-	60	ns	
Enable H pulse width	Read	t <sub>EWLR</sub>	-	140	ns	E
	Write	t <sub>EWLW</sub>	-	200	ns	
Rise and fall time	t <sub>r</sub> ,t <sub>f</sub>	-	-	15	ns	-



## 2.4 Display Command

Reference SED 1530 technical Manual

Command	Code											Function	
	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0		
Display ON/OFF	0	1	0	1	0	1	0	1	1	1	0	1	Turns on LCD panel when goes high, and turns off when goes low.
Initial Display Line	0	1	0	0	1	Start display address					Specifies RAM display line for COM0.		
Set Page Address	0	1	0	1	0	1	1	Page address				Sets the display RAM page in Page Address register.	
Set Column Address 4 higher bits	0	1	0	0	0	0	1	Higher column address				Sets 4 higher bits of column address of display RAM in register	
Set Column Address 4 lower bits	0	1	0	0	0	0	0	Lower column address				Sets 4 lower bits of column address of display RAM in register	
Read Status	0	0	1	Status				0	0	0	0	Reads the status information.	
Write Display Data	1	1	0	Write data							Writes data in display RAM.		
Read Display Data	1	0	1	Read data							Reads data from display RAM.		
ADC Select	0	1	0	1	0	1	0	0	0	0	0	1	Sets normal relationship between RAM column address and segment driver when low, but reverses the relationship when high.
Normal/Reverse Display	0	1	0	1	0	1	0	0	1	1	0	1	Normal indication when low, but full indication when high.
Entire Display ON/OFF	0	1	0	1	0	1	0	0	1	0	0	1	Selects normal display (0) or Entire display ON (1).
Set LCD Bias	0	1	0	1	0	1	0	0	0	1	0	1	Sets LCD drive voltage bias ratio.
Read-Modify- Write	0	1	0	1	1	1	0	0	0	0	0	0	Increments Column Address counter during each write when high and during each read when low.
End	0	1	0	1	1	1	0	1	1	1	0	0	Releases the Read-Modify-Write.
Reset	0	1	0	1	1	1	0	0	0	0	1	0	Resets internal functions.
Set Output Status Register	0	1	0	1	1	0	0	0	*	*	*	*	Selects COM output scan direction. * Invalid data
Set Power Control	0	1	0	0	0	1	0	1	Operation status			Selects the power circuit operation mode.	
Set Electronic Control Register	0	1	0	1	0	0	Electronic control value					Sets V5 output voltage to Electronic Control register.	
Set Standby	0	1	0	1	0	1	0	1	1	0	0	1	Selects standby status. 0: OFF 1:ON
Power Save	-	-	-	-	-	-	-	-	-	-	-	-	Compound command of display OFF and entire display ON
Test Command	0	1	0	1	1	1	1	*	*	*	*	*	IC Test command. Do not use!

Note: Do not use any other command, or the system malfunction may result.



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## 2.5 Display Programming

### •Programming

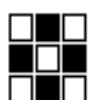
The display is programmed via an 8 Bit parallel interface (Data, Clock, and Latch). Data is clocked into the driver on the rising edge of the /CS line. Conversely, the MPU will latch data from the display driver on the rising edge of the /CS line. Table 2 shows the segment definitions (see figure 1 for the icon definitions). The pixel coordinates are defined by the following:

Upper leftmost pixel	Seg 0, Com 0
Lower leftmost pixel	Seg 0, Seg99/Com32
Upper rightmost pixel	Seg 95, Com 0
Lower rightmost pixel	Seg 95, Seg99/Com32

Table 1. Pixel Coordinates

ICON	LCD Out	ICON	LCD Out	ICON	LCD Out
15a	S69	17a	S84	1	S3
15b	S68	17b	S83	2	S18
15g	S71	17g	S86	3	S16
15c	S74	17c	S89	4	S14
15d	S73	17d	S88	5	S25
15e	S72	17e	S87	6	S39
15f	S70	17f	S85	7	S43
16a	S81	18a	S96	8	S45
16b	S80	18b	S95	9	S47
16g	S76	18g	S91	10	S49
16c	S79	18c	S94	11	S51
16d	S78	18d	S93	12	S56
16e	S77	18e	S92	13	S62
16f	S75	18f	S90	14	S66
		19	S82		

