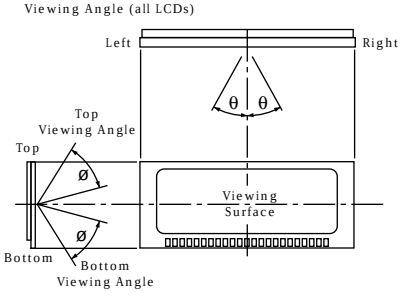
MONOCHROME OPTICAL CHARACTERISTICS

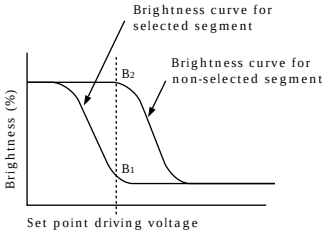
Note 1. Definition of Viewing Angle



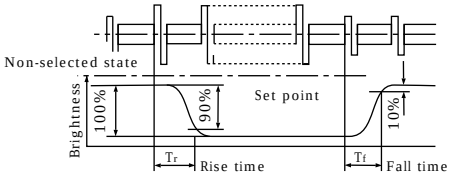
Note : Select either top or bottom viewing angle.

Note 2. Definition of Contrast Ratio "K"

$$K = \frac{\text{Brightness of non-selected segment } (B_2)}{\text{Brightness of selected segment } (B_1)}$$



Note 3. Definition of Optical Response Time



For TN Display Modules

Item	Symbol	Test Condition	Standard Value			Unit	Notes to see
			Min.	Typ .	Max.		
Viewing Angle	θ	K = 1.4	30	–	–	degree	1, 2
	Ø		–	–	30	degree	1, 2
Contrast Ratio	K	Ø = 20° θ = 0°	2.5	4	–	–	1, 2
Response Time (rise)	Tr	Ø = 0° θ = 0°	–	150	250	ms	3
Response Time (fall)	Tf	Ø = 0° θ = 0°	–	150	250	ms	3

For STN Display Modules

Item	Symbol	Test Condition	Standard Value			Unit	Notes to see
			Min.	Typ .	Max.		
Viewing Angle	θ	K = 2.0	50	–	–	degree	1, 2
	Ø		–	–	±40	degree	1, 2
Contrast Ratio	K	Ø = 0° θ = 0°	4	7	–	–	1, 2
Response Time (rise)	Tr	Ø = 0° θ = 0°	–	150	250	ms	3
Response Time (fall)	Tf	Ø = 0° θ = 0°	–	150	250	ms	3

For FSTN Display Modules

Item	Symbol	Test Condition	Standard Value			Unit	Notes to see
			Min.	Typ .	Max.		
Viewing Angle	θ	K = 2.5	50	–	–	degree	1, 2
	Ø		–	–	±40	degree	1, 2
Contrast Ratio	K	Ø = 0° θ = 0°	7	10	–	–	1, 2
Response Time (rise)	Tr	Ø = 0° θ = 0°	–	150	250	ms	3
Response Time (fall)	Tf	Ø = 0° θ = 0°	–	150	250	ms	3

STN LCD

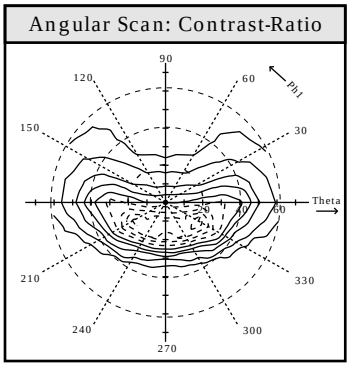
Principles

The following features are available STN mode:

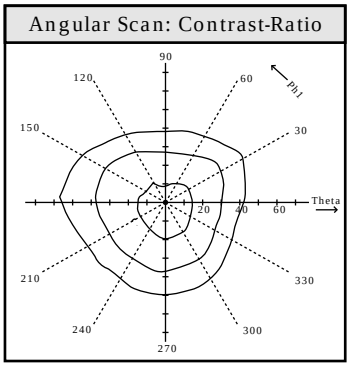
- High contrast, wide viewing angle.
- Assurance of vertical viewing angle of display.

This technology has come to be widely used in the last several years, because it permits the use of the existing process and makes it possible to obtain a high picture quality at low cost.

Equi-Contrast Distribution Curve TN vs STN



TN



STN

FSTN LCD

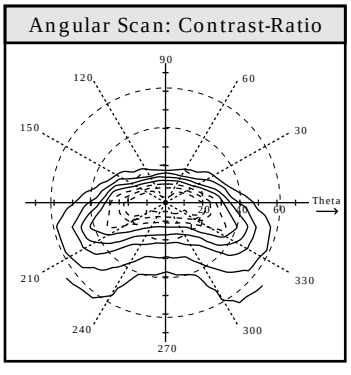
Features

- Clear and legible black and white display.
- High contrast and wide viewing angle at a high multiplex drive.
- Up to VGA resolution.
- Small temperature dependency of background color.
- Contrast of B/W display is approximately three times higher than STN.

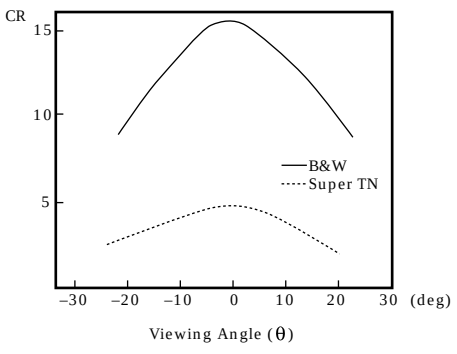
Principles

This technology is achieved by adding an optical retardation film to LC cell. The same driving method as STN is used.

