TINSHARP

TC1602D-11C

Specification For Approval

Client: PHP MARITEX

Customer Approval:_____ Date:_____

Prepared:_____Check:_____Approval:_____

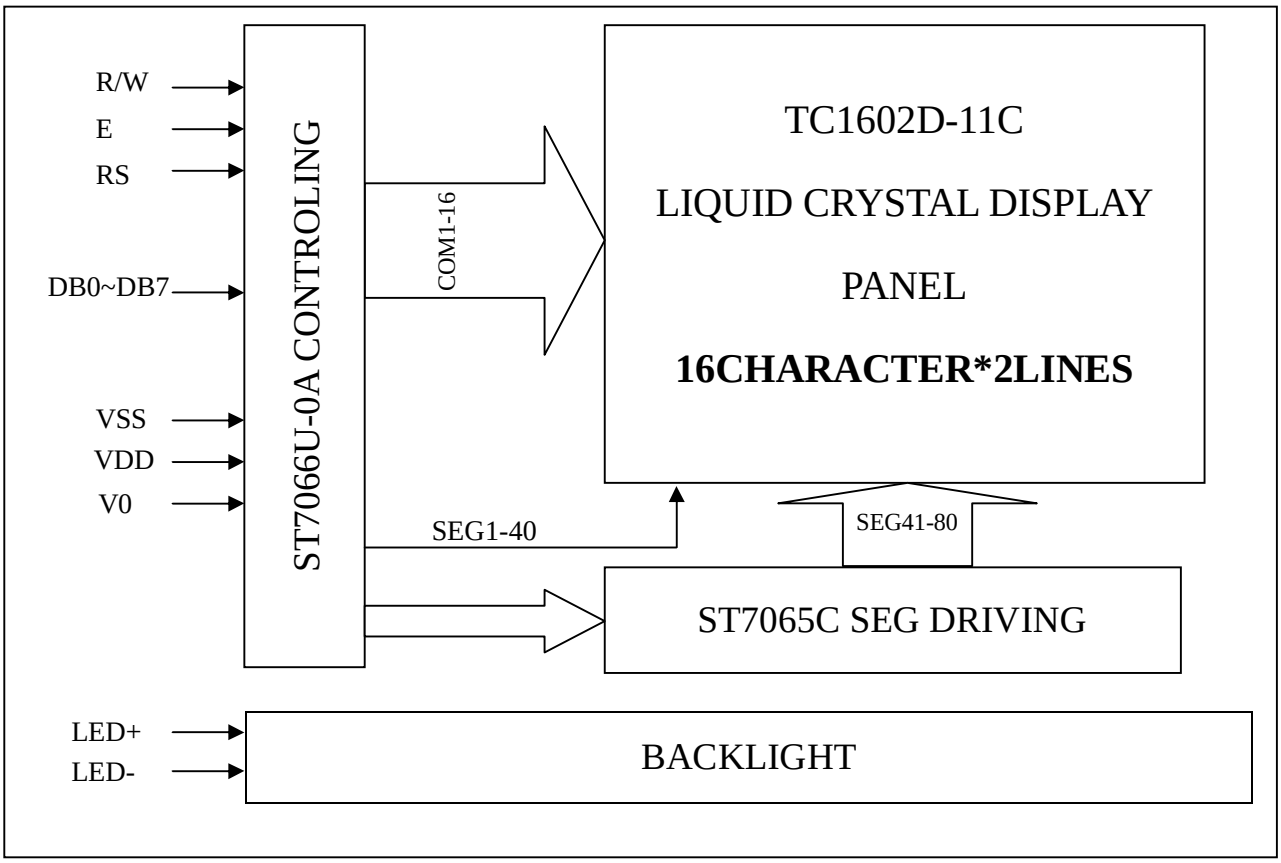
Date:_____Date:_____Date:_____

1. SPECIFICATIONS

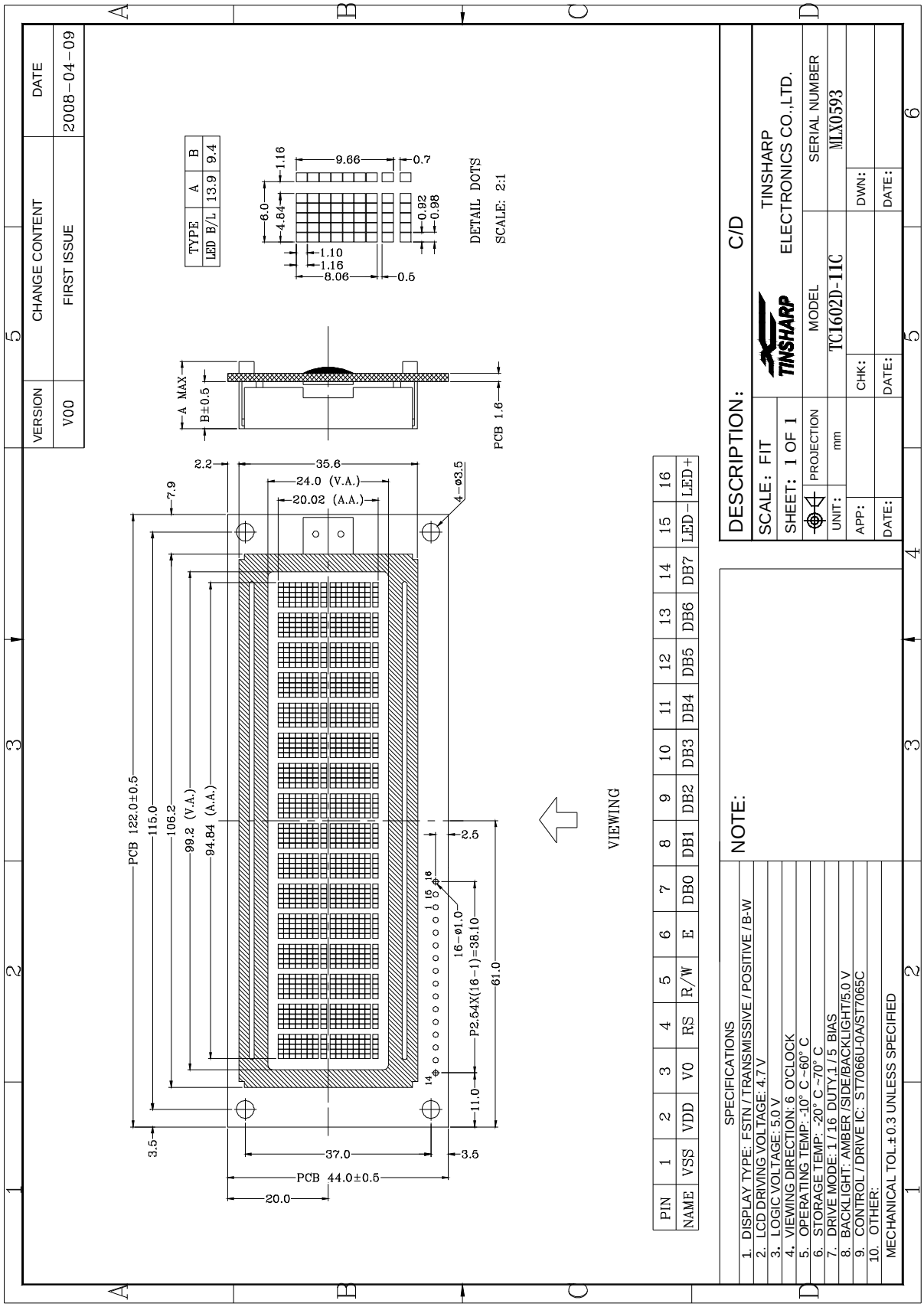
1.1 FEATURES

Item	Contents	Unit
LCD type	FSTN/Transmissive/Positive/Black-White	--
LCD duty	1/16	--
LCD bias	1/5	--
Viewing direction	6	o'clock
Module size(W x H x T)	122.0 X 44.0 X 13.9(MAX)	mm
Viewing area(W x H)	99.2 X 24.0	mm
Display Format	16 Characters X 2 Lines	dots
Character Size (W x H)	4.84 X 8.06	mm
Character pitch(W x H)	6.0 X 8.56	mm

1.2 BLOCK DIAGRAM



1.3 MECHANICAL SPECIFICATION



1.4 ABSOLUTE MAXIMUM RATINGS (Ta = 25℃)

Parameter	Symbol	Min	Max	Unit
Supply voltage for logic	V_{DD}	-0.3	7.0	V
Supply voltage for LCD	V_o	0.3	12.0	V
Input voltage	V_I	-0.3	V_{DD} +0.3	V
Normal Operating temperature	T_{OP}	-10	+60	℃
Normal Storage temperature	T_{ST}	-20	+70	℃