Table 2: Segment Definition



•I-con NUMBER

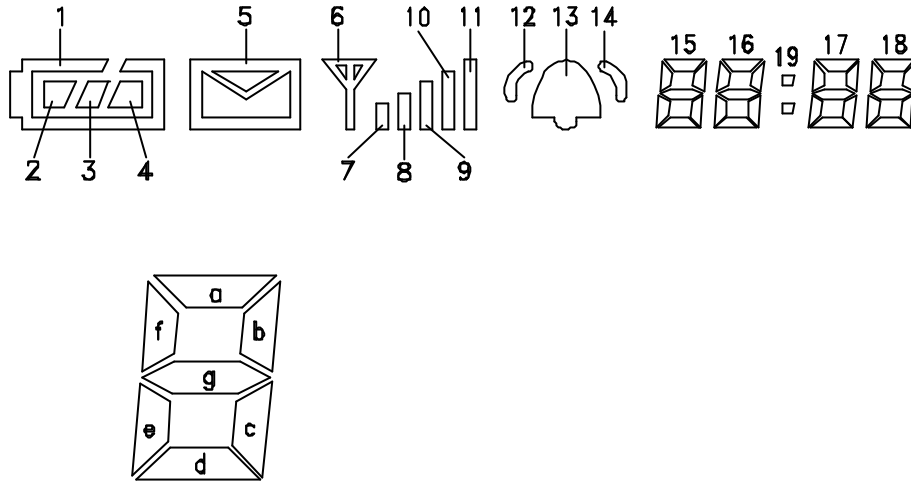
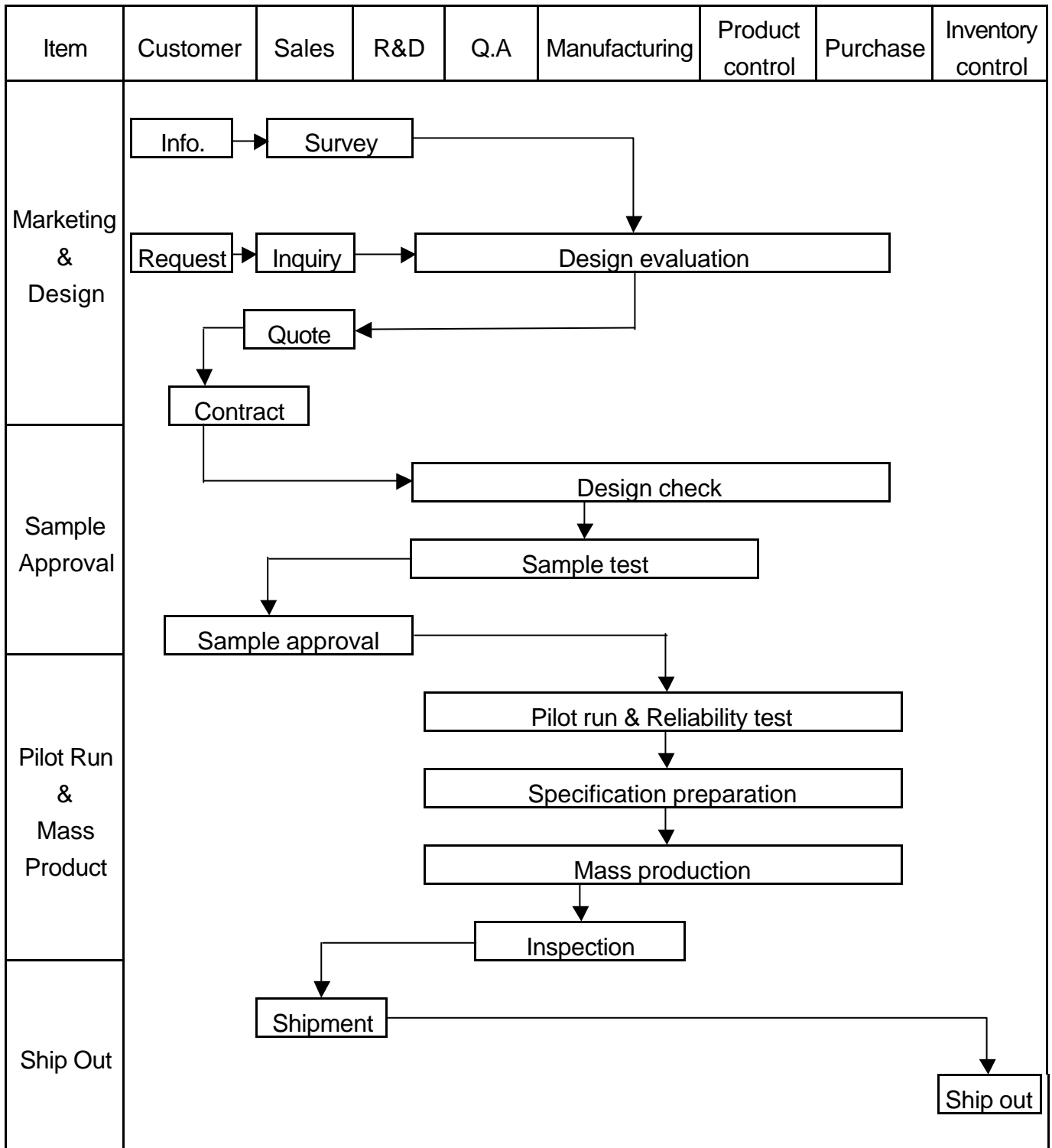