Equi-Contrast Distribution Curve



Contrast vs. Viewing Angle

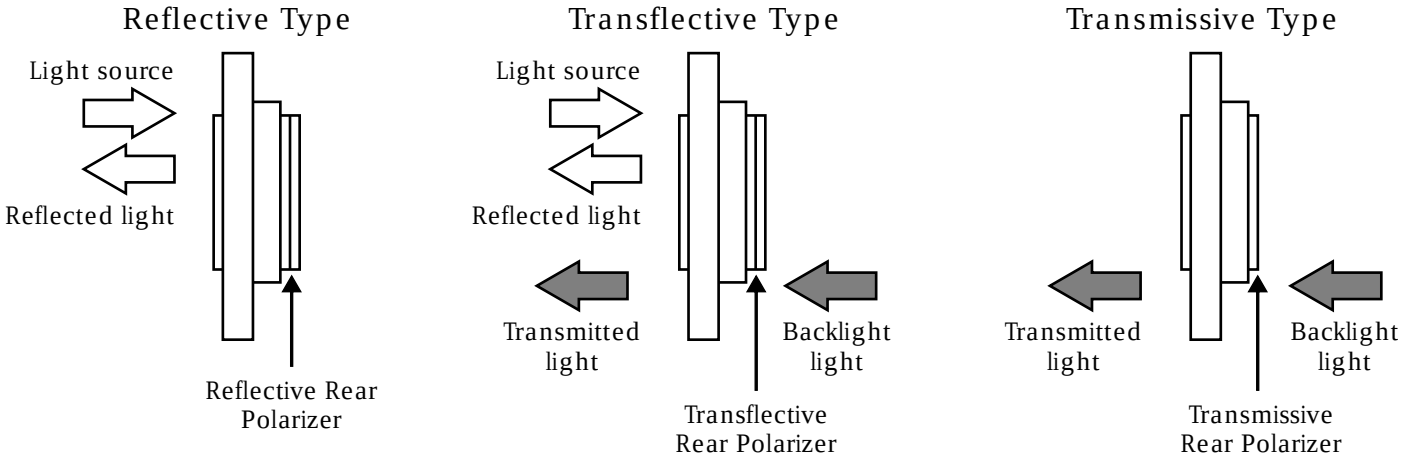


LCD PANEL

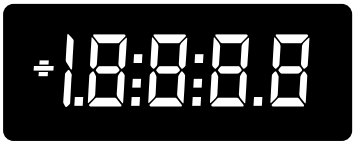
Features

- Low driving voltage, low power dissipation (0.2 ~ 2μA/cm²@5V$_{DC}$).
- Compact and thin structure.
- Custom artwork designs.
- Sunlight readable.

Viewing Modes



Positive type display requires no backlighting.



Negative type display requires backlighting.

LCD Modes

LCD MODE	COLOR MODE	DOT COLOR	BACKGROUND COLOR	STRUCTURE
TN	–	Black	Gray	Polarizer / LC / Glass / Polarizer / Twist angle 90°
STN	Yellow	Dark Blue	Yellow-Green	Polarizer / STN Cell / Polarizer / Twist angle 180° to 240°
	Gray	Medium Blue	Blue-Gray	
	Blue	White	Dark Blue	
FSTN	–	Black	White	Polarizer / Compensation Film / STN Cell / Polarizer

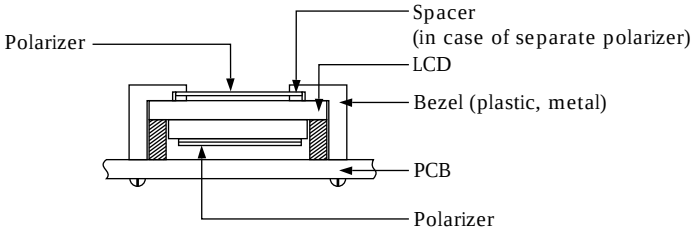
LCD MOUNTING METHODS

The following interfaces are available for connecting the LCD to the drive circuit :

Rubber Connector

- Structure :
  Alternate Lamination of Conductive Rubber and Insulating Rubber.
- Connecting Method :
  Mechanical Compression.
- Pitch (mm) :
  Min 0.5

LCD MOUNTING METHOD
Rubber Connector

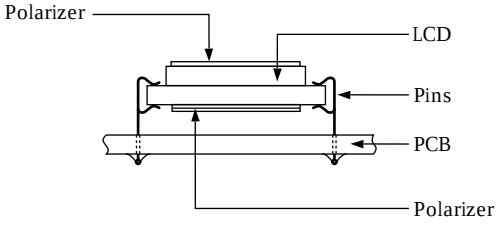


- Easy to assemble.
- Long Life.
- Wide Range of Applications.

Pin Connector

- Structure :
  Metal Pins Fit onto the Panel Pad.
- Connecting Method :
  Soldering.
- Pitch (mm) :
  1.27, 1.5, 1.8, 1.905, 2.0, 2.54

LCD MOUNTING METHOD
Pin Connector

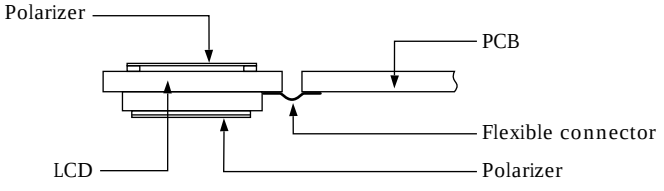


- Stable.
- Suitable for small production runs.

Flexible Connector

- Structure :
  Electroconductive thin film.
- Connecting Method :
  Heat and Pressure Fitting, Soldering or Mechanical Compression.
- Pitch (mm) :
  Heat Seal : Min 0.2, Soldering : Min 0.7

LCD MOUNTING METHOD (example)
Flexible Connector

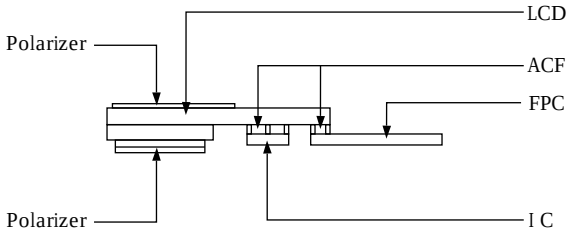


- Low Profile.
- Bending Flexibility

COG Structure

Chip On Glass

Connecting Method :
Heat and pressure fitting (ACF),
Heatseal, Fpc, Rubber, Socket or Pin.

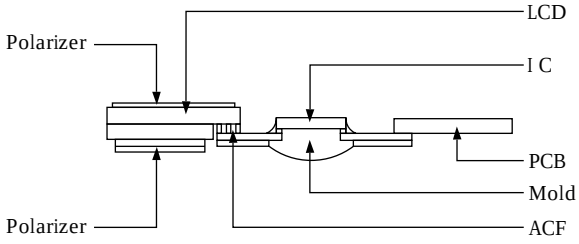


- Enables high resolution display.
- Saves mounting space.
- Can achieve a Low Profile Structure.

TAB Structure

Tape Automated Bonding / Tape Carrier Package (with driver)

Connecting Method :
Heat and pressure fitting (ACF) or Soldering.

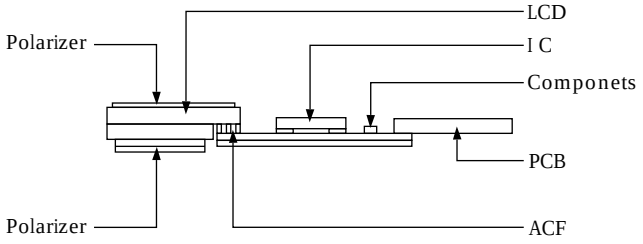


- Enables high resolution display.
- Can achieve a Low Profile Structure.