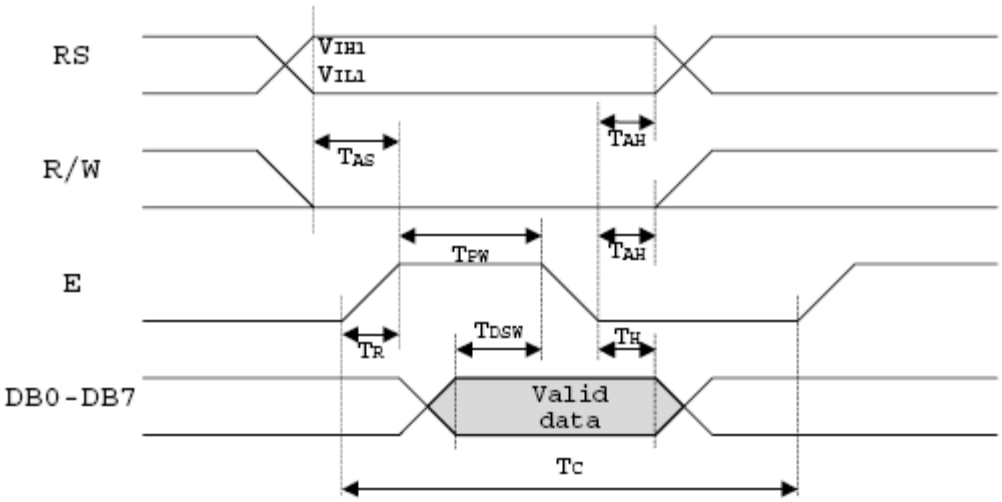
Note: Stresses beyond those given in the Absolute Maximum Rating table may cause operational errors or damage to the device. For normal operational conditions see AC/DC Electrical Characteristics.

1.5 DC ELECTRICAL CHARACTERISTICS

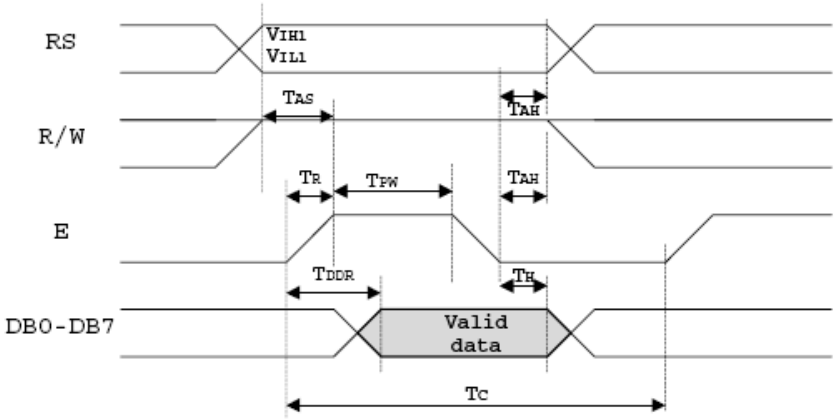
Parameter	Symbol		Min	Typ	Max	单位
Power voltage	V_{DD}-V_{SS}		4.8	5.0	5.2	V
LCD Voltage	V_{DD}–V_0	Ta=0	4.7	4.9	5.1	
		Ta=25	4.5	4.7	4.9	
		Ta=50	4.3	4.5	4.7	
Input voltage level	V_{IH}		0.8 V_{DD}	-	V_{DD} +0.3	
	V_{IL}		0	-	0.2 V_{DD}	
logic operating current	I_{DD}		--	2.5	5	mA

1.6 AC Characteristics

(1) Write Mode Timing Diagram (Writing data from MPU to ST7066U-0A)



(2) Read Mode Timing Diagram (Reading data from ST7066U-0A to MCU)

