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**POLYTRONIX, INC.**  
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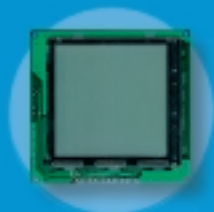
OPTIC NETWORKING

MEASUREMENTS & TESTING

SECURITY DEVICES

LCD's & LCM's

CUSTOM & STANDARD



POLYTRONIX HAS RECEIVED TEN SMALL BUSINESS INNOVATIVE RESEARCH AWARDS FOR PRODUCTS RANGING FROM PLASTIC LCD'S TO THIN FILM COATINGS FOR INFRARED DETECTORS.

WITH FIVE PENDING PATENTS, OUR AWARD-WINNING INNOVATION AND RECOGNITION IN THE LCD FIELD DEMONSTRATES POLYTRONIX' COMMITMENT TO RESEARCH, QUALITY AND CUSTOMER SERVICE.

IT IS OUR GOAL TO DESIGN AND PRODUCE TECHNOLOGICALLY SUPERIOR, COMPETITIVELY PRICED LCD PRODUCTS WHICH COMPLY WITH APPLICABLE SPECIFICATIONS, AND MEET ALL THE CUSTOMERS' NEEDS AND EXPECTATIONS WITH REGARDS TO PERFORMANCE, COST, QUALITY, RELIABILITY, SCHEDULE, AND SUPPORT.



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Many advances in TN LCDs have been produced. Super twisted nematic (STN) LC material offers a higher twist angle ( $> 180^\circ$  vs.  $90^\circ$ ) that provides higher contrast and a better viewing angle. However, one negative feature is the birefringence effect, which shifts the background color to yellow-green and the character color to blue. This background color can be changed to a gray by using a special filter.

The most recent advance has been the introduction of film compensated super twisted nematic (FSTN) displays. This adds a retardation film to the STN display that compensates for the birefringence effect. This allows a black and white display to be produced. Because of the added filtering, FSTN displays look best when used with a backlight.

**Backlighting**

An LCD is basically a reflective part. It needs ambient light to reflect back to the eye. In applications where ambient light is low or non-existent, a light source must be placed behind the LCD. This is known as backlighting (see Fig.4). There are several technologies used:

- Electroluminescent (EL): EL backlights are very thin, light weight and provide a very uniform light. They are available in a variety of colors, with white being the most popular for use with LCDs. While their power consumption is fairly low, they require voltages of 80 to 100 VAC. This is supplied by an inverter that converts a 5 VDC input to the AC output. ELs have a limited life of 2,000 to 3,000 hours to half brightness.
- Light Emitting Diode (LED): LED backlights offer longer operating life—50,000 hours minimum—and are brighter than ELs. They do consume more power than ELs. Being a solid state device, they operate directly off +5 VDC, so they do not require an inverter. However, a current limiting resistor is recommended for protection of the LEDs. LEDs are mounted in an array directly behind the display, which increases the thickness by as much as 5mm. LEDs come in a variety of colors, with yellow-green being the most common.

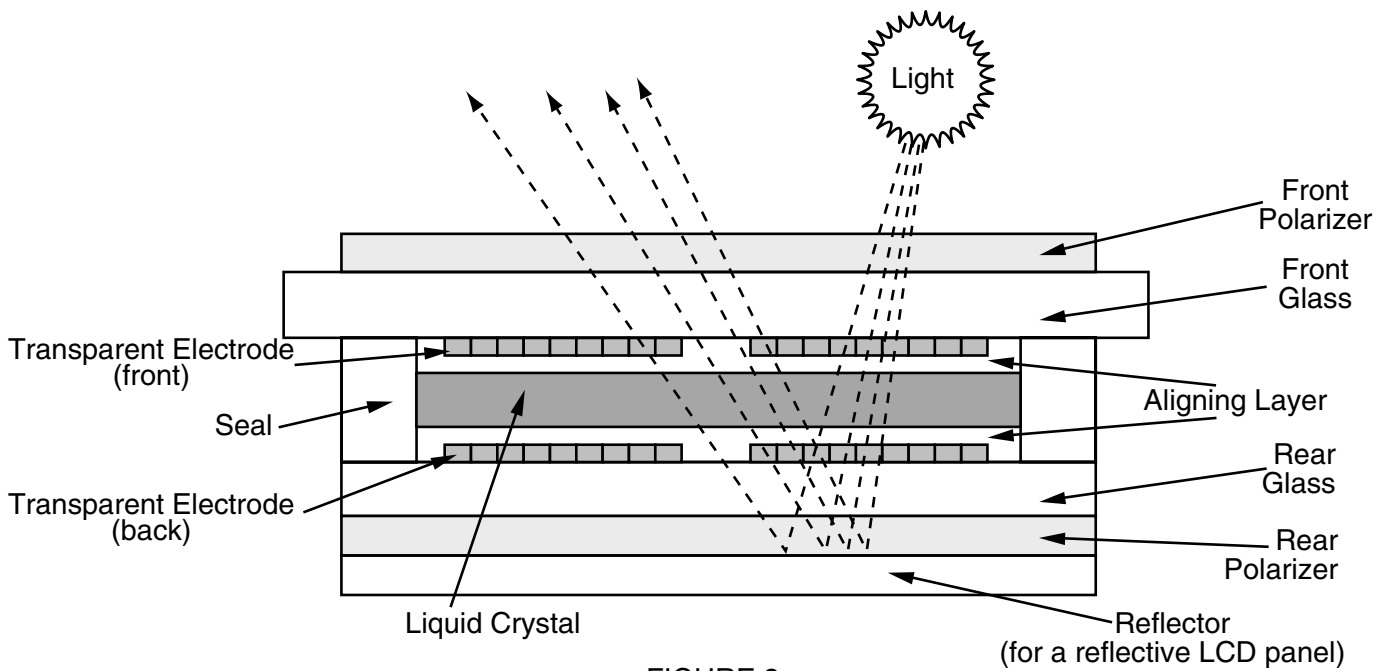


FIGURE 2

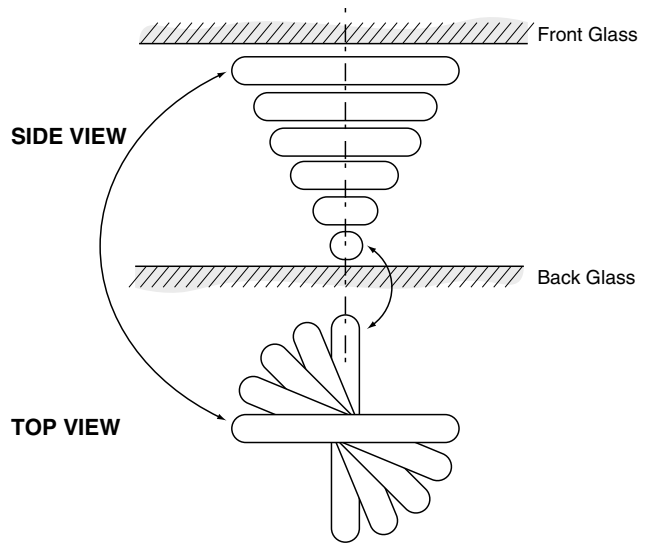


FIGURE 3: Orientation of nematic liquid crystal molecules (turning angle  $90^\circ$ )

### Viewing Modes

LCDs are offered in three basic light transmission modes: reflective, transmissive and transreflective (see Fig. 5).

In the reflective mode, available light is used to illuminate the display. This is achieved by combining a reflector with the rear polarizer. It works best in an outdoor or well-lighted office environment.

Transflective LCDs are a mixture of the reflective and transmissive types, with the rear polarizer having partial reflectivity. They are combined with a backlight for use in all types of lighting conditions. The backlight can be left off where there is sufficient light, conserving power. In darker environments, the backlight can provide a bright display. Transreflective LCDs will not "wash out" when operated in direct sunlight.

Transmissive LCDs have a transparent rear polarizer and do not reflect ambient light. They require a backlight to be visible. They work best in low light conditions with the backlight on continuously.

Another feature of the viewing module is whether the LCD is a positive or negative image (see Fig. 6). The standard image is positive which means a light background with a darker character or dot. This works best in reflective or transflective mode. The negative mode provides a dark background with a light character. A strong backlight must be used to provide good illumination. In most graphic applications, the transmissive negative mode is inverted. This combination provides a light background with dark characters, which offers the user better readability.

### LCD Modules

Early LCDs were composed of only the LCD glass panel. This left the drive circuitry to the customer. More recent developments have combined the LCD panel with a PCB (printed circuit board) containing the drive LSI. This is known as an LCD module, which offers a more complete solution.

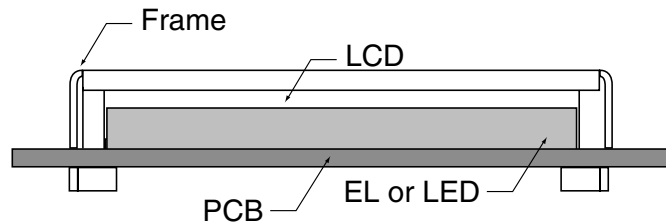


FIGURE 4: EL and LED Backlight

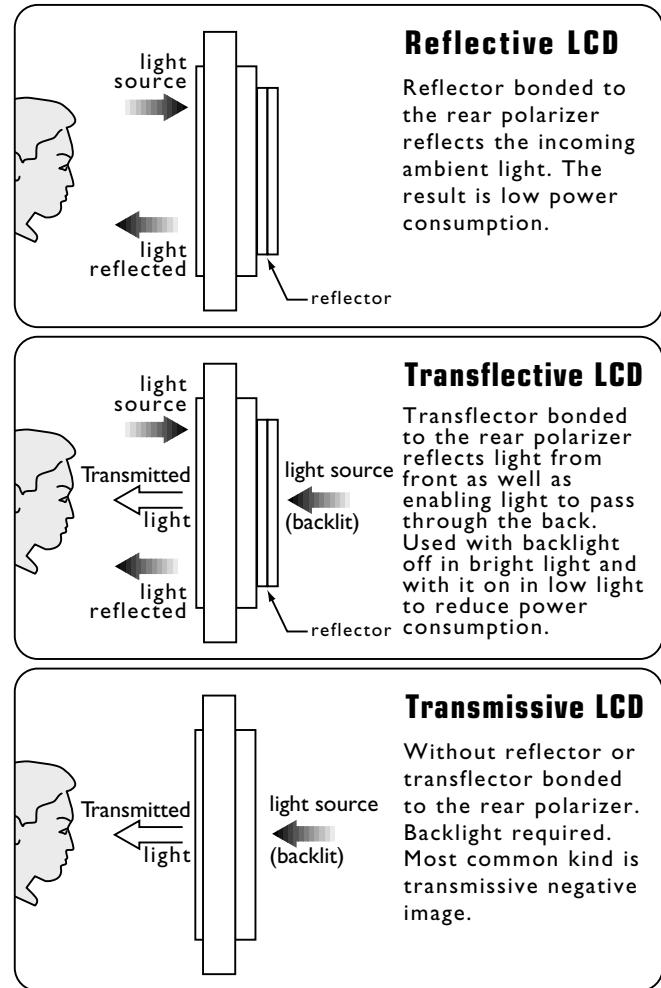


FIGURE 5

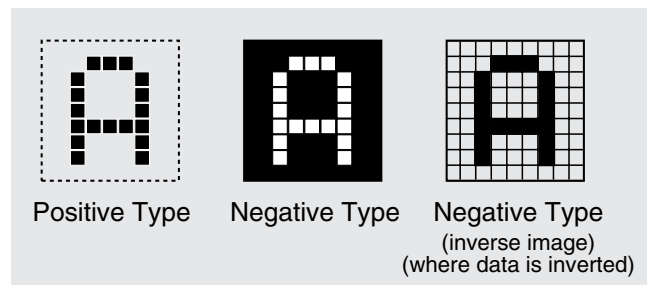


FIGURE 6

There are two types of LCD modules: character and graphic. The character module is composed of 1 to 4 lines of 10 to 40 character blocks having 5x8 dots. Each character block is addressed separately and can form alphanumeric characters and a limited number of symbols.

Graphic modules provide users with a greater degree of flexibility. They are composed of pixels (dots) arranged in rows and columns. Each pixel can be addressed individually for text, graphics or any combination of the two. An LCD controller IC (integrated circuit) is required to operate the graphic LCD. Some models feature the controller chip built into the module. See the Graphic Module Section for details.

**Character Modules**

Dot matrix character LCD modules are offered in a variety of sizes and configurations. Character modules are organized in blocks of 5x8 dots. (5x7 dots for characters, and 5x8 dots for characters) This permits them to display alphanumeric characters to 4 lines of 40 characters. Each model is offered with either Twisted Nematic (TN) or Super Twisted Nematic (STN) fluid for enhanced viewing characteristics. EL or LED backlighting is an option for most models.

Character modules contain a built-in controller chip (HD44780 or equivalent) that allows the LCD module to receive data directly from a 4-bit or 8-bit microprocessor or microcontroller. The controller has at least 160 character patterns in the character generator (CG) ROM. Also available is user-definable CG RAM, which allows the user to program up to 8 characters.

**Features**

- Interfaces with 4-bit or 8-bit microprocessor or microcontroller
- Built-in controller provides internal CG ROM: at least 160 characters in 5x7 dot matrix
- CG RAM allows for 8 user-programmable characters
- Display data RAM offers 80 bytes (80 characters)
- Numerous functions: display on/off, display clear, character blink or shift, cursor blink, shift or home

**Data Interface**

To display data on the module, data is sent through the data bus from the microprocessor to the LCD controller (see Fig. 7). The controller contains two 8-bit registers, one for instructions and one for data. They are selected by the register select (RS) signal. First, positioning data is sent to the LCD and written into the instruction register. This is followed by a character code that is written into the data register. The LCD module will then display the specified character in the correct position.

The controller allows incremental or decremental positioning of successive characters, so that only character codes need to be sent for a continuous character string. Use of the display/cursor shift instruction allows the entry of characters in either right-to-left or left-to-right direction. Another feature is the use of the CG RAM and display data RAM as general data storage by the microprocessor.

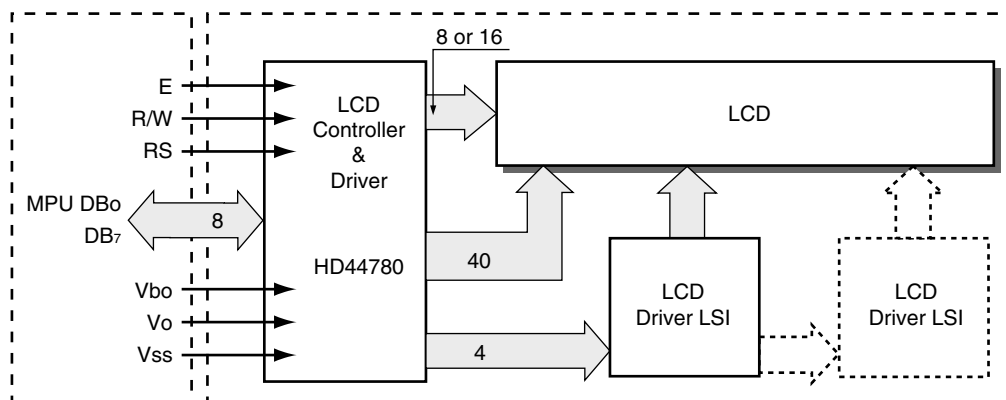


FIGURE 7

### Contrast Adjustment Circuit

A fixed resistor limits the LCD to a finite voltage and, therefore, a very limited viewing angle. It also does not allow for compensation of temperature changes. Fixed resistors should be used in those applications where the display can be adjusted to the user (i.e., hand-held products). A variable resistor is advisable, especially for stationary equipment. The variable resistor allows the user to adjust the voltage to get maximum contrast in relationship to whatever angle the user is viewing the LCD (within the optimum viewing range). A variable resistor also allows the user to adjust the voltage for any temperature fluctuations between 0 and 50 C (-20 to +70 C on some models).

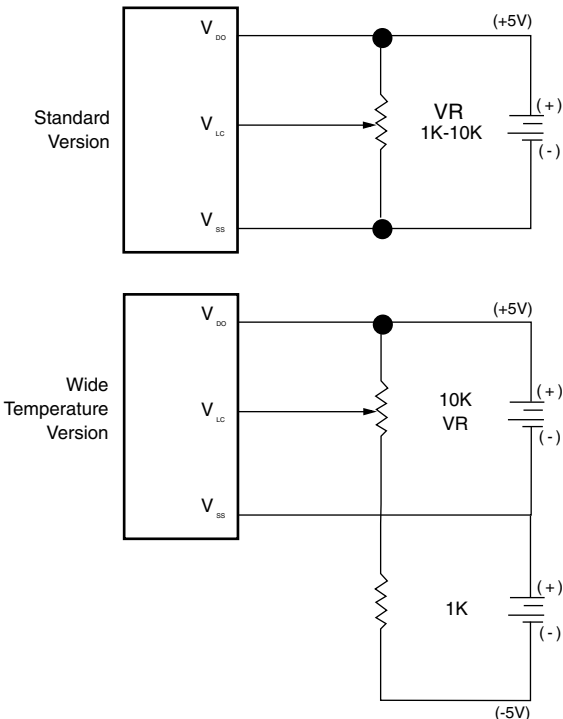


FIGURE 8: contrast adjustment circuit

### GRAPHIC LCD MODULES

#### Features

- STN & FSTN technology offers excellent contrast
- Wide viewing angle
- Thin, light weight with low power consumption
- Built-in controller on some models

Graphic modules offer the greatest flexibility in formatting data on the display. They allow for text, graphics or any combination of the two. Since character size is defined by software, they allow any language or character font to be shown. The only limit is the resolution of the display.

Graphic modules are organized in rows (horizontal) and columns (vertical) of pixels. Each pixel is addressed individually, allowing any combination to be "on". This bitmapping provides the user with the ability to construct text of any size or shape, or true graphics, if that is desired. Polytronix offers resolutions of 120x32 to 320x240 in its standard module.

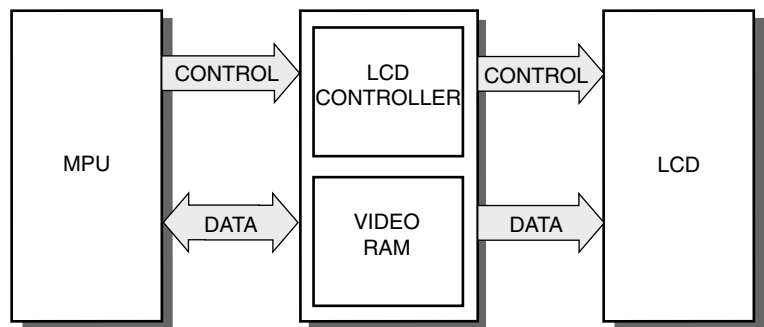


FIGURE 9: circuit block diagram in its standard module

#### Circuit Block Diagram

An LCD controller is required to send data to the graphic module (see Fig.9). This specialized IC receives data from the MPU and sends the proper timing and data signals to the display. Each row of data is sent to a data register and then latched. This starts at the top of the display (line 1) and continues until the bottom is reached.

#### Controller Chips

Several of Polytronix' standard graphics modules include built-in controller chips. For those models which do not include controllers, Polytronix will provide a list of recommended controller chips upon request.

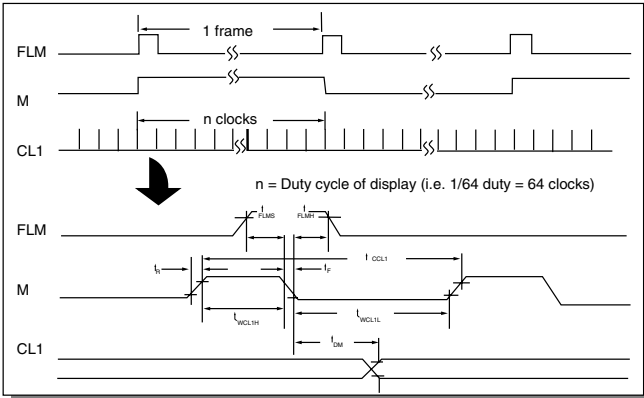


# Graphic LCD Specifications

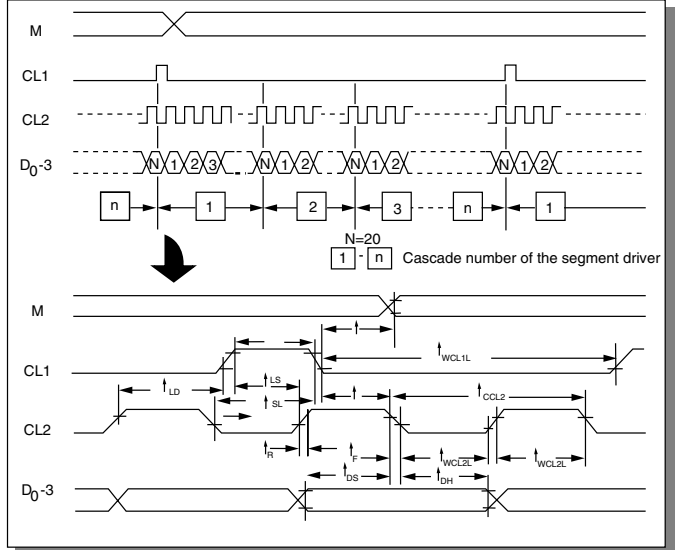
## TIMING CHARACTERISTICS

The following Timing diagrams apply to all graphic modules without a built-in controller.

Timing characteristics of signal input into common driver

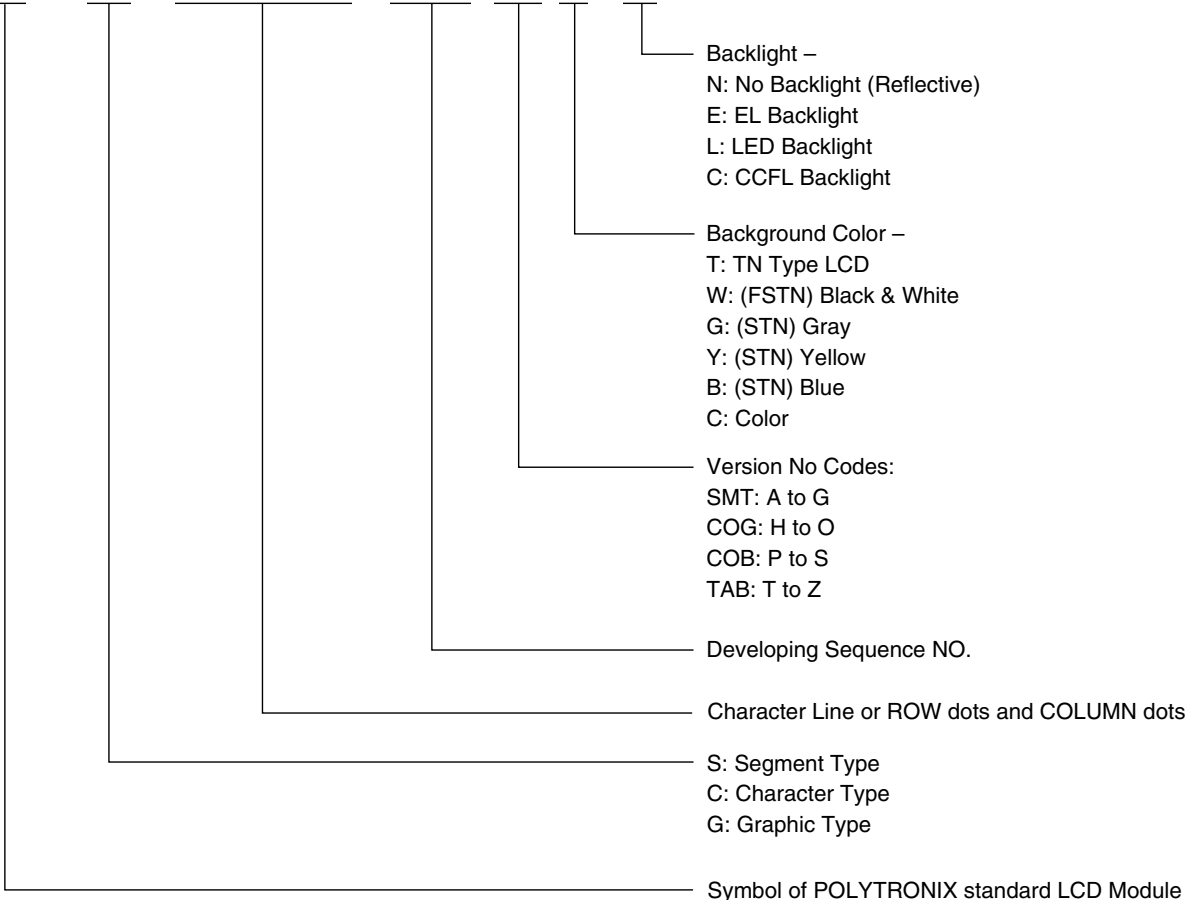


Timing characteristics of signal input into segment driver



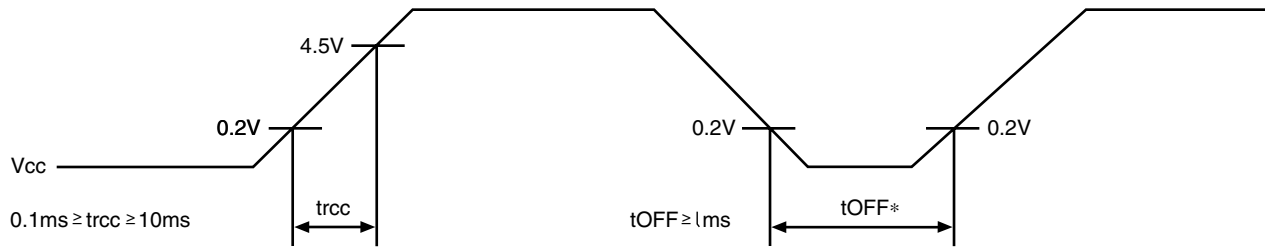
**LCD Module:**

P C-1601 01 P T N



• Power Supply Conditions Using Internal Reset Circuit

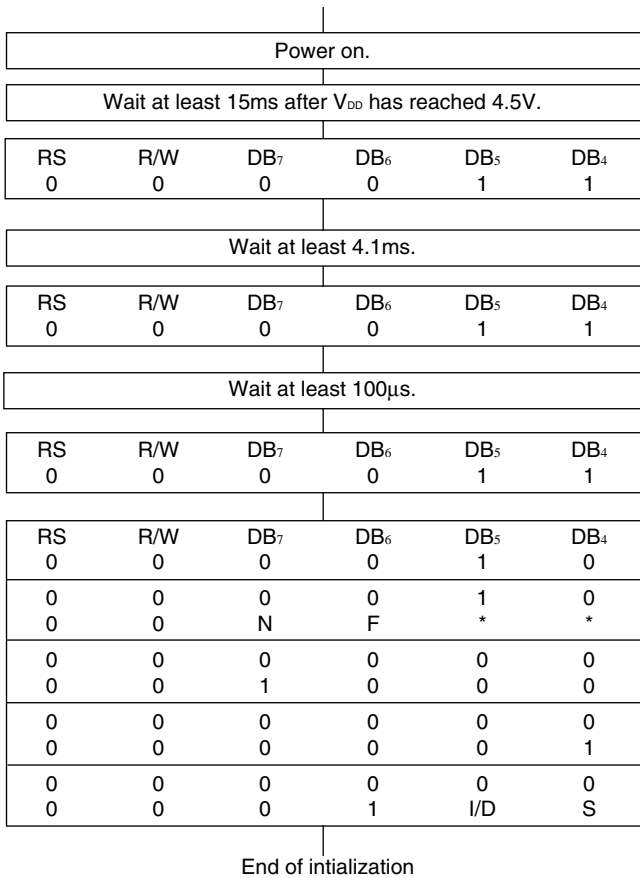
Item	Symbol	Test condition	Limit		Unit
			min	max	
Power Supply Rise Time	$t_{rcc}$	—	0.1	10	ms
Power Supply OFF Time	$t_{OFF}$	—	1	—	ms



Since the internal reset circuit will not operate normally unless the preceding conditions are met, initialize by instruction. (Refer to “Initializing by Instruction”)



### How to initialize for which interface data length is 4 BITS



Busy flag cannot be checked before this instruction is executed.

Function set (interface data length of 8 bits)

Busy flag cannot be checked before this instruction is executed.

Function set (interface data length of 8 bits)

Busy flag cannot be checked before this instruction is executed.

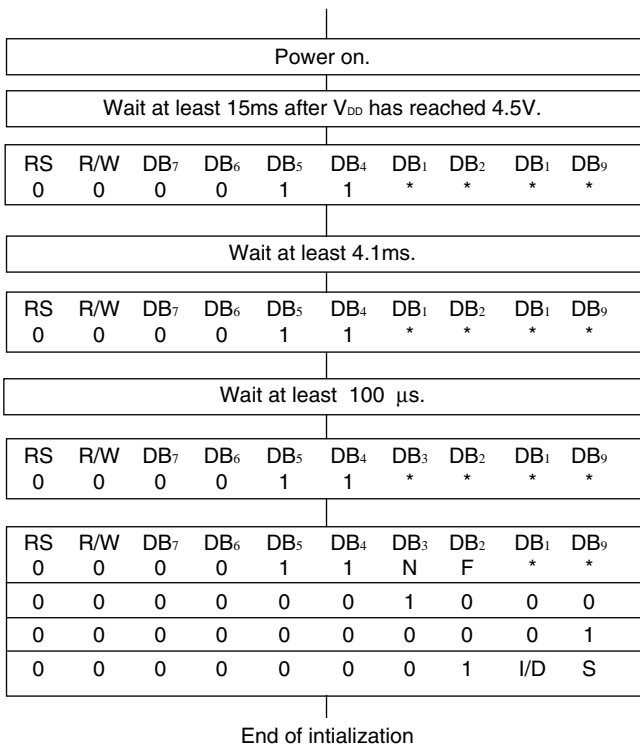
Function set (interface data length of 8 bits)

Busy flag can be checked from the following instructions on. When busy flag is not checked. The waiting time taken till the next instruction is given is required more than executing time of instructions.

- Function Set (set to interface data length of 4 bits) (instruction of 8 bits length)
- Function Set
- Display OFF
- Display clear
- Entry Mode Set

Note: N= 1:2 lines, N= 0:1 lines  
F= 1:5 x 10 dots, F= 0:5 x 8 dots

### How to initialize for which interface data length is 8 BITS

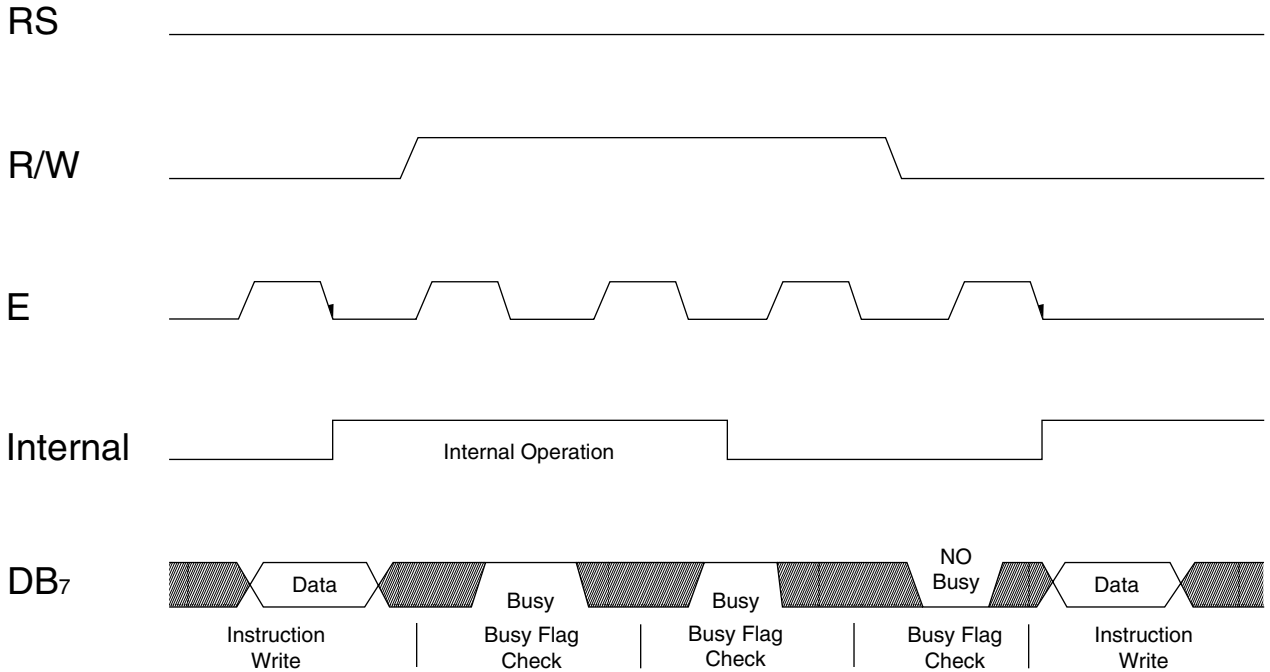


Function set (interface data length of 8 bits)

Function set (interface data length of 8 bits)

Busy flag can be checked from the following instructions on. When busy flag is not checked. The waiting time taken till the next instruction is given is required more than executing time of instructions.