COF Structure

Chip-On-Film

Connecting Method :
Heat and pressure fitting (ACF),
Soldering, Mechanical Compression,
Plug in with Adjoining Socket or Heat
and Pressure Fitting (ACF).



- Desired design for LCD with FPC.
- Enables high resolution display.
- Saves mounting space.
- Can achieve a Low Profile Structure.
- Fine bending flexibility.

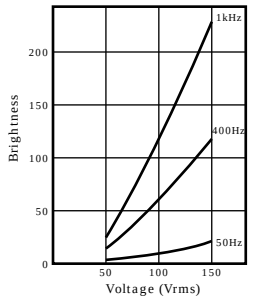
EL

Features

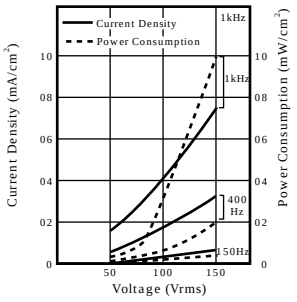
- Max 1.3mm thickness (Max 1.5mm for lead portion).
- Wide driving condition of 60 – 1,000Hz and 150V AC Max. with inverter; step-up voltage from 1.5V battery is available.
- Emitted colors are blue-green and white.
- Life : 3K ~ 8K Hours.

Electrical Characteristics

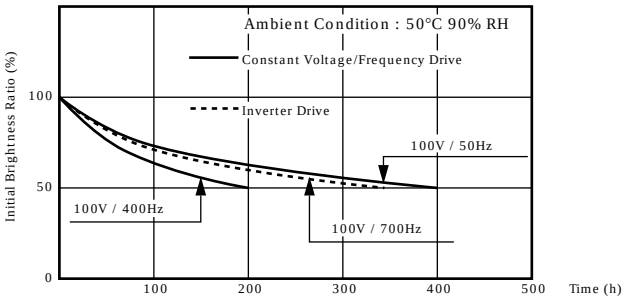
- Voltage vs. Brightness



- Voltage vs. Current Density



Life Characteristics



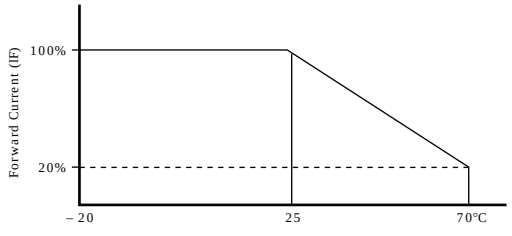
LED

Features

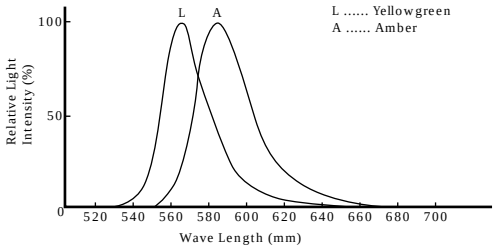
- Low voltage driving (DC) is available without inverter.
- Life: 100,000 hours (average).
- No noise.
- Various colors.

Electrical Characteristics (Reference Data)

- Forward Current Derating Curve



- Wave Length vs. Relative Light Intensity



Note : The above spec. are only for reference

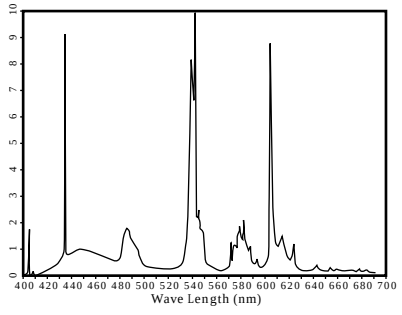
Cold Cathode Fluorescent Lamp

Features

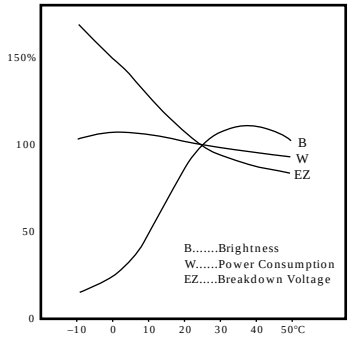
- Hight brightness of 3,000-4,000cd/m²
- OE lamp and AE lamp show good results in color enhancement
- Life: 20,000 hours
- Low heat generation when operating at rated lamp current of 5-20mA

Electrical Characteristics (Reference Data)

- Spectrum



- Temperature Characteristics Curve



CCFL Backlight

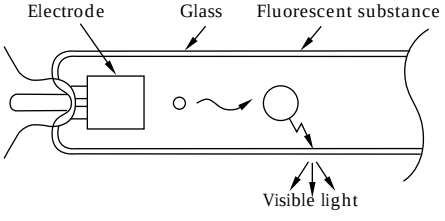
CCFL backlight provides two to three times the luminance of an EL backlight.

- Outline

	Characteristics	Direct Lighting	Edge Lighting	Remarks
1	Luminescent Color	White	White	
2	Luminance	Approx 100 nt typ.	Approx 60 nt typ.	
3	Thickness (Unit base)	24.2mm max.	14mm max.	
4	Operating Voltage	1,500 Vrms AC max.	1,500 Vrms AC max.	
5	Power Consumption	Approx 3 to 6 W (including inverter) Approx 3.4W (CCFL only) CCFL : 2 pcs.	Approx 3 to 6 W (including inverter) Approx 3.4W (CCFL only) CCFL : 2 pcs.	To lower the power consumption, improve the efficiency of inverter design.
6	Life	20,000 hours (IL = 5mA)	10,000 hours (IL = 5mA)	Continuous operation The definition of life differs by each MFR's spec.

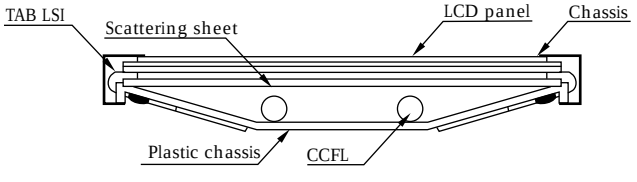
Note : The above spec. is for reference only.