figure 1 icon definitions

### 3. QUALITY ASSURANCE SYSTEM

#### 3.1 Quality Assurance Flow Chart



<p>Sales Service</p>	<pre> graph TD     Info[Info.] --&gt; Claim[Claim]     Claim --&gt; Failure[Failure analysis]     Failure --&gt; Report[Analysis report]     Failure --&gt; Action[Corrective action]     Action --&gt; Tracking[Tracking]         </pre>
<p>Q.A Activity</p>	<ol style="list-style-type: none"> <li>1. ISO 9001 Maintenance Activities</li> <li>2. Process improvement proposal</li> <li>3. Equipment calibration</li> <li>4. Education And Training Activities</li> <li>5. Standardization Management</li> </ol>



### 3.2 Inspection Specification

Inspection Standard : MIL-STD-105E Table Normal Inspection Single Sampling Level

Equipment : Gauge、MIL-STD、Powertip Tester、Sample。

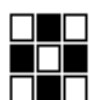
IQC Defect Level : Major Defect AQL 0.65; Minor Defect AQL 1.0。

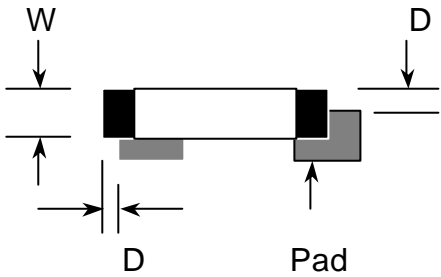
FQC Defect Level : 100% Inspection。

OUT Going Defect Level : Sampling。

Specification :

NO	Item	Specification	Judge	Level
1	Part Number	Inconsistent with the P/N on the flow chart of production	N.G.	Major
2	Quantity	Inconsistent Q'TY with the flow chart of production	N.G.	Major
3	Electronic characteristics  A=( L + W ) ÷ 2	Display short	N.G.	Major
		Missing line	N.G.	Major
		Dot missing A > 1/2 Dot size	N.G.	Major
		No function	N.G.	Major
		Out put data error	N.G.	Major
4	Appearance  A=( L + W ) ÷ 2	Material difference with flow chart	N.G.	Major
		LCD Assembled in opposite direction	N.G.	Major
		Bezel assembled in opposite direction	N.G.	Major
		Shadow within LCD V./A + 1.0 mm	N.G.	Major
	Dirty particle ( Include scratch、bubble )	Dirty particle A > 0.4 mm	N.G.	Minor
		Dirty particle length > 3.0mm And 0.01mm < Width 0.05mm ( Width > 0.05mm Measure by area )	N.G.	Minor
		Without protective film	N.G.	Minor
		Conductive rubber over bezel	N.G.	Minor
5	PCB Appearance  A=( L + W ) ÷ 2	Burned PCB	N.G.	Major
		Green paint stripped & visible circuit A > 1.0mm ( Finish coat not counted in )	N.G.	Minor
		A particle across the circuit	N.G.	Minor
		Circuit split > 1/2 Circuit width	N.G.	Minor
		Any circuit risen	N.G.	Minor
		0.2mm < Tin ball area A 0.4mm And Q'TY > 4 Pieces	N.G.	Minor
		Tin ball area A > 0.4mm	N.G.	Minor



