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SPECIFICATION OF LCD MODULE
PART NO: HMF6598SYH-PY

CUSTOMER: INGENICO (AFF0058)

APPROVED BY: (FOR CUSTOMER USE ONLY)
DATE ISSUED:

Prepared by:	Date:
Verified by:	Date:
Approved by:	Date:

CONTENT

RECORD OF REVISION

REV	Description of Amendment	Originator	Date	Page
0	First Release	Fang Jun	25/05/03	
A	Change Timing Diagram	Fang Jun	30/05/03	
B	Add in customer's part number	Fang Jun	18/07/03	
C	Correct customer's part number	Fang Jun	01/06/04	P1
D	Correct instructions table	Fang Jun	22/06/04	P10
E	Add RS status in to Instruction table	Fang Jun	22/06/22	P10

1.0 GENERAL SPECIFICATION	
Display Format	128x64 Dots Graphic Display
General Dimension	64.00(W) x 40.50(H) x 6.50 Max (T) mm
View Area	58.00(W) x 31.00(H) mm
Image Area	48.60(W) x 24.28(H)
Dot Size	0.34(W) x 0.34(H) mm
LCD type	STN Yellow-green Positive
Polarizer Mode	Transflective
View Angle	6 O'clock
Controller/Driver	KS0713TB03 or equivalent
Operating Temperature	-20°C to +70°C
Storage Temperature	-30°C to +80°C
Backlight	Yellow-green LED backlight

2.0 ABSOLUTELY MAXIMUM RATING				
Item	Symbol	Min	Max	Unit
Supply Voltage For Logic	V_{DD}-V_{SS}	0	7	V
Supply Voltage For LCD	V_O-V_{SS}	0	15	V
Input Voltage	V_I	V_{SS}	V_{DD}	V
Operating Temperature	TOP	-20	+70	°C
Storage Temperature	TSTG	-30	+80	°C

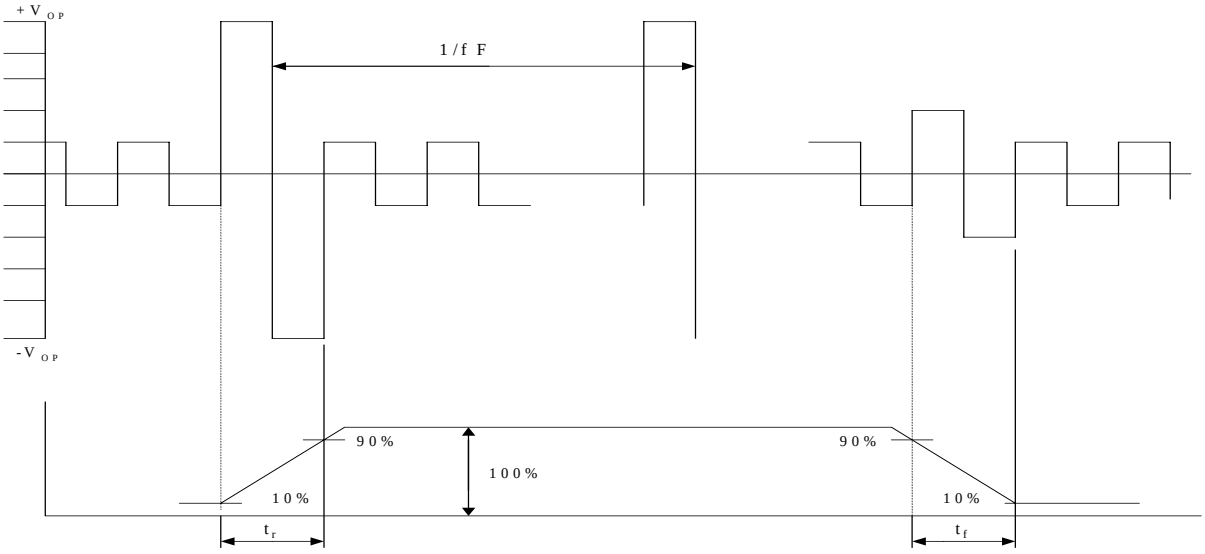
3.0 ELECTRICAL CHARACTERISTICS						(T_a =25°C)
Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage (Logic)	V_{DD}	-----	3.0	3.3	3.6	V
Supply Voltage (LCD)	V_{OP}	-----	10.0	10.2	10.4	V
Input Voltage	V_{IH}	-----	$0.8V_{DD}$	-	V_{DD}	V
	V_{IL}	-----	0	-	$0.2V_{DD}$	
Output Voltage	V_{OH}	I_{OH}=1mA	$0.8V_{DD}$	-	V_{DD}	V
	V_{OL}	I_{OL}=1mA	0	-	$0.2V_{DD}$	
Logic Supply Current	I_{DD}*	V_{DD} =5V	-	1.8	3.8	mA