- Sectional View

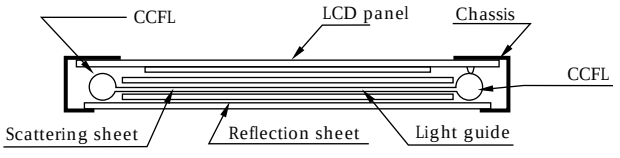


- Sectional View of The LCD Unit

Direct lighting method (Example)



Edge lighting method (Example)

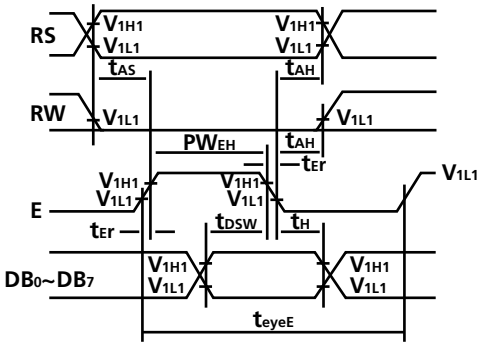


Interface Pin Connections

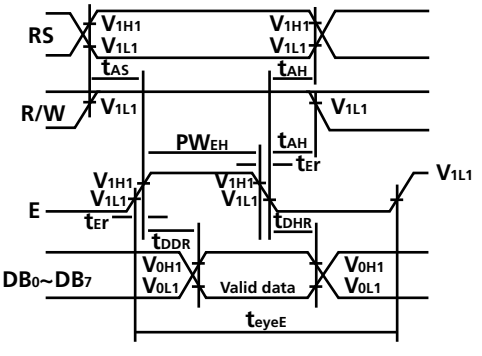
Pin No.	Symbol	Level	Pin Description	Functions
1	V_{SS}	—	Ground	0V
2	V_{DD}	—	Supply voltage for logic and LCD(+)	5V ± 5%
3	V_O	—	Supply voltage for LCD	Decision by user system
4	RS	H/L	Register selection	H : Data L : Instruction code
5	R/W	H/L	Read / Write	H : Read L : Write
1	E	H, H→L	Enable signal	—
1	DB0	H/L	Data bit 0	4 bits / 8 bits
1	DB1	H/L	Data bit 1	
1	DB2	H/L	Data bit 2	
1	DB3	H/L	Data bit 3	
1	DB4	H/L	Data bit 4	
1	DB5	H/L	Data bit 5	
1	DB6	H/L	Data bit 6	
1	DB7	H/L	Data bit 7	
1	LED +	LED Backlight		
1	LED –			

Interface Timing

Write Operation



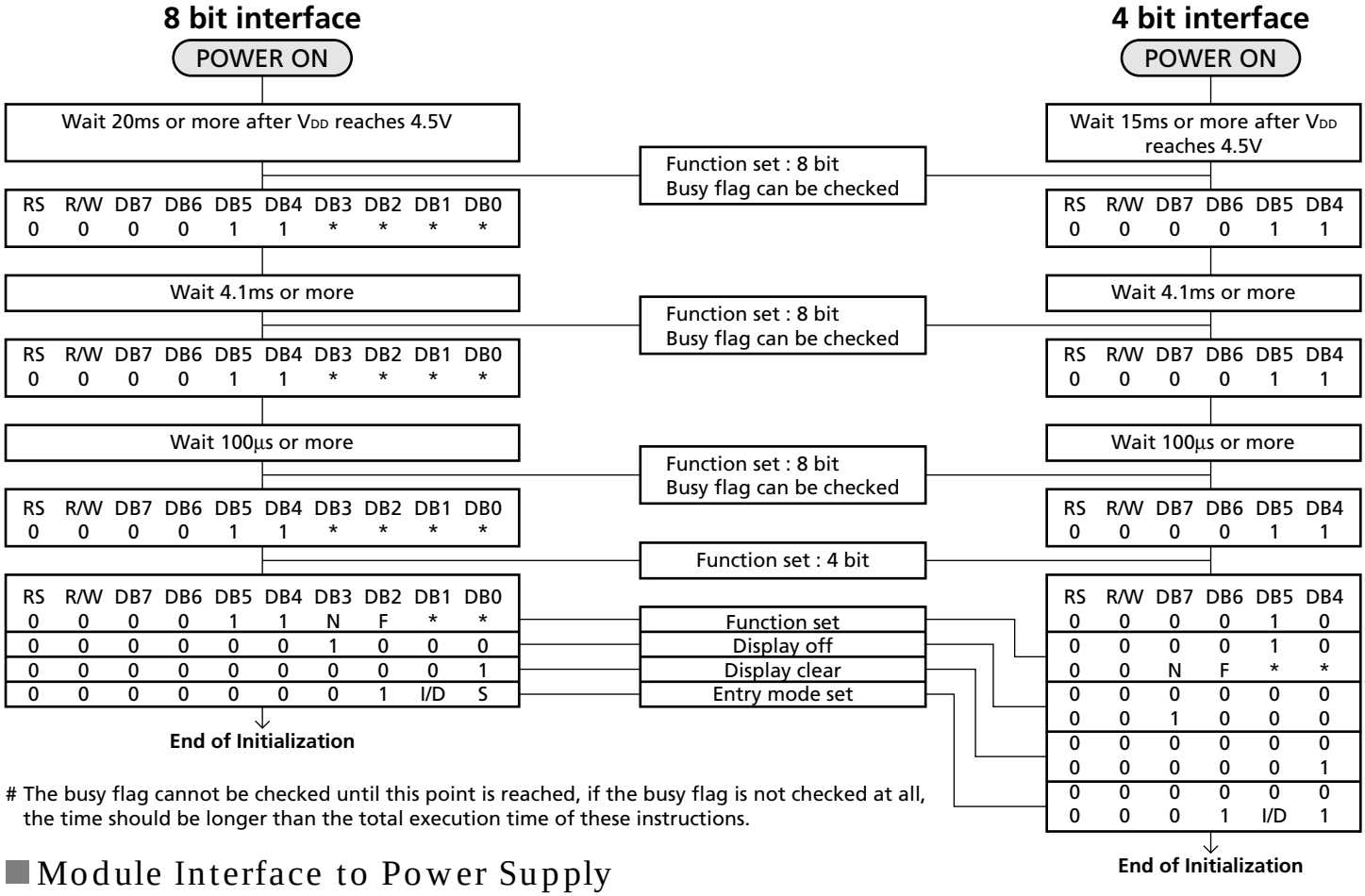
Read Operation



Item	Symbol	Measuring conditions	Standard Value		Unit
			Min	Max	
Enable cycle time	t_{eyeE}	As shown above	800	–	ns
Enable pulse width "High" Level	PW_{EH}		450	–	ns
Enable rise time Enable decay time	t_{Er} t_{Er}		–	25	ns
Address set-up time RS.R/W-E	t_{AS}		140	–	ns
Address hold time	t_{AH}		10	*	ns
Data set-up time	t_{DSW}		195	320	ns
Data hold time	t_H		10	–	ns