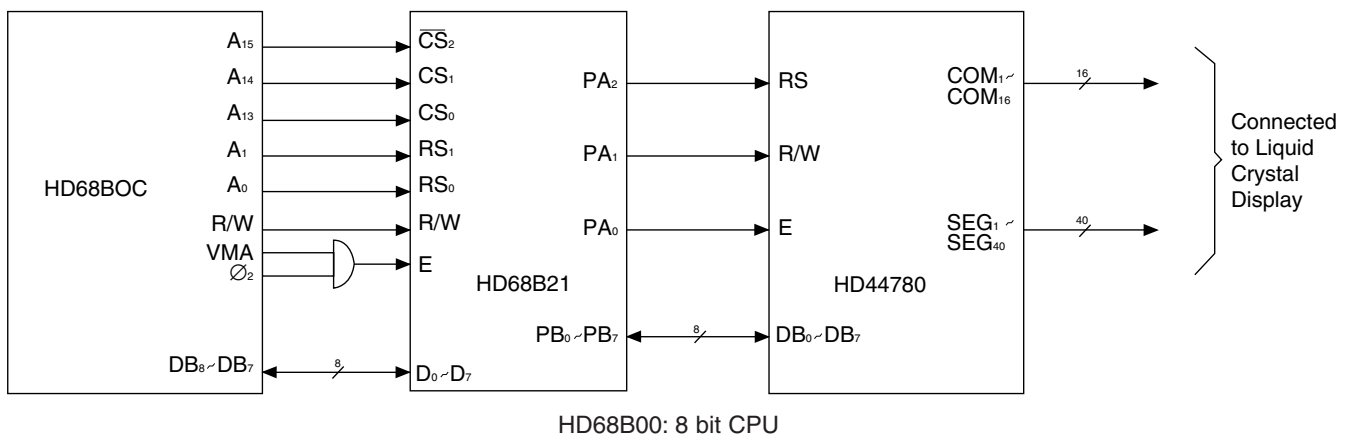
- Function Set
- Display OFF
- Display clear
- Entry Mode Set



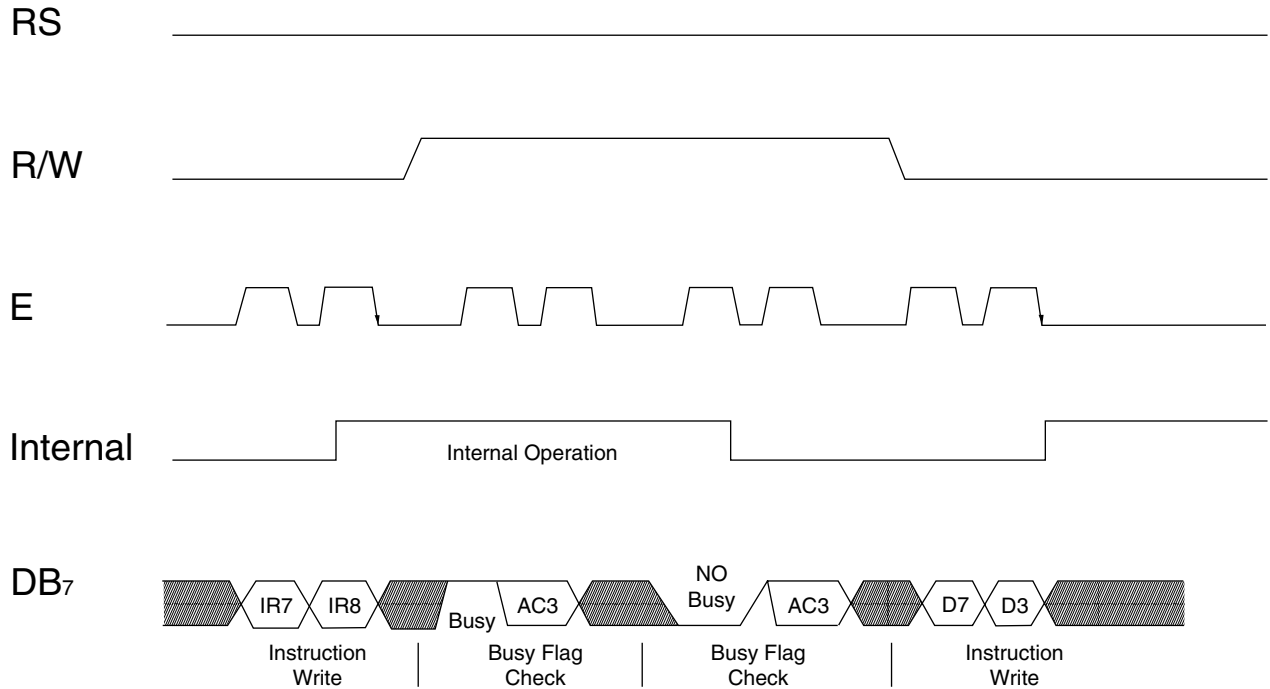
Example of Busy Flag Check timing sequence

- (1) When connecting to 8-bit MPU through PIA  
 Fig. 13-2 is an example of using a PIA or I/O port (for single chip microcomputer) as an interface device. Input and output of the device is TTL compatible.

In the example, PB<sub>0</sub> to PB<sub>7</sub> are connected to the data buses DB<sub>0</sub> to DB<sub>7</sub> and PA<sub>0</sub> to PA<sub>2</sub> are connected to E, R/W and RS respectively. Pay attention to the timing relation between E and other signals when reading or writing data and using PIA as an interface.



Example of Interface to HD68B00 Using PIA (HDG8B21)



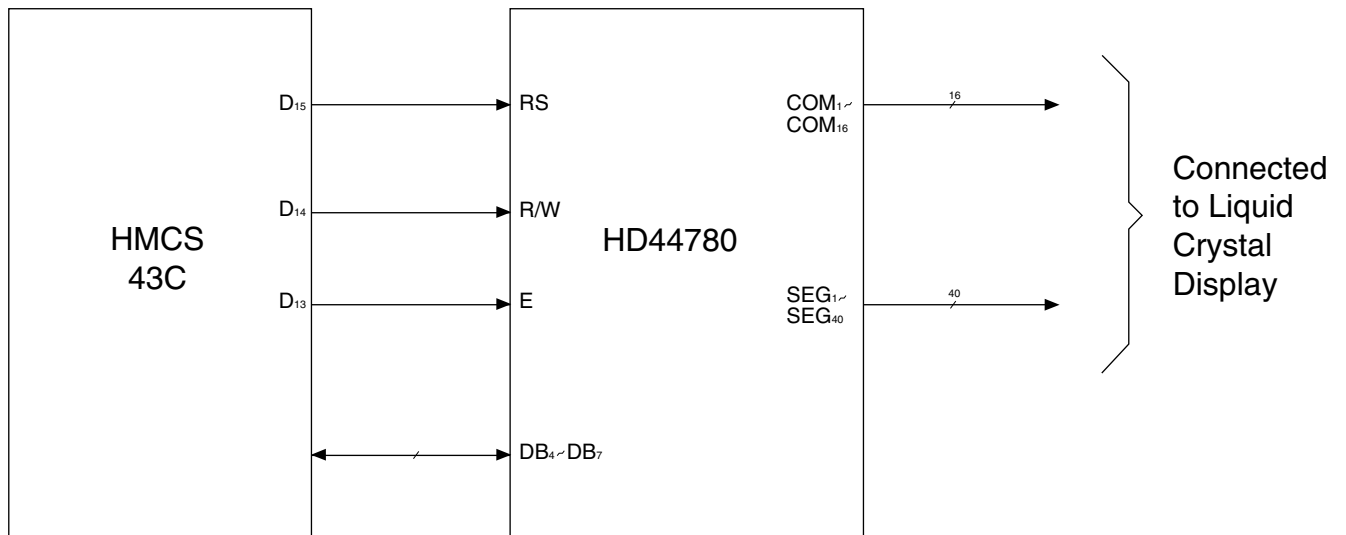
Standard I/O is Parallel.  
 (Note) IR7, IR3: Instruction 7th bit, 3rd bit  
 AC3: Address Counter 3rd bit

Example of 4-bit Data Transfer timing sequence

The HD44780 can be connected to a 4-bit MPU through the 4-bit MPU I/O port. If the I/O port has enough bits, data can be transferred in 8-bit lengths, but if the bits are insufficient, the transfer is made in two operations of 4 bits each (with designation of interface data length for 4 bits). In the latter case, the timing sequence becomes somewhat complex.

Fig. 13-4 shows an example of interface to the HMCS43C.

Note that 2 cycles are needed for the busy flag check as well as the data transfer. 4-bit operation is selected by program.



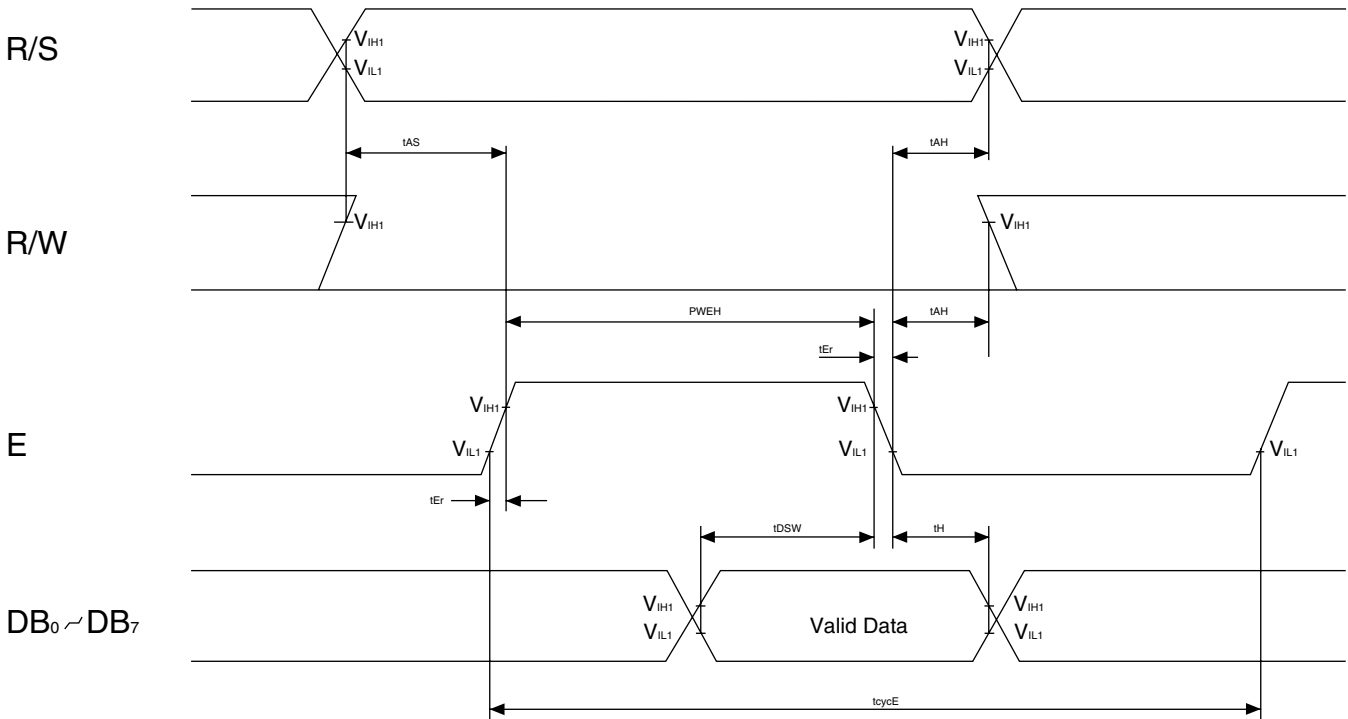
HMCS43C: Hitachi: 4-bit Single-chip microcomputer Example of Interface to the HMCS43C

Parameter	Symbol	Measuring Condition	Standard Value			Unit
			Min.	Typ.	Max.	
Enable Cycle Time	$T_{CYCE}$	Figs. 1.2	1000	–	–	ns
Enable Pulse Width, High Level	$P_{WEH}$	Figs.1.2	450	–	–	ns
Enable Rise and Decay Time	$t_{Er}, T_{Ef}$	Figs. 1.2	–	–	25	ns
Address Setup Time, RS, R/W-E	$t_{AS}$	Figs.1.2	140	–	–	ns
Data Delay Time	$t_{DDR}$	Fig. 2	–	–	320	ns
Data Setup Time	$t_{DSW}$	Fig. 1	195	–	–	ns
Data Hold Time (Write Operation)	$t_H$	Fig. 1	10	–	–	ns
Data Hold Time (Read Operation)	$t_{DHR}$	Fig. 2	20	–	–	ns
Address Hold Time	$t_{AH}$	Figs.1.2	10	–	–	ns

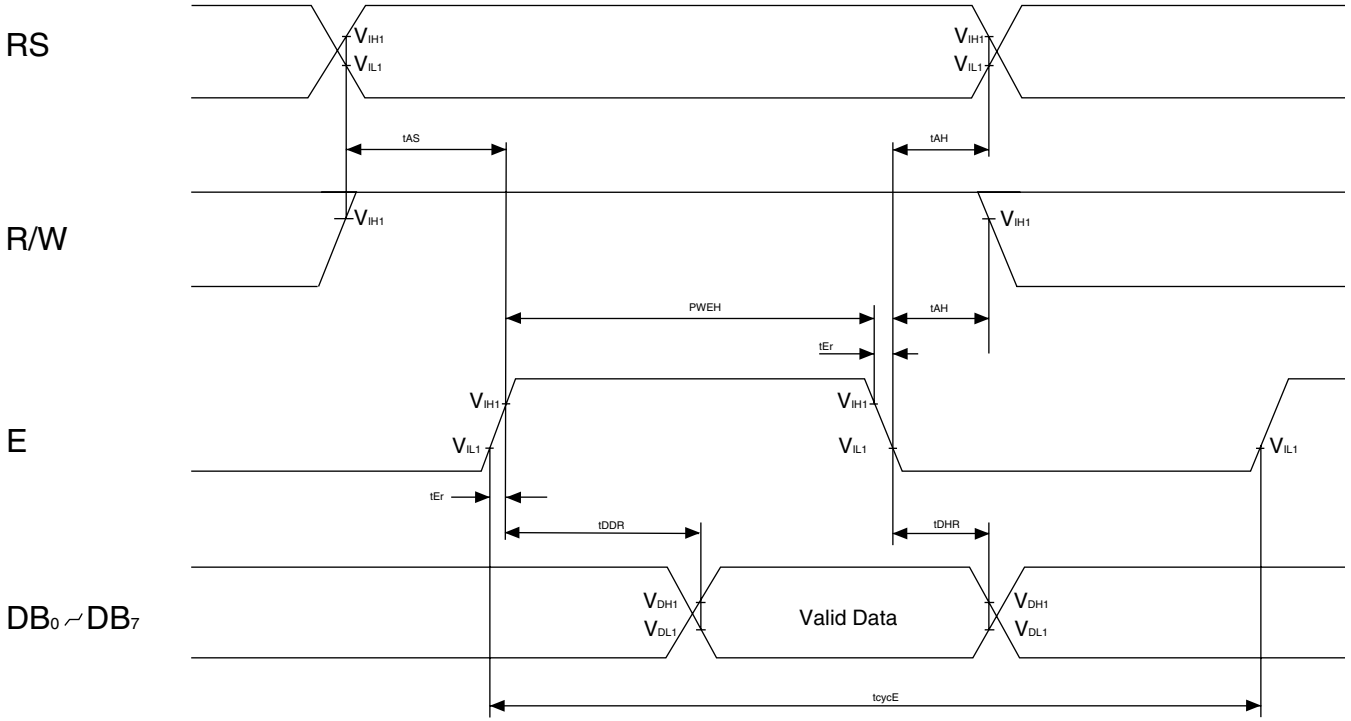
\* $V_{CC} = 5.0V \pm 10\%$ ,  $GND = 0V$ ,  $T_a = -20 \sim +75^\circ C$

(In case control LSI is HD44780)

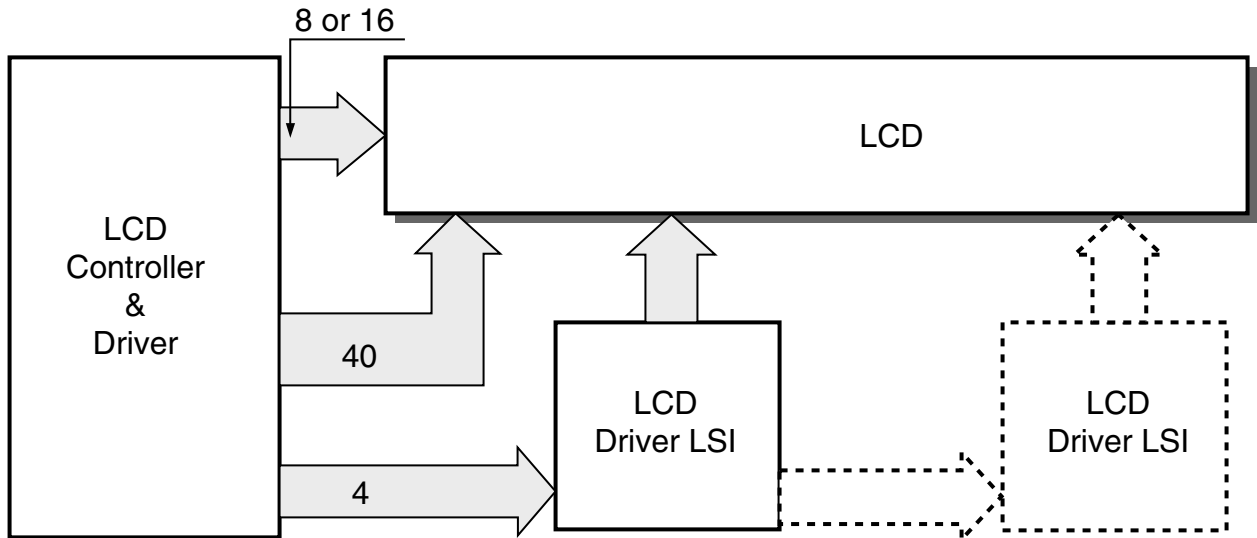
**FIG. 1 Write operation**



**FIG. 2 Read operation**

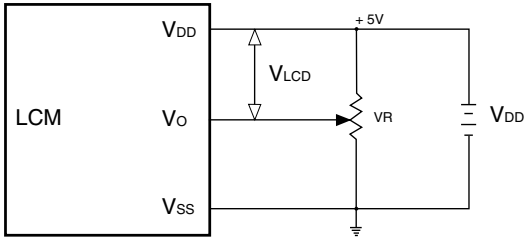


**Block diagram:**

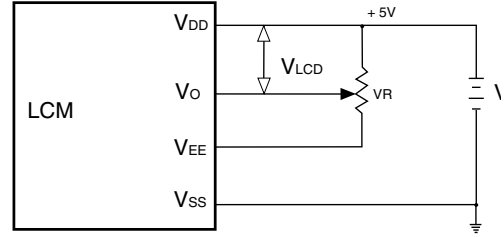


## Single Supply Voltage Type

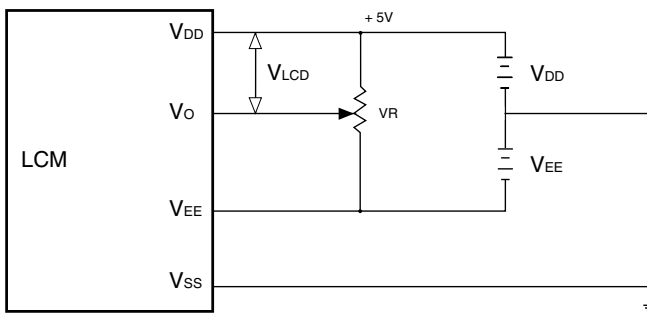
TYPE A



TYPE B

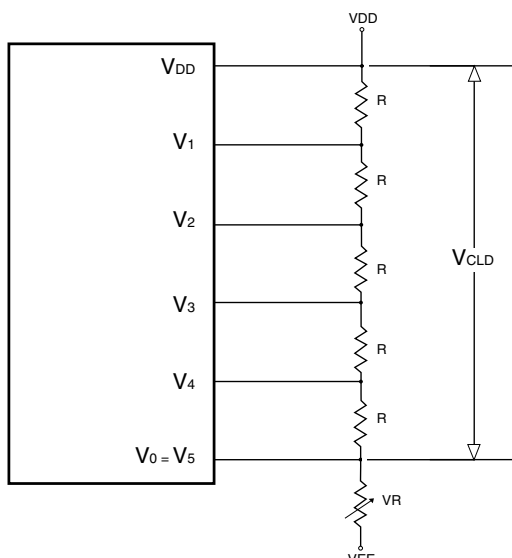


## Dual Supply Voltage Type



$V_{LCD}$ : LCD DRIVING VOLTAGE  
 $VR$ : 10K – 20K

## Example of LCD Driving Voltage Supply



$$V_1 = V_{DD} - 1/5 V_{LCD}$$

$$V_2 = V_{DD} - 2/5 V_{LCD}$$

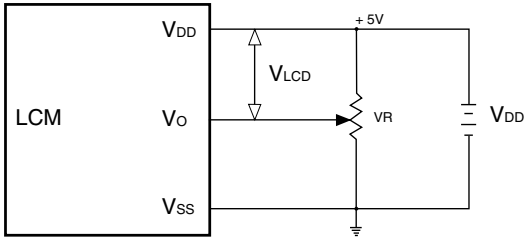
$$V_3 = V_{DD} - 3/5 V_{LCD}$$

$$V_4 = V_{DD} - 4/5 V_{LCD}$$

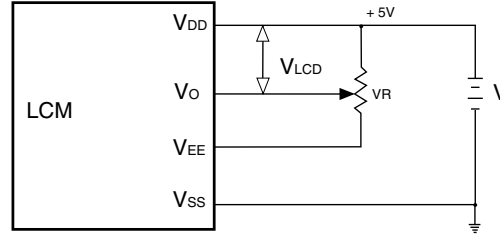
$$V_5 = V_{DD} - V_{LCD}$$

## Single Supply Voltage Type

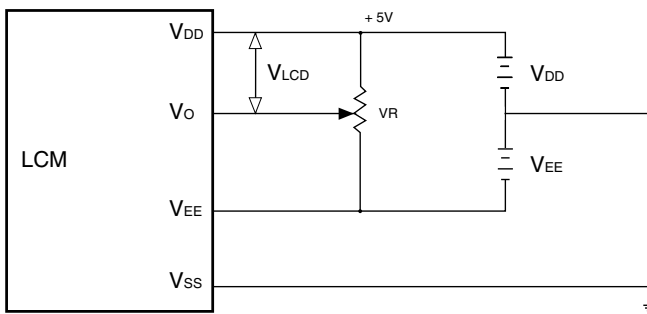
TYPE A



TYPE B

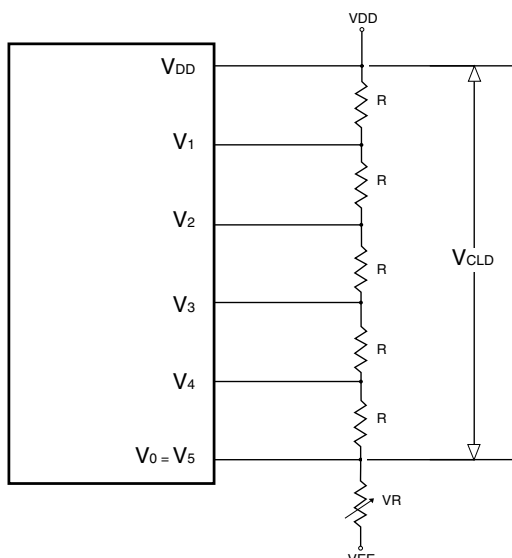


## Dual Supply Voltage Type



$V_{LCD}$ : LCD DRIVING VOLTAGE  
 $VR$ : 10K – 20K

## Example of LCD Driving Voltage Supply



$$V_1 = V_{DD} - 1/5 V_{LCD}$$

$$V_2 = V_{DD} - 2/5 V_{LCD}$$

$$V_3 = V_{DD} - 3/5 V_{LCD}$$

$$V_4 = V_{DD} - 4/5 V_{LCD}$$

$$V_5 = V_{DD} - V_{LCD}$$



# CHARACTER GENERATOR ROM (CG ROM)

This character generator ROM (CG ROM) generates a character pattern of 5 x 7 dots from 8-bit character code and provides 192 character patterns.

Correspondence between Character Codes and Character Pattern.

High 4bit / Lower 4bit	0000	0010	0011	0100	0101	0110	0111	1010	1011	1100	1101	1110	1111
XXXX0000	CG RAM (1)		0	a	P	`	p	-	9	E	e	p	p
XXXX0001	(2)	!	1	A	B	a	9	a	7	7	4	a	q
XXXX0010	(3)	"	2	B	R	b	r	r	4	w	x	p	e
XXXX0011	(4)	#	3	C	S	c	s	u	o	t	e	e	e
XXXX0100	(5)	\$	4	D	T	d	t	v	I	t	t	p	a
XXXX0101	(6)	%	5	E	U	e	u	=	o	+	1	e	u
XXXX0110	(7)	&	6	F	V	f	v	9	o	2	3	p	z
XXXX1000	(8)	'	7	G	W	g	w	7	+	2	3	g	π
XXXX0111	(1)	(	8	H	X	h	x	4	o	*	U	r	x
XXXX1001	(2)	)	9	I	Y	i	y	e	9	J	W	'	y
XXXX1010	(3)	*	#	J	Z	j	z	z	3	n	v	j	7
XXXX1011	(4)	+	;	K	L	k	l	+	9	e	o	*	π
XXXX1100	(5)	,	<	L	*	l	l	+	9	o	o	e	π
XXXX1101	(6)	-	=	M	J	m	j	u	z	^	o	t	÷
XXXX1110	(7)	.	>	N	^	n	+	a	z	+	'	n	
XXXX1111	(8)	/	?	O	_	o	+	u	v	7	"	ö	

\* The user can specify any pattern for character-generator ROM.

# Instruction table

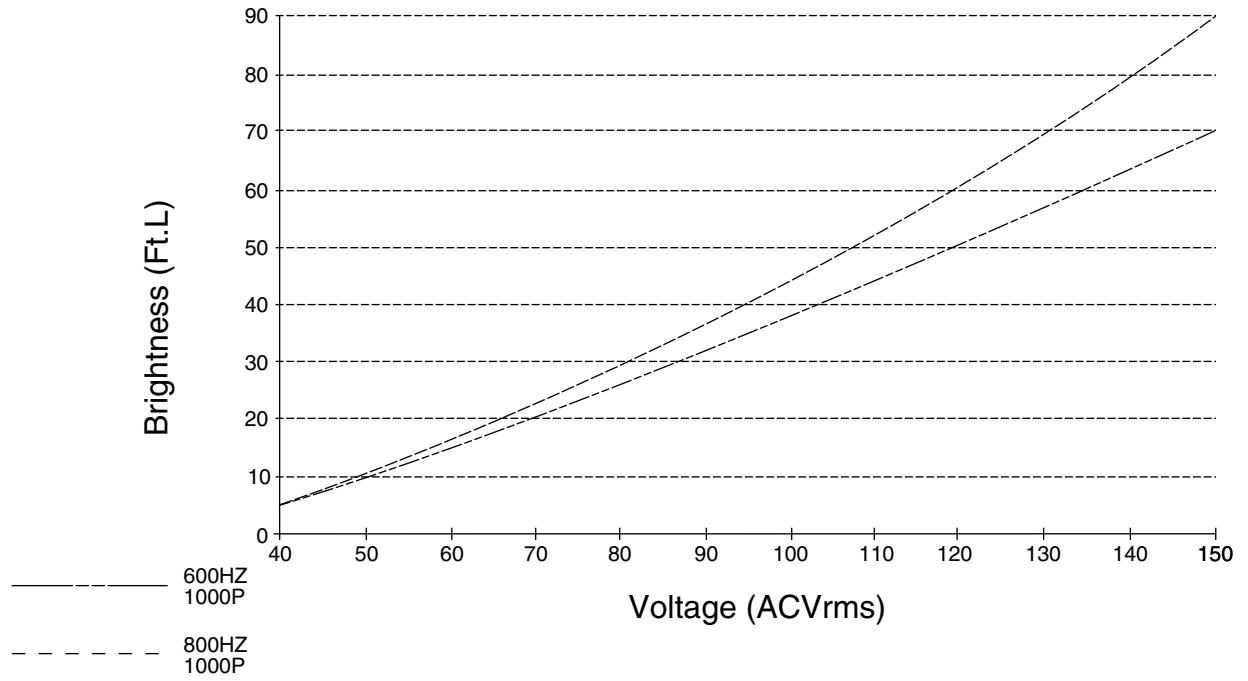
Instruction	CODE										Description	Execution time (when fosc is 250 kHz) Note 1	Execution time (when fosc is 160 kHz) Note 2	
	RS	R/W	DB <sub>7</sub>	DB <sub>6</sub>	DB <sub>5</sub>	DB <sub>4</sub>	DB <sub>3</sub>	DB <sub>2</sub>	DB <sub>1</sub>	DB <sub>0</sub>				
Clear display	0	0	0	0	0	0	0	0	0	0	1	Clears all display and returns the cursor to the home position (Address 0).	82µs ~ 1.64ms	120µs ~ 4.9ms
Return home	0	0	0	0	0	0	0	0	0	1	•	Returns the cursor to the home position (Address 0). Also returns the display being shifted to the original position. DD RAM contents remain unchanged.	40µs ~ 1.6ms	120µs ~ 4.8ms
Entry mode set	0	0	0	0	0	0	0	1	I/D	S		Sets the cursor move direction and specifies or not to shift the display. These operations are performed during data write and read.	40 µs	120 µs
Display ON/OFF control	0	0	0	0	0	0	1	D	C	B		Sets ON/OFF of all display (D), cursor ON/OFF (C), and blink of cursor position character (B).	40 µs	120 µs
Cursor and display shift	0	0	0	0	0	1	S/C	R/L	•	•		Moves the cursor and shifts the display without changing DD RAM contents.	40 µs	120 µs
Function set	0	0	0	0	1	DL	N	F	•	•		Sets interface data length (DL) number of display lines (L) and character font (F).	40 µs	120 µs
Set CG RAM address	0	0	0	1	ACG							Sets the CG RAM address. CG RAM data is sent and received after this setting.	40 µs	120 µs
Set DD RAM address	0	0	1	ADD							Sets the DD RAM address. DD RAM data is sent and received after this setting.	40 µs	120 µs	
Read busy flag & address	0	1	BF	AC							Reads Busy flag (BF) indicating internal operation is being performed and reads address counter contents.	1 µs	1 µs	
Write data to CG or DD RAM	1	0	Write Data							Writes data into DD RAM or CG RAM.	40 µs	120 µs		
Read data to CG or DD RAM	1	1	Read data							Reads data into DD RAM or CG RAM.	40 µs	120 µs		
	I/D = 1: Increment (+1) I/D = 0: Decrement (-1) S = 1: Accompanies display shift. S/C = 1: Display shift S/C = 0: Cursor move 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: Internally operating BF = 0: Can accept instruction										DD RAM: Display data RAM CG RAM: Character generator RAM ACG: CG RAM address ADD: DD RAM address Corresponds to cursor address. AC: Address counter used for both of DD and CG RAM address.	Execution time changes when frequency changes. (Example) When fosc is 270 kHz: 40 µs x _____ = 37 µs		

No effect

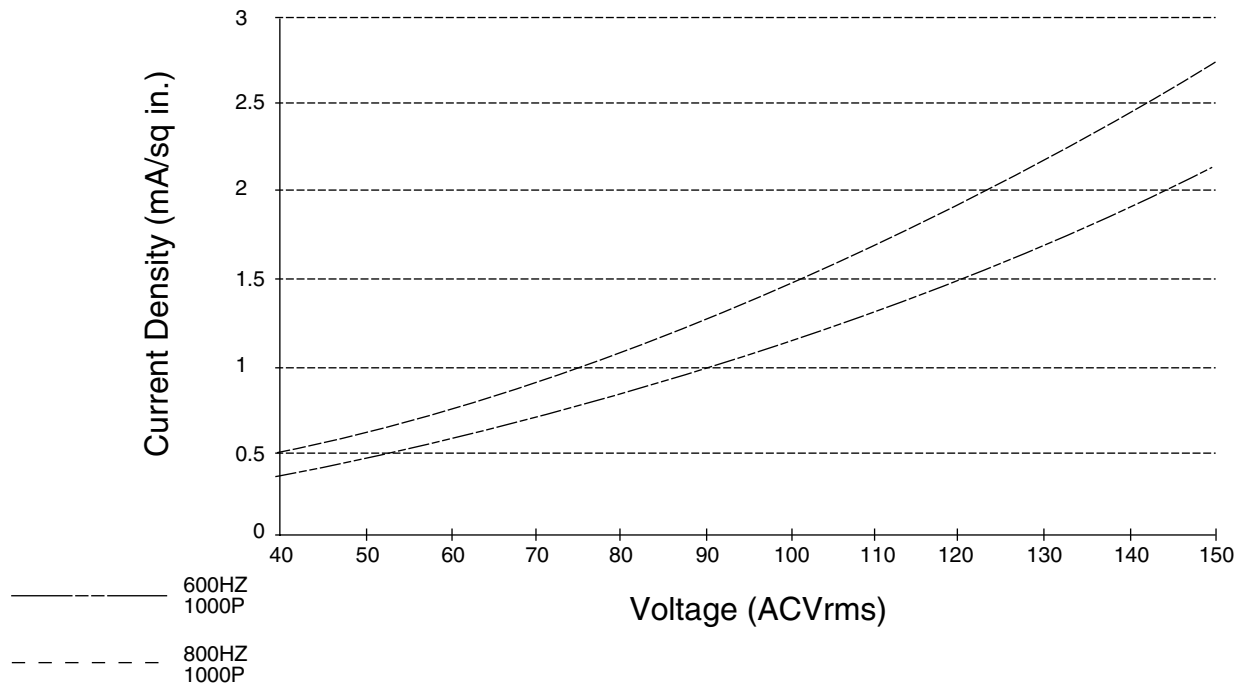
250

270

Voltage VS. Brightness



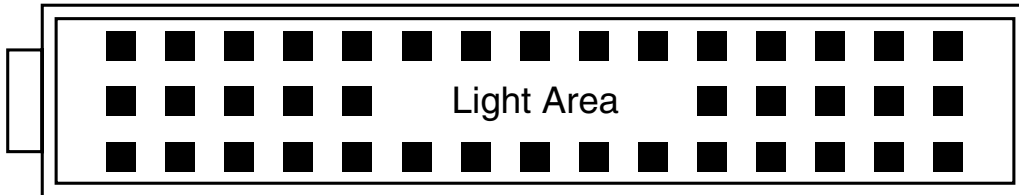
Voltage VS. Current Density



- Lifetime: more than 100,000 hrs.
- Low voltage DC: +5V
- Various color: Yellow Green (Standard), Red, Orange, Amber, Green (Option)
- 2 backlight methods are available: Bottom Backlight, Edge Backlight.  
Example of Bottom backlight (PVC160205 AYL)

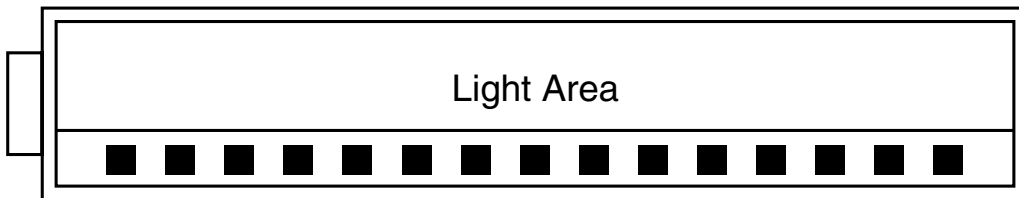
**Standard lamp styles: Bottom Backlight**

The LED chips are distributed over the whole light area of the illumination unit, which gives the most uniform light. As below:

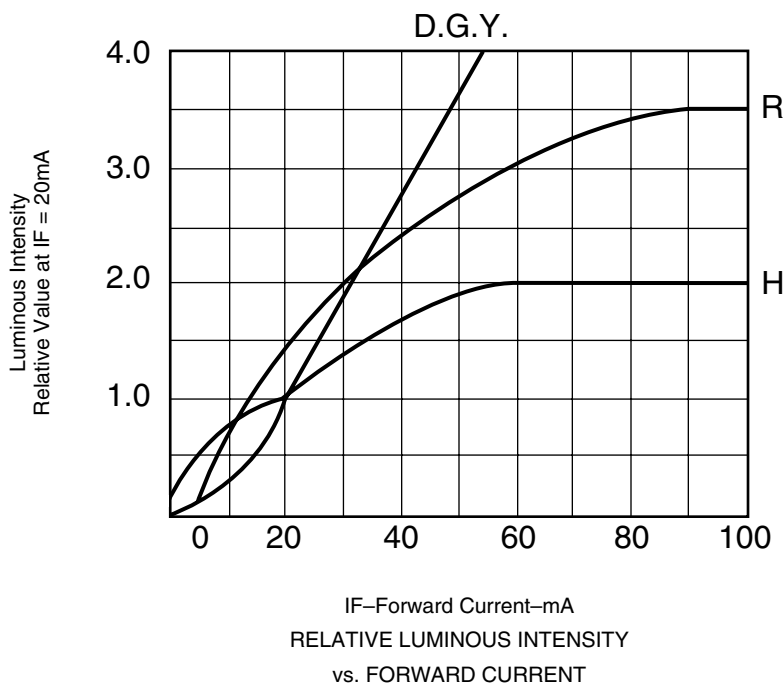


**Standard lamp styles: Edge Backlight**

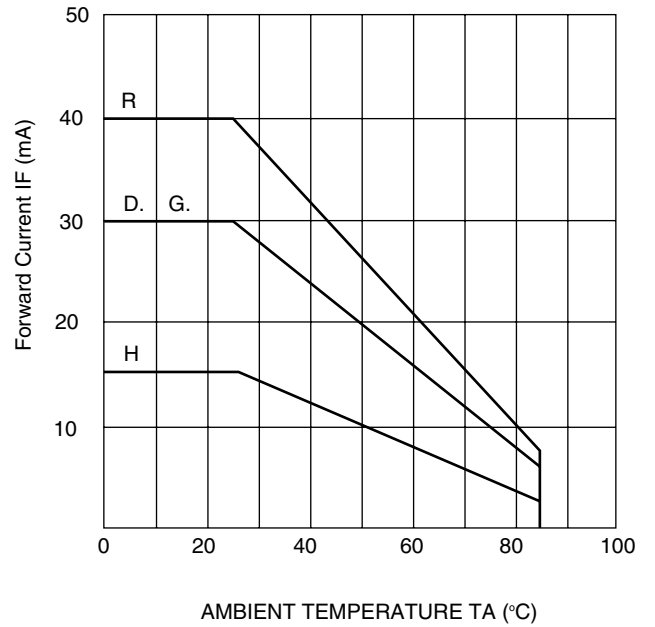
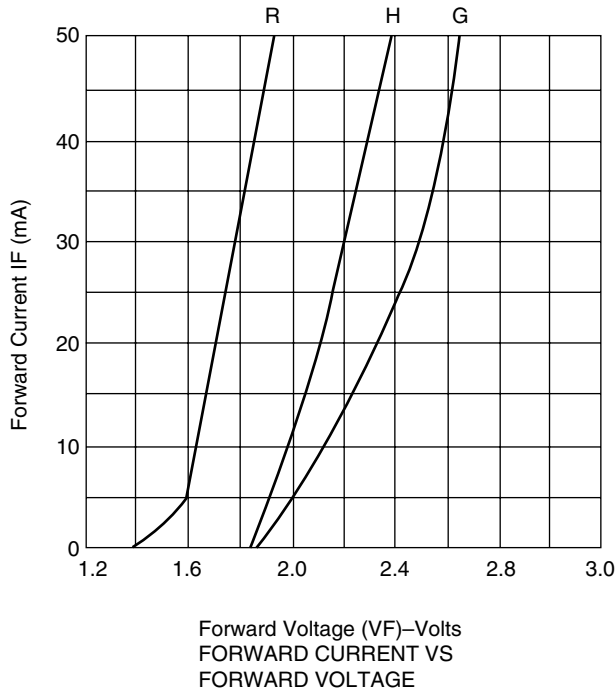
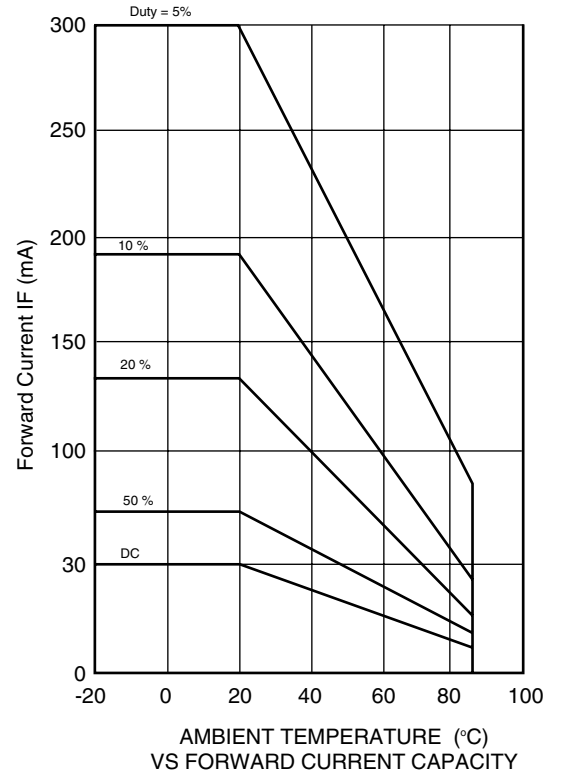
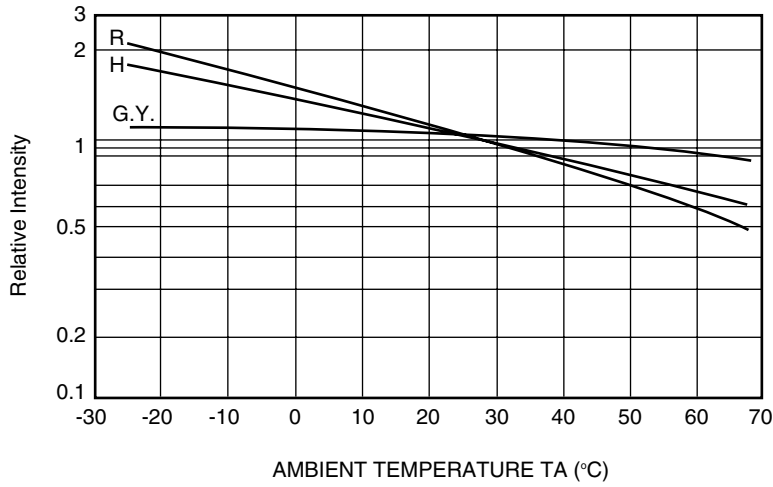
The LED chips are distributed across the bottom or top of the display area, which gives adequate illumination for 1 or 2 displays. As below:



**Characteristic curves**



CHARACTERISTIC CURVES

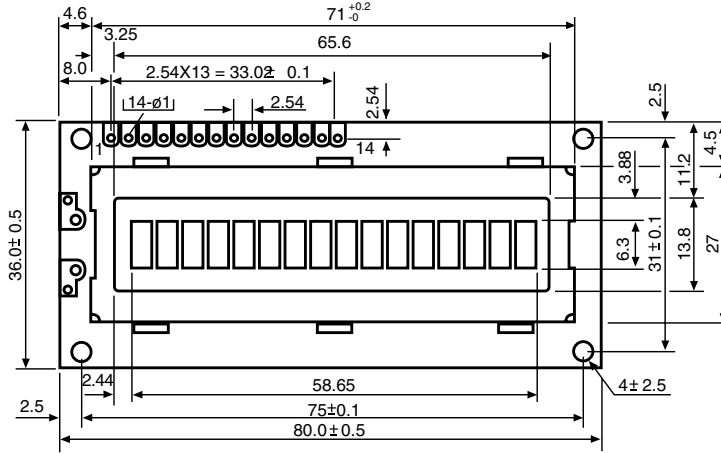
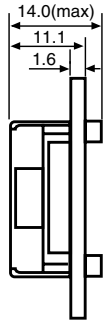


NOTICE: 25° free air temperature unless otherwise specified  
 G: GREEN  
 Y: YELLOW  
 O: ORANGE

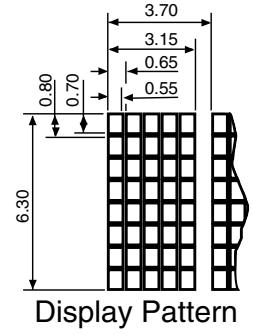
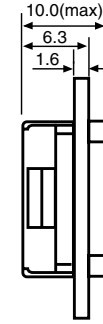
# CHARACTER MODULES

Display Format (Char.xLine)	Model #	Fonts	Module Size (WxHxT1/T2)mm T1/T2=none/with LED	Effective Viewing Area (WxH)mm	Character Size (WxH)mm	Dot Size (WxH)mm	Driving Method (Duty)	Process & Color			Backlight	
								TN	STN Yellow	STN Gray	None	EL
8 x 1	PC-080101	5x8 dots	84.0 x 44.0 x 10.0/14.5	61.0x15.8	6.45x10.75	1.25x1.30	1/8		●	●	●	●
	PC-080201	5x7 dots w/cursor	58.0 x 32.0 x 10.0/14.5	35.0x15.0	2.45x3.8	0.45x0.50	1/16		●	●	●	●
10 x 1	PC-100101	5x7 dots	58.0 x 21.0 x 8.4/-	46.00x11.50	3.20x5.55	0.56x0.95	1/16	●	●	●	●	●
	PC-160101	5x7 dots w/cursor	80.0 x 36.0 x 9.50/13.5	64.50x13.80	3.07x5.74	0.558x0.76	1/16		●	●	●	●
16 x 1	PC-160104	5x7 dots w/cursor	122.0 x 33.0 x 10.5/14.5	99.0x13.0	4.84x8.06	0.92x1.10	1/16		●	●	●	●
	PC-160201	5x7 dots w/cursor	100.0 x 36.5 x 10.0/14.0	80.0x20.0	7.79x4.07	0.90x0.75	1/16		●	●	●	●
	PC-160202	5x8 dots	80.0 x 36.0 x 10.5/14.5	64.5x13.8	2.78x4.89	0.50x0.55	1/16		●	●	●	●
	PC-160203	5x7 dots w/cursor	84.0 x 44.0 x 11.0/14.5	61.00x16.00	2.95x5.55	0.55x0.65	1/16		●	●	●	●
	PC-160204	5x7 dots w/cursor	85.0 x 36.0 x 9.5/13.5	65.0 x 17.4	0.6 x 0.7	0.56 x 0.66	1/16		●	●	●	●
	PC-160205	5x7 dots w/cursor	122.0 x 44.0 x1 0.0/13.0	99.0x24.0	4.84x8.06	0.92x1.10	1/16		●	●	●	●
16 x 2	PC-160206	5x8 dots	85.0 x 30.0 x 10.0/13.5	64.5x17.0	2.95x4.75	0.55x0.55	1/16		●	●	●	●
	PC-160401	5x8 dots	87.0 x 60.0 x 10.0/13.5	61.8x25.2	2.95x4.75	0.52x0.52	1/16		●	●	●	●
16 x 4	PC-160402	5x8 dots	115.0 x 70.0 x 10.0/13.5	88.0x44.2	4.45x6.95	0.85x0.95	1/16		●	●	●	●
	PC-200101	5x7 dots w/cursor	116.0 x 38.0 x 10.0/14.0	84.0x17.7	5.95x3.2	0.60x0.70	1/16		●	●	●	●
20 x 1	PC-200202	5x8 dots	116.0 x 37.0 x 10.0/13.5	83.0x18.6	3.2x5.55	0.6x0.65	1/16		●	●	●	●
	PC-200203	5x8 dots	163.0 x 48.0 x 10.0/13.5	129.0x30.0	5.058x9.6250.91x1.09	1/16		●	●	●	●	
	PC-200204	5x8 dots	148.0 x 45.0 x 10.5/13.5	122.0x23.3	4.85x9.22	0.92x1.10	1/16		●	●	●	●
20 x 2	PC-200401	5x7 dots w/cursor	98.0 x 60.0 x 10.0/14.0	76.00x25.20	2.95x4.75	0.55x0.55	1/16		●	●	●	●
	PC-240202	5x7 dots w/cursor	118.0 x 36.0 x 10.0/14.5	93.5x15.8	3.15x4.45	0.55x0.55	1/16		●	●	●	●
24 x 2	PC-240203	5x8 dots	189.0 x 42.0 x 11.0/15.0	160.0x23.0	5.48x8.74	1.04x1.04	1/16		●	●	●	●
	PC-240401	5x8 dots	119.35 x 56.85 x 10.0/14.0	91.15x29.85	2.95x4.85	0.55x0.65	1/36		●	●	●	●
24 x 4	PC-240801	5x8 dots	120.5 x 81.5 x 10.0/14.0	91.8x52.25	2.95x4.85	0.55x0.65	1/36		●	●	●	●
	PC-400201	5x8 dots	182.0 x 35.0 x 10.5/14.5	154.5x15.8	3.20x5.55	0.60x0.65	1/16		●	●	●	●
40 x 2	PC-400401	5x8 dots	190.0 x 54.0 x 10.0/14.5	147.0x29.5	2.78x4.27	0.5x0.55	1/16		●	●	●	●
	PC-800401	5x8 dots	289.0 x 88.0 x 10.0/14.5	227.0x34.0	2.375x4.22	0.435x0.56	1/16		●	●	●	●

LED Backlight

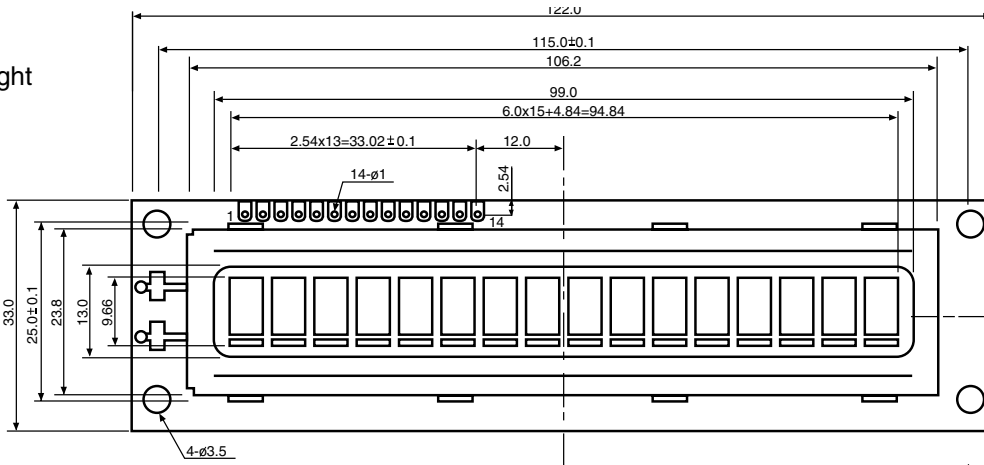
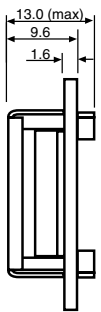


EL Backlight  
NO Backlight

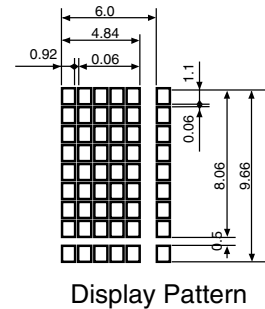
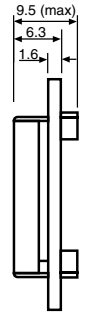


CHARACTER SERIES

LED Backlight



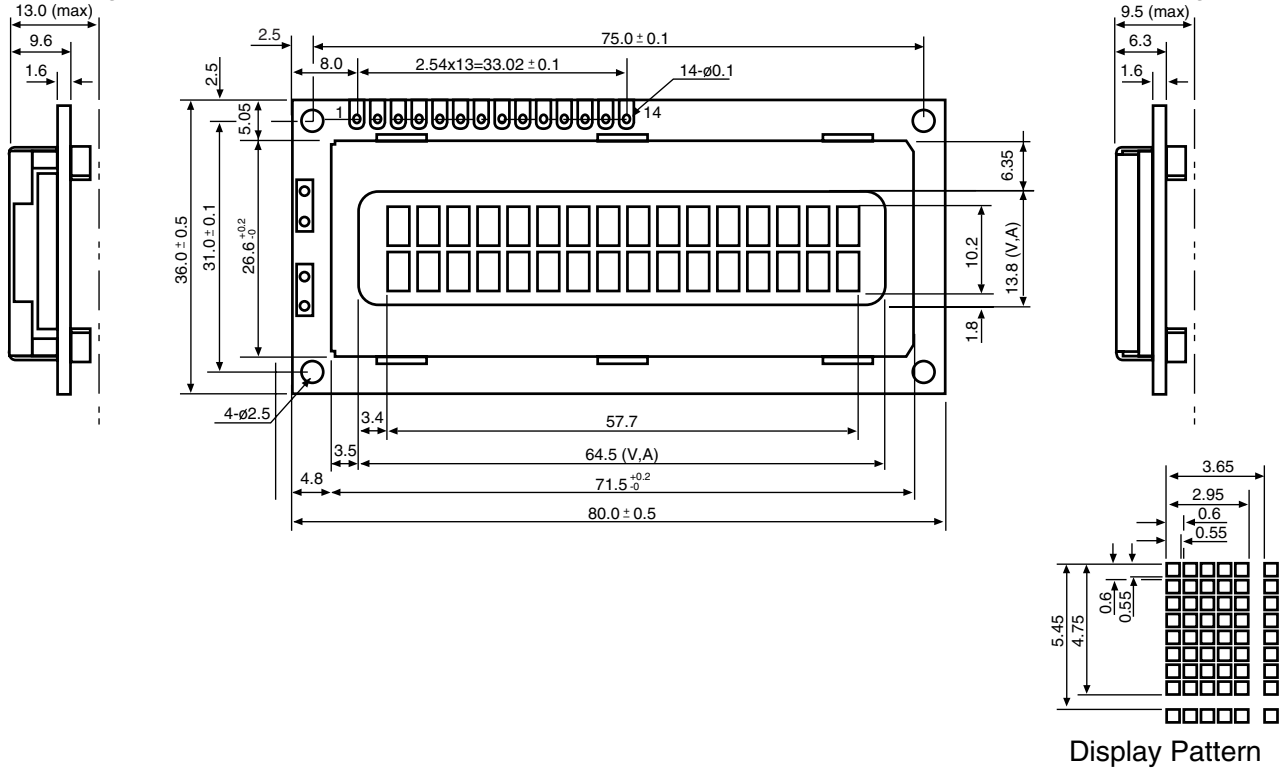
EL Backlight  
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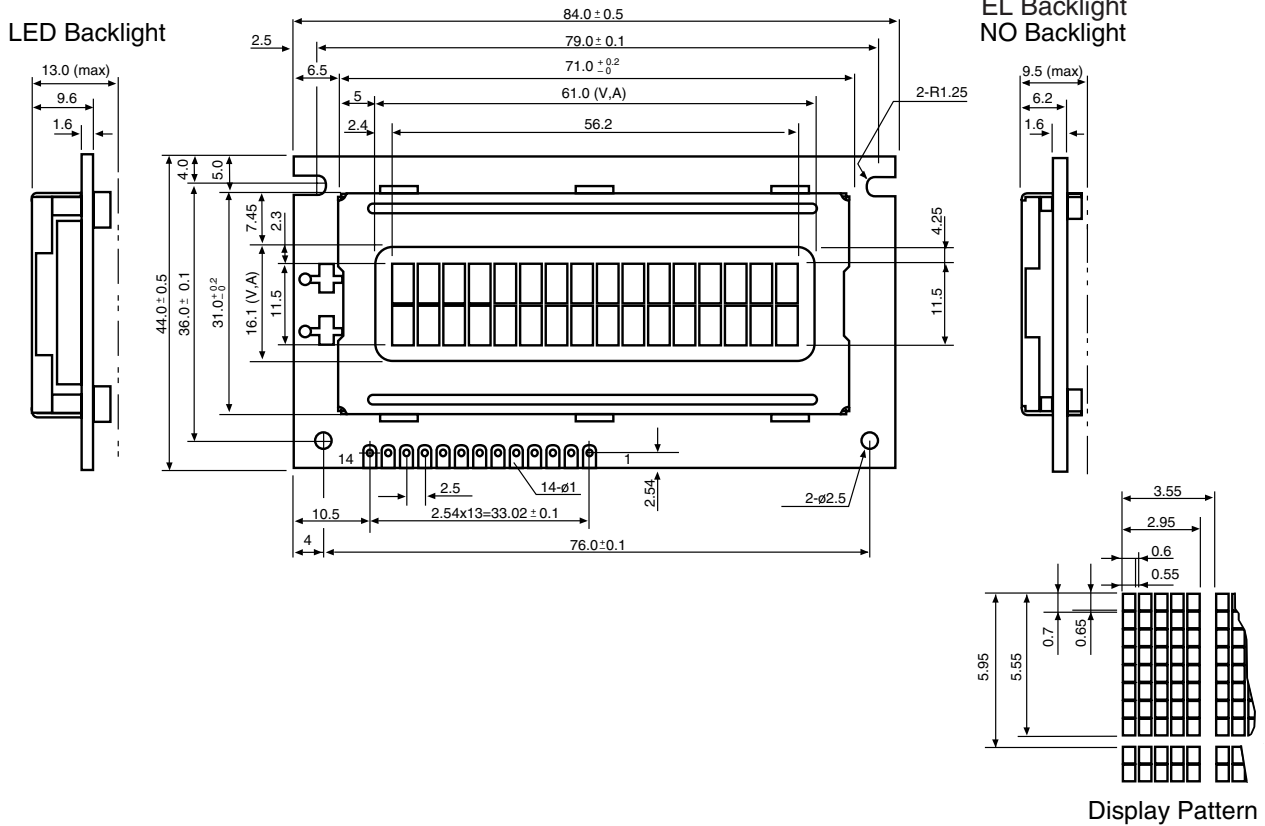
LED Backlight

NO Backlight



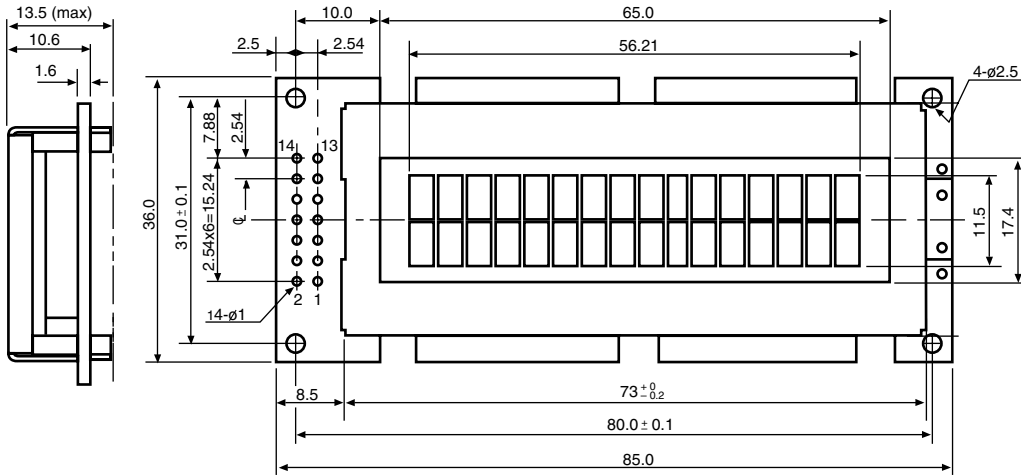
LED Backlight

EL Backlight  
NO Backlight

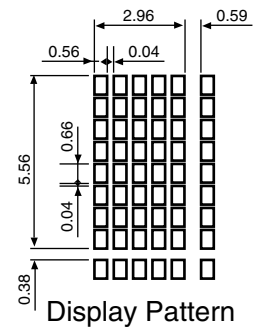
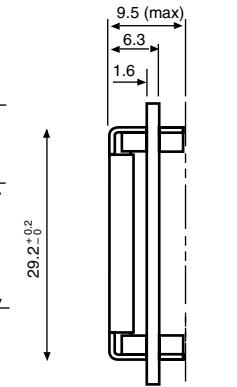


CHARACTER SERIES

LED Backlight

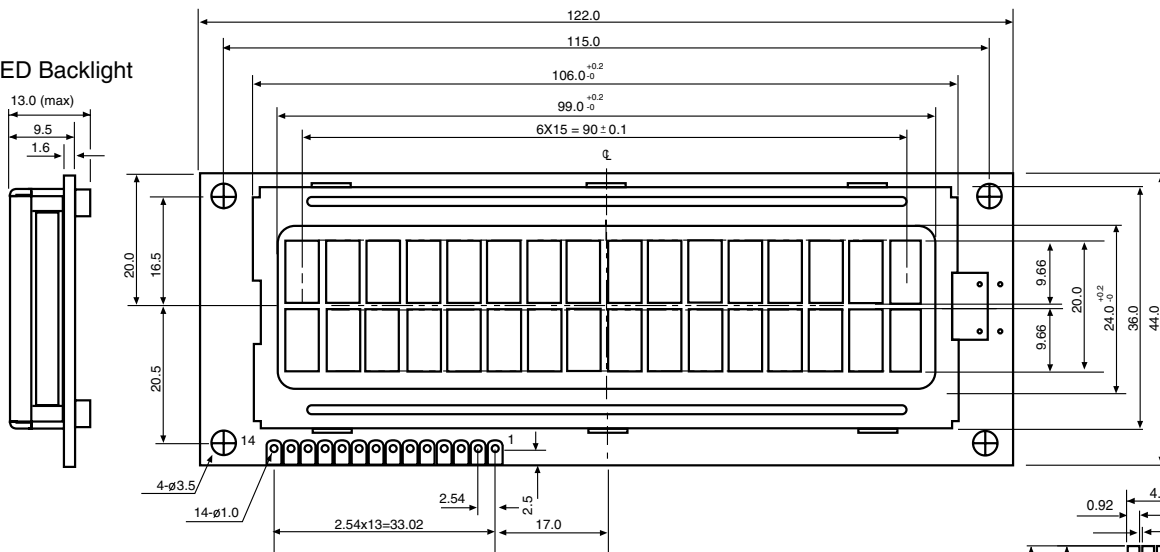


EL Backlight  
NO Backlight

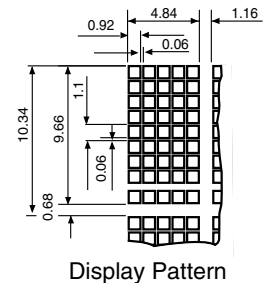
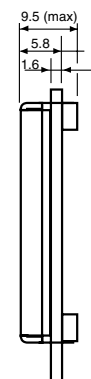


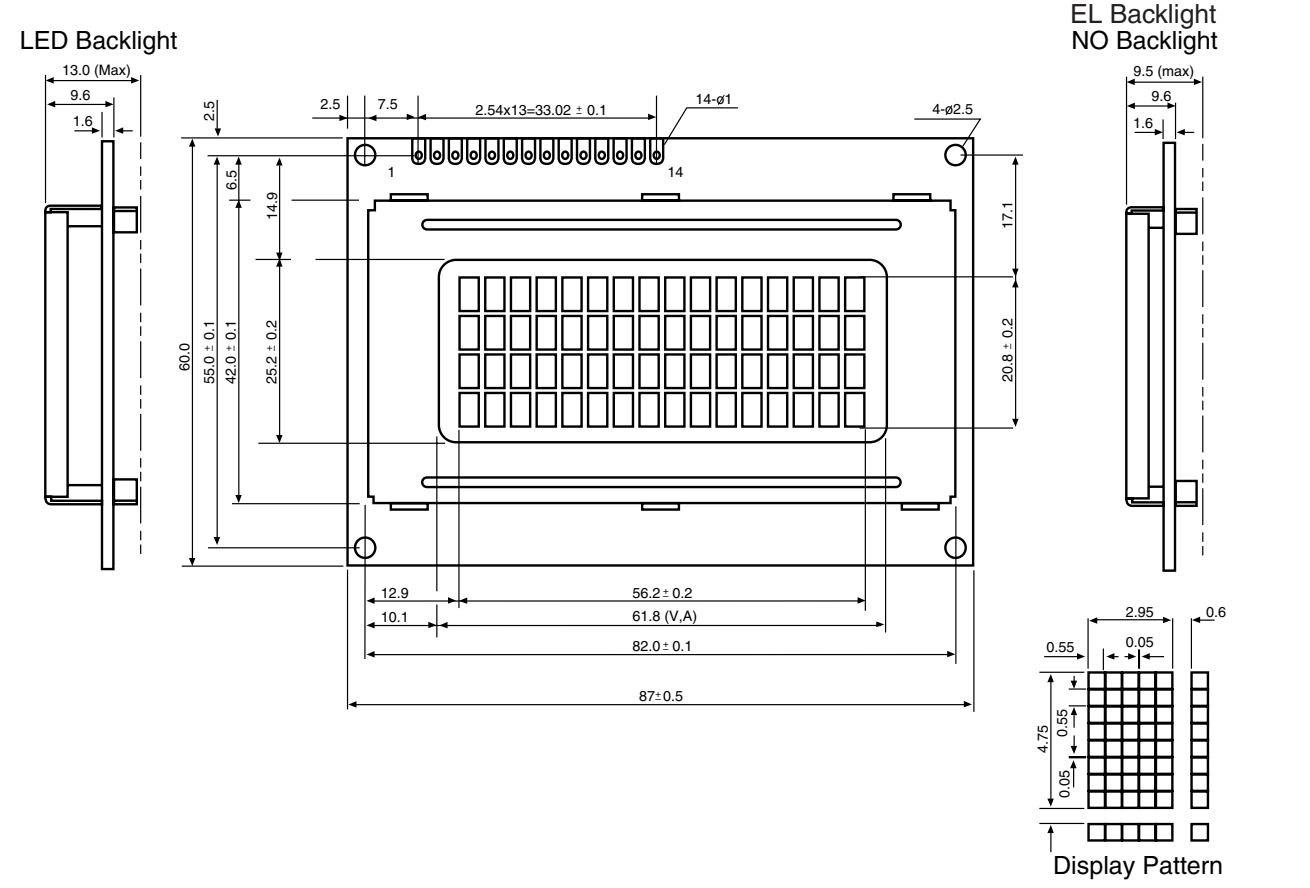
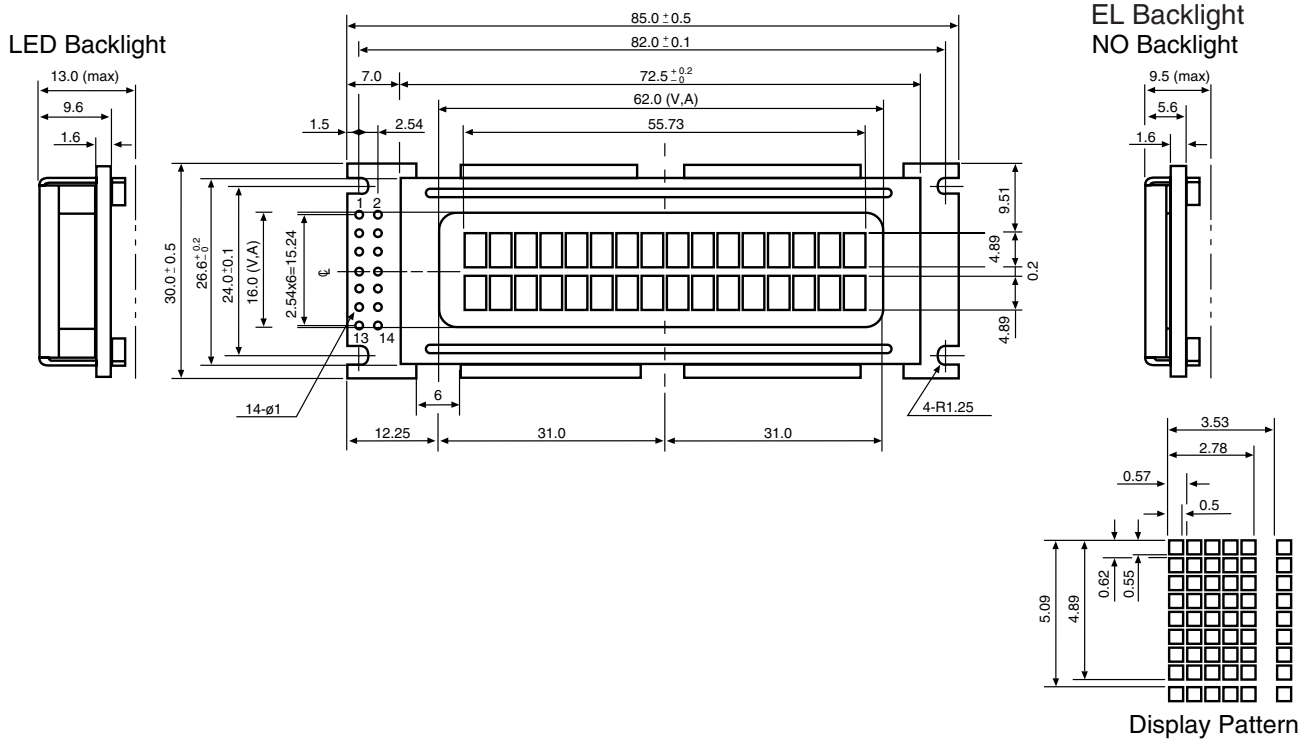
CHARACTER SERIES