*I_{DD}: Measurement condition is for all "Q" pattern on display.

V_{OP} Conditions:
Reference voltage register: XX110101(TYPE)
XX110000(MIN)
XX111010(MAX)

4.0 ELECTRO-OPTICAL CHARACTERISTICS							
Item	Symbol	Condition	Min	Typ	Max	Unit	Ref.
Rise Time	T_r	-20°C	-	-	2000	ms	Note(1)
		25°C	-	150	300		
Fall Time	T_f	-20°C	-	-	2500	ms	
		25°C	-	150	300		
Contrast Ratio	K	25°C	3.0	-	-		Note(2)
View Angle	θ_2-θ_1	25°C & CR≥3	-	45	-	°	
Frame Frequency	F_f	25°C	32	-	120	Hz	
Operating Voltage For LCD	V_{OP}	-20°C	-	9.6	-	V	
		25°C	-	10.2	-		
		70°C	-	10.7	-		

Note(1) Response time is measured as the shortest period of time possible between the change in state of an LCD segment as demonstrated below:

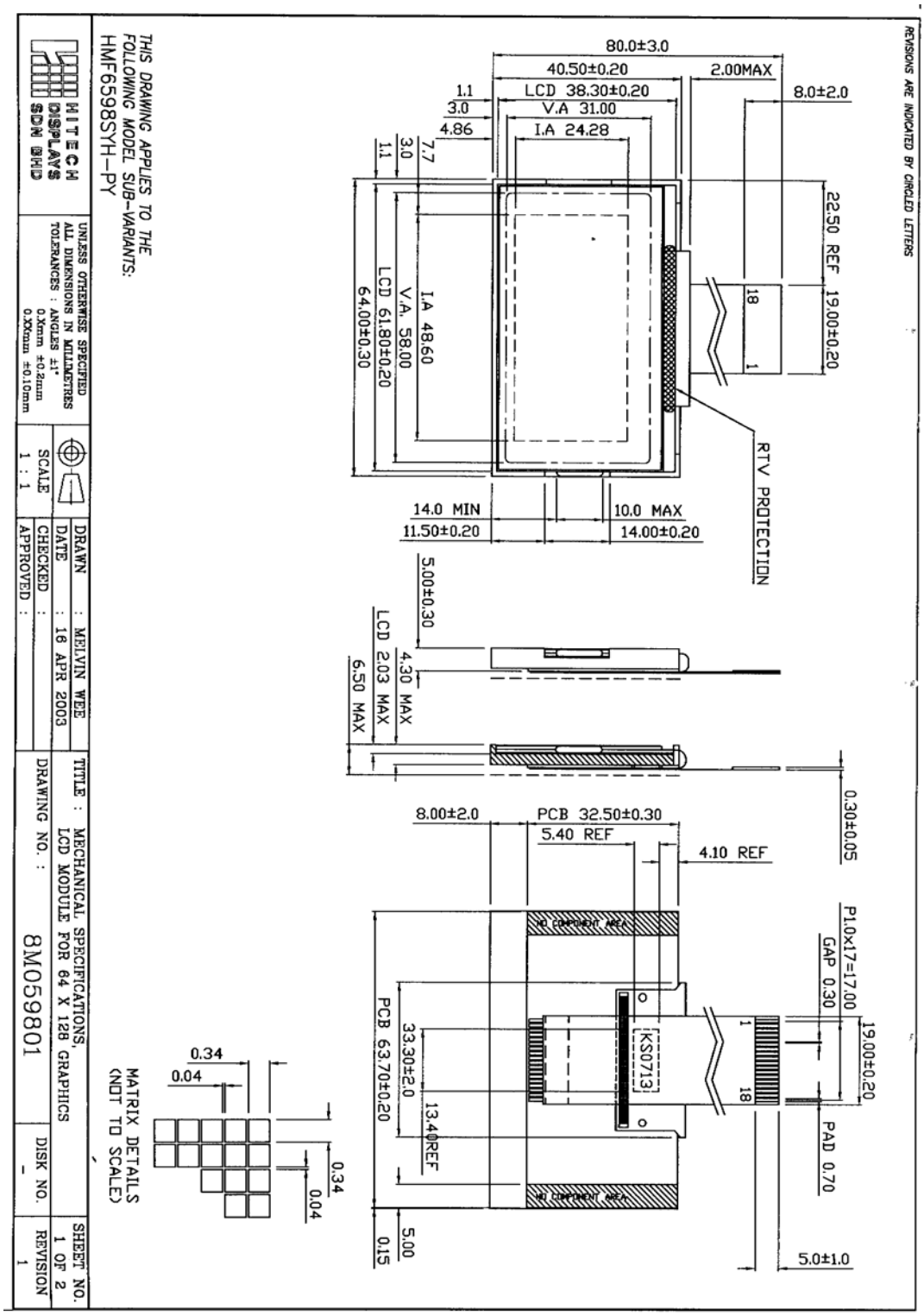


Note(2): Contrast ration is defined under the following condition,

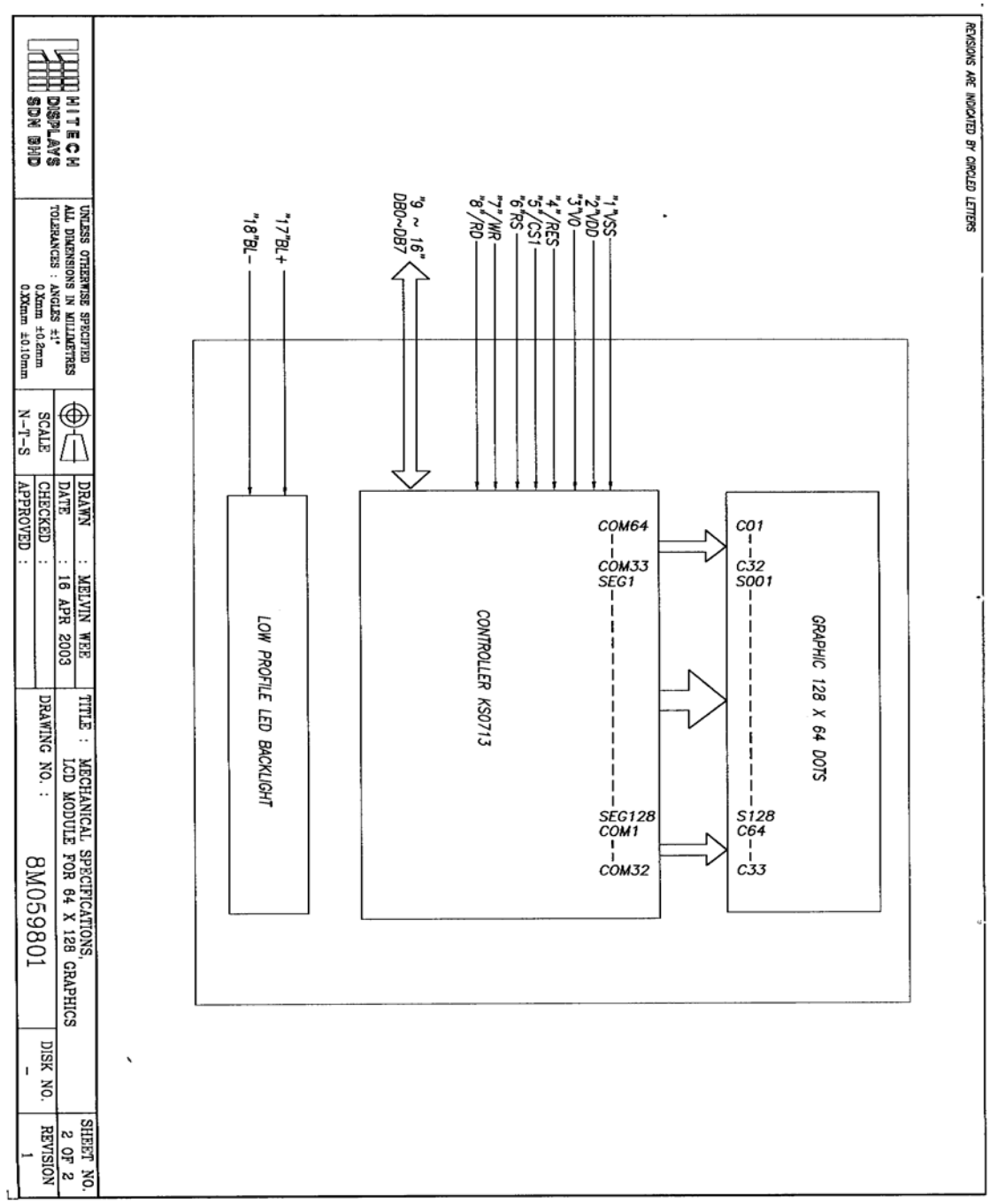
$$CR = \frac{\text{Brightness at non-selected segment}}{\text{Brightness at selected segment}}$$

(a) Temperature_____25°C
(b) Frame frequency_____64°C
(c) Viewing angle_____$\theta = 0°, \phi = 0°$
(d) Driving Voltage _____ 10.2 V

5.0 MECHANICAL DIMENSIONS



6.0 BLOCK DIAGRAM



7.0 PINOUT

Pin No	Symbol	Level	Function
1	V_{SS}		Power Supply -
2	V_{DD}		Power Supply +
3	V_0		Operating Voltage for LCD
4	/RES		Reset Signal. The LCM is rest when “L” is entered.
5	/CS1		Used to enter chip select signal Normally address bus signal is decoded and entered.
6	RS	H/L	RS=”H”, the data on DB[7 0] is display data RS=”L”, the data on DB[7 0] is control data
7	/WR	H/L	/WR is enabled at low.
8	/RD	H/L	/RD is enabled at low.
9~16	DB0~DB7	H/L	Data bus line
17	BL+		Backlight Supply +
18	BL-		Backlight Supply -