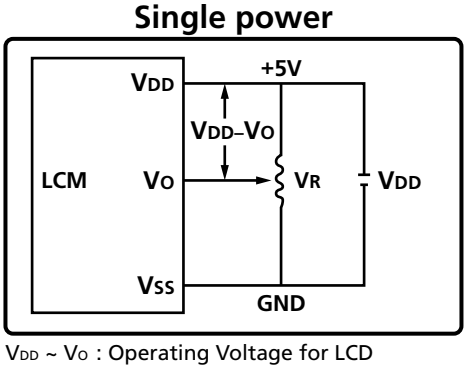
Item	Symbol	Measuring conditions	Standard Value		Unit
			Min	Max	
Enable cycle time	t_{eyeE}	As shown above	800	–	ns
Enable pulse width "High" Level	PW_{EH}		450	–	ns
Enable rise time Enable decay time	t_{Er} t_{Er}		–	25	ns
Address set-up time RS.R/W-E	t_{AS}		140	–	ns
Address hold time	t_{AH}		10	–	ns
Data set-up time	t_{DDR}		–	320	ns
Data hold time	t_{DHR}		20	–	ns

Initialization Procedure

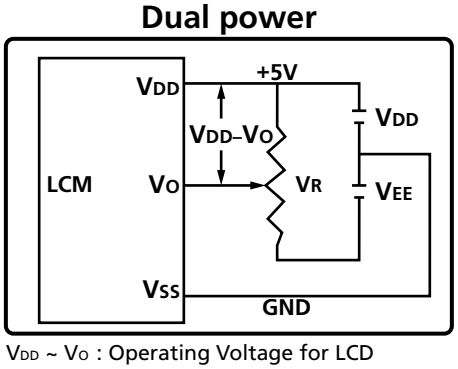


The busy flag cannot be checked until this point is reached, if the busy flag is not checked at all, the time should be longer than the total execution time of these instructions.

Module Interface to Power Supply

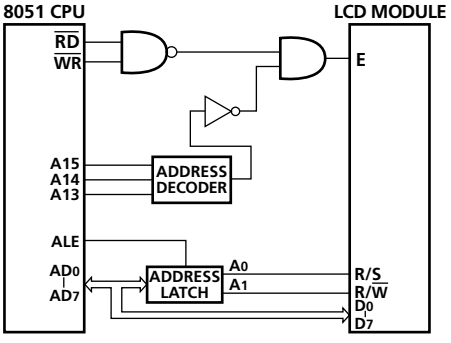


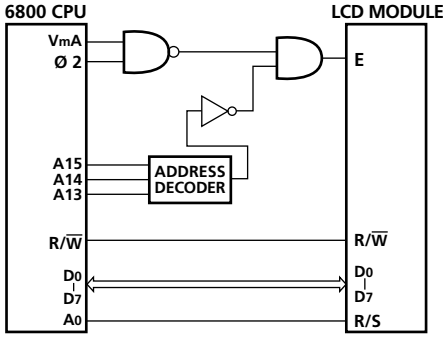
V_{DD} ~ V_O : Operating Voltage for LCD
V_R : 10k ~ 20k



V_{DD} ~ V_O : Operating Voltage for LCD
V_R : 10k ~ 20k

Module Interface to MPU





INSTRUCTION SET

Instructions	Code										Description	Execution time (fosc = 250KHz)	Execution time (fosc = 160KHz)
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0			
Clear display	0	0	0	0	0	0	0	0	0	1	Cursor is resumed to home Position (address 0) after entire display clear	82μs ~ 1.64ms	120μs ~ 4.9ms
Cursor at home	0	0	0	0	0	0	0	0	1	*	Cursor is resumed to home Position (address 0). Shifted display is also returned to the original position. Contents of DDRAM are not changed	40μs ~ 1.6ms	120μs ~ 4.8ms
Entry mode set	0	0	0	0	0	0	0	1	1/D	S	Cursor advance direction and display shift are set. These operations are performed during data write and read modes	40μs	120μs
Display ON/OFF control	0	0	0	0	0	0	1	D	C	B	Entire display ON/OFF (D), cursor ON/OFF (C) and character blink (B) at cursor position are set.	40μs	120μs
Cursor / display shift	0	0	0	0	0	1	S/C	R/L	*	*	Cursor and display are shifted without changing the contents of DDRAM	40μs	120μs
Function set	0	0	0	0	1	DL	N	F	*	*	Interface data length (DL), number of display lines (N) and character font (F) are set.	40μs	120μs
CGRAM address set	0	0	0	1	Acc						CGRAM address is set. Transmitted and received after this are the data of CGRAM.	40μs	120μs
DDRAM address set	0	0	1	ADD							DDRAM address is set. Transmitted and received after this are the data of DDRAM.	40μs	120μs
Busy flag	0	0	BF	AC							Busy flag (BF) showing internal operation and contents of address counter are read.	1μs	1μs
CGRAM/DDRAM data write	1	0	Write Data								Data are written in DDRAM or CGRAM	40μs	120μs
CGRAM/DDRAM data read	1	1	Read Data								Data are read out of DDRAM or CGRAM	40μs	120μs

I/D = 1 : Increment (+1)
I/D = 0 : Decrement (–1)
S = 1 : With display shift
S/C = 1 : With display shift
S/C = 0 : Cursor movement
R/L = 1 : Shift to the right
R/L = 0 : Shift to the left
DL = 1 : 8 bits
DL = 0 : 4 bits
N = 1 : 2 lines
N = 0 : 1 line
F = 1.5 x 10 dots
F = 0.5 x 7 dots
BF = 1 : Internal operation is being performed
BF = 0 : Instruction acceptable

DDRAM : Display data RAM
CGRAM : Character Generator RAM
ACC : Address of CGRAM
ADD : Address of DDRAM These correspond to cursor address.
AC : Address counter used for both DDRAM and CGRAM.

Execution time changes with change in internal oscillation frequency (fosc).

(Ex.) When fosc = 270KHz.

$$40\mu s \times \frac{250}{270} = 37\mu s$$

Character modules with built in controllers and Character Generator (CG) ROM & RAM will display 96 ASCII and special characters in a dot matrix format. Then first 16 locations are occupied by the character generator RAM. These locations can loaded with the user designed symbols and displayed along with the characters stored in the CG ROM.