LED Backlight



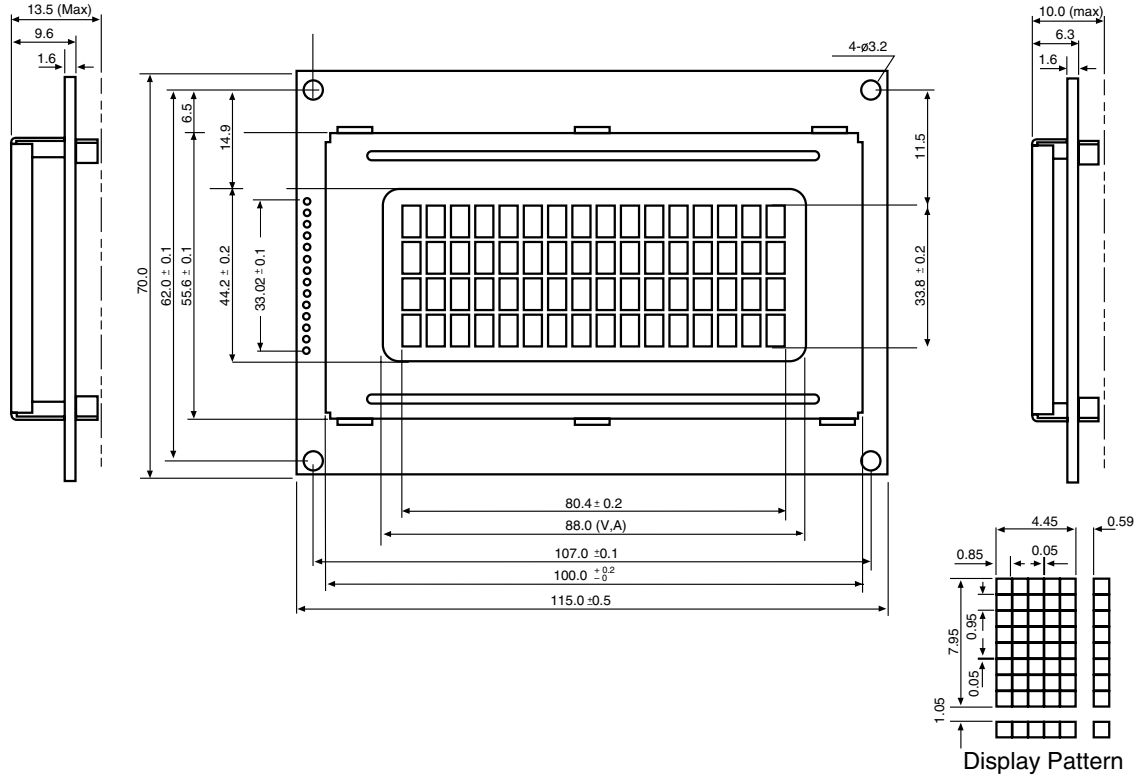
EL Backlight  
NO Backlight





LED Backlight

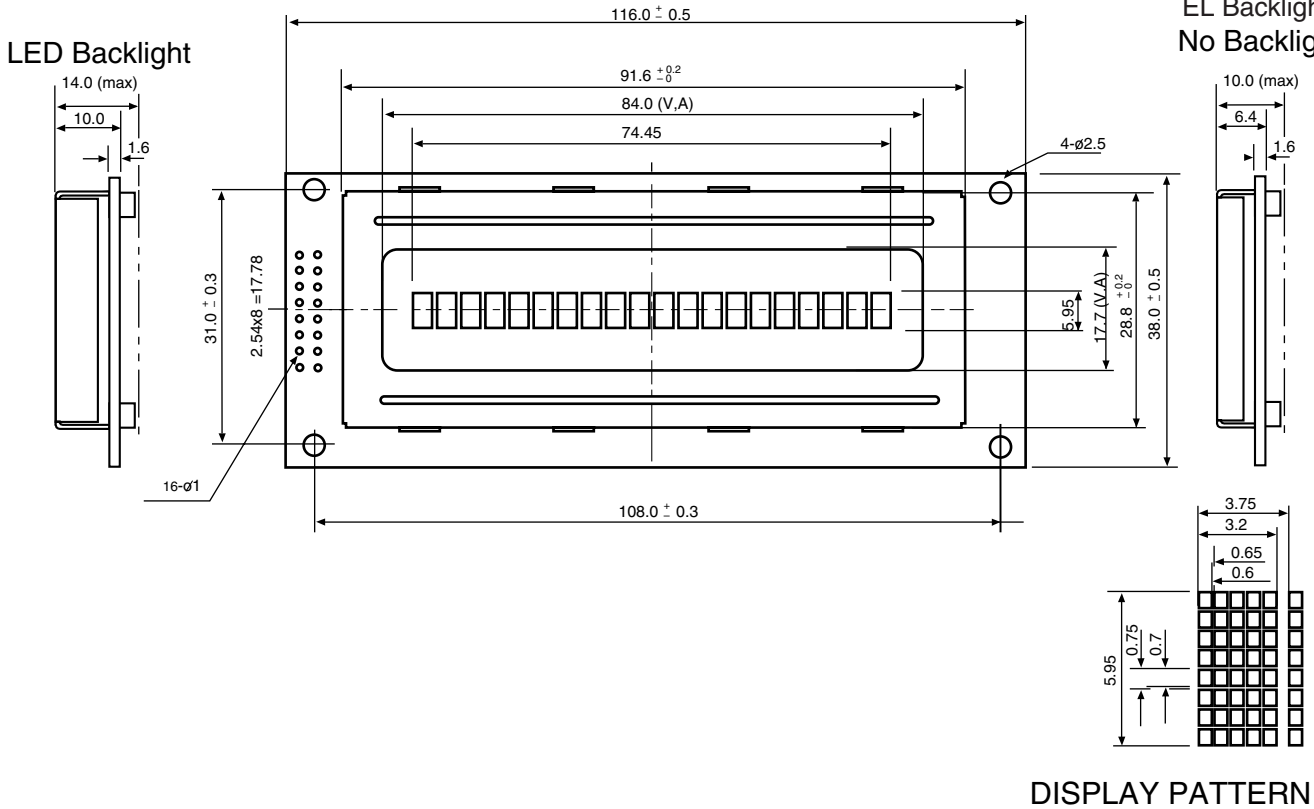
EL Backlight  
NO Backlight

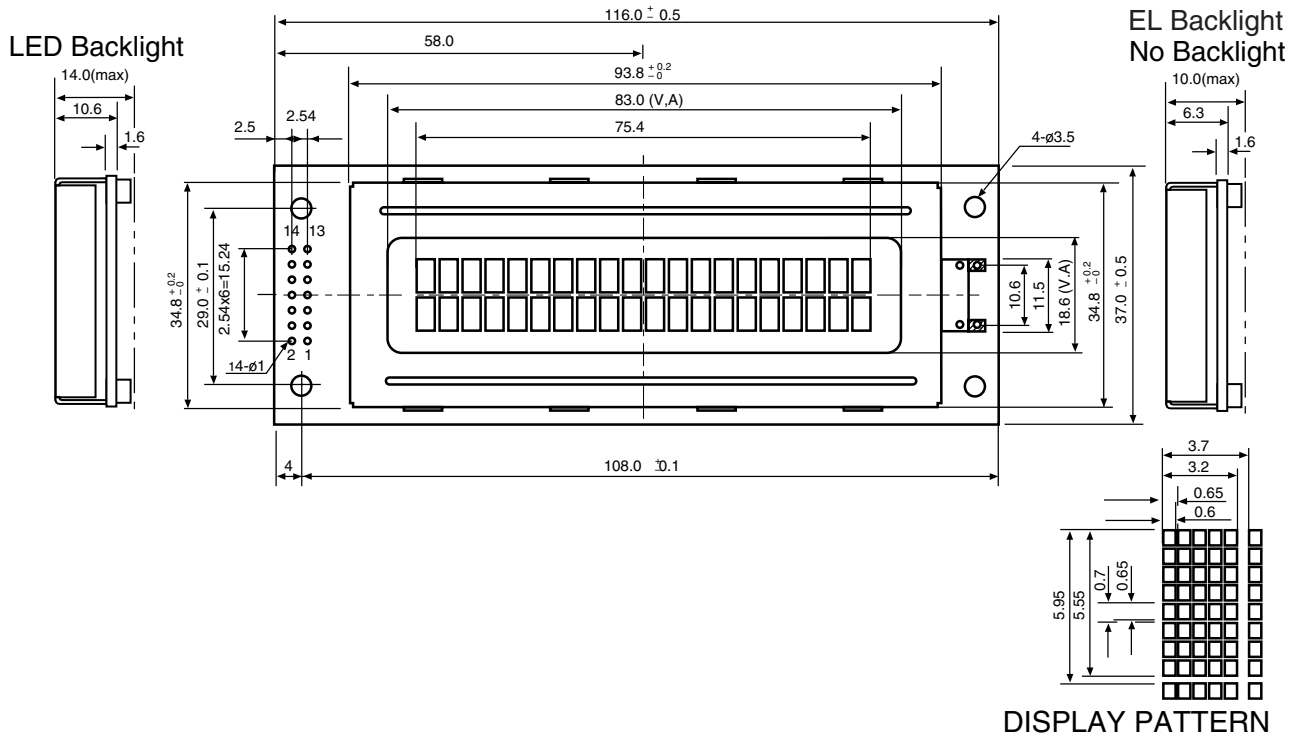
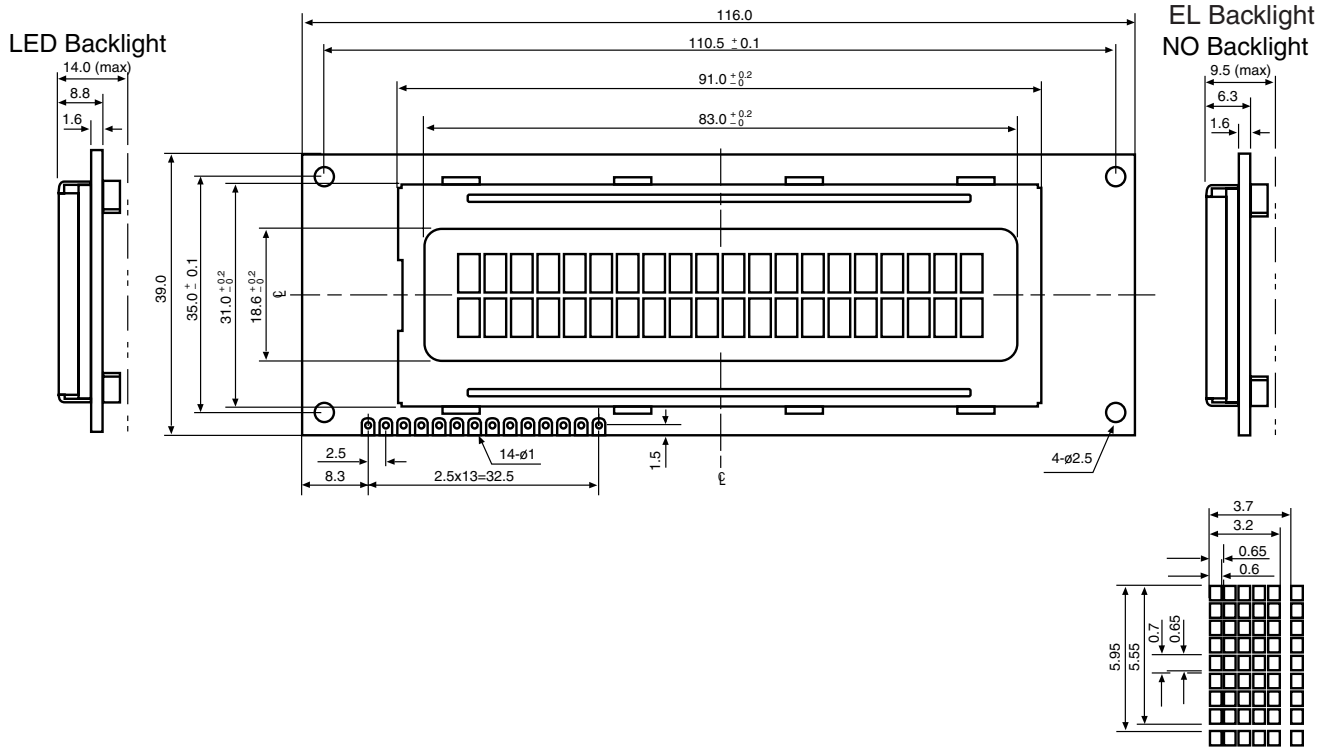


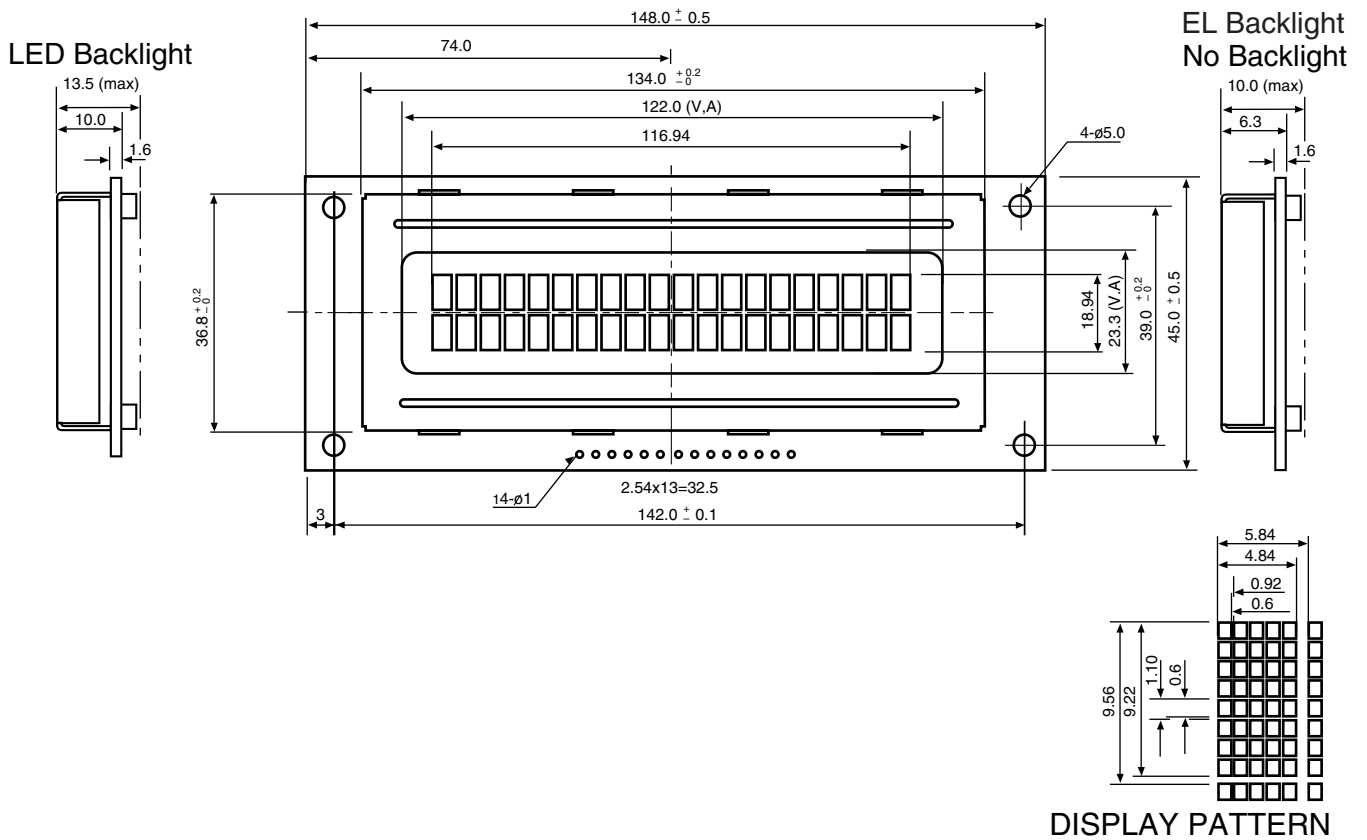
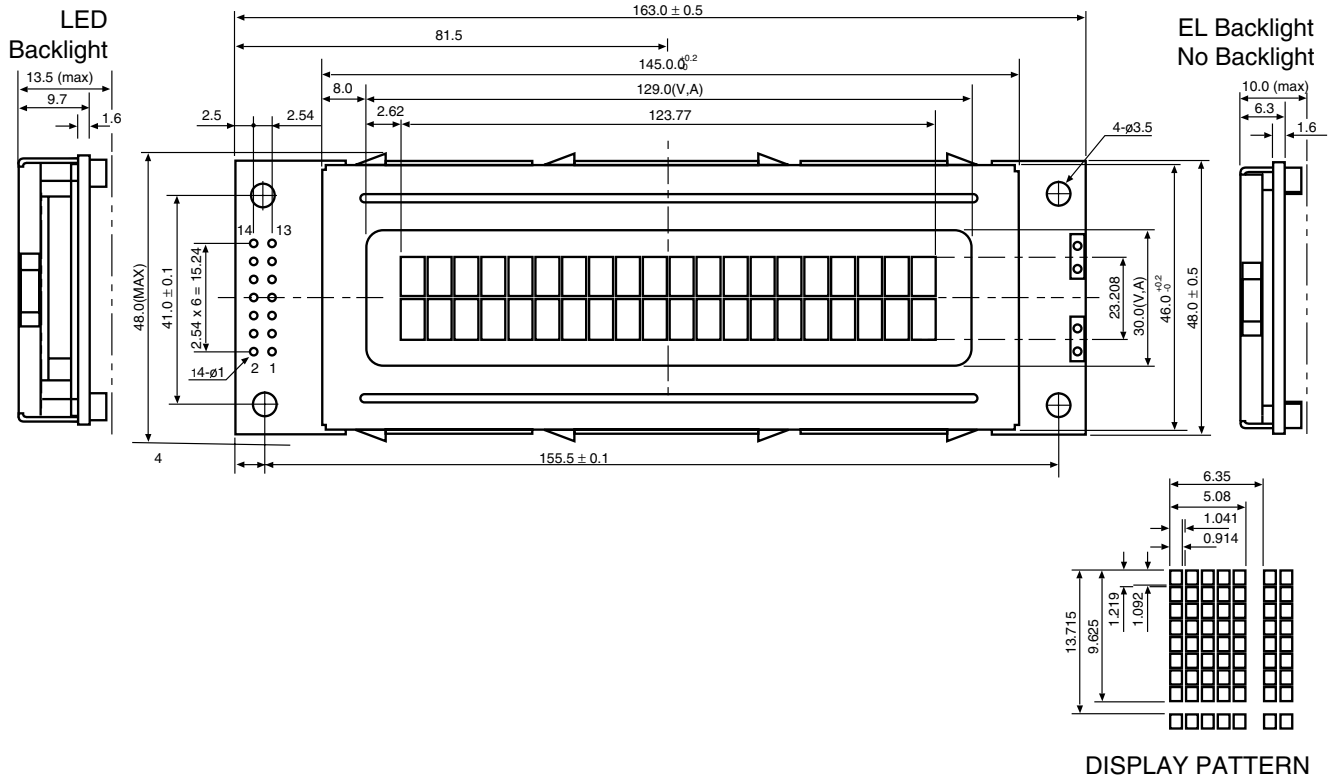
CHARACTER SERIES

LED Backlight

EL Backlight  
No Backlight

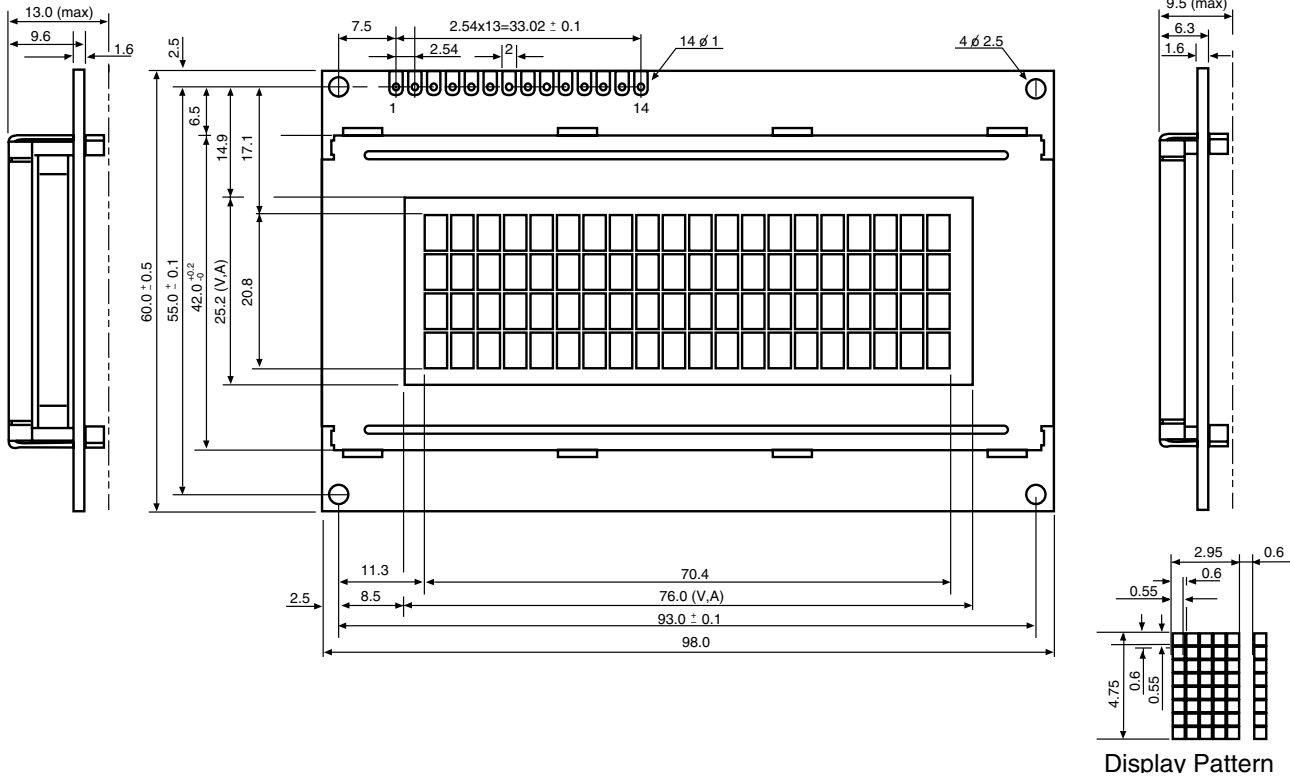






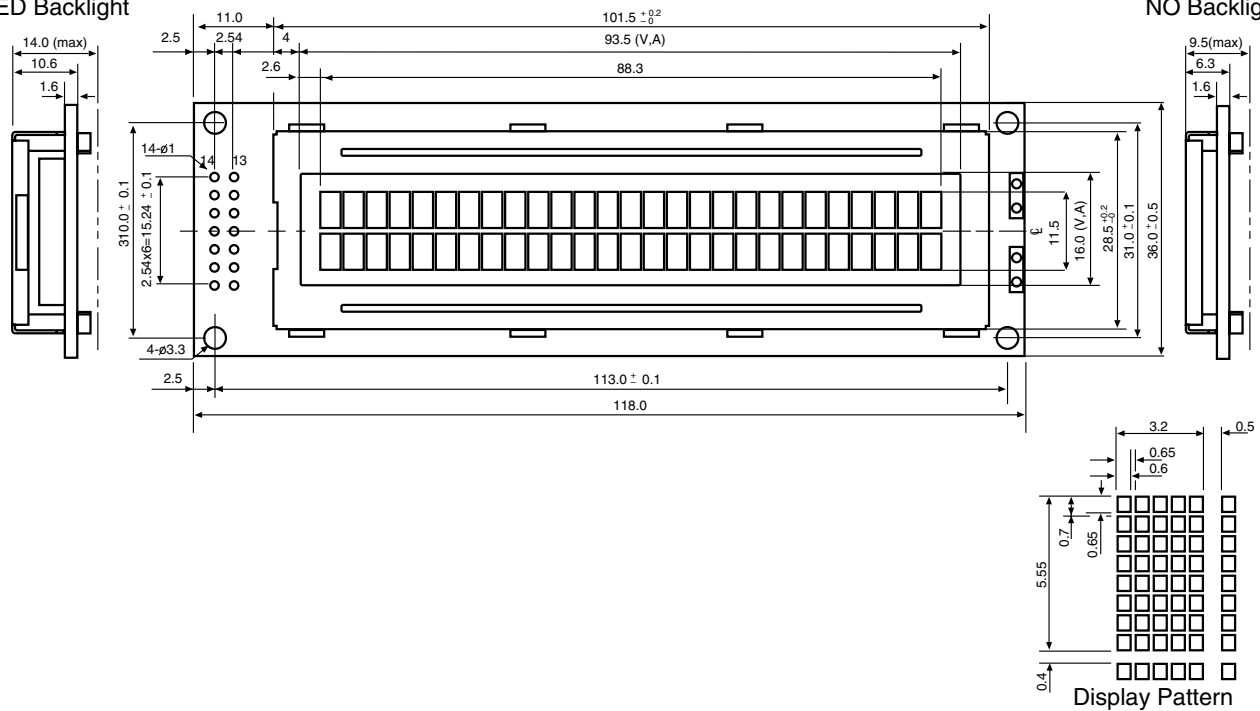
LED Backlight

EL Backlight  
NO Backlight



LED Backlight

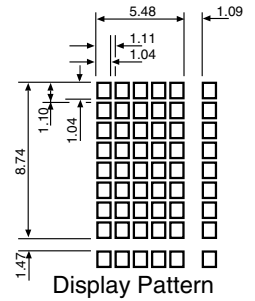
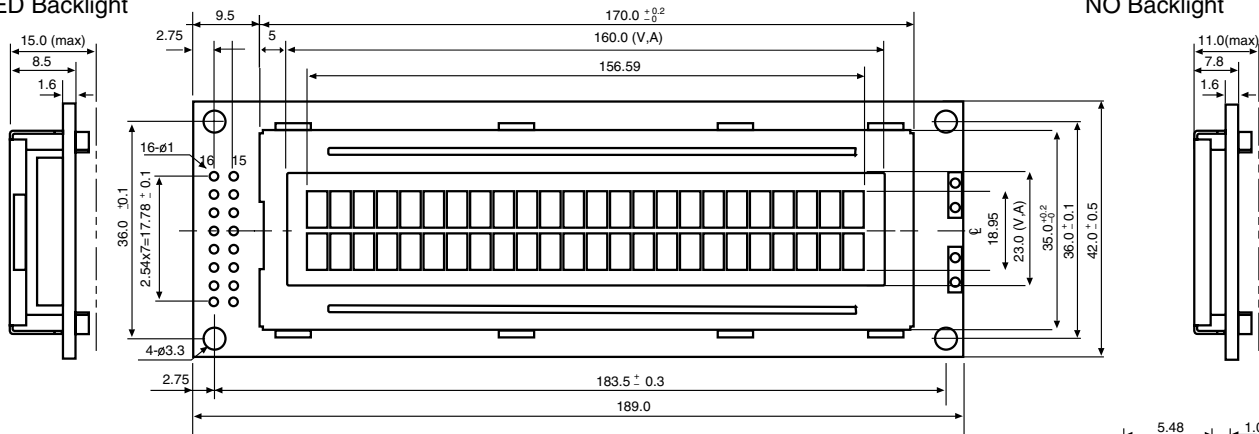
EL Backlight  
NO Backlight





LED Backlight

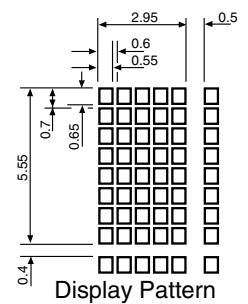
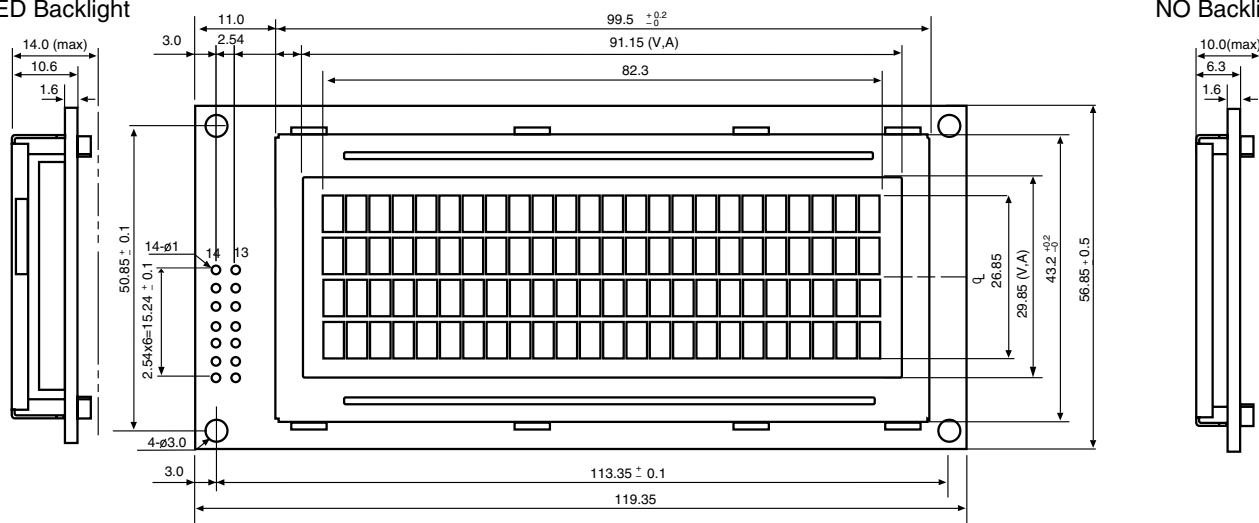
EL Backlight  
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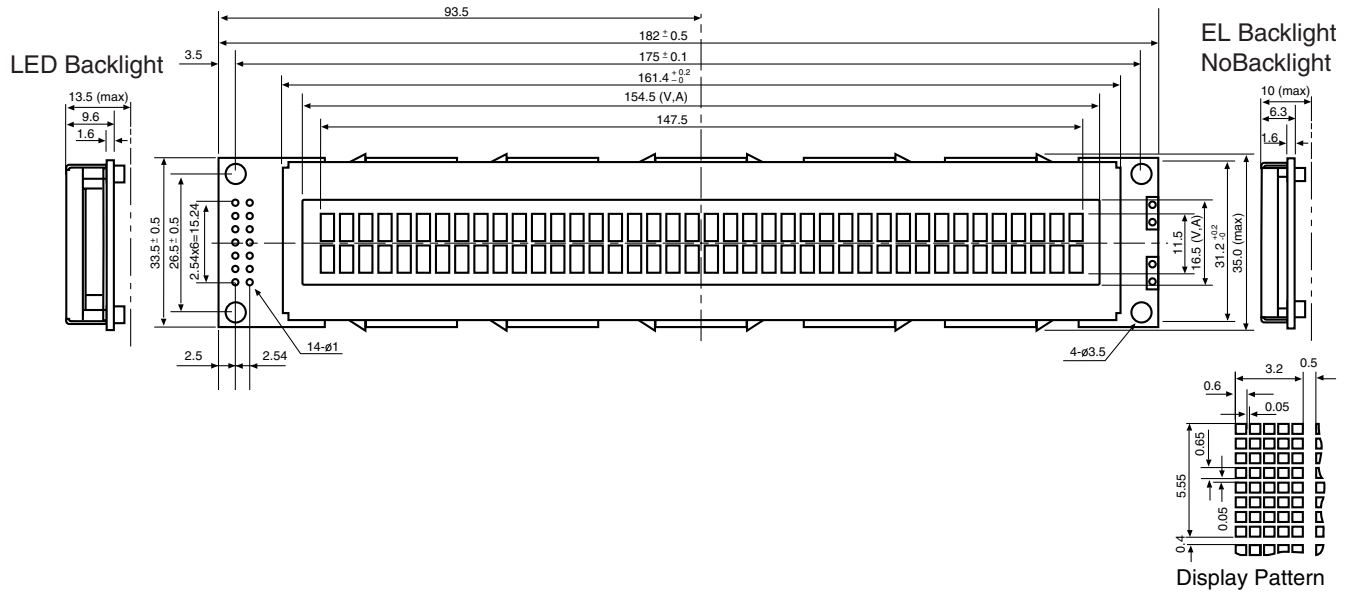
CHARACTER SERIES

LED Backlight

EL Backlight  
NO Backlight



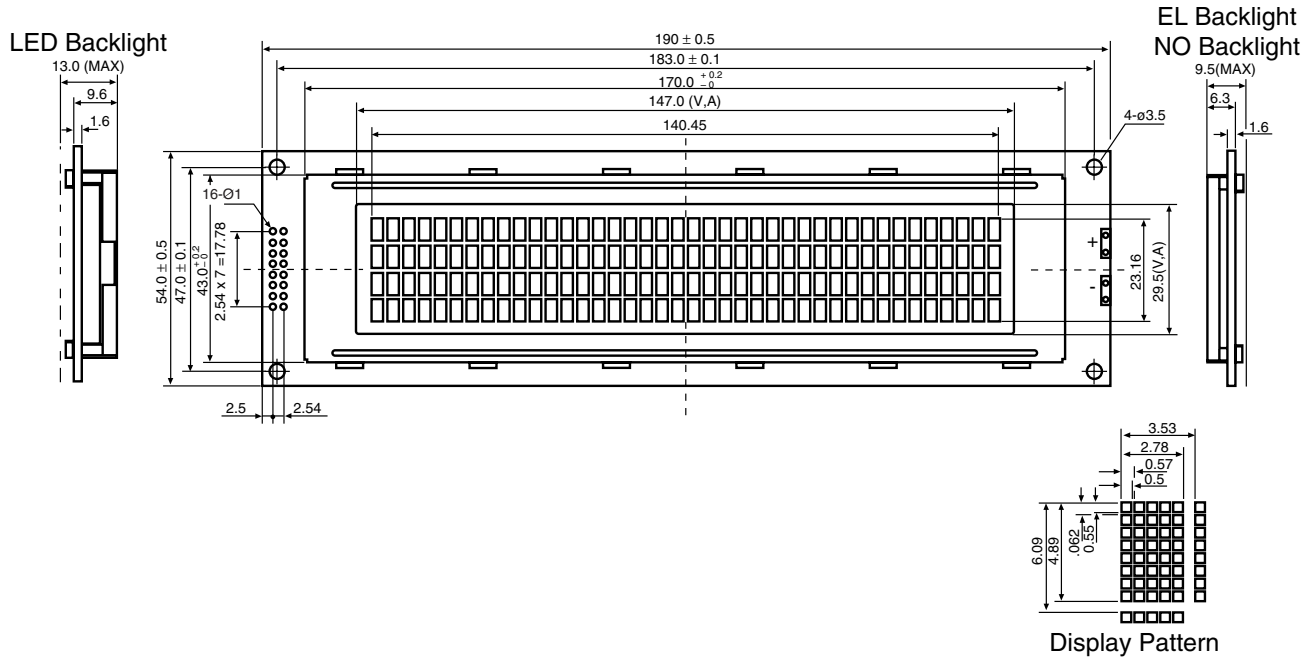




CHARACTER SERIES

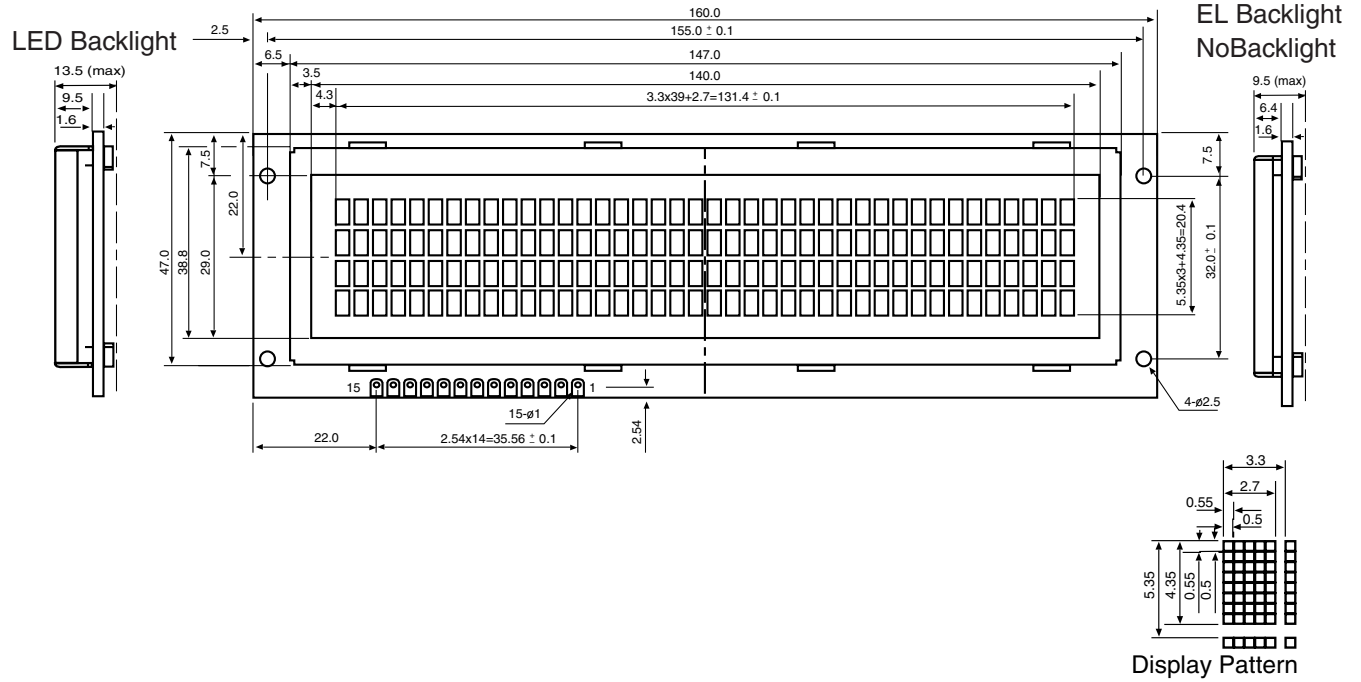
Interface Pin Connections

Pin No.	Symbol	Level	Pin Description	Functions
1	V <sub>SS</sub>	-	Ground	OV
2	V <sub>DD</sub>	-	Supply voltage for logic	5V ± 5%
3	V <sub>0</sub>		Contrast adjustment	decision by user system
4	RS	H/L	Register selection	H: Data input L: Instruction code input
5	R/W	H/L	Read/Write	H: Read L: Write
6	E	H, H→L	Enable signal	-
7	DB0	H/L	Data bit 0	
8	DB1	H/L	Data bit 1	
9	DB2	H/L	Data bit 2	
10	DB3	H/L	Data bit 3	
11	DB4	H/L	Data bit 4	
12	DB5	H/L	Data bit 5	
13	DB6	H/L	Data bit 6	
14	DB7	H/L	Data bit 7	