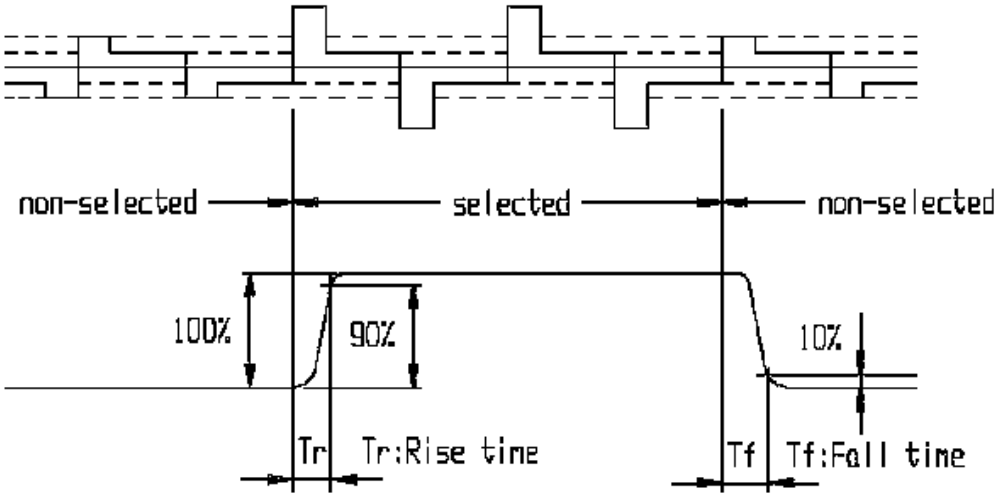


Symbol	Characteristics	Test Condition	Min.	Typ.	Max.	Unit
V_{CC}	Operating Voltage	-	2.7	-	5.5	V
V_{LCD}	LCD Voltage	V_{CC}-V5	3.0	-	11	V
I_{CC}	Power Supply Current	f_{OSC} = 270KHz, V_{CC}=5V	-	0.3	0.6	mA
V_{IH1}	Input High Voltage (Except OSC1)	-	2.2	-	V_{CC}	V
V_{IL1}	Input Low Voltage (Except OSC1)	-	-0.3	-	0.6	V
V_{IH2}	Input High Voltage (OSC1)	-	V_{CC}-1	-	V_{CC}	V
V_{IL2}	Input Low Voltage (OSC2)	-	-	-	1.0	V
V_{OH1}	Output High Voltage (DB0 - DB7)	I_{OH} = -0.1mA	2.4	-	V_{CC}	V
V_{OL1}	Output Low Voltage (DB0 - DB7)	I_{OL} = 0.1mA	-	-	0.4	V
V_{OH2}	Output High Voltage (Except DB0 - DB7)	I_{OH} = -0.04mA	0.9V_{CC}	-	V_{CC}	V
V_{OL2}	Output Low Voltage (Except DB0 - DB7)	I_{OL} = 0.04mA	-	-	0.1V_{CC}	V
R_{COM}	Common Resistance	V_{LCD} = 4V, I_d = 0.05mA	-	2	20	KΩ
R_{SEG}	Segment Resistance	V_{LCD} = 4V, I_d = 0.05mA	-	2	30	KΩ
I_{LEAK}	Input Leakage Current	V_{IN} = 0V to V_{CC}	-1	-	1	µA
I_{PUP}	Pull Up MOS Current	V_{CC} = 5V	10	50	120	µA

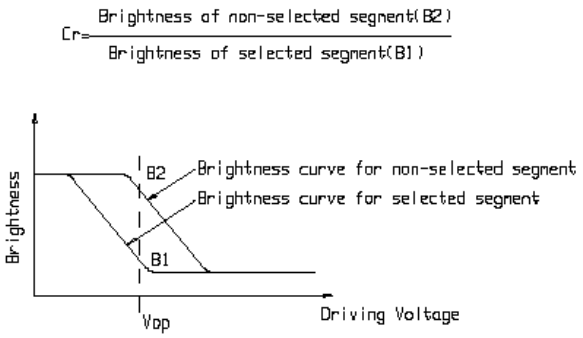
1.7 ELECTRO-OPTICAL CHARACTERISTICS

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	NOTE
Contrast ratio	K	θ=0，Φ=0	-	3	-		
Response time(rise)	Tr	25℃	-	-	250	ms	
Response time(fall)	Tf		-	-	230		
Viewing angle	Φ	25℃	-	-	-	deg.	
	θ		-	-	-		