CHARACTER MODULE FONT TABLE (Standard Font)

Character Font Table

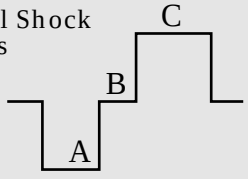
LOWER 4 BITS \ UPPER 4 BITS	0000	0010	0011	0100	0101	0110	0111	1010	1011	1100	1101	1110	1111
0000	CG RAM (1)												
0001	(2)												
0010	(3)												
0011	(4)												
0100	(5)												
0101	(6)												
0110	(7)												
0111	(8)												
1000	(1)												
1001	(2)												
1010	(3)												
1011	(4)												
1100	(5)												
1101	(6)												
1110	(7)												
1111	(8)												

CHARACTER MODULE FONT TABLE (European Font)

Character Font Table

LOWER 4 BITS \ UPPER 4 BITS	0000	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000	CG RAM (1)		0	@	P	`	p	Ö	É	ä	§	∝	·	α	p
0001	(2)	!	1	A	Q	a	q	Ü	È	í	±	∟	¨	¼	q
0010	(3)	"	2	B	R	b	r	ó	É	ì	ü	∩	°	½	θ
0011	(4)	#	3	C	S	c	s	Ü	Ë	í	↑	ß	`	¼	∞
0100	(5)	$	4	D	T	d	t	ô	ê	ï	↓	Σ	´	⅓	Ω
0101	(6)	%	5	E	U	e	u	ù	è	ì	↵	σ	~	⅛	ρ
0110	(7)	&	6	F	V	f	v	ó	ò	Ñ	ƒ	µ	÷	ρ	Σ
0111	(8)	'	7	G	W	g	w	ô	ë	ñ	£	τ	∝	q	‾
1000	(1)	(	8	H	X	h	x	ò	à	ñ	¾	Φ	∞	↕	Ψ
1001	(2)	)	9	I	Y	i	y	ó	ä	ª	÷	ø	ⁱ	↕	y
1010	(3)	*	:	J	Z	j	z	º	à	º	¶	ü	↘	j	Ω
1011	(4)	+	;	K	[	k	{	á	á	¿	↓	Ä	×	∏	∏
1100	(5)	,	<	L	¥	l	|	ò	à	¿	¶	¢	∅	¼	Ä
1101	(6)	−	=	M	]	m	}	ó	á	¡	¡	á	∅	я	Ц
1110	(7)	.	>	N	^	n	→	ö	ä	«	¼	ß	∎	ñ	↳
1111	(8)	/	?	O	_	o	←	¿	ä	«	¼	ß	=	∎	∎

MONOCHROME RELIABILITY CRITERIA

		TN Type		STN Type	
		Normal Temperature	Wide Temperature	Normal Temperature	Wide Temperature
VIEWING ANGLE	Horizontal Ø	± 30°	± 30°	± 30°	± 30°
	Vertical θ (min)	10° to 30°	10° to 30°	–10° to 40°	–10° to 40°
Operating Temperature		–10°C to 70°C	–25°C to 80°C	0°C to 50°C	★ –20°C to 70°C
Storage Temperature		–20 °C to 80°C	–35 °C to 90°C	–20 °C to 70°C	★ –30 °C to 80°C
High Temperature (Power Off)		240 Hours @ 70°C	240 Hours @ 90°C	240 Hours @ 65°C	240 Hours @ 75°C
Low Temperature (Power Off)		240 Hours @ –20°C	240 Hours @ –35°C	240 Hours @ –15 °C	240 Hours @ –25°C
High Temperature (Power On)		240 Hours @ 70°C	240 Hours @ 80°C	240 Hours @ 60°C	240 Hours @ 70°C
Low Temperature (Power On)		240 Hours @ –10°C	240 Hours @ –25°C	240 Hours @ –10°C	240 Hours @ –20°C
High Temperature & High Humidity		55°C/90%RH 240 Hours	75°C/90%RH 240 Hours	45°C/90%RH 240 Hours	65°C/90%RH 240 Hours
Thermal Shock 5 Cycles 	A	60 Min @ –20°C	60 Min @ –35°C	60 Min @ –20°C	60 Min @ –30°C
	B	5 Min @ 25°C	5 Min @ 25°C	5 Min @ 25°C	25 Min @ 25°C
	C	60 Min @ 70°C	60 Min @ 90°C	60 Min @ 70°C	60 Min @ 80°C
Expected Life		50,000 Hours	50,000 Hours	50,000 Hours	50,000 Hours

★ *Wide temp. version may not be available for some products. Please consult our sales engineer or representative.*

MONOCHROME ABSOLUTE MAXIMUM RATINGS

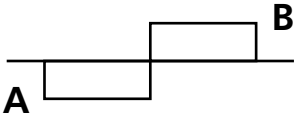
For Character Display Modules

Item	Symbol	Test Condition	Standard Value		Unit
			Min.	Max.	
Supply Voltage for Logic	V_{DD}–V_{SS}	Ta =25°C	0	7.0	V
Supply Voltage for LCD	V_{DD}–V_{EE}		0	6.5	V
Input Voltage	V_I		V_{SS}	V_{DD}	V
Operating Temperature	Topr	–	0	50	°C
Storage Temperature	Tstg	–	-10	60	°C

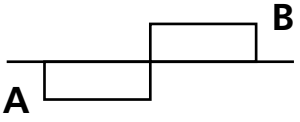
For Graphic Display Modules

Item	Symbol	Test Condition	Standard Value		Unit
			Min.	Max.	
Supply Voltage for Logic	V_{DD}–V_{SS}	Refer to individual spec.			V
Supply Voltage for LCD	V_{DD}–V_{EE}				V
Input Voltage	V_I				V
Operating Temperature	Topr				°C
Storage Temperature	Tstg				°C

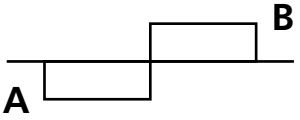
Color STN (CSTN) :

Item	Condition
Operation life time	100000 Hours
High temperature (storage)	80°C x 480 Hours
Low temperature (storage)	–30°C x 480 Hours
High temperature high humidity (storage)	60°C x 90% RH x 480 Hours
Cold-Hot rotation impact One cycle 	**A** : –30°C x 30 minutes **B** : 80°C x 30 minutes **Total** : 20 cycles

OLED :

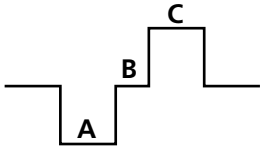
Item	Condition
Operation life time	8000 Hours
High temperature (storage)	70°C x 240 Hours
Low temperature (storage)	–30°C x 240 Hours
High temperature high humidity (storage)	50°C x 90% RH x 120 Hours
Cold-Hot rotation impact One cycle 	**A** : –20°C x 30 minutes **B** : 55°C x 30 minutes **Total** : 10 cycles

TFT :

Item	Condition
Operation life time	100000 Hours
High temperature (storage)	80°C x 480 Hours
Low temperature (storage)	–30°C x 480 Hours
High temperature high humidity (storage)	60°C x 90% RH x 480 Hours
Cold-Hot rotation impact One cycle 	**A** : –30°C x 30 minutes **B** : 80°C x 30 minutes **Total** : 20 cycles