Interface Pin Connections

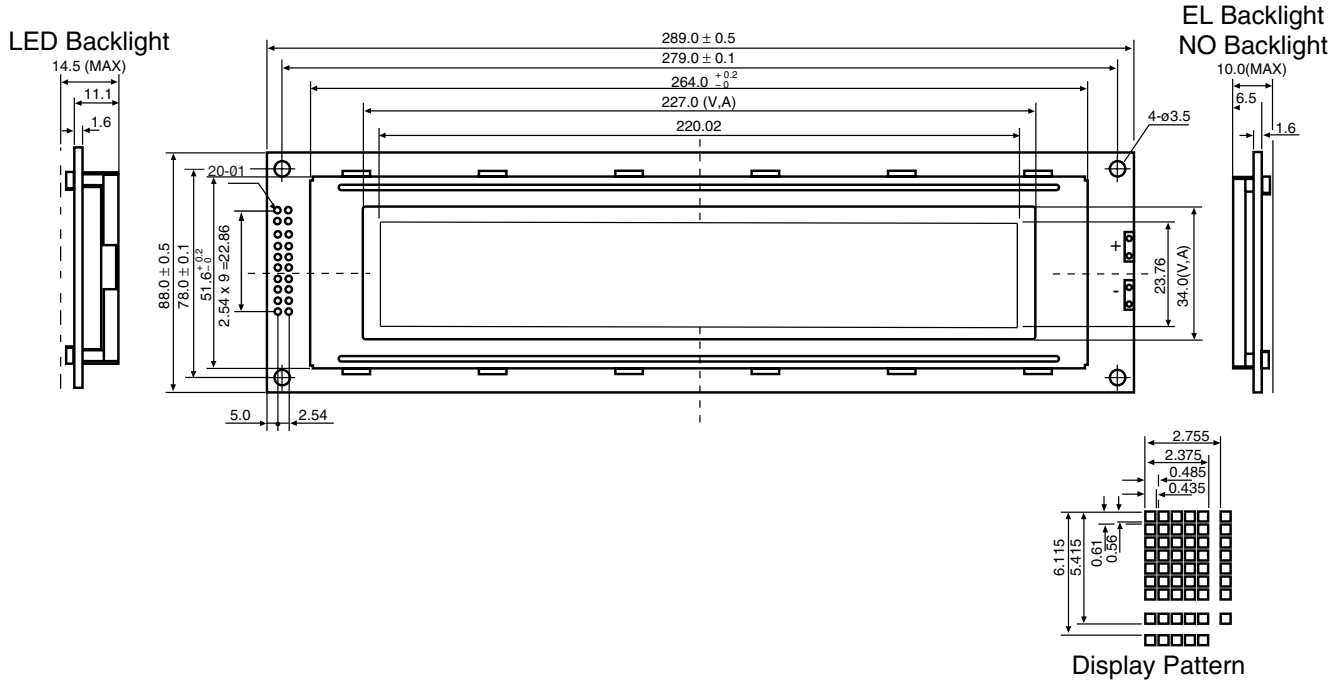
Pin No.	Symbol	Level	Pin Description	Functions
1	DB7	H/L	Data bit 7	
2	DB6	H/L	Data bit 6	
3	DB5	H/L	Data bit 5	
4	DB4	H/L	Data bit 4	
5	DB3	H/L	Data bit 3	
6	DB2	H/L	Data bit 2	
7	DB1	H/L	Data bit 1	
8	DB0	H/L	Data bit 0	
9	E <sub>1</sub>	H, H→L	Enable signal for upper panel	—
10	R/W	H/L	Read/Write	H: Read L: Write
11	RS	H/L	Register selection	H: Data input L: Instruction code input
12	V <sub>O</sub>	—	Contrast adjustment	Decision by user system
13	GND	—	Ground	0V
14	V <sub>DD</sub>	—	Supply voltage for logic	5V ± 5%
15	E <sub>2</sub>	H, H→L	Enable signal for lower panel	—
16	NC	—	No connection	—



CHARACTER SERIES

Interface Pin Connections

Pin No.	Symbol	Level	Pin Description	Functions
1	V <sub>SS</sub>	-	Ground	OV
2	V <sub>DD</sub>	-	Supply voltage for logic	5V ± 5%
3	V <sub>0</sub>		Contrast adjustment	decision by user system
4	RS	H/L	Register selection	H: Data input L: Instruction code input
5	R $\bar{W}$	H/L	Read/Write	H: Read L: Write
6	E	H, H→L	Enable signal	-
7	E	H, H→L	Enable signal	-
8	DB0	H/L	Data bit 0	<p>4 BITS</p> <p>8 BITS</p>
9	DB1	H/L	Data bit 1	
10	DB2	H/L	Data bit 2	
11	DB3	H/L	Data bit 3	
12	DB4	H/L	Data bit 4	
13	DB5	H/L	Data bit 5	
14	DB6	H/L	Data bit 6	
15	DB7	H/L	Data bit 7	



CHARACTER SERIES

Interface Pin Connections

Pin No.	Symbol	Level	Pin Description	Remark
1	/		No connection	
2	Vss		Ground	OV
3	DB0	H/L	Data bit 0	
4	VDD		Supply voltage for logic	V + 5 %
5	DB2	H/L	Data bit 2	
6	DB1	H/L	Data bit 1	
7	DB4	H/L	Data bit 4	
8	DB3	H/L	Data bit 3	
9	DB6	H/L	Data bit 6	
10	DB5	H/L	Data bit 5	
11	E2	H, H → L	Enable signal 2	
12	DB7	H/L	Data bit 7	
13	E1	H, H → L	Enable signal 1	
14	E4	H, H → L	Enable signal 4	
15	R/W	H/L	Read/Write	H: Read L: Write
16	E3	H, H → L	Enable signal 3	
17	VDD		Supply voltage for logic	5V + 5%
18	RS	H/L	Register selection	H= Data L= Instruction code
19	VSS		Ground	OV
20	VO		Contrast adjustment	Decided by user system

**A. Interface Pin Connections**

Pin No.	Symbol	Level	Pin Description	Functions
1	V <sub>SS</sub>	—	Ground	0V
2	V <sub>DD</sub>	—	Supply voltage for logic	5V ± 5%
3	V <sub>0</sub>		Contrast adjustment	decision by user system
4	RS	H/L	Register selection	H: Data input L: Instruction code input
5	R/W	H/L	Read/WriteH: Read	L: Write
6	E	H, H→L	Enable signal	—
7	DB0	H/L	Data bit 0	
8	DB1	H/L	Data bit 1	
9	DB2	H/L	Data bit 2	
10	DB3	H/L	Data bit 3	
11	DB4	H/L	Data bit 4	
12	DB5	H/L	Data bit 5	
13	DB6	H/L	Data bit 6	
14	DB7	H/L	Data bit 7	

**B. Interface Pin Connections**

Pin No.	Symbol	Level	Pin Description	Functions
1	DB7	H/L	Data bit 7	
2	DB6	H/L	Data bit 6	
3	DB5	H/L	Data bit 5	
4	DB4	H/L	Data bit 4	
5	DB3	H/L	Data bit 3	
6	DB2	H/L	Data bit 2	
7	DB1	H/L	Data bit 1	
8	DB0	H/L	Data bit 0	
9	E	H, H→L	Enable signal	—
10	R/W	H/L	Read/WriteH: Read	L: Write
11	RS	H/L	Register selection	H: Data input L: Instruction code input
12	V <sub>LC</sub>	—	Contrast adjustment	Decision by user system
13	V <sub>SS</sub>	—	Ground	0V
14	V <sub>DD</sub>	—	Supply voltage for logic	5V ± 5%



# GRAPHIC SERIES CHART 1 OF 2

Display Format (Dot)	Model #	Module Size (WxHxT1/T2)mm T1/T2=none/with LED	Effective Viewing Area (WxH)mm	Dot Pitch (WxH)mm	Dot Size (WxH)mm	Driving Method (Duty)	Process & Color			Backlight			Technology	Remark
							STN Yellow	STN Gray	FSTN	None	EL	LED		
<b>100x32</b>	PG-100301	75.0 x 54.0 x 10.0/14.0	61.0x26.5	0.55x0.65	0.50x0.60	1/32	●	●		●	●	●	SMT/COB	
<b>122x32</b>	PG-120301	81.0 x 47.0 x 10.0/14.0	71.0x23.0	0.54x0.54	0.49x0.49	1/32	●	●		●	●	●	SMT	
	PG-120302	88.3 x 51.0 x 10.0/13.5	71.0x23.0	0.54x0.54	0.49x0.49	1/32	●	●		●	●	●	SMT	
	PG-120303	83.5 x 44.0 x 10.0/14.0	62.0x22.0	0.48x0.57	0.43x0.52	1/32	●	●		●	●	●	COB	
<b>128x16</b>	PG-120101	85.75 x 40.0 x 10.0/14.0	62.8x14.0	0.47x0.47	0.42x0.42	1/32	●	●		●	●	●	SMT/COB	
	PG-120102	80.0 x 36.0 x 11.0/14.0	64.5x13.8	0.48x0.67	0.41x0.60	1/16	●	●		●	●	●	SMT	
<b>128x32</b>	PG-120304	110.0 x 65.0 x 11.0/14.0	78.0x25.0	0.57x0.57	0.51x0.51	1/32	●	●		●	●	●	SMT	
	PG-120305	96.0 x 58.0 x 10.0/14.0	75.0x27.0	0.50x0.50	0.45x0.45	1/32	●	●		●	●	●	SMT/COB	
<b>128x64</b>	PG-120601	75.0 x 52.7 x 7.4	60.0x32.5	0.43x0.43	0.40x0.40	1/64	●	●		●	●	●	COB	
	PG-120602	42.33 x 73.64 x 2.1	36.53x20.22	0.27x0.28	0.24x0.25	1/65	●	●		●	●	●	COG	
	PG-120603	93.0 x 70.0 x 10.0/14.0	72.0x40.0	0.52x0.52	0.48x0.48	1/64	●	●		●	●	●	SMT	
	PG-120604	37.0 x 48.7 x 1.8	33.3x22.34	0.22x0.24	0.20x0.22	1/65	●	●	●	●	●	●	TAB	
	PG-120605	90.0 x 85.0 x 11.0/15.0	70.7x38.8	0.52x0.52	0.48x0.48	1/64	●	●		●	●	●	COB	
	PG-120606	78.0 x 70.5 x 12.5	62.0x44.0	0.44x0.60	0.40x0.56	1/64	●	●		●	●	●	COB	
	PG-120607	113.0 x 65.0 x 11.0	70.7x38.8	0.52x0.52	0.48x0.48	1/64	●	●		●			COB	
	PG-120608	102.0 x 70.0 x 10.0/14.0	72.0x40.0	0.52x0.52	0.48x0.48	1/64	●	●		●	●	●	SMT	
	PG-120609	78.0 x 70.0 x 11.0/15.0	62.0x44.0	0.44x0.60	0.39x0.55	1/64	●	●		●	●	●	SMT	
	PG-120610	110.2 x 84.8 x 10.0/14.0	92.8x48.9	0.69x0.69	0.64x0.64	1/64	●	●		●	●	●	SMT	
<b>128x128</b>	PG-121201	36.07 x 81.57 x 1.80	28.17x31.37	0.20x0.22	0.19x0.21	1/128	●	●	●	●	●	●	TAB	
	PG-121202	88.4 x 88.4 x 9.5	69.0x69.0	0.50 x 0.50	0.46 x 0.46	1/128	●	●	●	●	●		SMT	
	PG-121203	85.0 x 100.0 x 10.0/14.0	62.0x62.0	0.43x0.43	0.39x0.39	1/128	●	●		●	●	●	SMT	
	PG-121204	99.0 x 100.0 x 10.0/14.0	69.0x69.0	0.50 x 0.50	0.46 x 0.46	1/128	●	●		●	●	●	SMT	
<b>128x160</b>	PG-121601	36.3 x 44.3 x 8.1	29.5x36.2	0.21x0.21	0.20x0.20	1/160	●	●	●	●		●	TAB	
<b>132x64</b>	PG-130601	65.53 x 42.99 x 2.9	62.5x33.0	0.43x0.43	0.40x0.40	1/65	●	●	●	●	●		COG	Color

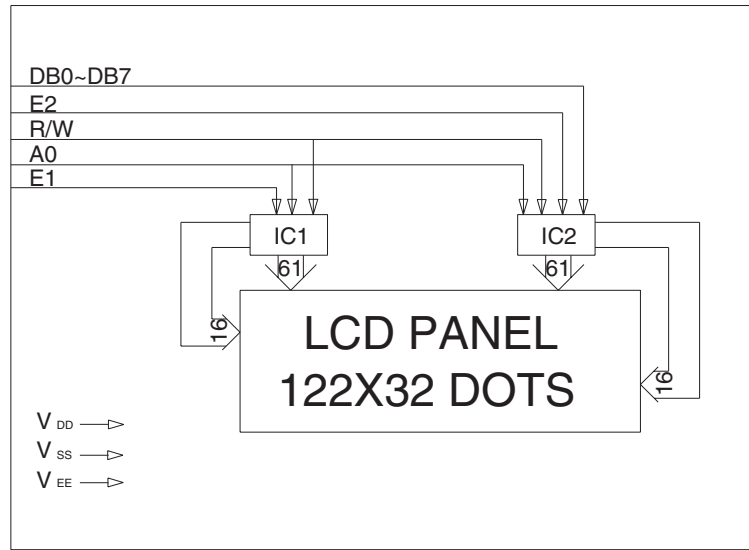
# GRAPHIC SERIES CHART 2 OF 2

Display Format (Dot)	Model #	Module Size (WxHxT1/T2)mm T1/T2=none/with LED	Effective Viewing Area (WxH)mm	Dot Pitch (WxH)mm	Dot Size (WxH)mm	Driving Method (Duty)	Process & Color			Backlight			Technology	Remark
							STN Yellow	STN Gray	FSTN	None	EL	LED		
160x32	PG-160301	122.0 x 46.5 x 10.0/14.0	99.0x24.0	0.58x0.58	0.53x0.53	1/32	●	●	●	●	●	●	SMT	
	PG-160302	116.0 x 37 x 10.0/14.0	84.0x19.0	0.49x0.49	0.45x0.45	1/32	●	●	●	●	●	●	SMT	
160x150	PG-161501	78.5 x 78.5 x 12.0	53.0x50.0	0.30x0.30	0.26x0.26	1/150	●	●	●	●	●	●	COB	
160x160	PG-161601	80.31 x 88.27 x 9.5	62.79x62.79	0.38x0.38	0.34x0.34	1/160	●	●	●	●	●		SMT	
	PG-161602	70.2 x 89.6 x 12.5	60.98x80.90	0.35x0.35	0.335x0.335	1/160	●	●	●	●	●		TAB	Touch Panel
	PG-161603	88.0 x 88.0 x 10.0/-	62.0x62.0	0.38x0.38	0.34x0.34	1/160	●	●	●	●	●		SMT	
	PG-161604	69.0 x 69.0 x 4.9	60.2x60.2	0.35x0.35	0.32x0.32	1/160	●	●	●	●	●	●	TAB	
160x240	PG-162401	56.1 x 74.6 x 5.5	41.4x60.6	0.24x0.24	0.23x0.23	1/240	●	●	●	●	●		TAB`	Touch Panel
	PG-162402	52.9 x 71.6 x 4.1	42.4x61.6	0.24x0.24	0.22x0.22	1/240	●	●	●	●	●		TAB/COG	Touch Panel
192x64	PG-190602	120.0 x 62.0 x 14.5	100.0x37.0	0.50x0.50	0.46x0.46	1/64	●	●	●	●	●		SMT	
240x64	PG-240602	180.0 x 65.0 x 10.0/13.5	132.0x39.0	0.53x0.53	0.48x0.48	1/64	●	●		●	●		SMT	
240x128	PG-241201	144.0 x 104.0 x 10.0/16.0	114.0x64.0	0.45x0.45	0.40x0.40	1/128	●	●		●	●		SMT	
	PG-241202	69.20 x 59.05 x 2.10	62.6x33.7	0.24x0.24	0.23x0.23	1/128	●	●	●	●	●		TAB	
240x160	PG-241601	74.6 x 56.1 x 5.5	61.6x42.5	0.24x0.24	0.23x0.23	1/160	●	●	●	●	●		TAB	Touch Panel
	PG-241602	93.7 x 69.7 x 6.6	81.0x55.4	0.32x0.32	0.31x0.31	1/160	●	●	●	●	●		TAB	Touch Panel
240x320	PG-243201	65.6 x 84.1 x 4.1	57.8x76.6	0.23x0.23	0.22x0.22	1/320					●		TAB	Color
256x64	PG-250601	184.0 x 75.0 x 10.0/-	149.6x43.0	0.56x0.56	0.51x0.51	1/64	●	●		●	●	●	STM	
	PG-250602	176.0 x 64.0 x 13.5	150.0x40.0	0.56x0.56	0.51x0.51	1/64	●	●	●	●	●		COB	
320x240	PG-322401	167.1 x 109.0 x 14.0	122.0x92.0	0.36x0.36	0.33x0.33	1/240	●						SMT	CCFL
	PG-322402	143.0 x 97.6 x 10.1	105.0x80.0	0.3x0.3	0.27x0.27	1/240	●	●	●	●	●		SMT	
	PG-322403	139.0 x 100.0 x 10.0	103.0x79.0	0.3x0.3	0.27x0.27	1/240	●	●	●	●	●		SMT	
	PG-322405	93.80 x 75.10 x 5.50	80.80x61.60	0.24x0.24	0.23x0.23	1/240	●	●	●	●	●		TAB	Touch Panel
480x120	PG-481201	208.0 x 58.5 x 8.05	186x47.2	0.38x0.36	0.36x0.34	1/120	●	●	●	●	●		TAB	

## FEATURE:

1. Display mode: Reflective/  
Transflective/Transmissive/  
and Positive type STN
2. Input Data: 8-Bits Parallel  
Data Input from a MPU
3. Assembly: SMT
4. Backlight: Optional

## BLOCK DIAGRAM

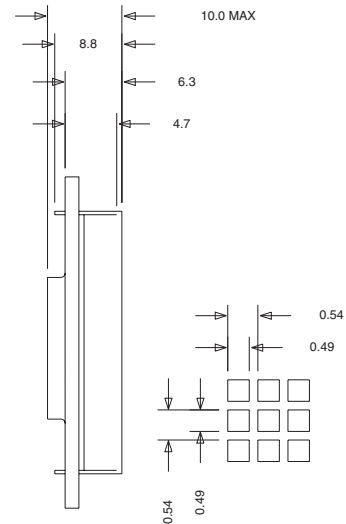
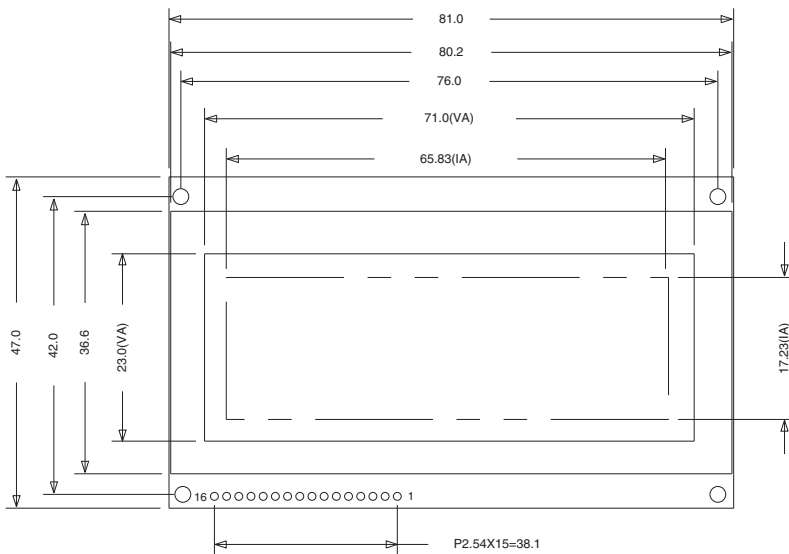


## ELECTRICAL CHARACTERISTICS:

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage for LCD	VLCD	Ta=25°C	---	6.0	---	V
Supply Current	IDD	VDD=5.0V	---	---	2.0	mA

## INTERFACE PIN CONNECTOR:

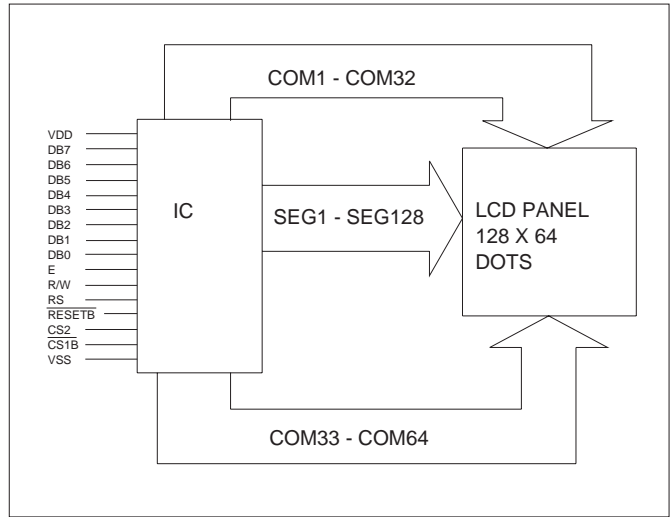
1	2	3	4	5	6	7	8	9	10
A0	E2	R/W	RST	E1	V <sub>SS</sub>	V <sub>EE</sub>	V <sub>DD</sub>	DB0	DB1
11	12	13	14	15	16				
DB2	DB3	DB4	DB5	DB6	DB7				



FEATURE:

1. Built in Controller (S6B1713)
2. +3.0V Power Supply
3. 1/65 Duty Cycle
4. Built in Fourfold Boosting Circuit
5. With Temperature Compensation Function

BLOCK DIAGRAM

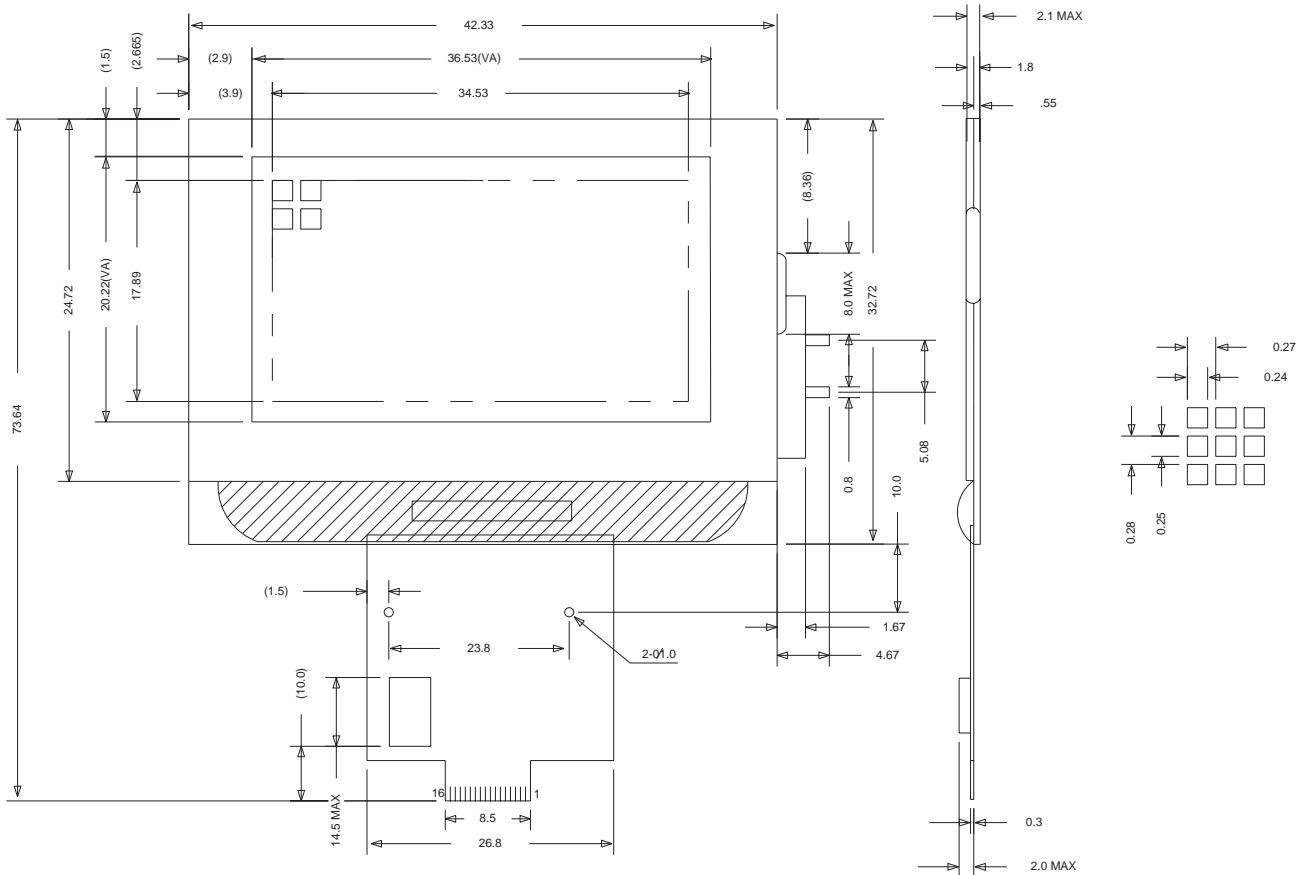


ELECTRICAL CHARACTERISTICS:

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage for LCD	VLCD	Ta=25fC	---	9.5	---	V
Supply Current	IDD	VDD=3.0V	---	0.3	1.0	mA

INTERFACE PIN CONNECTOR:

1	2	3	4	5	6	7	8	9	10
V <sub>SS</sub>	/CS1B	CS2	/RESETB	RS	R/W	E	DB0	DB1	DB2
11	12	13	14	15	16				
DB3	DB4	DB5	DB6	DB7	V <sub>DD</sub>				

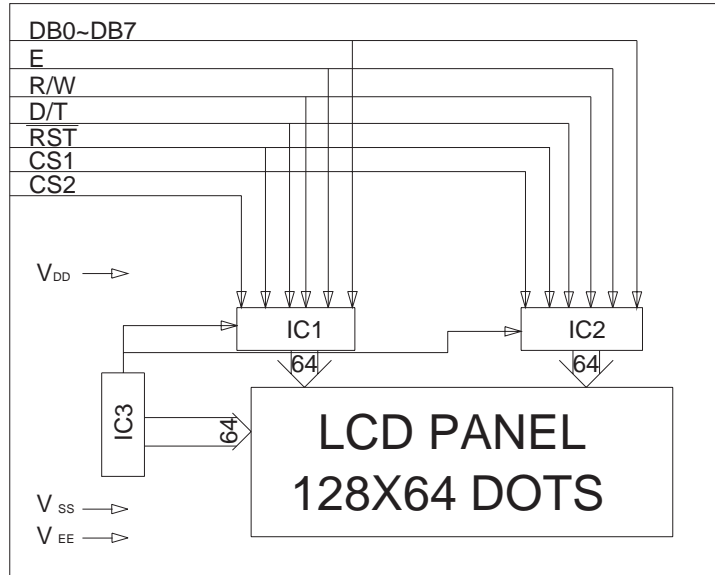


GRAPHIC SERIES 128 X 64

## FEATURE:

1. Display mode: Reflective/  
Transflective/Transmissive/  
and Positive type STN
2. Input Data: 8-Bits Parallel  
Data Input from a MPU
3. Assembly:SMT
4. Backlight: Optional

## BLOCK DIAGRAM

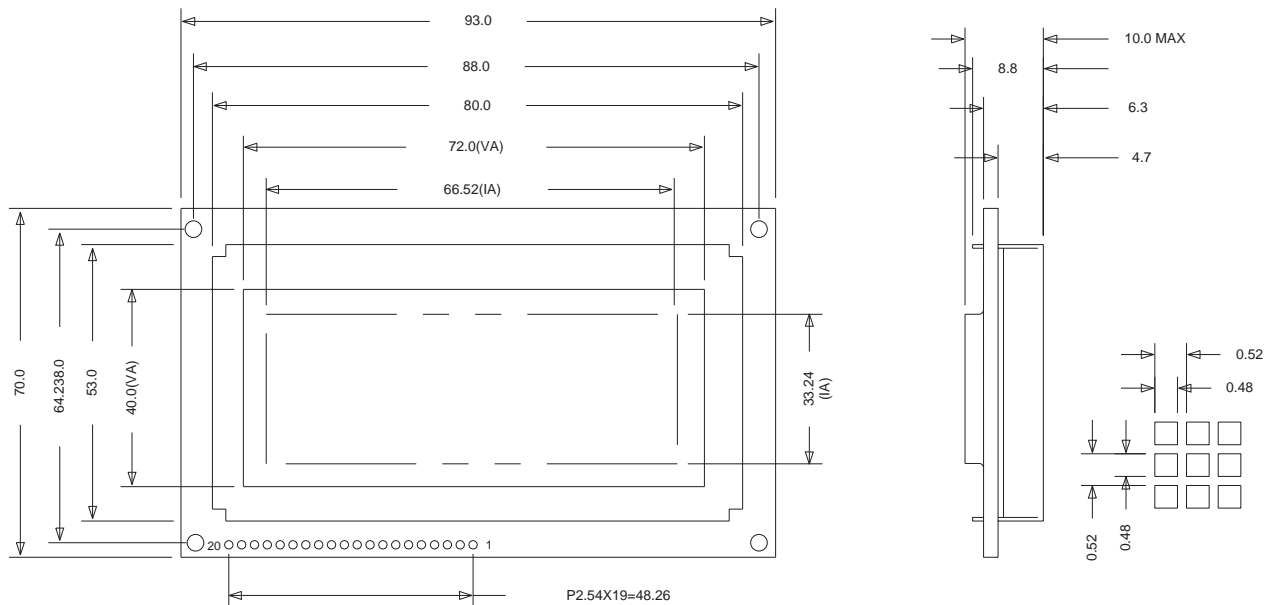


## ELECTRICAL CHARACTERISTICS:

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage for LCD	VLCD	Ta=25fC	---	---	17	V
Supply Current	IDD	VDD=5.0V	---	1.8	3.8	mA

## INTERFACE PIN CONNECTOR:

1	2	3	4	5	6	7	8	9	10
V <sub>SS</sub>	V <sub>DD</sub>	V <sub>EE</sub>	D/I	R/W	E	DB0	DB1	DB2	DB3
11	12	13	14	15	16	17	18	19	20
DB4	DB5	DB6	DB7	CS2	CS1	RST	V <sub>EE</sub>	BL	BL

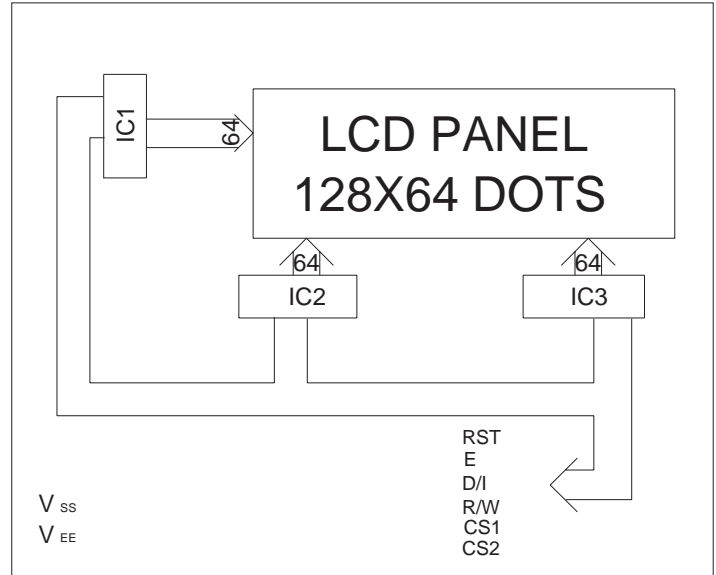


GRAPHIC SERIES 128 X 64

## FEATURE:

1. Display mode: Reflective/  
Transflective/Transmissive/  
and Positive type STN
2. Input Data: 8-Bits Parallel  
Data Input from a MPU
3. Assembly:SMT
4. Backlight: Optional

## BLOCK DIAGRAM

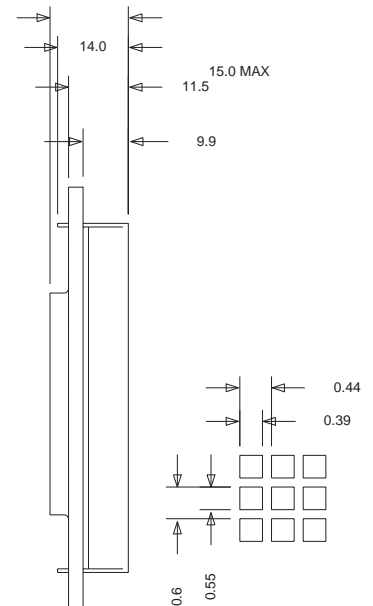
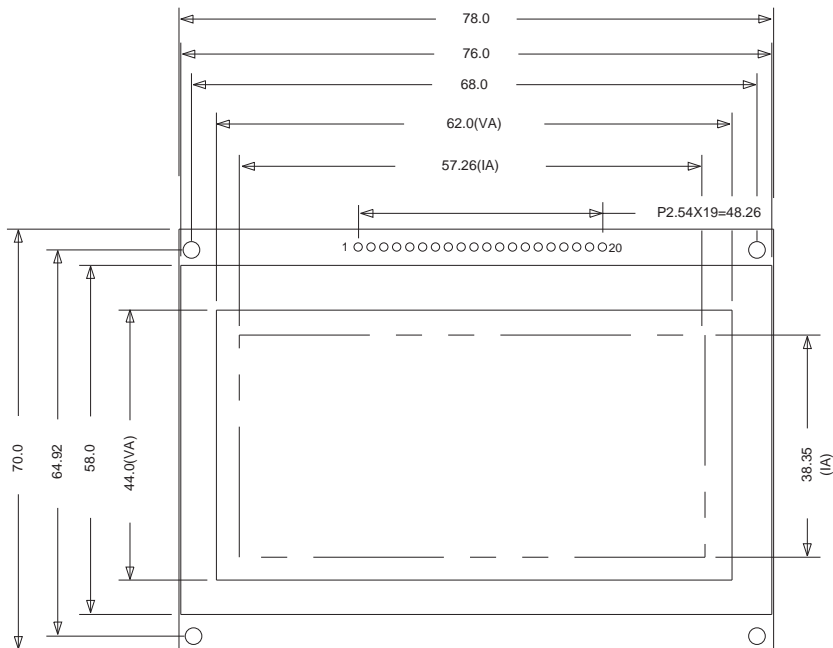


## ELECTRICAL CHARACTERISTICS:

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage for LCD	VLCD	Ta=25fC	---	15.0	18.0	V
Supply Current	IDD	VDD=5.0V	---	3.3	6.0	mA