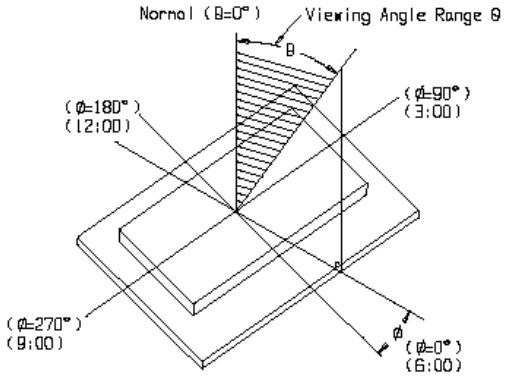
Note1: Definition of response time.



Note2: Definition of contrast ratio 'Cr' .



Note3: Definition of viewing angle range 'θ'.



1.8 BACKLIGHT CHARACTERISTICS

1.8.1ABSOLUTE MAXIMUM RATINGS(Ta=25℃)

Item	Symbol	Conditions	Rating	Unit
Absolute maximum forward current	Ifm		120	mA
Reverse voltage	Vr		2	V
Reverse Current	I_r		20	uA
Max.allowable power dissipation	P_d		120	mW
Operating Temperature Range	T_{oper}		-20~+70℃	℃
Storage Temperature Range	Tst		-30~+80℃	℃

Color	Wavelength λρ(nm)	Spectral line half width Δλ(nm)	Operating voltage(V) (±0.2V)	Forward current (mA)
Amber	--	--	2.0	60

2. MODULE STRUCTURE

2.1 INTERFACE PIN CONNECTIONS

Pin No.	Symbol	Level	Description
1	**VSS**	0V	Ground.
2	**VDD**	+5.0V	Power supply for logic operating.
3	**V0**	--	Adjusint LCD contrast.
4	**RS**	H/L	RS = “H”: Indicates that D0 to D7 are display data. RS = “L”: Indicates that D0 to D7 are control data.
5	**R/W**	H/L	R/W = “H”: Read mode. R/W = “L”: Write mode.
6	**E**	H/L	An enable signal for writing or reading data.
7	**DB0**	H/L	This is an 8-bit bi-directional data bus.
8	**DB1**		
9	**DB2**		
10	**DB3**		
11	**DB4**		
12	**DB5**		
13	**DB6**		
14	**DB7**		
15	**LED-**	0V	The backlight ground.
16	**LED+**	+5.0V	Power supply for backlight.

2. 2 COMMAND TABLE

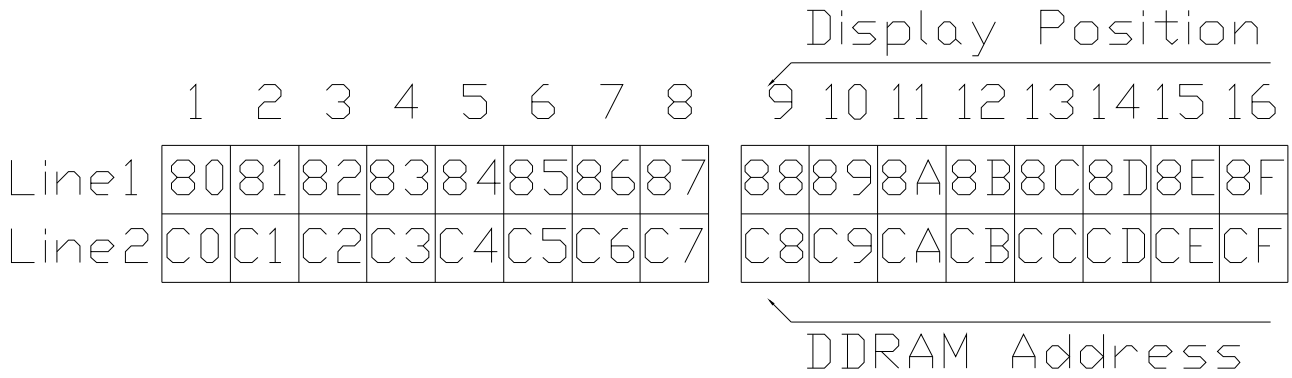
Instruction	Instruction Code										Description	Description Time (270KHZ)
	RS	RW	DB 7	DB 6	DB 5	DB 4	DB 3	DB 2	DB 1	DB 0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM. and set DDRAM address to "00H" from AC	1.52 ms
Retum Home	0	0	0	0	0	0	0	0	1	x	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.52 ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Sets cursor move direction and specifies display shift. These operations are performed during data write and read.	37 us
Display ON/OFF	0	0	0	0	0	0	1	D	C	B	D=1: entire display on C=1: cursor on B=1: cursor position on	37 us
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	x	x	Set cursor moving and display shift control bit, and the direction, without changing DDRAM data.	37 us
Function Set	0	0	0	0	1	DL	N	F	x	x	DL: interface data is 8/4 bits NL: number of line is 2/1 F: font size is 5x11/5x8	37 us
Set CGRAM address	0	0	0	1	AC 5	AC 4	AC 3	AC 2	AC 1	AC 0	Set CGRAM address in address counter	37 us
Set DDRAM address	0	0	1	AC 6	AC 5	AC 4	AC 3	AC 2	AC 1	AC 0	Set DDRAM address in address counter	37 us
Read Busy flag and address	0	1	BF	AC 6	AC 5	AC 4	AC 3	AC 2	AC 1	AC 0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	0 us
Write data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM)	43 us
Read data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM)	43 us