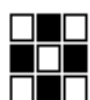
NO	Item	Specification	Judge	Level
6	Molding appearance $A=(L+W) \div 2$	Too soft : Shape by touch changed	N.G.	Major
		Insufficient epoxy : IC circuit or IC pad visible	N.G.	Minor
		Excessive epoxy : Diameter > 20mm Or High > 2.5mm	N.G.	Minor
		Pin hole through to IC and A > 0.2mm	N.G.	Minor
7	Bezel appearance $A=(L+W) \div 2$	Angle between frame and TAB > 45 +10	N.G.	Minor
		Electroplate strip A > 1.0mm ( Top view only )	N.G.	Minor
		Rust ( Top view only )	N.G.	Minor
		Crack	N.G.	Minor
8	Backlight electric characteristics $A=(L+W) \div 2$	Error backlight color	N.G.	Major
		No function	N.G.	Major
		Any LED dot no function	N.G.	Major
		PIN soldering without tin A > 1/2 solder pad	N.G.	Minor
		Solder PIN high > 1.5mm	N.G.	Minor
9	LCD Appearance $A=(L+W) \div 2$	Polarize rise over V/A	N.G.	Minor
10	Assembly parts $A=(L+W) \div 2$	Components mark unclearly	N.G.	Minor
		Components' distance more than 0.7mm from the PCB	N.G.	Minor
		Error position ,not in center $D > 1/4W$	N.G.	Minor
				
		Non- solder area > Twice solder area	N.G.	Minor
		Flux area A > 1/4 solder area	N.G.	Minor
		Component broken	N.G.	Minor



## 4. RELIABILITY TEST

### 4.1 Reliability Test Condition

NO	Item	Test Condition		Applicable Standard
1	High Temperature Storage	Storage At $80 \pm 2$ 96~100 hrs Surrounding Temperature , Then Storage At Normal Condition 4hrs.		MIL-202E
2	Low Temperature Storage	Storage At $-30 \pm 2$ 96~100 hrs Surrounding Temperature, Then Storage At Normal Condition 4hrs.		MIL-202E
3	High Temperature Humidity Storage	1.Storage 96~100 hrs $60 \pm 2$ , 90~95%RH Surrounding Temperature, Then Storage At Normal Condition 4hrs .(Polarizer may fail in this environment). or 2.Storage 96~100 hrs $40 \pm 2$ , 90~95%RH Surrounding Temperature, Then Storage At Normal Condition 4 hrs.		MIL-202E
4	Temperature Cycling	-20 25 70 25 (30Mins) (5Mins) (30Mins) (5Mins) 10 Cycle		MIL-202E
5	Vibration	10~55Hz ( 1 Minute ) 1.5mm X,Y And Z Direction * (Each 2hrs)		MIL-202E
6	Drop Test	Packing Weight (Kg)	Drop High (Cm)	MIL-810E
		0 ~ 45.4	122	
		45.4 ~ 90.8	76	
		90.8 ~ 454	61	
		Over 454	46	



## 5. PRECAUTION RELATING PRODUCT HANDLING

### 5.1 SAFETY

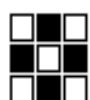
- 5.1.1 If the LCD panel breaks , be careful not to get the liquid crystal to touch your skin.
- 5.1.2 If the liquid crystal touches your skin or clothes , please wash it off immediately by using soap and water.

### 5.2 HANDLING

- 5.2.1 Avoid any strong mechanical shock which can break the glass.
- 5.2.2 Avoid static electricity which can damage the CMOS LSI—When working with the module , be sure to ground your body and any electrical equipment you may be using.
- 5.2.3 Do not remove the panel or frame from the module.
- 5.2.4 The polarizing plate of the display is very fragile. So , please handle it very carefully , do not touch , push or rub the exposed polarizing with anything harder than an HB pencil lead (glass , tweezers , etc.)
- 5.2.5 Do not wipe the polarizing plate with a dry cloth , as it may easily scratch the surface of plate.
- 5.2.6 Do not touch the display area with bare hands , this will stain the display area.
- 5.2.7 Do not use ketonics solvent & aromatic solvent. Use with a soft cloth soaked with a cleaning naphtha solvent.

### 5.3 STORAGE

- 5.3.1 Store the panel or module in a dark place where the temperature is 25 ± 5 and the humidity is below 65% RH.
- 5.3.2 Do not place the module near organics solvents or corrosive gases.
- 5.3.3 Do not crush , shake , or jolt the module.



## 5.4 TERMS OF WARRANTY

### 5.4.1 Applicable warrant period

The period is within thirteen months since the date of shipping out under normal using and storage conditions.

### 5.4.2 Unaccepted responsibility

This product has been manufactured to your company's specification as a part For use in your company's general electronic products. It is guaranteed to Perform according to delivery specifications. For any other use apart from general electronic equipment , we cannot take responsibility if the product is used in medical devices , nuclear power control equipment , aerospace equipment , fire and security systems or any other applications in which there is a direct risk to human life and where extremely high levels of reliability are required.