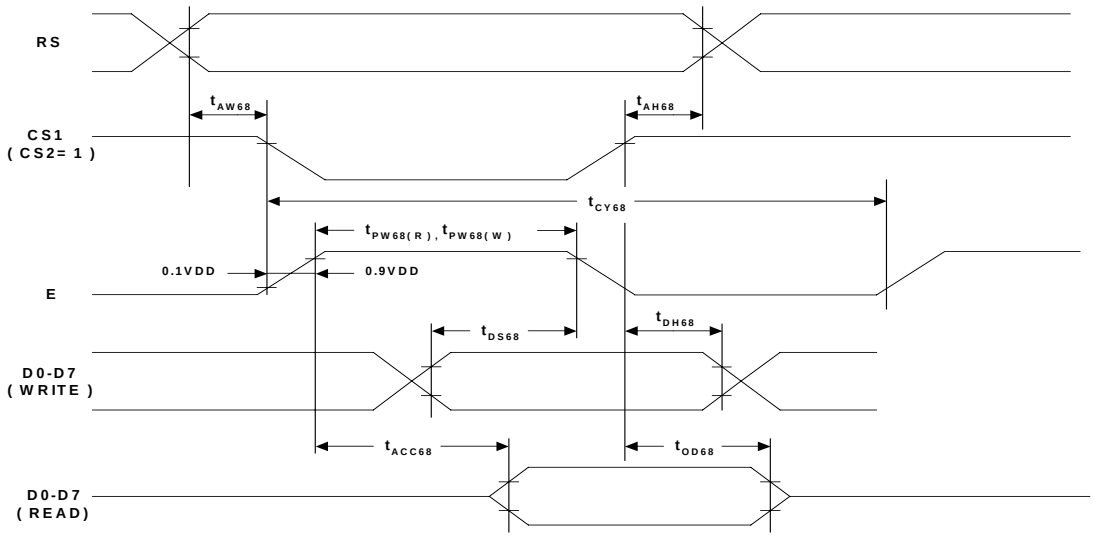
8.0 INITIALIZATION TABLE

INSTRUCTION	CODE	DESCRIPTION
Duty Ratio Set	11001000	Duty = 65
Bias	10100011	Bias = 1/9
1 + (R_b/R_a) Ratio	00100111	6.48
EVER Register Set	01000110	EVR = 46

9.0 TIMING CHARACTERISTICS (Ta = -40^{O}C to 80^{O}C, V_{DD} = 2.4V to 3.3V)

Parallel Interface

Parameter	Signal	Symbol	Condition	Min	Max	Unit
Address setup time	RS	t_{AS68}		13	-	ns
Address hold time	RS	t_{AH68}		17	-	
System cycle time	RS	t_{CYC68}		400	-	
Data setup time	D0~D7	t_{DS68}		35	-	
Data hold time	D0~D7	t_{DH68}		13	-	
Access time		t_{ACC68}	C_L=100pF	-	125	
Output disable time		t_{OH68}		10	90	
Enable width for Read	E_RD	$T_{PW68(R)}$		125	-	
Enable width for Write	E_RD	$T_{PW68(W)}$		55	-	