2. 3 COMMAND DETAIL EXPLAIN

Please refer to IC(ST7066U-0A) specification.

2.4. DISPLAY DATA RAM (DD RAM)

The 80-bit DD RAM is normally used for storing display data. Those DD RAM not used for display data can be used as general data RAM. Its address is configured in the Address Counter.



Timing Generation Circuit

The timing generating circuit is able to generate timing signals to the internal circuits. In order to prevent the internal timing interface, the MPU access timing and the RAM access timing are generated independently.

LCD Driver Circuit

Total of 16 commons and 40 segments signal drivers are valid in the LCD driver circuit. When a program specifies the character fonts and line numbers, the corresponding common signals output drive-waveforms and the others still output unselected waveforms. The relationships between Display Data RAM Address and LCD′ s position are depicted as follows.

Character Generator ROM (CG ROM)

Using 8-bit character code, the character generator ROM generates 5 x 8 dots or 5 x 10 dots character patterns. It also can generate 192's 5 x 8 dots character patterns and 64's 5 x 10 dots character patterns.

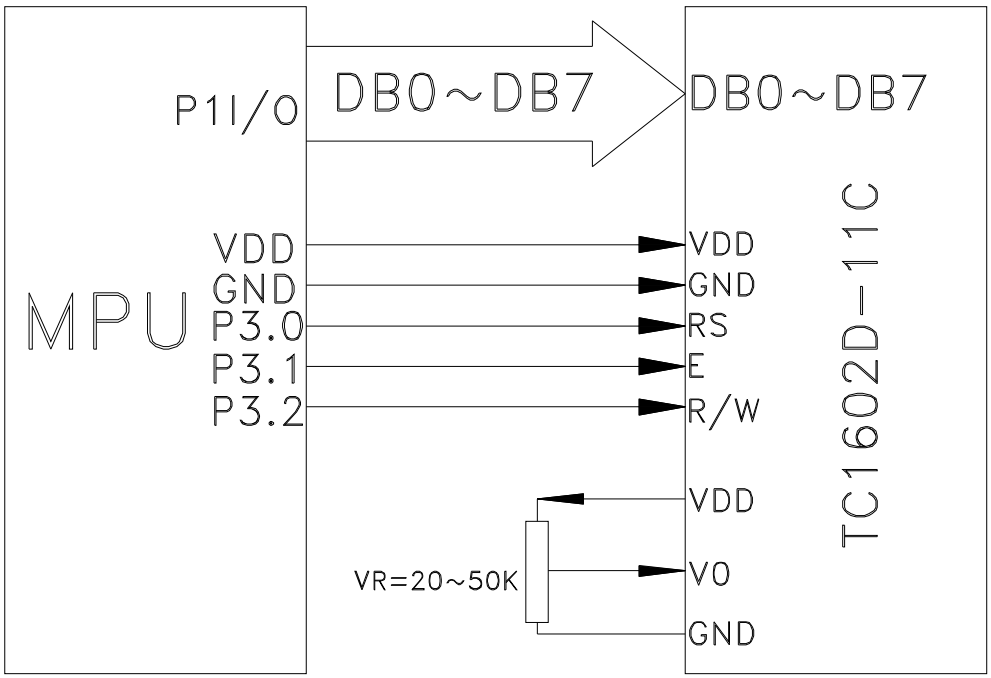
Character Generator RAM (CG RAM)