## INTERFACE PIN CONNECTOR:

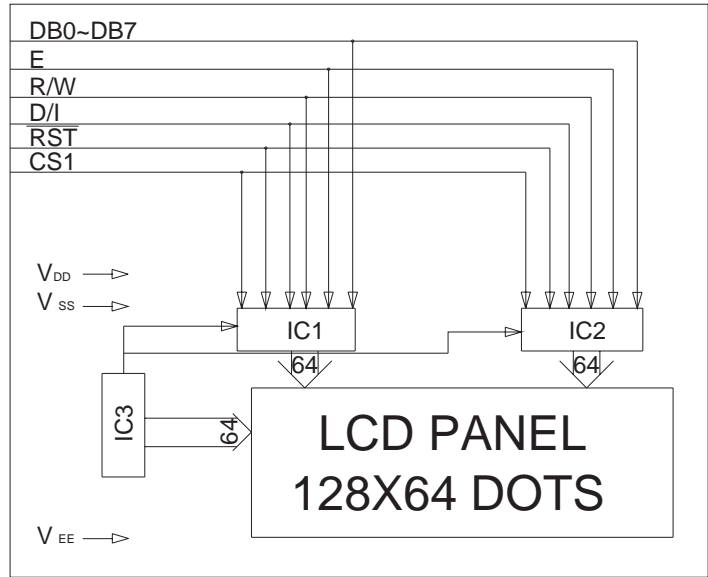
1	2	3	4	5	6	7	8	9	10
FG	V <sub>SS</sub>	V <sub>DD</sub>	V <sub>EE</sub>	/WR	/RD	/CE	C/D	/RESET	D0
11	12	13	14	15	16	17	18	19	20
D1	D2	D3	D4	D5	D6	D7	FS1	LED-	LED+



## FEATURE:

1. Display mode: Reflective/  
Transflective/Transmissive/  
and Positive type STN
2. Input Data: 8-Bits Parallel  
Data Input from a MPU
3. Assembly: SMT
4. Backlight: Optional

## BLOCK DIAGRAM

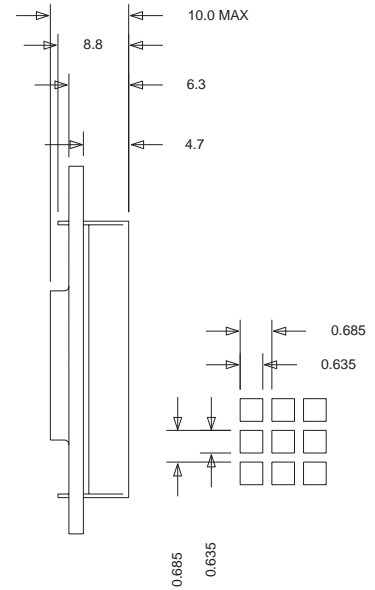
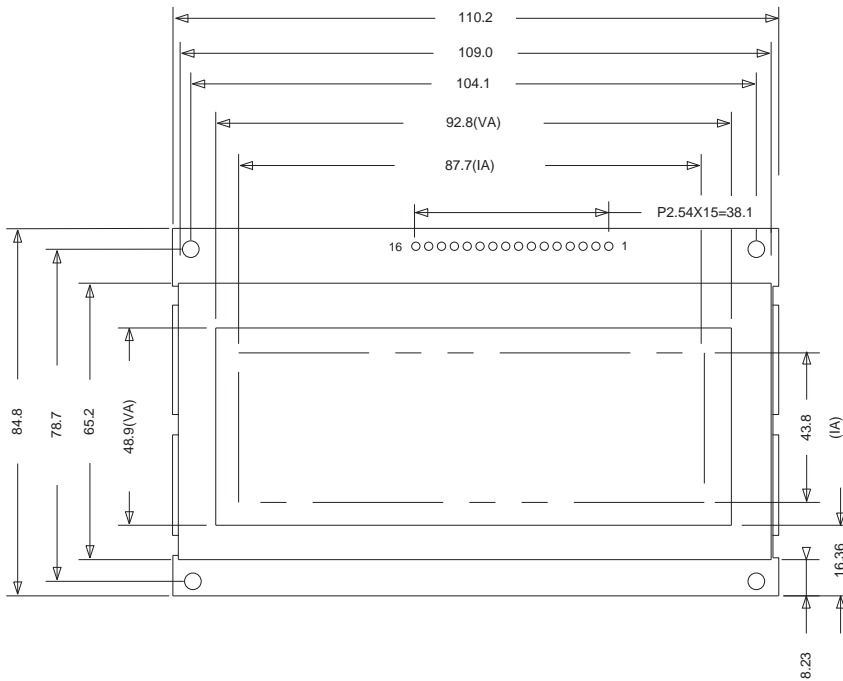


## ELECTRICAL CHARACTERISTICS:

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage for LCD	VLCD	Ta=25fC	---	---	17	V
Supply Current	IDD	VDD=5.0V	---	1.8	3.8	mA

## INTERFACE PIN CONNECTOR:

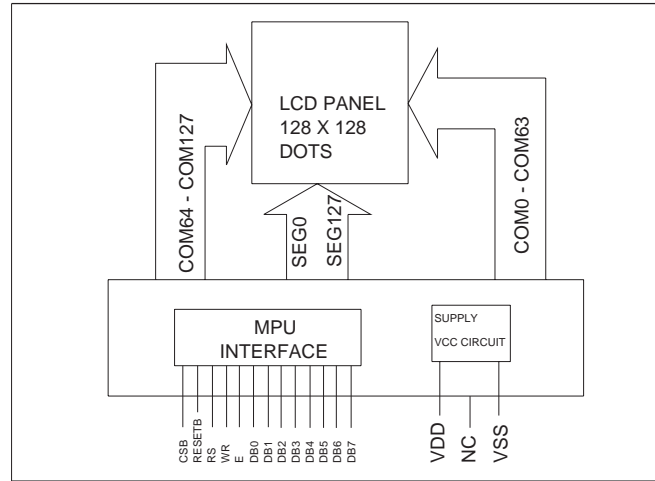
1	2	3	4	5	6	7	8	9	10
V <sub>EE</sub>	V <sub>DD</sub>	V <sub>SS</sub>	E	D/I	R/W	RST	CS	DB7	DB6
11	12	13	14	15	16				
DB5	DB4	DB3	DB2	DB1	DB0				



FEATURE:

1. Built in Controller (S6B0741)
2. +3.0V Power Supply
3. 1/128 Duty Cycle
4. Built in Fivefold Boosting Circuit
5. With Temperature Compensation Function

BLOCK DIAGRAM

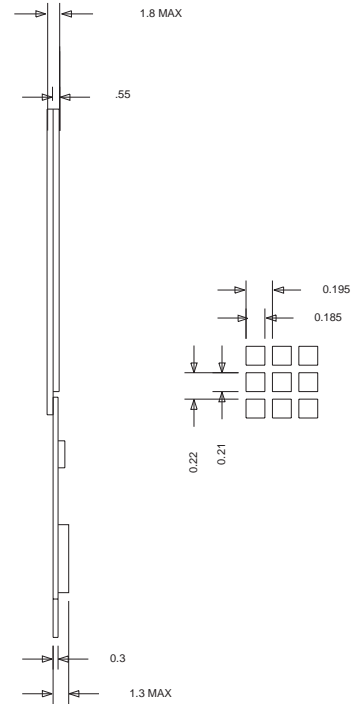
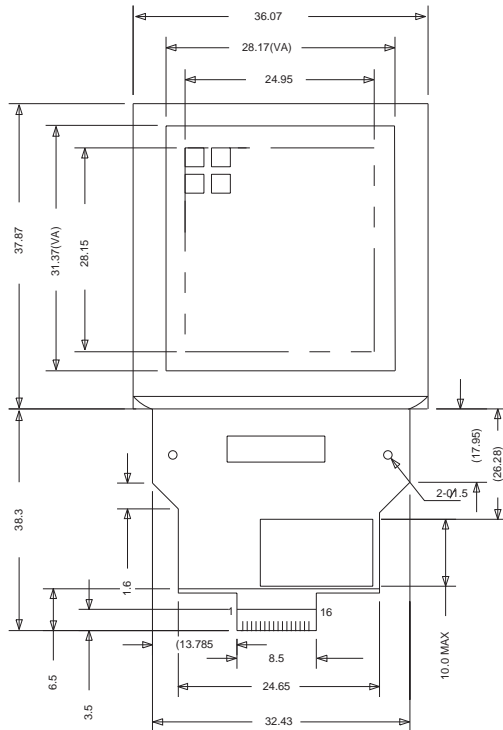


ELECTRICAL CHARACTERISTICS:

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage for LCD	VLCD	Ta=25fC	---	13.0	---	V
Supply Current	IDD	VDD=3.1V	---	1.0	2.0	mA

INTERFACE PIN CONNECTOR:

1	2	3	4	5	6	7	8	9	10
CSB	/RES	RS	R/W	E	DB0	DB1	DB2	DB3	DB4
11	12	13	14	15	16				
DB5	DB6	DB7	V <sub>DD</sub>	NC	V <sub>SS</sub>				

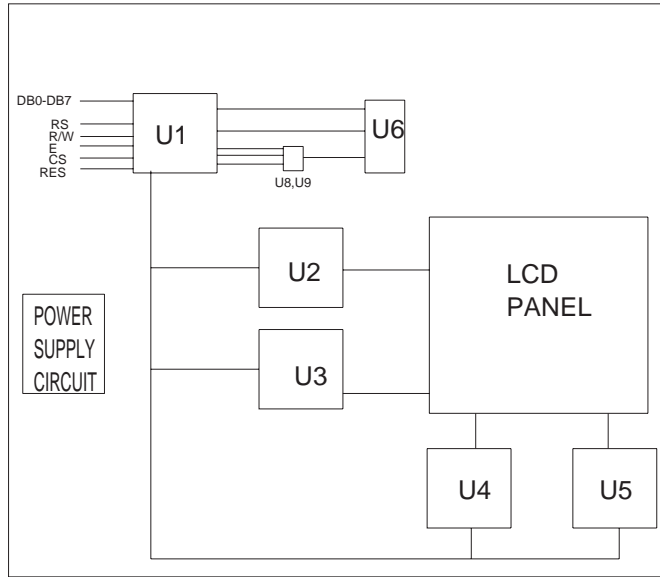




### FEATURE:

1. Display mode: Transflective Positive FSTN
2. Input Data: 8-Bits Parallel Data Input from a MPU
3. Assembly:SMT
4. Backlight: EL

### BLOCK DIAGRAM

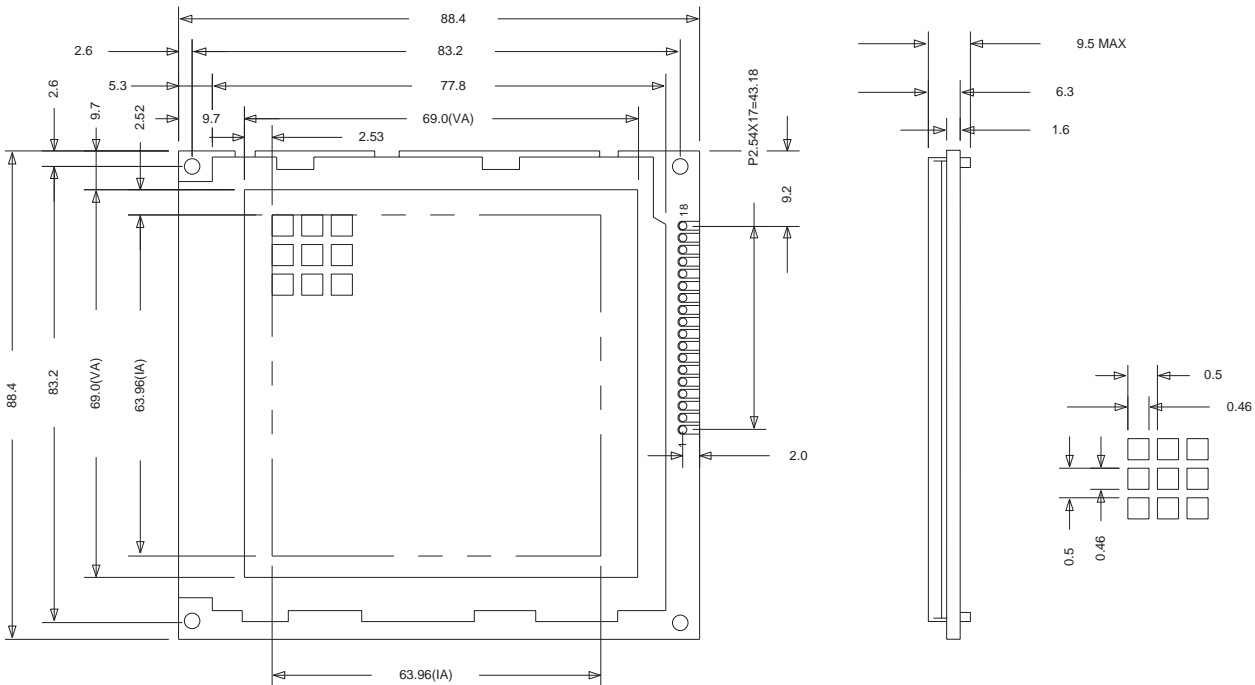


### ELECTRICAL CHARACTERISTICS:

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage for LCD	VLCD	Ta=25fC	---	18.5	---	V
Supply Current	IDD	VDD=5.0V	---	6.0	---	mA

### INTERFACE PIN CONNECTOR:

1	2	3	4	5	6	7	8	9	10
V <sub>SS</sub>	V <sub>DD</sub>	V <sub>0</sub>	RS	R/W	E	D0	D1	D2	D3
11	12	13	14	15	16	17	18		
D4	D5	D6	D7	CS	RES	V <sub>EE</sub>	G/C		



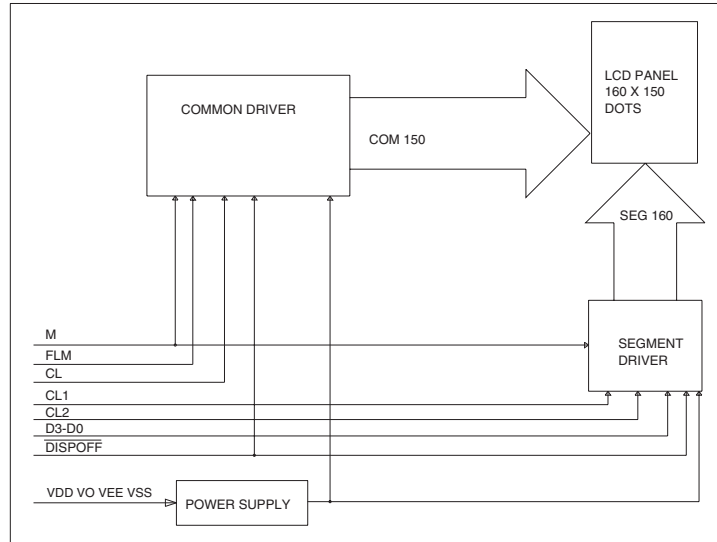
GRAPHIC SERIES 128 X 128



### FEATURE:

1. Recommended Controller (SED 1353 OR Equivalent)
2. +5.0 Power Supply
3. 1/150 Duty Cycle
4. Dual Power Supply

### BLOCK DIAGRAM

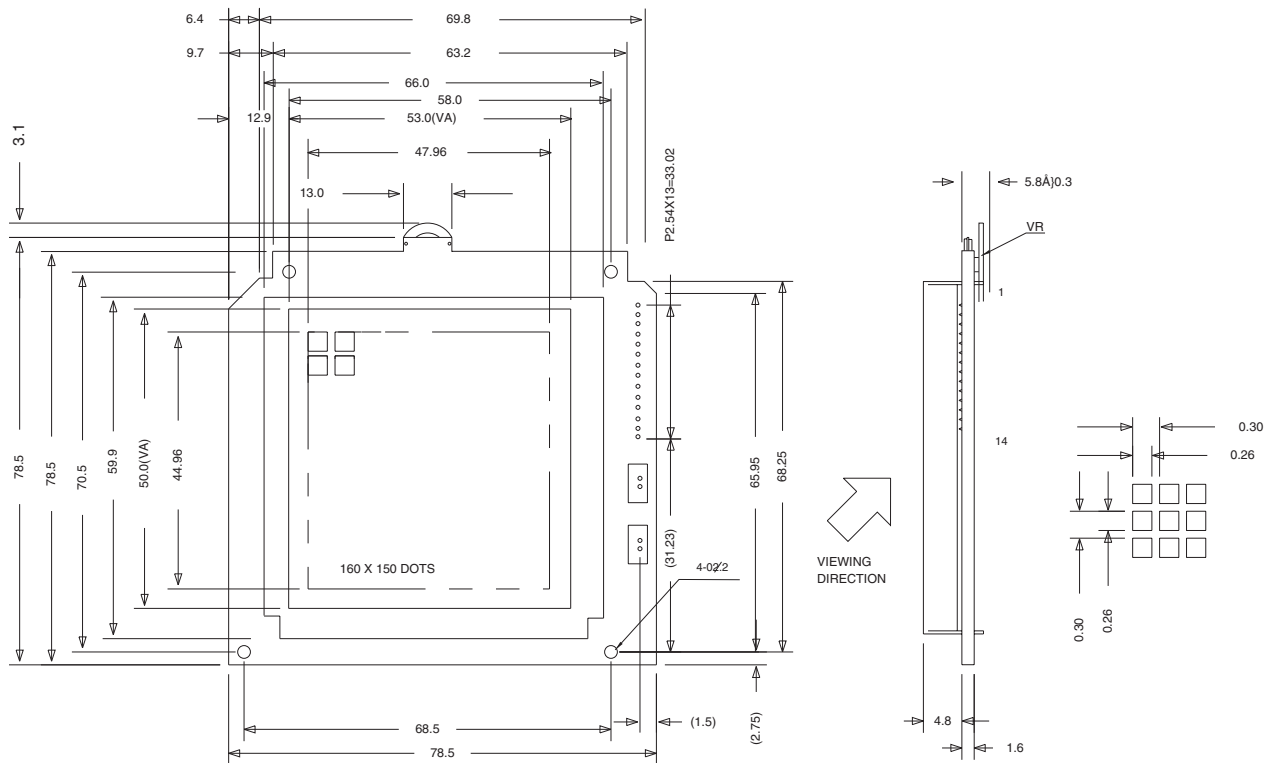


### ELECTRICAL CHARACTERISTICS:

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage for LCD	VLCD	Ta=25fC	---	17.5	---	V
Supply Current	IDD	VDD=5.0V	---	1.5	3.3	mA

### INTERFACE PIN CONNECTOR:

1	2	3	4	5	6	7	8	9	10
V <sub>SS</sub>	M	FLM	CL	CL1	CL2	DB3	DB2	DB1	DB0
11	12	13	14						
V <sub>EE</sub>	V <sub>DD</sub>	/D.OFF	V <sub>O</sub>						

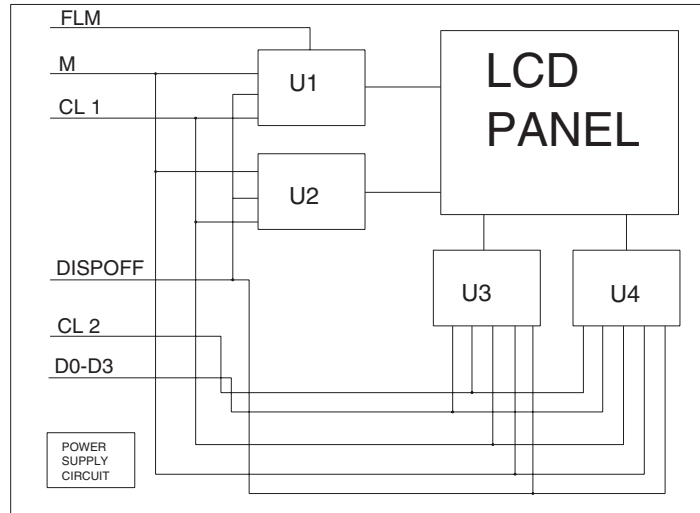


GRAPHIC SERIES 160 X 150

### FEATURE:

1. Display Mode: Transflective  
Positive FSTN
2. Input Data: 4-Bit Parallel  
Data Input from a MPU
3. Assembly: SMT
4. Backlight: EL(Cool White)

### BLOCK DIAGRAM

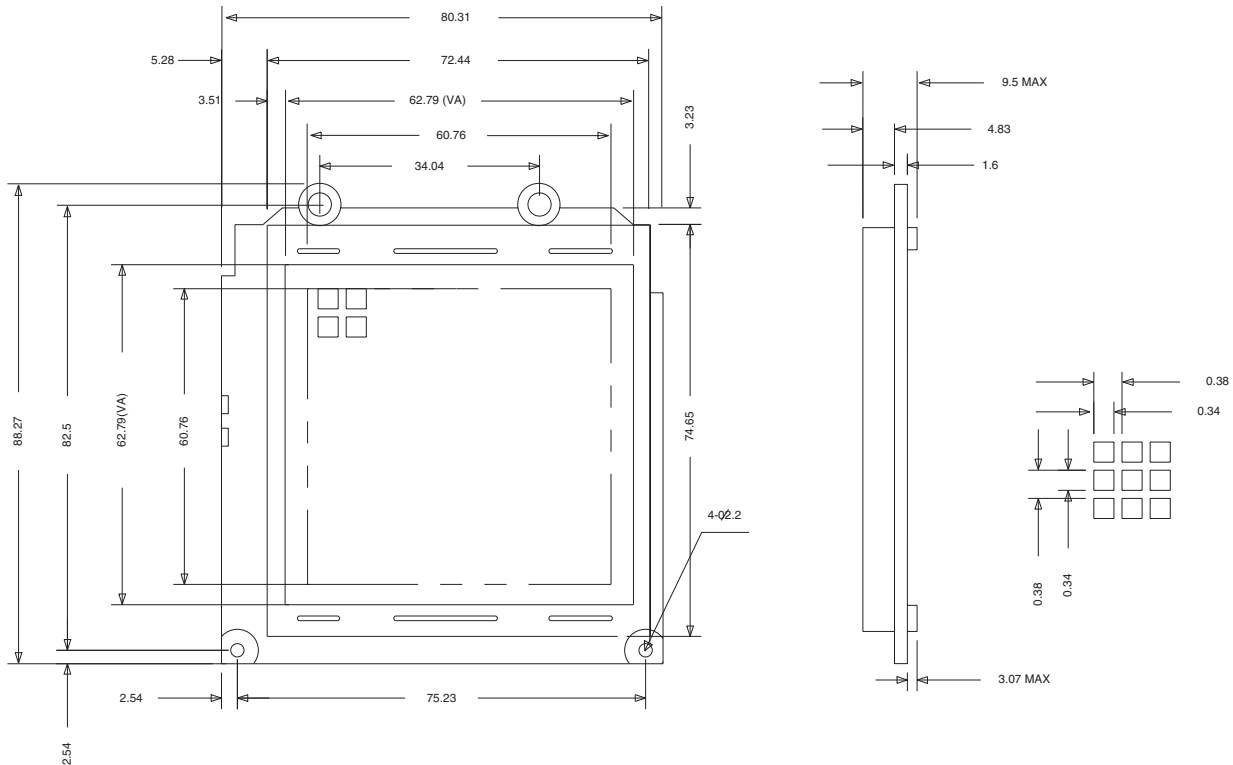


### ELECTRICAL CHARACTERISTICS:

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage for LCD	VLCD	Ta=25fC	---	18.0	---	V
Supply Current	IDD	VDD=5.0V	---	6.0	---	mA

### INTERFACE PIN CONNECTOR:

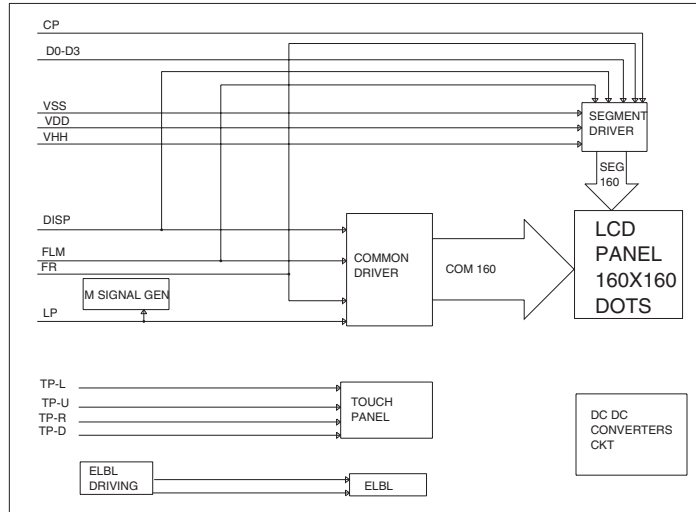
1	2	3	4	5	6	7	8	9	10
M	FLM	CL1	DGND	CL2	DGN0	D0	D1	D2	D3
11	12	13	14	15	16	17	18	19	20
VDD	VEE	V0	DOFF	NC	NC	NC	NC	EL-2	EL-1



FEATURE:

1. Recommended Controller (SED 1353 or Equivalent)
2. +3.3V Power Supply
3. 1/160 Duty Cycle
4. Built in EL Inverter
5. Built in M Signal Generator

BLOCK DIAGRAM

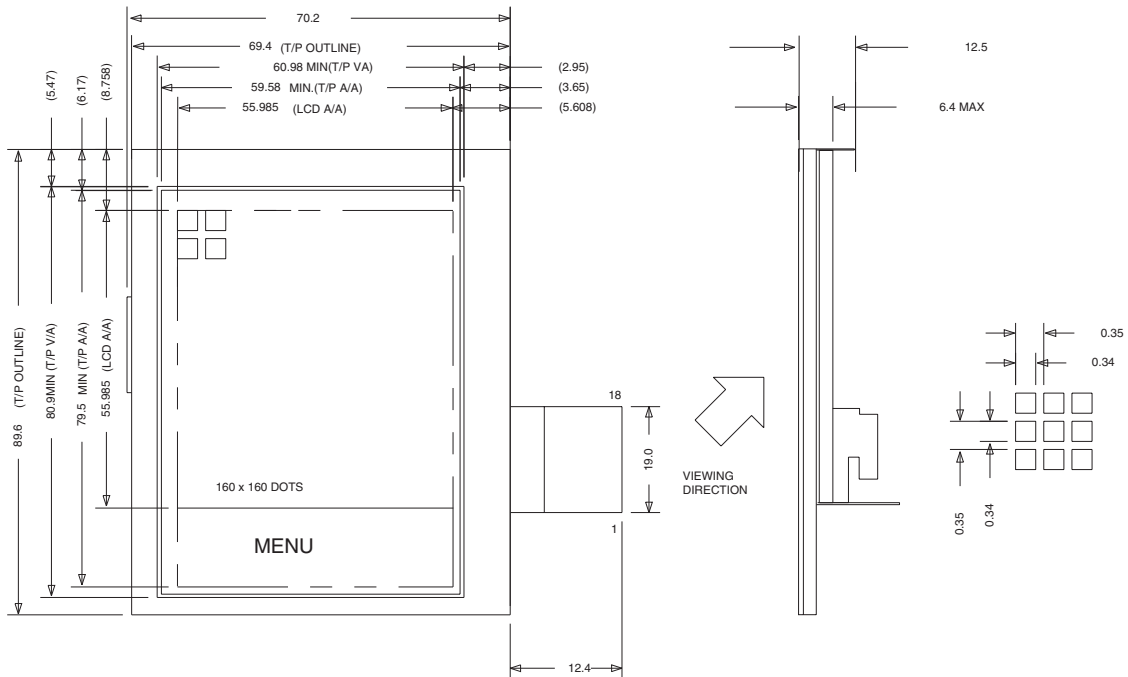


ELECTRICAL CHARACTERISTICS:

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage for LCD	VLCD	Ta=25°C	---	19.0	---	V
Supply Current	IDD	VDD=5.0V	---	18.0	25.0	mA

INTERFACE PIN CONNECTOR:

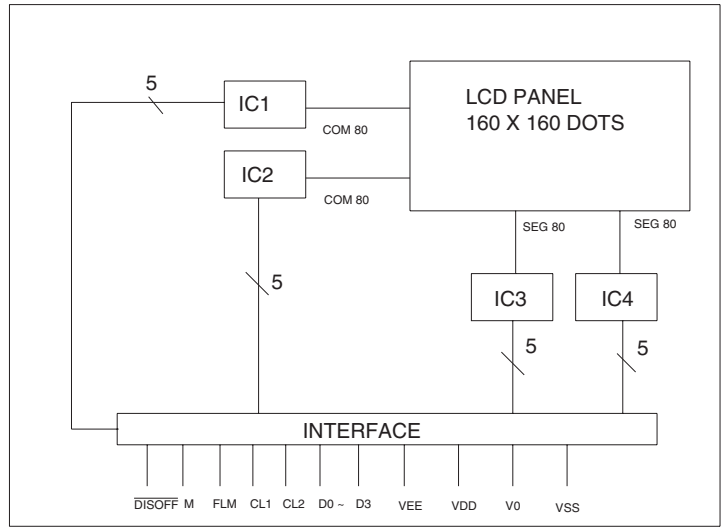
1	2	3	4	5	6	7	8	9	10
V <sub>SS</sub>	FLM	CL1	CL2	M	V <sub>DD</sub>	EL-ON	V <sub>EE</sub>	DB3	DB2
11	12	13	14	15	16	17	18		
DB1	DB0	TP-L	TP-U	TP-R	TP-D	V <sub>SS</sub>	V <sub>SS</sub>		



FEATURE:

1. Display Mode: Reflective/Transflective Transmissive and Positive Type STN
2. Input Data: 4-Bits Parallel Data  
Input from a MPU
3. Assembly: SMT
4. Backlight: Optional

BLOCK DIAGRAM

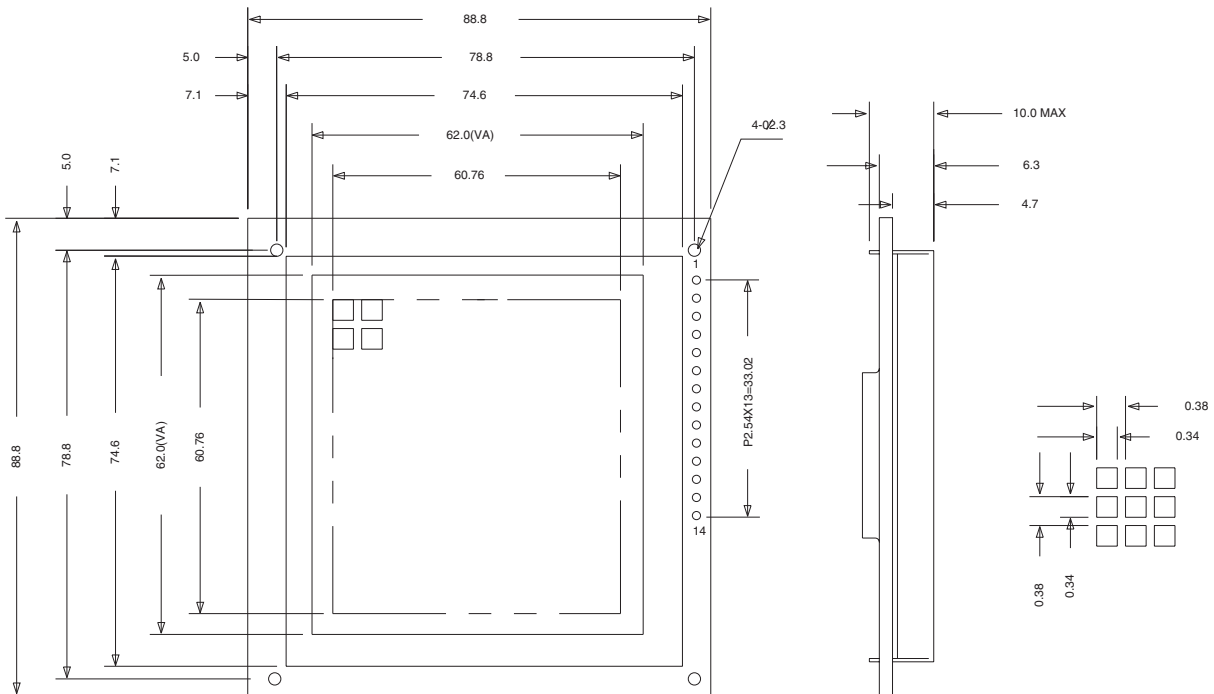


ELECTRICAL CHARACTERISTICS:

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage for LCD	VLCD	Ta=25°C	---	16.0	---	V
Supply Current	IDD	VDD=5.0V	---	---	10.0	mA

INTERFACE PIN CONNECTOR:

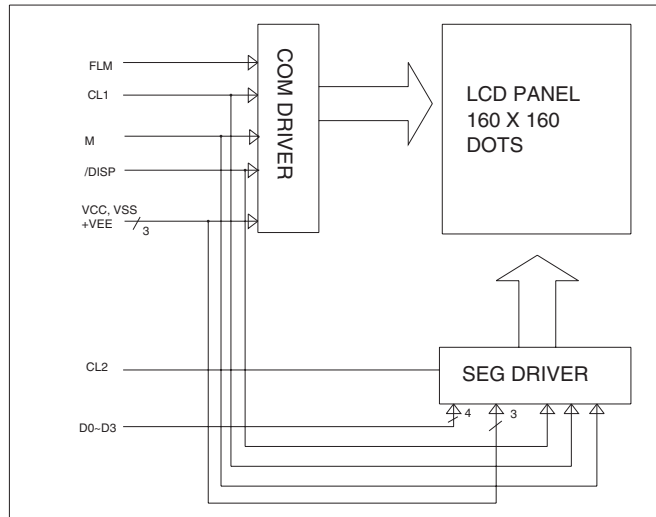
1	2	3	4	5	6	7	8	9	10	
V <sub>SS</sub>	M	FLM	NC	CL1	CL2	D0	D1	D2	D3	
11	12	13	14							
NC	V <sub>DD</sub>	V <sub>EE</sub>	DISPOFF							



**FEATURE:**

1. Display Mode: Transflective Positive FSTN
2. Input Data: 4-Bits Parallel Data  
Input from a MPU
3. Assembly: Foldable TCP IC
4. Backlight: None

**BLOCK DIAGRAM**

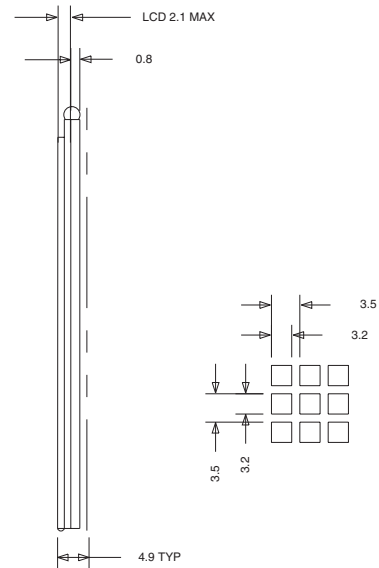
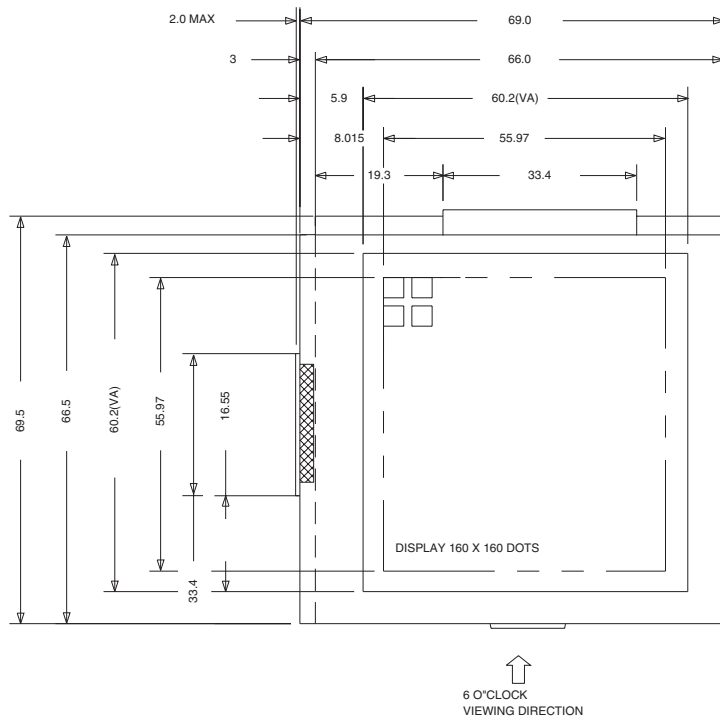