RS
CS1
(CS2= 1)
E
D0-D7
(WRITE)
D0-D7
(READ)
tAW68
tAH68
tCY68
tPW68(R), tPW68(W)
0.1VDD
0.9VDD
tDS68
tDH68
tACC68
tOD68

10.0 INSTRUCTION TABLE

(Note) *: Disable data

INSTRUCTION	CODE											DESCRIPTION
	RD	WR	RS	D7	D6	D5	D4	D3	D2	D1	D0	
Read Display Data	0	1	1	Read Data								Read Data from DDRAM
Write Display Data	1	0	1	Write Data								Write Data into DDRAM
Read Status	0	1	0	BUSY	ADC	ON/OFF	RESETB	0	0	0	0	Read the Internal Status
Display ON/OFF	1	0	0	1	0	1	0	1	1	1	DON	Turn ON/OFF LCD panel When DON = 0; display is OFF When DON = 1; display in ON
Initial Display Line	1	0	0	0	1	ST5	ST4	ST3	ST2	ST1	ST0	Specifies DDRAM line for COM1
Set reference voltage mode	1	0	0	1	0	0	0	0	0	0	1	Set reference voltage mode
Set reference voltage register	1	0	0	*	*	SV5	SV4	SV3	SV2	SV1	SV0	Set reference voltage register
Set page address	1	0	0	1	0	1	1	P3	P2	P1	P0	Set page address
Set column address MSB	1	0	0	0	0	0	1	Y7	Y6	Y5	Y4	Set column address MSB
Set column address LSB	1	0	0	0	0	0	0	Y3	Y2	Y1	Y0	Set column address LSB
ADC select	1	0	0	1	0	1	0	0	0	0	ADC	Select SEG output direction When ADC = 0, normal direction (SEG1 to SEG132) When ADC = 1, reverse direction (SEG132 to SEG1)
Reverse display ON/OFF	1	0	0	1	0	1	0	0	1	1	REV	Select normal/reverse display When REV = 0, normal When REV = 1, reverse
Entire display ON/OFF	1	0	0	1	0	1	0	0	1	0	EON	Select normal display/entire display ON When EON = 0, normal display When EON = 1, entire display ON
LCD bias select	1	0	0	1	0	1	0	0	0	1	BIAS	Sets LCD bias
Set modify - read	1	0	0	1	1	1	0	0	0	0	0	Set modify- read mode
Reset modify – read	1	0	0	1	1	1	0	1	1	1	0	Release modify – read mode
Reset	1	0	0	1	1	1	0	0	0	1	0	Initialize internal functions
SHL select	1	0	0	1	1	0	0	SHL	*	*	*	Selects COM output direction When SHL = 0, normal direction (COM1 to COM64) When SHL = 1, reverse direction (COM64 to COM0)
Power control	1	0	0	0	0	1	0	1	VC	VR	VF	Control power circuit operation
Regulator resistor select	1	0	0	0	0	1	0	0	R2	R1	R0	Select resistance ratio of the regulator resistor
Set static indicator mode	1	0	0	1	0	1	0	1	1	0	SM	Set static indicator mode
Set static indicator register	1	0	0	*	*	*	*	*	*	S1	S0	Set static indicator register
Power Save	-	-		-	-	-	-	-	-	-	-	Compound instruction of display OFF and entire display ON
Test instruction	1	0	0	1	1	1	1	*	*	*	*	Don't use this instruction

11.0 BACKLIGHT SPECIFICATION

STANDARD LAMP STYLES (EDGE SIDE TYPE):
The LED chips are distributed over the edge light area of illumination unit which gives less power consumption.

THE MAIN ADVANTAGES OF THE LED BACKLIGHT ARE AS FOLLOWS:

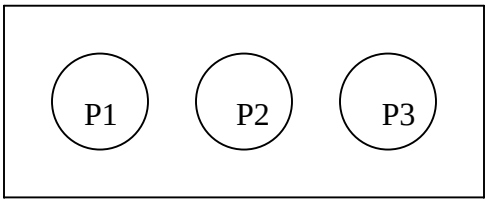
- Long life expectancy of more than 100,000 hours.
- The brightness of the backlight can simply be adjusted by a resistor or a potentiometer

Data about LED Backlight							
Parameter	Symbol	Min	Typ	Max	Unit	Test Condition	Note
Supply Current	I	-	75	110	mA	V = 4.2V	
Supply Voltage	V	-	4.2	4.6	V	-	
Reverse Voltage	V_R	-	-	5	V	-	
Luminous Intensity	I_V	9.0	14.9	-	cd/m^2	V = 4.2V	1,2
Luminous Intensity Tolerance			-	50	%	V = 4.2V	3
Peak Emission Wavelength	λ_P	-	572		nm	V = 4.2V	
Life Time	I_V	-	100000	-	Hr	V ≤ 4.6V	
Colour	YELLOW-GREEN						

Note:

1. Backlight Only
2. Average Luminous Intensity of P1 – P3
3. Luminous Intensity Tolerance = $\frac{\text{Max-Min}}{\text{Max}}$ X 100%

Measuring Method :



(Effective Spatial Distribution)
Hole Diameter ± 1∅ ; 1 to 3 per Position Measured Luminous Intensity