RELIABILITY TEST DATA

Camera Module Reliability Criteria:

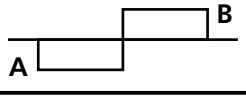
Item	Temperature
Operation temperature	–20°C ~ 70°C
Storage temperature	–30°C ~ 80°C
High temperature (Power Off)	80°C
Low temperature (Power Off)	–30°C
High temperature (Power ON)	70°C
Low temperature (Power ON)	–20°C
High temperature & High humidity	40°C / 90% RH, 48 Hours
Thermal Shock 10 Cycles 	**A** : 30 Min @ –30°C **B** : 5 Min @ 25°C **C** : 30 Min @ 80°C

Compact Camera Module CCM:

Item	Temperature
High temperature storage	80˚C, 120 Hours
Low temperature storage	–30˚C, 120 Hours
High temperature operating	70˚C, 120 Hours
Low temperature operating	–20˚C, 120 Hours
High temperature & High humidity storage	60˚C, 90%RH, 120 Hours
High temperature & High humidity operating	40˚C, 90%RH, 48 Hours
Thermal shock (Power Off)	10 times
Thermal cycle (Power Off)	10 times
Vibration test (Packaged)	X, Y, Z directions for 3 Hours
Dropping test (Packaged)	Dropping height: 150cm
ESD test (Power Off)	10 times

Remark:
1. The resolution, TV Line, dimension and torsion test must be recorded within the specification.
2. No any detectable defect is allowed.
3. All details are defined in the engineering drawings and specifications.
4. All functional and cosmetic checking will be conducted before and after the reliability test

Touch Panel Reliability Criteria:

Item	Condition
Touch durability	More than 1 millions times at a single location. **Note:1**
Pen sliding	More than 100k stroke durability. **Note:2**
Humidity test	60˚C x 90%RH x 240 Hours
High temperature storage test	50˚C x 90%RH x 120 Hours
Low temperature storage test	–20˚C x 240 Hours
Thermal shock test 	**A** : –10˚C x 1 Hours **B** : 60˚C x 1 Hours **Total** : 20 cycles

Note:1 - Test Condition: Hitting Pad (tip R 3.75mm, Hardness 40, Silicone Rubber); Load 2.45N; Speed 2 time/sec;
Note:2 - Test Condition: Hitting Pad (tip R 0.8mm, Plastic Pen); Load 1N; Speed 60 mm/second.

General Characteristic:
Recomended Operation: 80g or less (Plastic Pen Tip R0.8mm or Silicone Rubber pen Tip R3.75mm Hardness 40 degree)
Terminal Resistance: Rx-x: A±150Ω; Ry-y: B±150Ω (A, B: values of particular touch panel design)
Linearity: Linearity Error ≤ 1.5% (Analog Type Touch Panel)
Insulation: 20MΩ or over (DC25V)
Chattering time: 20 msec or less @100kΩ pull-up
Transmittance ≥ 82% (l = 550nm)

PROPER USE OF LCD MODULES

Liquid Crystal Display Modules

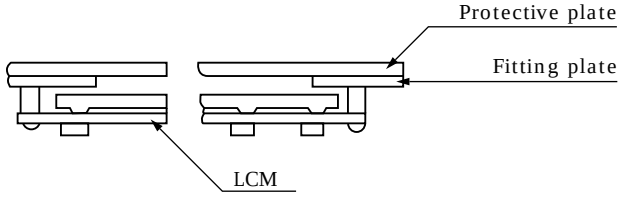
LCD is composed of glass and polarizer. Pay attention to the following items when handling.

(1) Please keep the temperature within specified range for use and storage. Polarization degradation, bubble generation or polarizer peel-off may occur with high temperature and high humidity.
(2) Do not touch, push or rub the exposed polarizers with anything harder than an HB pencil lead (glass, tweezers, etc.).
(3) N - hexane is recommended for cleaning the adhesives used to attach front/rear polarizers and reflectors made of organic substances which will be damaged by such chemicals as acetone, toluene, ethanol and isopropylalcohol.
(4) When the display surface becomes dusty, wipe gently with absorbent cotton or other soft material like chamois soaked in petroleum benzine. Do not scrub hard to avoid damaging the display surface.
(5) Wipe off saliva or water drops immediately. Contact with water over a long period of time may cause deformation or color fading.
(6) Avoid contacting oil and fats.
(7) Condensation on the surface and contact terminals due to cold will damage, stain or dirty the polarizers. After products are tested at low temperatures they must be warmed up in a container before coming to contact with room temperature air.
(8) Do not put or attach anything on the display area to avoid leaving marks on it.
(9) Do not touch the display with bare hands. This will stain the display area and degrade insulation between terminals. (Some cosmetics are detrimental to the polarizers).
(10) As glass is fragile, it tends to become chipped during handling especially on the edges. Please avoid dropping or jarring.

Installing LCD Modules

The hole in the printed circuit board is used to fix LCM as shown in the picture below. Attend to the following items when installing the LCM.

(1) Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



(2) When assembling the LCM into other equipment, the spacer to the bit between the LCM and the fitting plate should have enough height to avoid causing stress to the module surface. Refer to the individual specifications for measurements. The measurement tolerance should be ±0.1mm

Precaution for Handling LCD Modules

Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.

(1) Do not alter, modify or change the shape of the tab on the metal frame.
(2) Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.
(3) Do not damage or modify the pattern wiring on the printed circuit board.
(4) Absolutely do not modify the zebra rubber strip (conductive rubber) or touch it with another object.
(5) Except for soldering the interface, do not make any alterations or modifications with a soldering iron.
(6) Do not drop, bend or twist LCM.

Electro-Static Discharge Control

Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC.

(1) Make certain that you are grounded when handling LCM.
(2) Before removing LCM from its packing case or incorporating it into a set, be sure that the module and your body have the same electric potential.
(3) When soldering the terminal of LCM, make certain that the AC power source for the soldering iron does not leak.
(4) When using an electric screwdriver to attach LCM, the screwdriver should be of ground potentiality to minimize as much as possible any transmission of electromagnetic waves produced sparks coming from the commutator of the motor.
(5) As far as possible make the electric potential of your work clothes and that of the work bench the ground potential.
(6) To reduce the generation of static electricity be careful that the air in the working environment is not too dry. (A relative humidity of 50%–60% is recommended.)