**ELECTRICAL CHARACTERISTICS:**

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage for LCD	VLCD	Ta=25fC	---	18.4	---	V
Supply Current	IDD	VDD=3.3V	---	0.4	1.0	mA

**INTERFACE PIN CONNECTOR:**

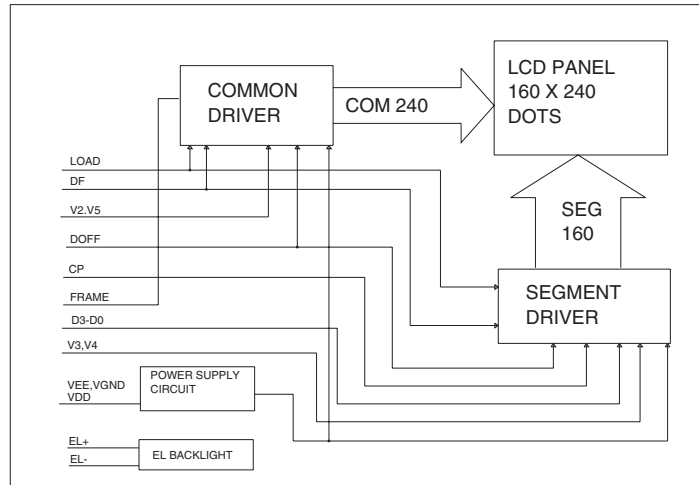
1	2	3	4	5	6	7	8	9	10
VSS	M	FLM	CL1	CL2	D0	D1	D2	D3	VEE
11	12	13							
VDD	V0	DISPOFF							



FEATURE:

1. Recommended Controller (SED1353 or Equivalent)
2. +3.3V Power Supply
3. 1/240 Duty Cycle
4. Dual Power Supply

BLOCK DIAGRAM



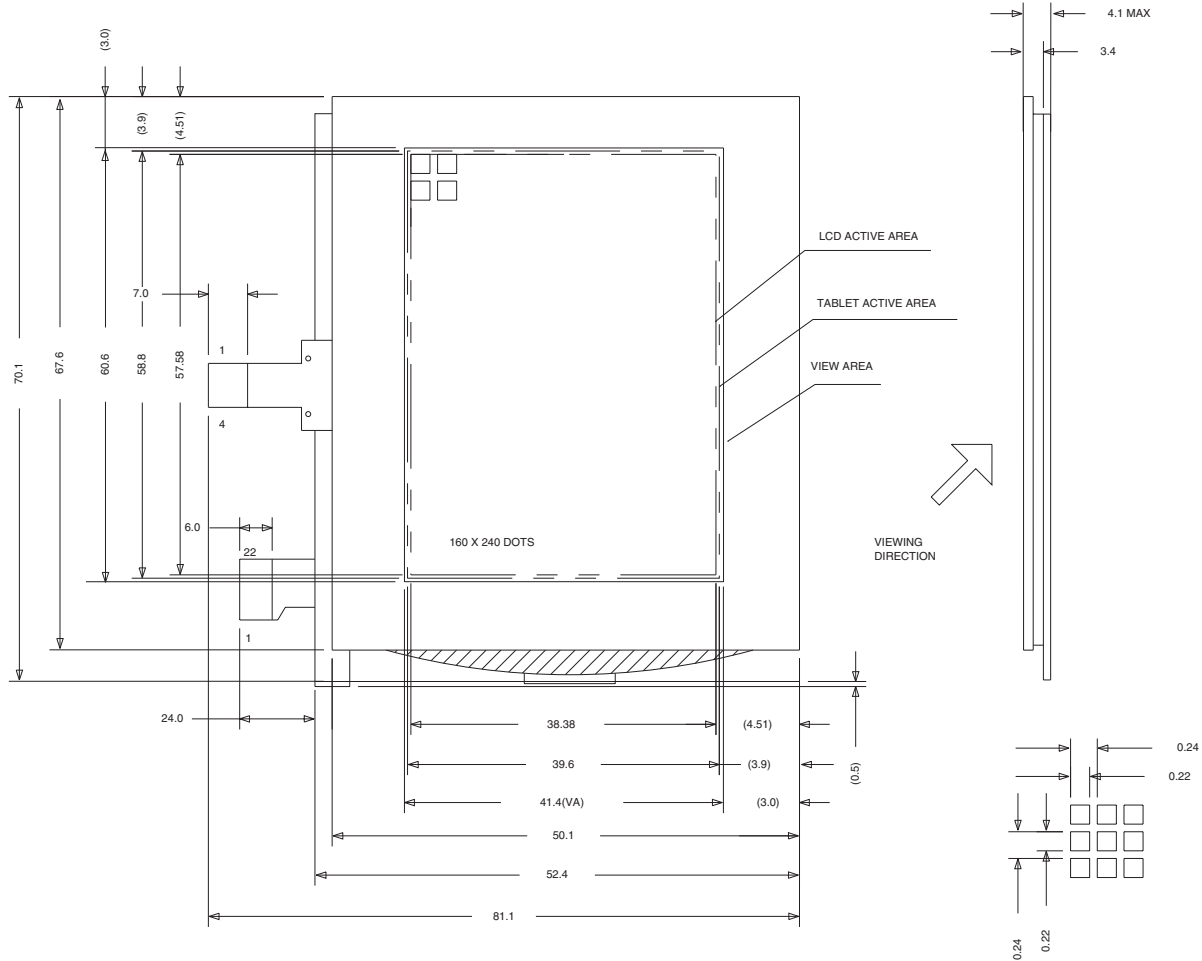
ELECTRICAL CHARACTERISTICS:

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage for LCD	VLCD	Ta=25fC	--	21.5	--	V
Supply Current	IDD	VDD=3.3V	--	0.5	1.0	mA

INTERFACE PIN CONNECTOR:

1	2	3	4	5	6	7	8
V5	V2	VEE	VDD	FRAME	VGND	LOAD	VSS
9	10	11	12	13	14	15	16
DF	D.OFF	CP	V4	V3	DB3	DB2	DB1
17	18	19	20	21	22		
DB0	VGND	VSS	EL-	VSS	EL+		

GRAPHIC SERIES 160 X 240

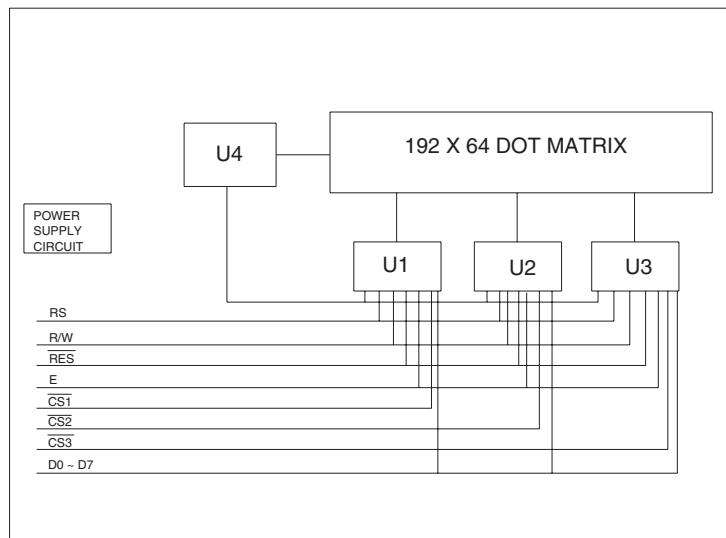




## FEATURE:

1. Display Mode: Reflective/Transflective  
Positive STN , FSTN
2. Input Data: 8-Bits Parrallel Data  
Input from a MPU
3. Assembly: SMT
4. Backlight: Optional

## BLOCK DIAGRAM

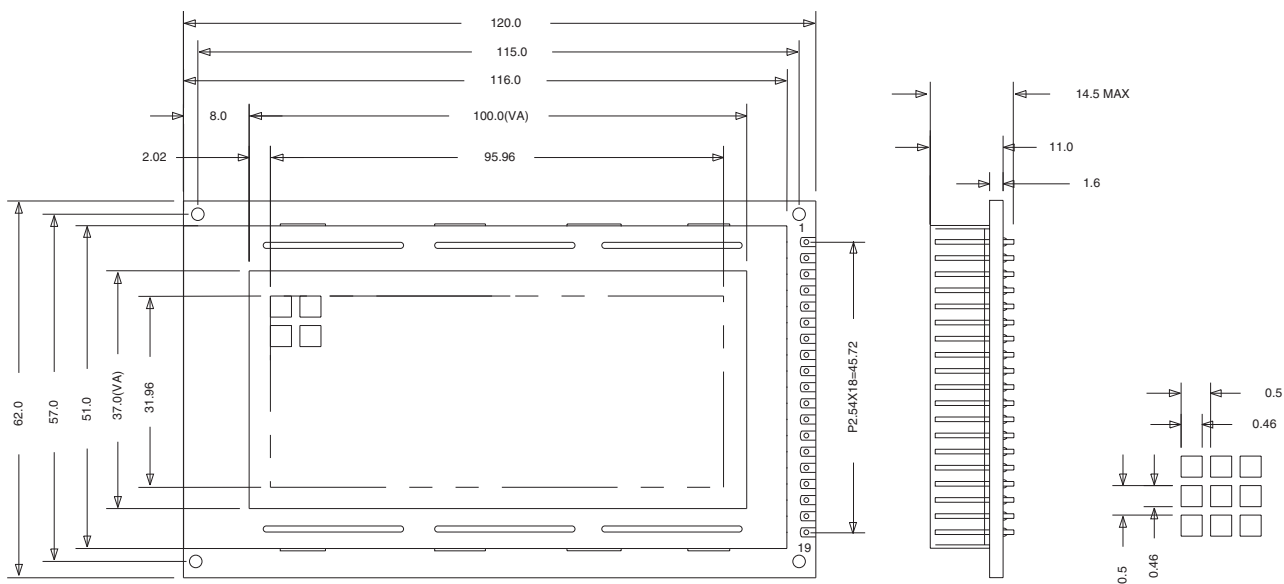


## ELECTRICAL CHARACTERISTICS:

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage for LCD	VLCD	Ta=25flC	---	13.0	---	V
Supply Current	IDD	VDD=5.0V	---	6.0	---	mA

## INTERFACE PIN CONNECTOR:

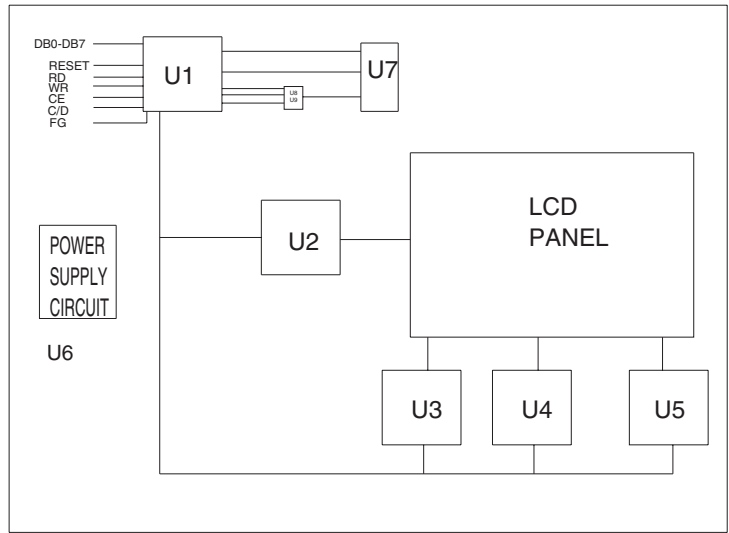
1	2	3	4	5	6	7	8	9	10
V <sub>SS</sub>	V <sub>DD</sub>	V <sub>O</sub>	V <sub>EE</sub>	RS	R/W	E	D0	D1	D2
11	12	13	14	15	16	17	18	19	
D3	D4	D5	D6	D7	CS1	CS2	CS3	RES	



### FEATURE:

1. Display Mode: Transflective Positive STN
2. Input Data: 8-Bits Parrallel Data  
Input from a MPU
3. Assembly: SMT
4. Backlight: LED

### BLOCK DIAGRAM

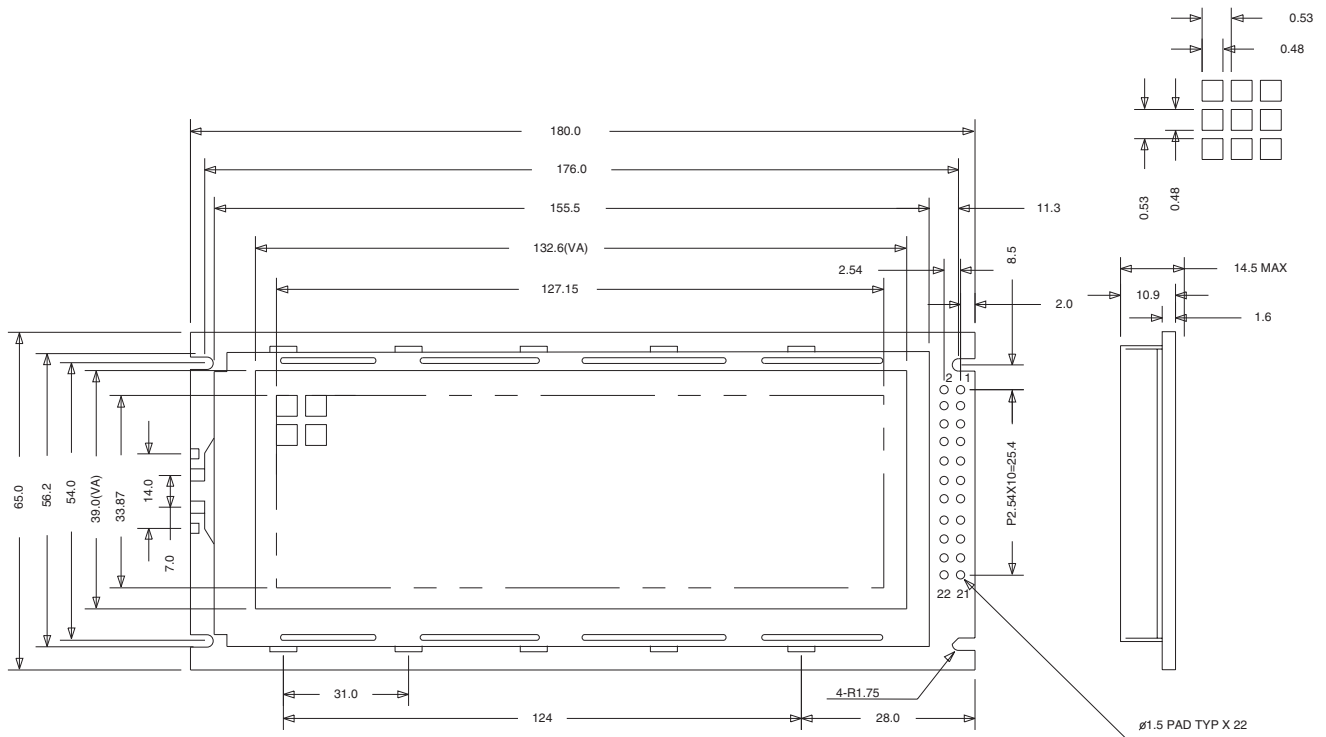


### ELECTRICAL CHARACTERISTICS:

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage for LCD	VLCD	Ta=25fC	...	13.0	...	V
Supply Current	IDD	VDD=5.0V	...	6.0	...	mA

### INTERFACE PIN CONNECTOR:

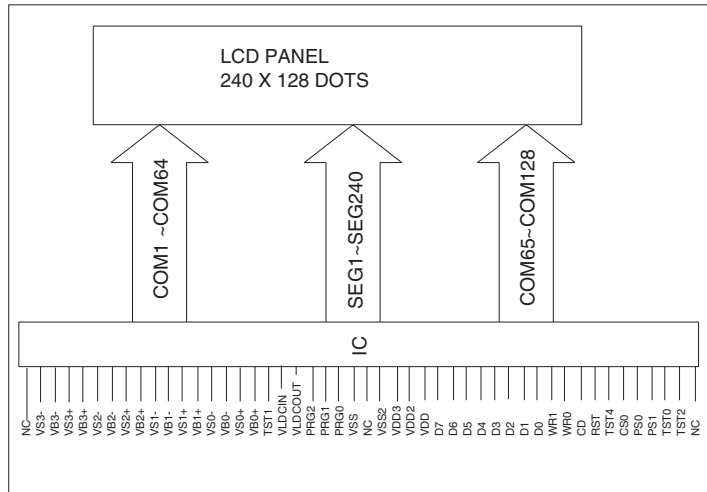
1	2	3	4	5	6	7	8	9	10
FGND	V <sub>SS</sub>	V <sub>DD</sub>	V <sub>EE</sub>	$\overline{WR}$	$\overline{RD}$	$\overline{CE}$	C/D	NC	RESET
11	12	13	14	15	16	17	18	19	20
D0	D1	D2	D3	D4	D5	D6	D7	FS	NC



FEATURE:

- 1. Built in Controller (UC1608)
- 2. +3.0V Power Supply
- 3. 1/128 Duty Cycle
- 4. Dual Power Supply

BLOCK DIAGRAM

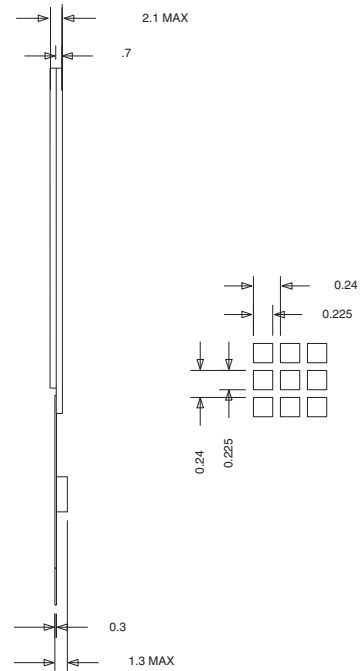
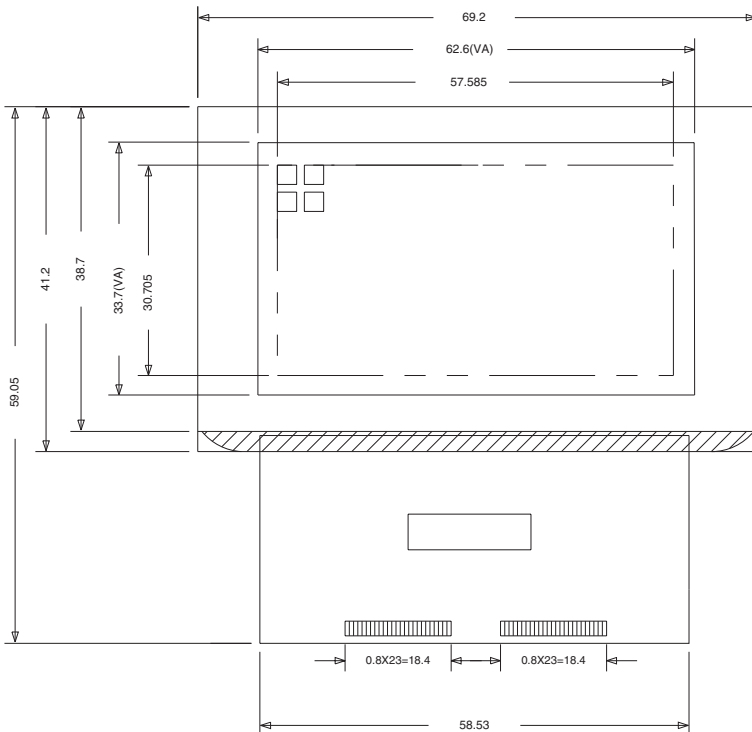


ELECTRICAL CHARACTERISTICS:

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage for LCD	VLCD	Ta=25°C	---	15.0	---	V
Supply Current	IDD	VDD=3.0V	---	1.0	2.0	mA

INTERFACE PIN CONNECTOR:

1	2	3	4	5	6	7	8
NC	VS3-	VB3-	VS3+	VB3+	VS2-	VB2-	VS2+
9	10	11	12	13	14	15	16
VB2+	VS1-	VB1-	VS1+	VB1+	VS0-	VB0-	VS0+
17	18	19	20	21	22	23	24
VB0+	TST1	VLCDIN	VLDCOUT	PRG2	PRG1	PRG0	V <sub>SS</sub>
25	26	27	28	29	30	31	32
NC	VSS2	VDD3	VDD2	V <sub>DD</sub>	DB7	DB6	DB5
33	34	35	36	37	38	39	40
DB4	DB3	DB2	DB1	DB0	WR1	WR0	CD
41	42	43	44	45	46	47	48
RET	TST4	CS0	PS0	PS1	TST0	TST2	NC

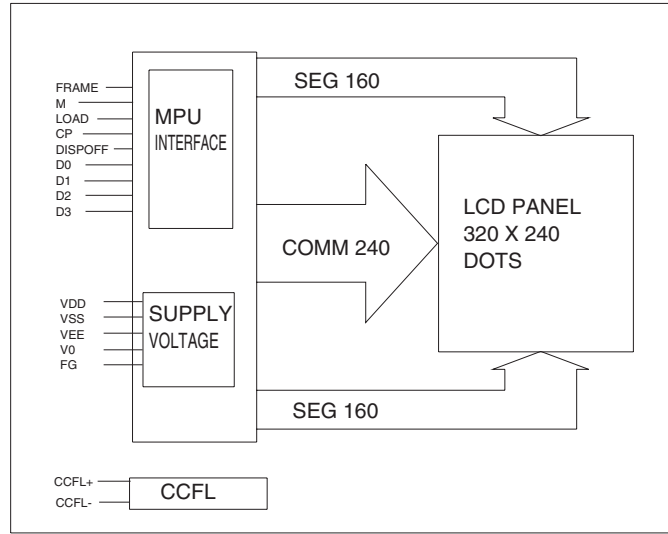


GRAPHIC SERIES 240 X 128

FEATURE:

1. Recommended Controller(SED 1353 or Equivalent)
2. +5.0V Power Supply
3. 1/240 Duty Cycle
4. Dual Power Supply
5. Edge Lighting Type CCFL Backlight

BLOCK DIAGRAM

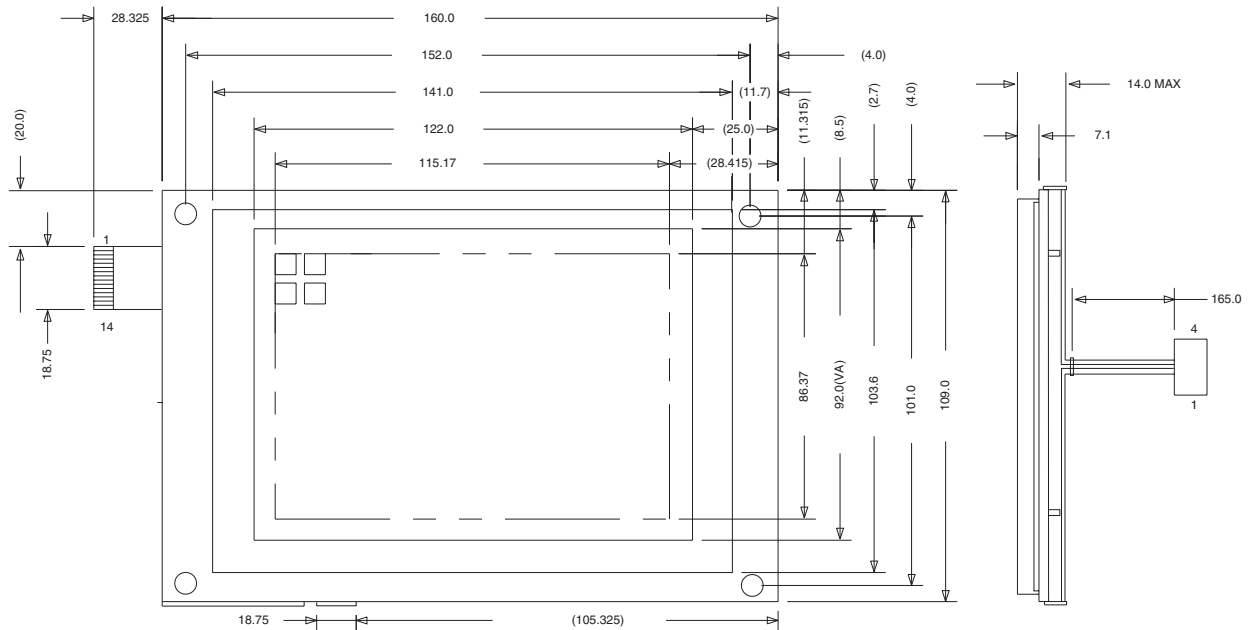
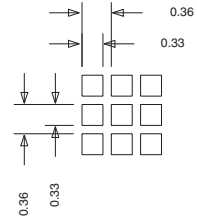


ELECTRICAL CHARACTERISTICS:

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage for LCD	V0-VSS	Ta=25f1C	---	24.0	---	V
Supply Current	IDD	VDD=5.0V	---	6.0	10.0	mA

INTERFACE PIN CONNECTOR:

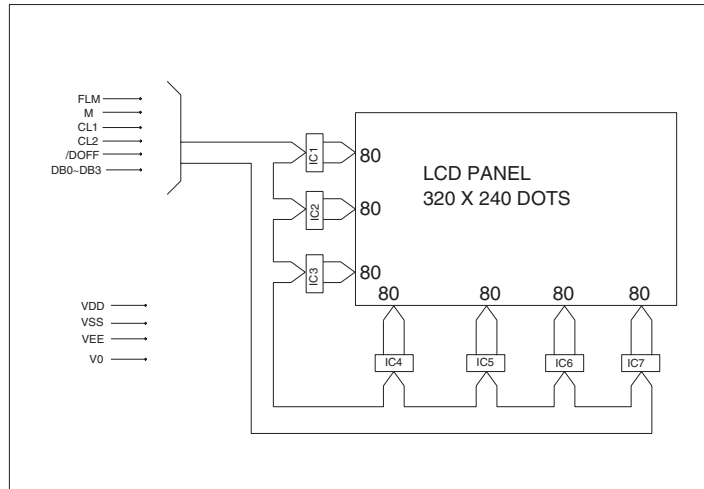
1	2	3	4	5	6	7	8	9	10
FRAME	M	LOAD	CP	/D.OFF	DB0	DB1	DB2	DB3	VDD
11	12	13	14						
VSS	VEE	V0	FGND						



**FEATURE:**

- 1. Display Mode: Reflective/Transflective  
Transmissive and Positive Type STN,FSTN
- 2. Input Data: 4-Bits Parallel Data  
Input from a MPU
- 3. Assembly: SMT
- 4. Backlight: Optional

**BLOCK DIAGRAM**

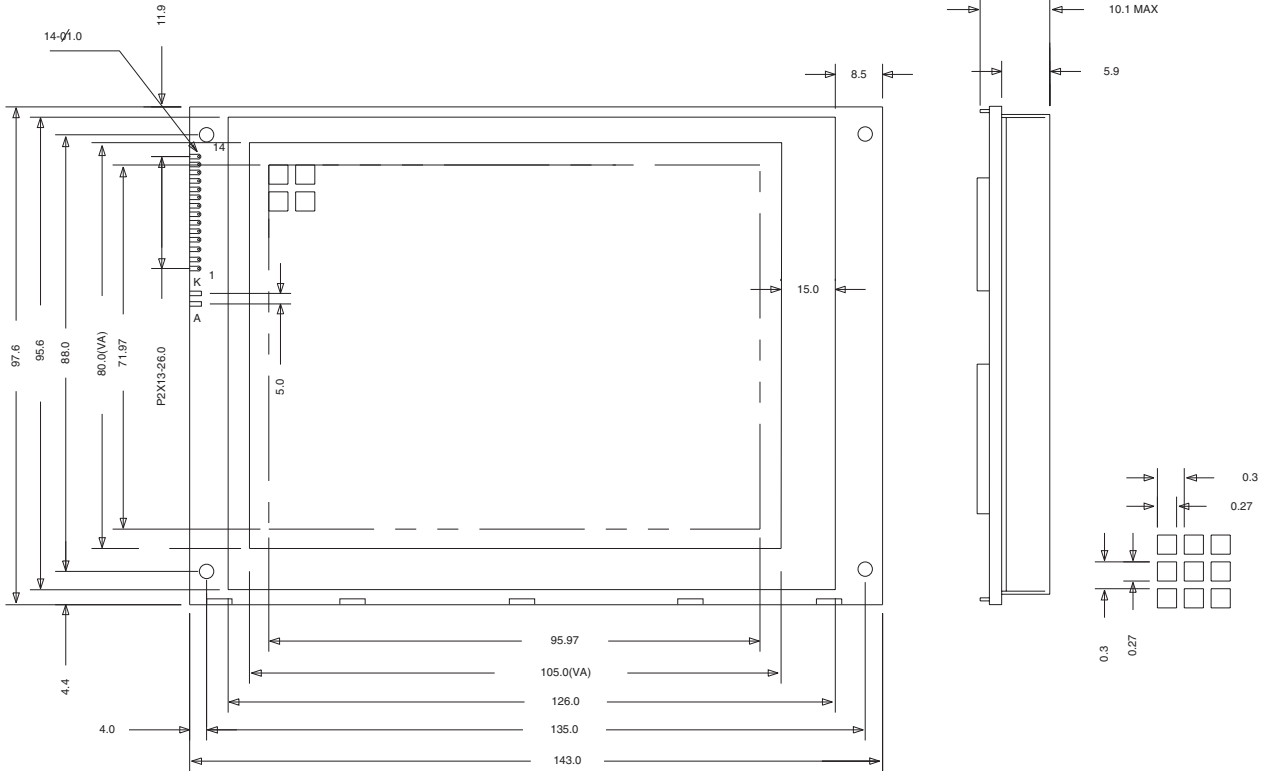


**ELECTRICAL CHARACTERISTICS:**

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage for LCD	VLCD	Ta=25fIC	---	25.0	---	V
Supply Current	IDD	VDD=5.0V	---	---	4.0	mA

**INTERFACE PIN CONNECTOR:**

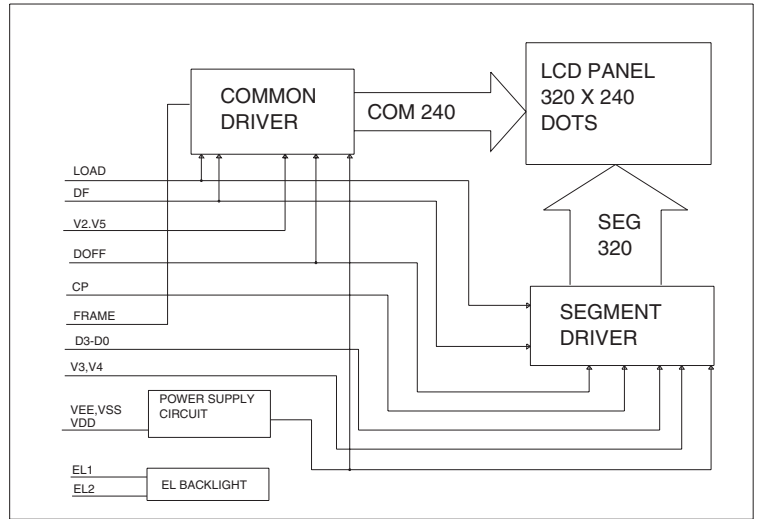
1	2	3	4	5	6	7	8
FLM	NC	CL1	CL2	/D.OFF	DB0	DB1	DB2
9	10	11	12	13	14		
DB3	VDD	VSS	VEE	V0	FG		



### FEATURE:

1. Recommended Controller (SED1353 or Equivalent)
2. +3.3V Power Supply
3. 1/240 Duty Cycle
4. Dual Power Supply

### BLOCK DIAGRAM



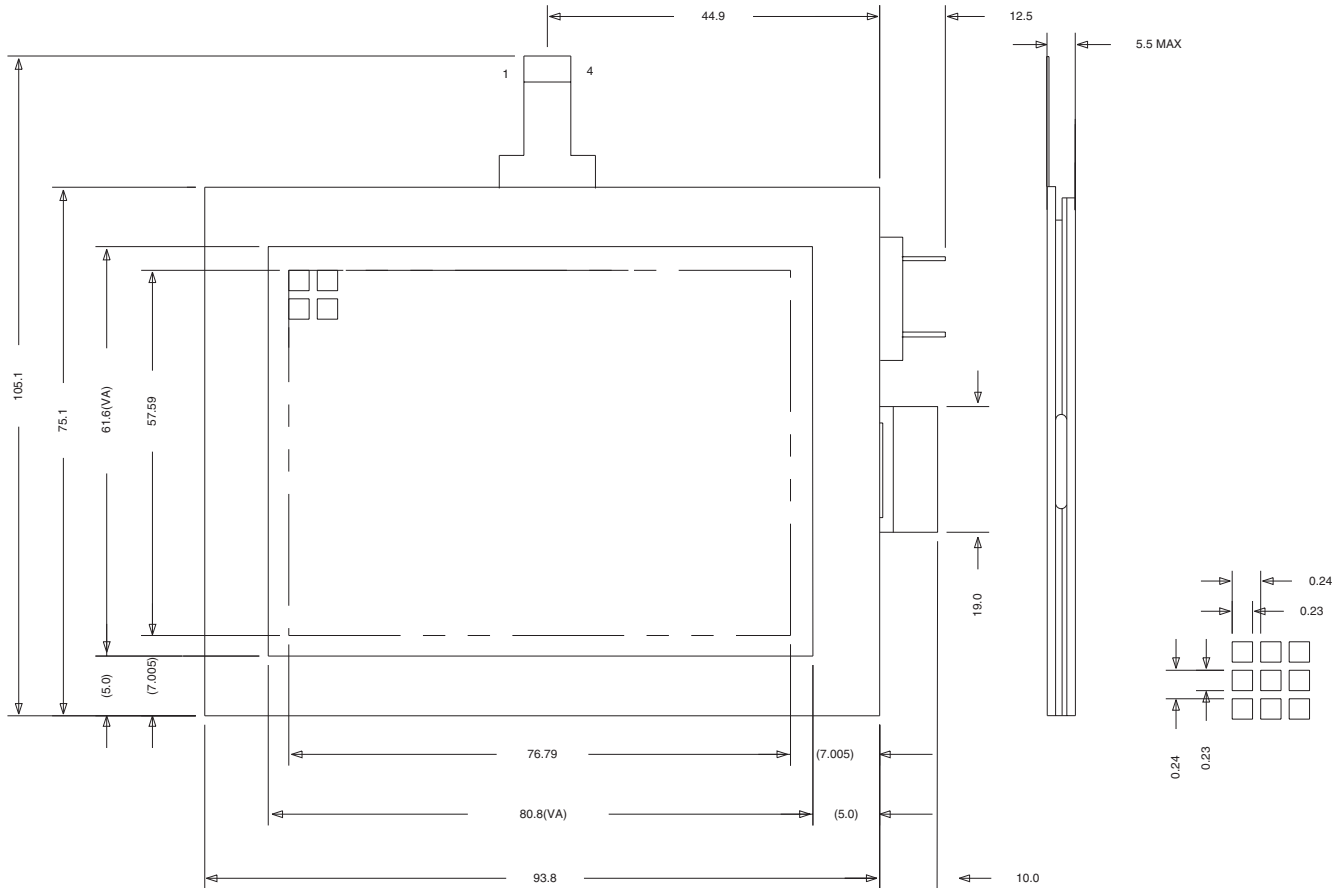
### ELECTRICAL CHARACTERISTICS:

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage for LCD	VLCD	Ta=25ffC	---	21.5	---	V
Supply Current	IDD	VDD=3.3V	---	0.2	0.5	mA

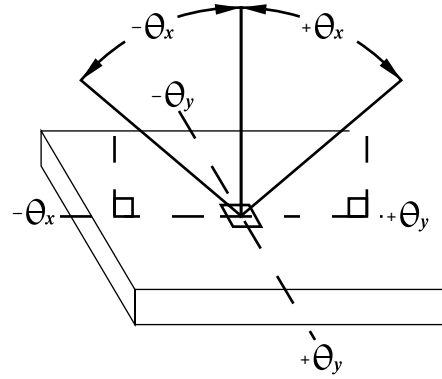
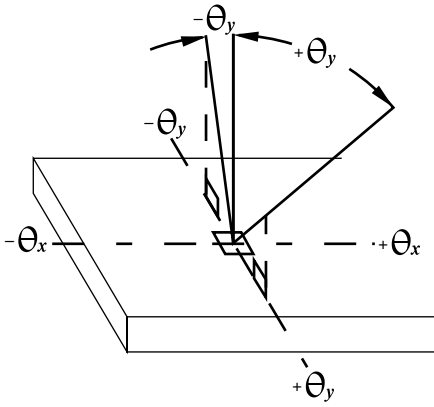
### INTERFACE PIN CONNECTOR:

1	2	3	4	5	6	7	8
V5	V2	VEE	VDD	FRAME	VGND	LOAD	VSS
9	10	11	12	13	14	15	16
DF	/D.OFF	CP	V4	V3	DB3	DB2	DB1
17	18						
DB0	NC						

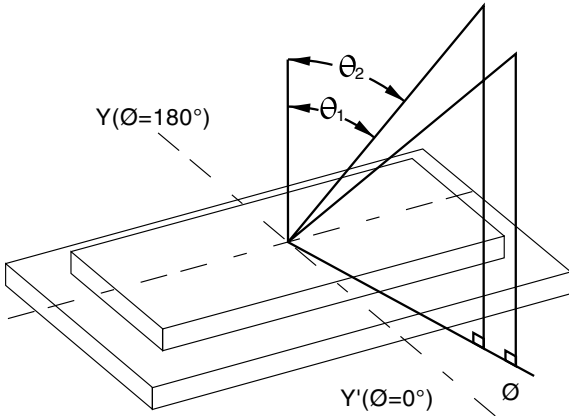
GRAPHIC SERIES 320 X 240



**STN Definition of  $\theta_x$  AND  $\theta_y$**

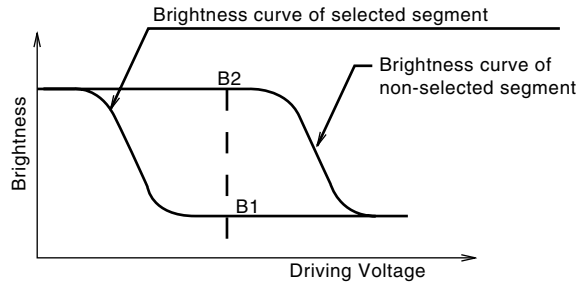


**TN Definition of  $\theta_x$  AND  $\theta_y$**

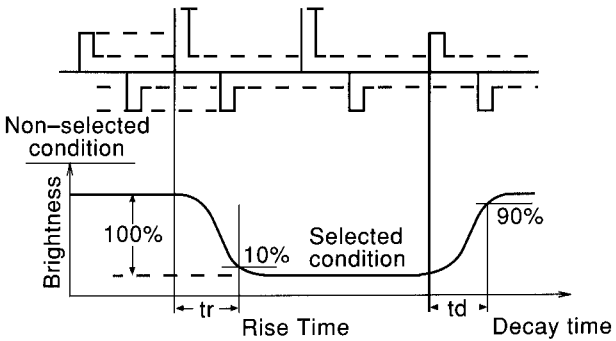


**TN, STN Definition of Contrast Ratio  $C_R$**

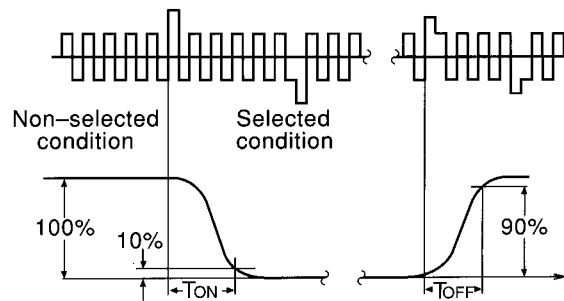
$$C_R = \frac{\text{Brightness curve of non-selected segment (B2)}}{\text{Brightness curve of selected segment (B1)}}$$



**Definition of Optical Response Time**



**Definition of Optical Response Time**



## Standard Segment Displays

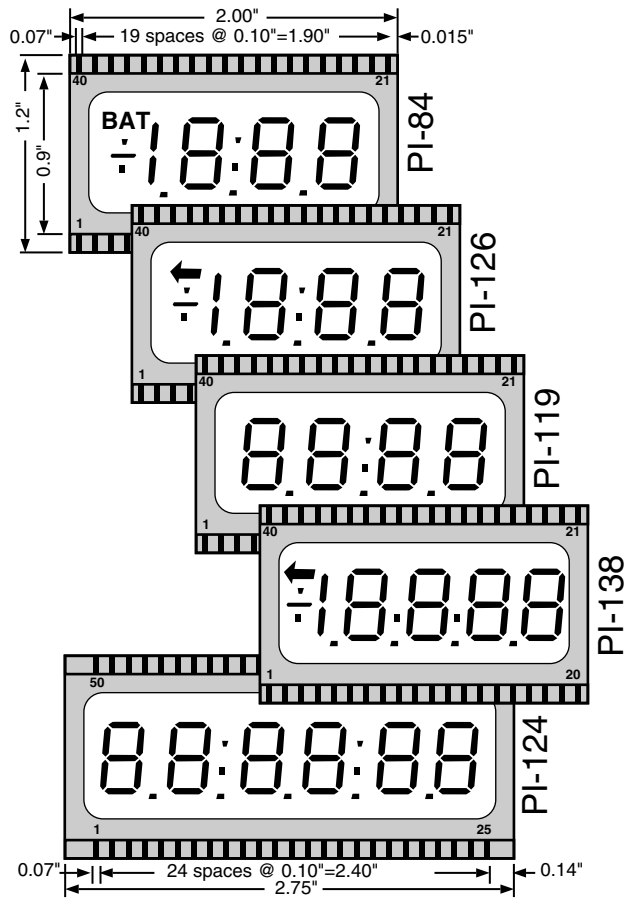
Polytronix, Inc. produces a wide variety of standard, custom TN segment and STN dot-matrix displays. They are currently used in many applications, including medical, consumer products, industrial controls, instrumentation and avionics.

Please contact our Customer Service department for a careful review of your specific requirements, or refer to the Check List For Custom Designed LCD Panels at page 87.

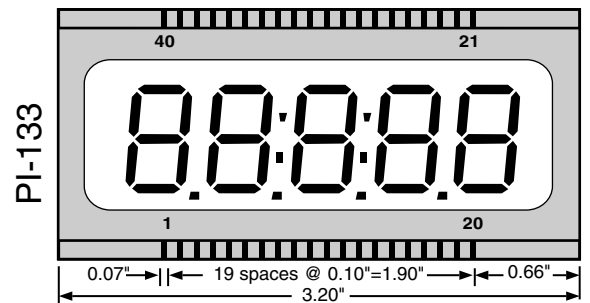
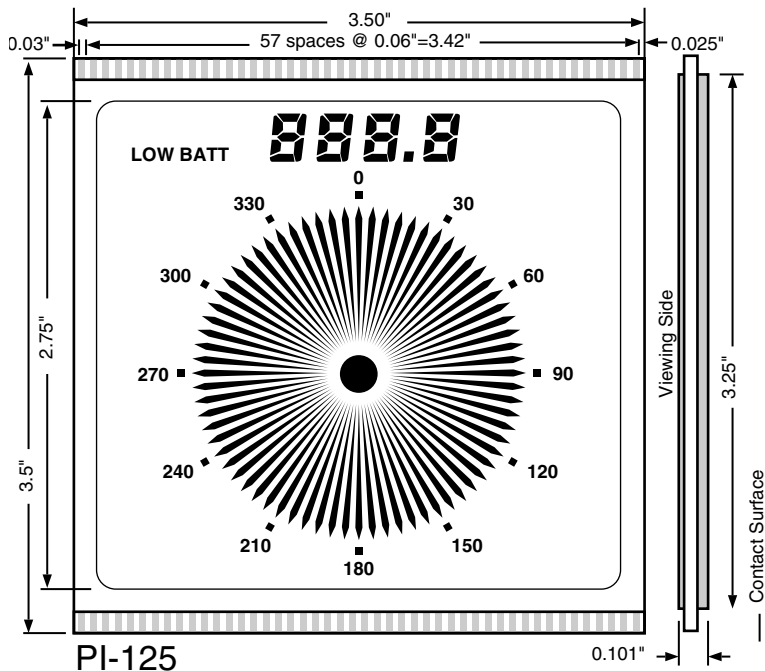
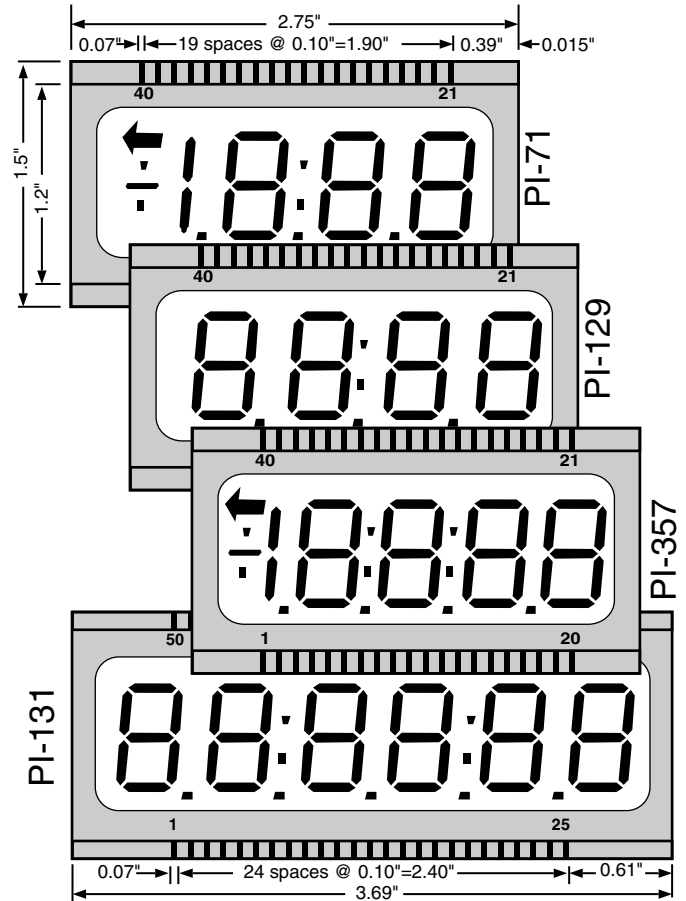
Provided below are sketches of a few of our standard LCD panels.

# STANDARD SEGMENT DISPLAYS

### 0.5" Character LCDs



### 0.7" Character LCDs





## SAFETY

The liquid in the LCD should not be swallowed or touched. If it accidentally gets on your hands, wash them thoroughly with water.

## Handling Instructions

The LCD panel is a glass product developed through precision processing and special orientation treatment. If pressure is applied to the panel, orientation may be disturbed, making it difficult to return to original condition. It is apt to crack or be broken easily if it is dropped or hit by a hard object, particularly around the edges. Attention must be paid to avoid external shock.

## Mounting Instructions

- When connecting an LCD to a circuit board, it is recommended to use a rubber or flexible connector. Direct soldering or mechanical connection is not possible. Then pin connected type LCD permits soldering of pins.
- When mounting an LCD panel on a cabinet, care must be taken not to apply excessive force on the display surface of the panel with a fingertip, etc. Otherwise, it may cause an operating failure or will shorten the lifetime of the panel.
- DC voltage or driving voltage higher than specified will reduce the lifetime of the liquid crystal display unit.
- LCD panels should be handled with care during shipment. If, however, the terminals are contaminated, wipe off with alcohol.
- The polarizer must be handled carefully, because it is soft and apt to suffer damage. If a protective panel is attached to the polarizer to avoid damage and contamination, it should be removed just before use as much as possible.
- Use a dry, soft cloth to clean the polarizer. If contamination persists, wipe it off with a small amount of petroleum benzene. Avoid using an organic solvent as much as possible.
- When attaching with the heat seal or anisotropically conductive film, wipe off with alcohol before use.

## Storing Instructions

- Avoid storage in high temperature and high humidity. When long-term storage is required, keep the panels in low temperature (5°C ~ 25°C) and low humidity.
- Do not expose to direct sunlight or fluorescent light for a long period of time.
- Note that the presence of water drops or dew in the LCD panel may deteriorate the polarizer or corrode the electrode.

## Standard Specifications For Reliability

- Life Time  
Functions, performance, appearance, etc. shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions (in areas not exposed to direct sunlight).
- High Temperature Resistance  
The sample shall be free from defects after it has been allowed to stand at 60°C under storage condition, 40°C under operating condition for 200 hours and then returning it to normal temperature and allowing it to stand for 30 minutes.
- Low Temperature Resistance  
The sample shall be free from defects after it has been allowed to stand at -20°C under storage condition, 0°C under operating condition for 200 hours and then returning it to normal temperature condition and allowing it to stand for 24 hours.
- High Humidity Resistance  
The sample shall be free from defects after it has been allowed to stand at 60°C, 90% RH under storage condition, 40°C, 90% RH under operation condition for 96 hours, then taking it out and drying it at normal temperature.
- Thermal Shock Resistance  
The sample shall be free from defects when it is subjected to the following 10 cycles of operation: +20°C for 30 minutes/-25°C for 5 minutes/-60°C for 30 minutes/-25°C for 5 minutes, as one cycle.
- Vibration Resistance  
The sample shall be free from defects after following the vibration has been given to it in three directions: X, Y and Z. Frequency: 10-55 Hz, Total amplitude: 2.0mm, Time: 1 hour in each direction.

## GLOSSARY

**Active Area/Effective Area** - Perimeter dimensions of the conductive area, within the viewing area of the LCD glass.

**Active Matrix, AMTFT** - Thin film transistor deposited onto the LCD glass substrate control each pixel or dot. The pixels then become "static drive" segments featuring excellent contrast and viewing characteristics. Applications are typically in highly populated graphic type panels.

**Annunciator** - An active element, such as a symbol, word, or phrase.

**Array Process** - A method of manufacture where sheets of glass consisting of several displays are assembled, the displays are isolated and filled with the liquid crystal material after assembly of the larger sheets (see also Endfill).

**Backplane** - The conductive area common to all segments (static drive only).

**Bezel** - A metal or plastic frame which fits over the LCD glass. The bezel acts as a pressure device, compressing the elastomeric connector between the LCD glass and PCB.

**C-N Point** - The temperature at which a crystalline solid changes into a liquid crystal; melting point.

**Cell Gap** - The spacing between the two pieces of glass. This space contains the liquid crystal fluid.

**Cell, LCD** - The area between the two glass plates; the area containing the liquid crystal material.

**Chip-On-Board** - The LCD driver is formatted into an area on the PCB. Electrical connections are made by micro diameter gold wires. The entire area is then covered with epoxy.

**Chip-On-Glass** - A new technology being developed, where the LCD driver format is actually mounted on the surface of the LCD glass.

**Chip-On-Flex** - The LCD driver is incorporated into a flex connector, which is attached to the contact edge of the LCD glass.

**Clearing Point** - The temperature at which a nematic liquid changes into an isotropic liquid; the upper limit of the liquid crystal state.

**Common/Backplane** - The conductive surface on one of the two pieces of glass, which superimposes the pattern on the second piece of glass. The number of backplanes corresponds to the duty ratio.

**Common Plate** - The glass plate having the back plane (see back plane).

**Cold Cathode Backlight (CCFT)** - A type of fluorescent backlighting. Used in medium to large size graphic LCD modules.

**Contact Edge** - The extended area of the LCD glass which contains the conductive leads/traces, to which electrical connection is made by a connector.

**Contrast Ratio** - The difference in luminance between the unselected area and the selected area.

**Controlled Cell** - An LCD having a uniform cell thickness, typically achieved with the use of spacers in the cell area.

**Cursor** - A row or block of dots, used to indicate the location of the next character or symbol to be entered. Used in dot matrix character and graphic LCD modules.

**Delay Time (Turn-off)** - The time interval between the end of the input pulse train and the luminance reaching a 90% On value.

**Delay Time (Turn-on)** - The time interval between initiation of an input pulse train and the luminance reaching a 10% On value.

**Dichroic/Guest Host** - A type of liquid crystal fluid in which color dye has been added. Molecular orientation is parallel to the glass surface.

**Dil** - Dual in line; an LCD having parallel contact ledges.

**Dil Pins** - Individual metal pins, bonded by epoxy, to each conductive lead/trace on the contact edge.

**Direct/Static Drive** - Each conductive lead on the contact edge, connects to one segment or annunciator.

**Dot/Pixel** - Typically a rectangular active element, when combined together in a matrix, form a character or symbol.

**Dot Matrix** - A group of dots/pixels forming a character or symbol. The most common dot matrix is a 5x7 matrix (5 dots across; 7 dots down).

**Dual-In-Line** - Two parallel rows of connection holes on a PCB. Also refers to the type of connector needed with this array.

**Duplex Drive** - An LCD using two back planes; also known as multiplexing.

**Duty Ratio** -  $1/N$ , where N equals the number of energized or unenergized segments (commons and/or back-planes) selected by one complete cycle.

**Effective Area** - See "Active Area".

**Elastomer Connector** - A strip of silicone rubber made up of sequentially spaced conductive and non-conductive material. This is the most common connection method for LCD modules.

**Electrode** - Etched area of Indium Tin Oxide on the inside glass surfaces of an LCD.

**Electrophoresis** - A phenomenon which occurs when excess DC voltage is applied to an LCD. Conductive particles from one piece of glass are transferred through the LC fluid and deposited on the conductive surface of the opposite piece of glass. A conductive spike is created thus causing a dead short.

**Electroluminescent Lamp** - Is a thin membrane consisting of two coated electrode plates with an aluminum reflector. When AC voltage is applied to the electrodes, the electrons collide with the light emission core. The energy given off is light.

- Endfill, EF** - A method of manufacturing whereby the liquid crystal enters an assembled cell through an opening in the seal; also vacuum fill. (see Array Process)
- Fall Time** - The time during which the luminosity changes from the 90% on to the 10% on value.
- Ferroelectric, FLC** - A type of liquid crystal possessing a permanent dipole. Devices made from these materials exhibit stability, fast switching and high contrast. Current applications in shuttering and light manipulation.
- Fill Hole** - A space left between the epoxy seals, after assembly on one end of the LCD glass. This space is used to fill the glass with the LC fluid, which is noted by a mound of epoxy on one end of the glass.
- First Minimum** - A TN LCD using low birefringence fluid and "controlled" cell spacing to achieve a very wide viewing angle with no nulls in the viewing cone. Best results are achieved when the LCD is positive image and static drive.
- Font** - The active pattern which has all information to be displayed in the LCD glass.
- Front Plate** - The glass plate having the segment electrodes and connectors.
- Ghosting** - A phenomenon which occurs when voltage from an energized element leaks to an adjacent OFF element and turns the adjacent element partially ON.
- Heat Seal** - A flat, flexible, adhesive connector which is bonded to the contact edge of the glass by heat. Typically used on large graphic modules.
- Image Area** - The area which encompasses the display image without a tolerance (for reference, see viewing area).
- Ink Overlay, Ink Process** - A process of printing opaque or transfective inks on an LCD for the purpose of adding color or reducing the number of active area in the display.
- Interconnect Dot** - Connects pattern pieces of glass to each backplane. Consists of silver impregnated epoxy.
- Internal Color Filter(s)** - A process of printing a color or colors internal to the LCD cell to achieve a color display.
- Inverter (DC to AC)** - Used to power electroluminescent lamps. Converts DC to AC voltage at a high frequency 300Hz~1KHz.
- Inverse/Reverse Image** - Used exclusively on negative image graphic displays (Transmissive negative). With EL or cold cathodes backlight where the background is energized and the information to be displayed remains static or the same color as the polarizer in the OFF state. This is achieved by inverting the signal of the data lines before going to the LCD module.
- Iso Contrast Plot** - A plot that shows contrast ratio versus viewing angle. Curves on the plot connect points of equal contrast.
- Isotropic Stage** - When the fluid heats up to the point where the fluid is no longer in the twisted nematic state. The molecules can no longer twist light and, therefore, all incoming light is absorbed. In positive image displays, the viewing area turns completely dark. The display will revert back to the twisted nematic state when cooled below the isotropic temperature.

**LCF, LXF** - See Liquid Crystal Fluid.

**Lead(s)** - The conductive trace(s) on the contact edge.

**LED Backlight** - A form of backlighting for small to medium size LCD's that use surface mount LED's on a substrate with a light diffuser over the top. In some cases LED's are placed at each end of the module and light is directed into the center.

**Liquid Crystal Fluid** - Has properties of both a fluid and solid. Consisting of rod shaped, bi-polar molecules, which in the OFF state are capable of twisting polarized light.

**Module** - Consists of an LCD (glass) connected to a PCB with drivers on board. Controllers, temperature compensation circuits, etc., are optional.

**Multiples** - Using multiple backplanes (commons) in order to reduce the number of connections between the drivers and LCD.

**Negative Image** - The viewing area is a dark color in the OFF state. This condition is achieved by having both front and rear polarizers in the same axis. In this mode, light passes through the energized areas. Some type of backlight must be used in order to effectively view the information.

**N-I** -- Nematic to Isotropic - See Clearing Point.

**Pattern Plate** - The glass plate having the segment connections and the image pattern.

**Pin-Out** - The identification of which conductive pad or pin (terminal) connects to which segment(s).

**Pitch** - Is the center to center dimension of adjacent conductive traces, dots, or connector holes.

**Pixel** - See "Dot".

**Polarizers** - Are made of a polymer acetate with iodide molecules incorporated in the material. The molecules are arranged to only allow scattered light to enter in one plane/axis. Twisted nematic LCD's require two polarizers, one on the front and one on the back.

**Positive Image** - Active elements, when energized, appear dark in color against a light background (non-energized) - (i.e. reflective, transfective, (positive) inverse image).

**Reflective** - Typically a smooth silver/gray piece of polished aluminum foil bonded to the rear polarizer. Reflects the incoming ambient light. Note: Backlighting cannot be used with a reflective type LCD.

**Response Time (T<sub>off</sub>)** - Total of delay time (T<sub>d off</sub>) and fall time (T<sub>f</sub>).

**Response Time (T<sub>on</sub>)** - Total of rise time (T<sub>r</sub>) and delay time (T<sub>d on</sub>).

**Rise Time** - Time interval between 10%(off) to 90%(on).

**Saturation Voltage** - RMS voltage required to turn fluid to 90% on.

**Segment** - An active element of a digit (i.e. typically numeric digits have 7 segments and alpha/numeric digits can have 14 or 16 segments).

**Sil** - Single-In-Line; An LCD module having a single row of connection holes. LCD glass having a single contact edge.

**Static Drive** - See "Direct Drive".

**Supertwist** - An improved twisted nematic display ( $180^\circ$  twist or greater) which has better contrast and optimum viewing range than standard twisted nematic ( $90^\circ$ ). Acronyms - SBE, New TN; NTN; SNTN.

**Third Contact Ledge** - An "offset" contact ledge typically used for the backplane/common connections on a greater than 16 level multiplex LCD.

**Threshold Voltage** - RMS voltage required to turn fluid to 10% on.

**Transflective** - A type of backing which is bonded to the rear polarizer. Enables light to pass through the back, as well as reflecting light from the front.

**Transmissive** - A type of LCD which does not have a reflector or transflector bonded to the rear polarizer. A backlight must be used with this type of LCD configuration. Most common is transmissive negative image.

**Triplex Drive** - An LCD with three back planes; also known as three-way multi-plexing.

**Twisted Nematic (TN)** - displays constructed in such a way as to cause the liquid crystal to twist at a  $90^\circ$  angle from one surface to the other.

**Viewing Angle** - A cone of visibility from the LCD in which acceptable contrast can be seen.

**Viewing Area** - The dimensions measured from the inside perimeter of the LCD bezel or LCD glass epoxy seal.

**Zebra Connector** - See "Elastomer Connector".

# CHECK-LIST FOR CUSTOM DESIGNED LCD MODULES

## 7. Electrical Specifications:

### 7.1 IC Requirement

7.1.1 Controller: \_\_\_\_\_ X \_\_\_\_\_ Pieces

7.1.2 Driver: \_\_\_\_\_ X \_\_\_\_\_ Pieces

### 7.2 Voltage Requirement

7.2.1 Supply Voltage for Logic (Vdd) \_\_\_\_\_ Volts

7.2.2 Supply Voltage for LCD Driver (Vee) \_\_\_\_\_ Volts

7.2.3 Operating Voltage (Vop) \_\_\_\_\_ Volts

7.3 Power Consumption: \_\_\_\_\_ mA (Typ.) \_\_\_\_\_ mA (Max.)

7.4 Frame Frequency: \_\_\_\_\_ Hz

7.5 Data Clock Frequency: \_\_\_\_\_ Hz

7.6 Note: \_\_\_\_\_

## 8. Maximum Rating

8.1 Operating Temperature Range:  0°C—50°C, OR \_\_\_\_\_ °C—\_\_\_\_\_ °C

8.2 Storage Temperature Range:  0°C—50°C, OR \_\_\_\_\_ °C—\_\_\_\_\_ °C

8.3 Max. Supply Voltage for Logic (Vdd) Max. \_\_\_\_\_ Volts

8.4 Max. Operating Supply Voltage (Vop) Max. \_\_\_\_\_ Volts

## 9. Other Material Specifications:

### 9.1 Printed Circuit Board

9.1.1  FR-4

9.1.2  FRC

9.1.3  Other Specific Requirement: \_\_\_\_\_

9.1.4 Thickness: \_\_\_\_\_

### 9.2 Terminal

9.2.1  Standard Connector

9.2.2  Specific Connector: Type \_\_\_\_\_ Source \_\_\_\_\_

### 9.3 Bezel

9.3.1  Material Follow Polytronix's Bezel

9.3.2  Steel,  Secc,  Other

9.3.3 Plating Material:  Zinc,  Varnish,  Nickel,  Other

9.3.4 Plating Color: \_\_\_\_\_

9.4 Note: \_\_\_\_\_

## 10. Backlight:

10.1  Edgelit LED,  Bottom Lit,  EL,  CCFL

10.2 Backlight Color: \_\_\_\_\_

## 11. Schedule

11.1 Estimate: \_\_\_\_\_

11.2 Sample Delivery: \_\_\_\_\_

11.3 Mass Production: • Delivery: \_\_\_\_\_

• Quantity Per Month: \_\_\_\_\_

• Total Quantity Per Year: \_\_\_\_\_

12. Other Condition: \_\_\_\_\_



# CHECK-LIST FOR CUSTOM DESIGNED LCD MODULES

1. Customer name: \_\_\_\_\_
2. Product #: \_\_\_\_\_
3. Product Specification: \_\_\_\_\_
  - 3.1 Application: \_\_\_\_\_
  - 3.2 Structure: \_\_\_\_\_  
Please attach drawing of the structure if one is available
  - 3.3 Note: \_\_\_\_\_
4. LCD Panel Specifications:
  - 4.1  Static:
  - 4.2  Multiplexing: \_\_\_\_\_ Duty: \_\_\_\_\_ Bias: \_\_\_\_\_
  - 4.3  Segment: \_\_\_\_\_
  - 4.4  Character Type: \_\_\_\_\_ Character\* \_\_\_\_\_ line
  - 4.5  Graphic Type: Width X Height = \_\_\_\_\_ X \_\_\_\_\_ dots
  - 4.6  Other: \_\_\_\_\_
  - 4.7  Note: \_\_\_\_\_

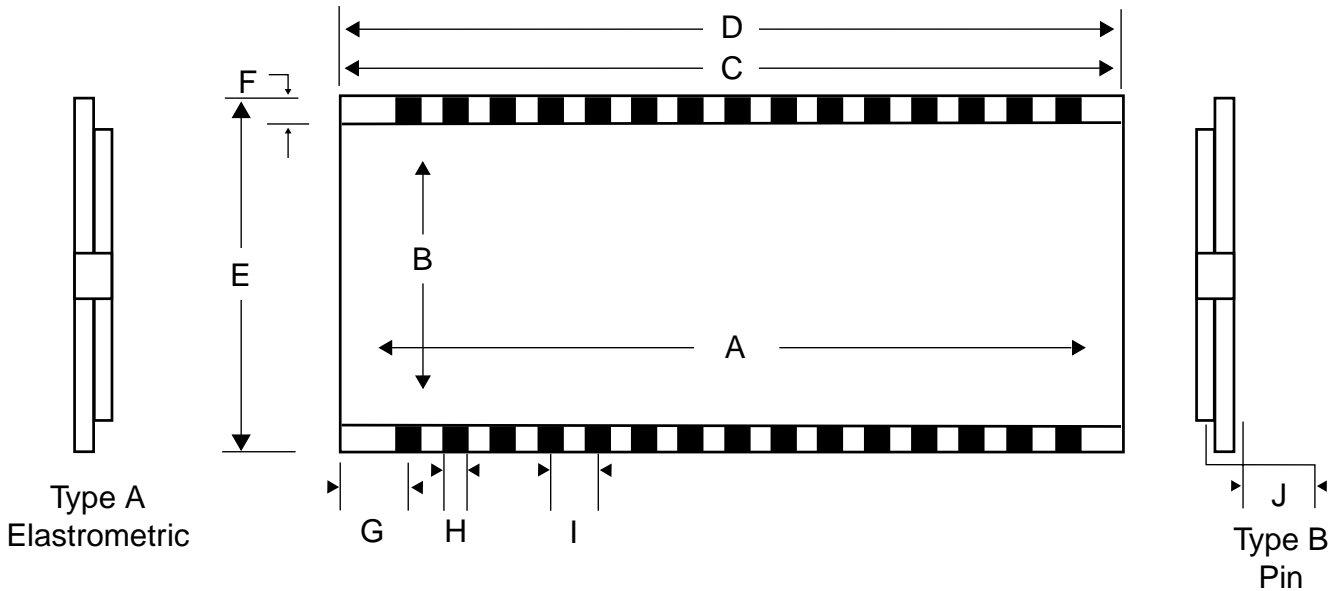
\* Please attach a drawing if the information is not enough.
5. LCD Specifications
  - 5.1 Display Type
    - TN Type
    - STN Type:  Yellow-Green,  Gray,  Blue
    - FSTN (Black & White)
    - Others
  - 5.2 Viewing Direction
    - 6:00,  12:00,  Other O'Clock
  - 5.3 Polarizer Mode
    - Reflective,  Transflective,  Transmissive,
    - Positive Type,  Negative Type
  - 5.4 Note: \_\_\_\_\_
6. Mechanical Dimensions
  - 6.1 Outline Dimension
    - 6.1.1  Follow Polytronix's Dimensions
    - 6.1.2  Specific Dimensions: \_\_\_\_\_ (L) X \_\_\_\_\_ (W) X \_\_\_\_\_ (H)
  - 6.2 Viewing Area: \_\_\_\_\_ (L) X \_\_\_\_\_ (H)
  - 6.3 Bezel Dimensions
    - 6.3.1  Follow Polytronix's Dimensions
    - 6.3.2  Specific Dimensions: \_\_\_\_\_ (L) X \_\_\_\_\_ (W)
  - 6.4 Terminal Position
    - 6.4.1  Follow Polytronix's Dimensions
    - 6.4.2  Specific Dimensions:
      - Top,  Bottom,  Left,  Right,  Other: \_\_\_\_\_
  - 6.5 Note: \_\_\_\_\_





# CHECK-LIST FOR CUSTOM DESIGNED LCD PANELS

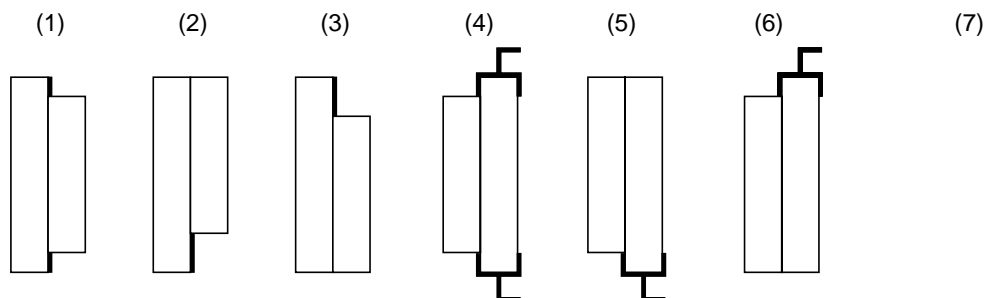
- Customer name: \_\_\_\_\_
- Product #: \_\_\_\_\_



### 3. Dimensions

- Minimum length of viewing area: \_\_\_\_\_ In. (cm)
- Minimum width of viewing area: \_\_\_\_\_ In. (cm)
- Maximum glass length: \_\_\_\_\_ In. (cm)
- Maximum display length, including enfill plug: \_\_\_\_\_ In. (cm)
- Maximum glass width: \_\_\_\_\_ In. (cm)
- Contact ledge width: \_\_\_\_\_ In. (cm) (minimum 0.100 if pins are used)
- Location of center of contact pad #1: \_\_\_\_\_ In. (cm)
- Contact pad width: \_\_\_\_\_ In. (cm)
- Contact pad pitch: \_\_\_\_\_ In. (cm) (0.100 if pins are used)
- Type A: \_\_\_\_\_ or Type B: \_\_\_\_\_ Pin Length: \_\_\_\_\_ In. (cm)
- Digit height and location: \_\_\_\_\_ In. (cm)
- Contact pad width: \_\_\_\_\_ In. (cm) (0.100 if pins are used)

### 4. LCD Configuration: bold lines indicate the terminal electrodes.



# CHECK-LIST FOR CUSTOM DESIGNED LCD PANELS

## 5. Specifications

### 5.1 Display Type

- TN Type
- STN Type:  Yellow-Green,  Gray,  Blue
- FSTN (Black & White)
- Others

### 5.2 Viewing Direction

- 6:00,  12:00,  Other O'Clock

### 5.3 Polarizer Mode

- Reflective,  Transflective,  Transmissive,
- Positive Type,  Negative Type

### 5.4 Driving Method

- Static:
- Multiplexing: \_\_\_\_\_  Duty: \_\_\_\_\_  Bias: \_\_\_\_\_
- Voltage: \_\_\_\_\_

### 5.5 Temperature Range

Operating Temperature:  0°C–50°C, OR \_\_\_\_\_ °C—\_\_\_\_\_ °C

Storage Temperature:  0°C–50°C, OR \_\_\_\_\_ °C—\_\_\_\_\_ °C

## 6. Other: \_\_\_\_\_







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