12.0 PRECAUTION FOR HANDLING LCD MODULE

12.1 LIQUID CRYSTAL DISPLAY (LCD)

The LCD panel is made up of glass, organic fluid and polarizer. When handling, please pay attention to the following items:

a) Keep the operating and storage temperature of the LCD within the range specified in the LCD specification. Otherwise, excessive temperature and humidity would cause polarization degradation, bubble generation or polarizer peel-off.
b) Prevent it from mechanical shock by dropping it from high places, etc.
c) Do not contact, push or rub the exposed polarizer with anything harder than an HB pencil lead
d) Avoid using chemicals such as acetone, toluene, ethanol and isoropyalcohol to clean the front/rear polarizer and reflector, which will cause damage to them.
e) Wipe off saliva or water drops immediately when contact with water over long period of time may cause deformation or color fading.
f) Do not put or attach anything on the display area. Avoid touching the display area with bare hand.

12.2. LCD MODULE

LCD modules are assembled and adjusted with a high degree of precision, do not apply excessive shocks to it or making any alteration or modification to it. The following precaution should be taken when handling.

a) Do not drop, bend or twist module
b) Do not alter or making any modification on the shape of the metal frame.
c) Do not change the shape, the pattern wiring or add any extra hole on the printed circuit board
d) Do not modify or touch the zebra rubber strip (conductive rubber) with another object.
e) Do not change the positions of the components on the PCB.

12.3. ELECTRO-STATIC CONTROL

Careful attention should be paid to control the electrostatic discharge of the module, since LCD modules contains no. of CMOS LSI

a) Make sure you are grounded properly when removing LCD module from its antistatic bag. Be sure that the module and your body have the same electric potential.
b) Only properly grounded soldering iron should be used.
c) Modules should store in antistatic bag or other containers resistant to static remove from its original package.
d) When using the electric screwdriver, make sure the screwdriver has been ground potentially to minimize the transmission of EM waves produced by commutator sparks.
e) In order to reduce the generation of static electricity, a relative humidity of 50-60% is recommended.

12.4 SOLDERING TO LCD MODULE

a) Soldering should apply to I/O terminals only.
b) Soldering temperature is 280°C ± 10°C.
c) Soldering time is 3 to 4 seconds.
d) Electric solder (rosin flux is filled) should be used.
e) If soldering flux is used, be sure to remove any remaining flux after finishing the soldering operation and LCD surface should be covered during soldering to prevent any damage due to flux spatters.
f) When removing the lead wires from the I/O terminals, use proper de-soldering methods. E.g. suction type desoldering irons. Do not repeat wiring by soldering more than three times as the pads and plated through holes may be damaged.

12.5 OPERATION

a) Adjust liquid crystal driving voltage (V_o) to varies viewing angle and obtain the best contrast.
b) V_o should be kept in proper range stated in the specification. Excess voltage will shorten the LCD life.
c) Response time is greatly delayed at temperature below the operating range. It will recover when it returns to the specified range.
d) If the display area is pushed hard during operation, the display will become abnormal. However it will return to normal if it is turned off and then back on.
e) Condensation on terminals can cause an electrochemical reaction disrupting the terminal circuit. Therefore, it must be used under the relative condition at 50% RH.

12.6 STORAGE

When long term storage is required, the following precautions are necessary:

a) Store them in a sealed polyethylene bag (antistatic type), seal the opening and store it where it is not subjected to direct sunshine, or to the light of a florescent lamp. If properly sealed, there's no need for desiccant.
b) B) Store them in the temperature range of 0-35°C and at low humidity is recommended.

13.0 LIFE TIME

Functions, performance, appearance, etc shall be free from remarkable deterioration within 50,000 hours under ordinary operating conditions room temperature (25±10°C), normal humidity (45±20%RH), and in area not exposed to direct sunlight.
(Life time of backlight, please refer to data about backlight).