Users can easily change the character patterns in the character generator RAM through program. It can be written to 5 x 8 dots, 8-character patterns or 5 x 10 dots for 4-character patterns.
The following diagram shows the ST7066U-0A character patterns:
Correspondence between Character Codes and Character Patterns.

b7-b4 / b3-b0	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	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)															

2.5 CIRCUIT CONNECTION BLOCK

MPU AND MODULE CONNECTION (Connections circuit (Only for Reference):



3. REALIABILITY TEST AND QUALITY

3.1. RELIABILITY TEST CONDITION

No.	TEST Item	Content of Test	Test Condition	Applicable Standard
1	High temperature storage	Endurance test applying the high storage temperature for a long time.	70° C 96hrs	------
2	Low temperature storage	Endurance test applying the low storage Temperature for a long time	-20° C 96hrs	-----
3	High temperature operation	Endurance test applying the electric stress (Voltage & current)and the thermal stress to the element for a long time	60° C 96hrs	------
4	Low temperature operation	Endurance test applying the electric stress Under low temperature for a long time	-10° C 96hrs	------
5	High/temperature/ Humidity storage	Endurance test applying the electric stress(Voltage & current) and Temperature/ Humidity stress to the element for a long time	40° C 90%RH 96hrs	
6	High temperature/ Humidity operation	Endurance test applying the electric stress (voltage & current)and temperature/ humidity stress to the element for a long time	40° C 90%RH 96hrs	
7	Temperature cycle	Endurance test applying the low and high temperature cycle. -10° C →**25**° C→**60**° C 30min←**5min**←**30min.(1 cycle)**	-10° C/60° C 10 cycle	------

Supply voltage for logic system = 5V. Supply voltage for LCD system = Operating voltage at 25° C.

Mechanical Test

Vibration test	Endurance test applying the vibration during transportation and using	10~22Hz→1.5mmp-p 22~500Hz→1.5G Total 0.5hour	
Shock test	Constructional and mechanical endurance test applying the shock during transportation.	50G half sign wave 11 msede 3 times of each direction	
Atmospheric pressure test	Endurance test applying the atmospheric pressure during transportation by air	115mbar 40hrs	
Static electricity test	Endurance test applying the electric stress to the terminal	VS=800V,RS-1.5KΩ **CS=100pF, 1 time**	

Failure Judgment criterion

Criterion Item	Test Item No.											Failure Judgment Criterion
	1	2	3	4	5	6	7	8	9	10	11	
Basic specification												Out of the Basic specification
Electrical characteristic												Out of the DC and AC characteristic
Mechanical characteristic												Out of the Mechanical specification Color change: out of Limit Appearance Specification
Optical characteristic												Out of the Appearance Standard

3-2. Precautions for using LCM Modules

1. Liquid Crystal Display Modules

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

(1) Please keep the temperature within specified range for use and storage. Polarization degradation, bubble generation or Polarizer peel-off may occur with high humidity.

(2) Do not touch, push or rub the exposed polarizer 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 chemicals such as acetone, toluene, ethanol and isopropyl alcohol.

(4) When the display surface becomes dusty, wipe gently with absorbent cotton or other soft material like chamois soaked in petroleum benzin. 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 with terminals due to cold will damage, stain or dirty the polarizers. After products are tested at low temperature the must be warmed up in a container before coming is contacting temperature air.

(8) Do not put or attach anything on the display area to avoid leaving marks on.

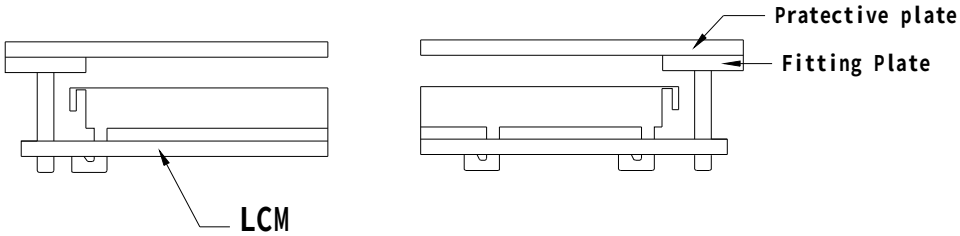
(9) Do not touch the display with bare hands. This will stain the display and degrade insulation between terminals (some cosmetics are determinate to the polarizers).