Precaution for Soldering to the LCM

(1) Observe the following when soldering lead wire, connector cable, etc., to the LCM.
- Soldering iron temperature : 280°C±10°C
- Soldering time : 3-4 sec.
- Solder ; eutectic solder

If soldering flux is used, be sure to remove any remaining flux after finishing to soldering operation. (This does not apply in the case of a non-halogen type of flux.) It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage due to flux spatters.
(2) When soldering the electroluminescent panel and PC board, the panel and board should not be detached more than three times. This maximum number is determined by the temperature and time conditions mentioned above, though there may be some variance depending on the temperature of the soldering iron.
(3) When removing the electroluminescent panel from the PC board, be sure that the solder has completely melted, the soldered pad on the PC board could be damaged.

LIQUID CRYSTAL DISPLAY HANDLING PROCEDURES

Liquid Crystal Display (LCD)

An LCD is made up of glass, organic sealant, organic fluid and polymer based polarizers. The following precautions should be taken when handling:

(1) Keep the temperature within range for use and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel-off or bubble generation. When storage for a long period over 40°C is required, the relative humidity should be kept below 60%.
(2) Do not contact the exposed polarizers with anything harder than an HB pencil lead. To clean dust off the display surface, wipe gently with cotton, chamois or other soft material soaked in petroleum benzine. Never scrub hard.
(3) Wipe off saliva or water drops immediately. Contact with water over a long period of time may cause polarizer deformation or color fading, while an active LCD with water condensation on its surface will cause corrosion of ITO electrodes.
(4) PETROLEUM BENZINE is recommended to remove adhesives used to attach front/rear polarizer and reflectors, while chemicals like acetone, toluene, ethanol and isopropyl alcohol will cause damage to the polarizer. Avoid oil and fats. Avoid lacquer and epoxies which might contain solvents and hardeners to cause electrode erosion. Some solvents will also soften the epoxy covering the DIL pins and thereby weaken the adhesion of the epoxy on glass. This will cause the exposed electrodes to erode electro-chemically when operating in high humidity and condensing environment.
(5) Glass can be easily chipped or cracked from rough handling, especially at corners and edges.
(6) Do not drive LCD with DC voltage.
(7) When soldering DIL pins, avoid excessive heat and keep soldering temperature between 260°C to 300°C for no more than 5 seconds.

Operation

(1) The viewing angle can be adjusted by varying the LCD driving voltage.
(2) Driving voltage should be kept within specified range; excess voltage shortens display life.
(3) Response time increases with decrease in temperature.
(4) Display may turn black or dark blue at temperatures above its operational range, however, this is not destructive and the display will return to normal once the temperature falls back to range.
(5) Mechanical disturbance during operation (such as pressing on the viewing area) may cause the segments to appear " fractured ". They will recover once the display is turned off.
(6) Condensation at terminals will cause malfunction and possible electro-chemical reaction. Relative humidity of the environment should therefore be kept below 60%.

Storage

(1) Store LCDs and modules in dark places and do not expose to sunlight or fluorescent light. Keep the temperature between 0°C and 35°C and the relative humidity low.
(2) Modules should be kept in antistatic packaging. If properly sealed, there is no need for desiccant.

Safety

If any fluid leaks out of a damaged glass cell, wash off with soap and water any human part that comes into contact with the fluid. Never swallow the fluid. The toxicity is extremely low but caution should be exercised at all times.

Limited Warranty

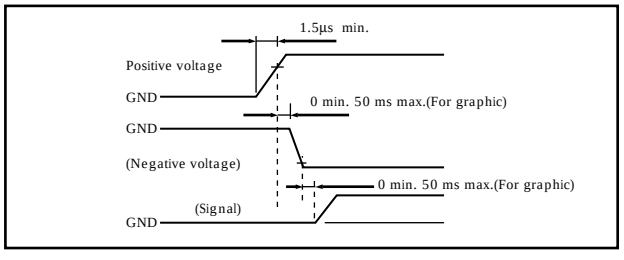
Unless otherwise agreed between TRULY and customer, TRULY will repair any of its LCDs functionally defective when inspected in accordance with TRULY LCD acceptance standards (copies available upon request)for a period of one year from date of shipments. Cosmetic/visual defects must be returned to TRULY within 90 days of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of TRULY is limited to repair and/or replacement on the terms set forth above. TRULY will not be responsible for any subsequent or consequential events.

Returning LCD under Warranty

No warranty can be granted if the precautions stated above have been disregarded. Broken glass, scratches on polarizers, mechanical damage as well as defects that are caused by accelerated environmental tests are excluded from warranty.

Precautions for Operation

(1) Viewing angle varies with the change of liquid crystal driving voltage(V_0).
Adjust V_0 to show the best contrast.
(2) Driving an LCD in the voltage above the limit shortens its life.
(3) Response time is greatly delayed at temperatures below the operating temperature range. The display area becomes dark color at temperatures above this range. However, this does not mean the LCD will be out of order, it will recover when it returns to the specified temperature range.
(4) 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.
(5) Condensation on terminals can cause an electrochemical reaction disrupting the terminal circuit. Therefore, it must be used in the relative condition of 40°C, 50% RH.
(6) when turning on power, input each signal after the positive / negative voltage becomes stable.



Storage

When storing LCDs as spares for some years, the following precautions are necessary.
(1) Store them in a sealed polyethylene bag. If Properly sealed, there's no need for dessicant.
(2) Store them in a dark place, do not expose to sunlight or fluorescent light. Keep the temperature between 0°C and 35°C.
(3) The polarizer surface should not come in contact with any other object. (We advise you to store them in the container in which they were shipped).
(4) Environmental conditions :
– Do not leave them for more than : 168 hrs. at 60°C.
– Should not be left for more than 48 hrs. at –20°C.

Safety

(1) It is recommended to crush damaged or unnecessary LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.
(2) If any liquid leakes out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

Limited Warranty

Unless otherwise agreed between TRULY and customer, TRULY will replace or repair any of its LCD and modules which are found to be functionally defective when inspected in accordance with TRULY LCD acceptance standards (copies available upon request), for a period of one year from date of shipments. Cosmetic/visual defects must be returned to TRULY within 90 days of shipment. Confirmation of such date be based on freight documents. The warranty liability of TRULY is limited to repair and/or replacement on the terms set forth above. TRULY will not be responsible for any subsequent or consequential events.

Return LCM under Warranty

No warranty can be granted if the precautions stated above have been disregarded. A typical examples of violations are:
– broken LCD glass;
– PCB eyelet's damaged or modified;
– PCB conductors damaged;
– circuit modified in any way, including addition of components;
– PCB tampered with by grinding, engraving or painting varnish;
– soldering to or modifying the bezel in any manner.
Module repairs will be invoiced to the customer upon mutual agreement. Modules must be returned in antistatic packaging together with sufficient description of the failures or defects. Any connectors or cables installed by the customer must be removed completely without damaging the PCB eyelet's, conductors and terminals.