(10) As glass is fragile. It tends to become or chipped during handling especially on the edges. Please avoid dropping or jarring.

3-3. Installing LCM Modules

The hole in the printed circuit board is used to if 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]

3-4. Precaution for Handing LCM 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 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 writing on the printed circuit board.
(4) Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector.
(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

3-5. Electro-Static Discharge Control

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

(1) Make certain that you are grounded when handing LCM.
(2) Before remove LCM from its packing case or incorporating it into a set, be sure the module and your body have the same electric potential.
(3) When soldering the terminal of LCM, make certain 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 workbench the ground potential.
(6) To reduce the generation of static electricity be careful that the air in the work is not too dried. A relative humidity of 50%-60% is recommended.

3-6. Precaution for soldering to the LCM

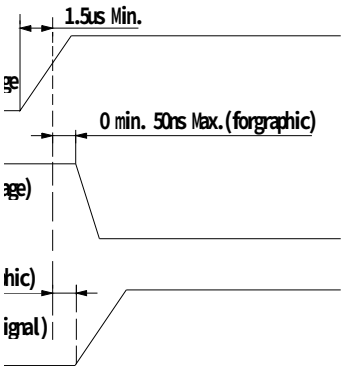
(1) Observe the following when soldering lead wire , connector cable and etc. to the LCM
-Soldering iron temperature: 280℃±10℃
-Soldering time: 3-4 seconds
-Solder: eutectic solder.

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 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 electro-luminescent 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 remove the electro-luminescent panel from the PC board, be sure the solder has completely melted, the soldered pad on the PX board could be damaged.

3-7. Precautions for operation

(1) Viewing angle varies with the change of liquid crystal driving voltage (V0). Adjust Vo to show the best contrast.
(2) Driving the LCD in the voltage above the limit shortens its life.
(3) Response time is greatly delayed at temperature below the operating temperature range. However, this does not mean the LCD cell be out of the 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. Used under the relative condition of 40℃, 50%RH.
(5) When turning the power on input each signal after the positive/negative voltage becomes stable.



3-8. Storage

When storing LCD as spares for some years, the following precautions are necessary.
(1) Store them in a sealed polyethylene bag. If properly sealed, there is no need for desiccant.
(2) Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0℃ and 35℃
(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:
-Don not leave them for more than 168hrs. at 60℃
-Should not be left for more than 48hrs. at -20℃.

3-9. Safety

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

3-10. Limited Warranty

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

3-11. Return LCM under warranty

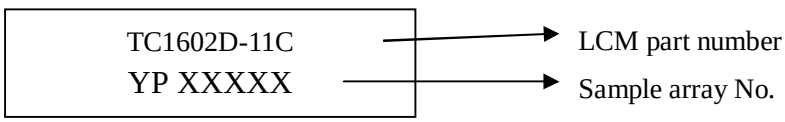
No warranty can be granted if the precautions stated above have been disregarded. The typical examples of violations are:

-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 lay manner.

Module repairs will be invoiced to the customer upon mutual agreement. Modules must be returned with sufficient description of the failures or defects. Any connectors or cable installed by the customer must be removed completely without damaging the PCB eyelets, conductors and terminals.

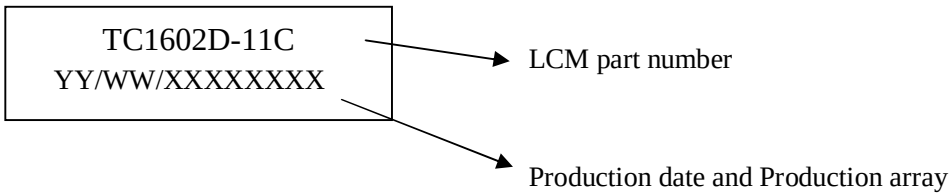
4. DATE CODE RULES

4.1. Date code for sample



YP: meaning sample

4.2. Date code for producing



A. TC1602D-11C represents LCM part number

C. YY/WW represents Year, Week

YY—Year WW—Week

XXXXXXXX—Production array No.

*****END*****