JEWEL HILL ELECTRONIC CO.,LTD.

SPECIFICATIONS FOR LCD MODULE

Module No. GG2018

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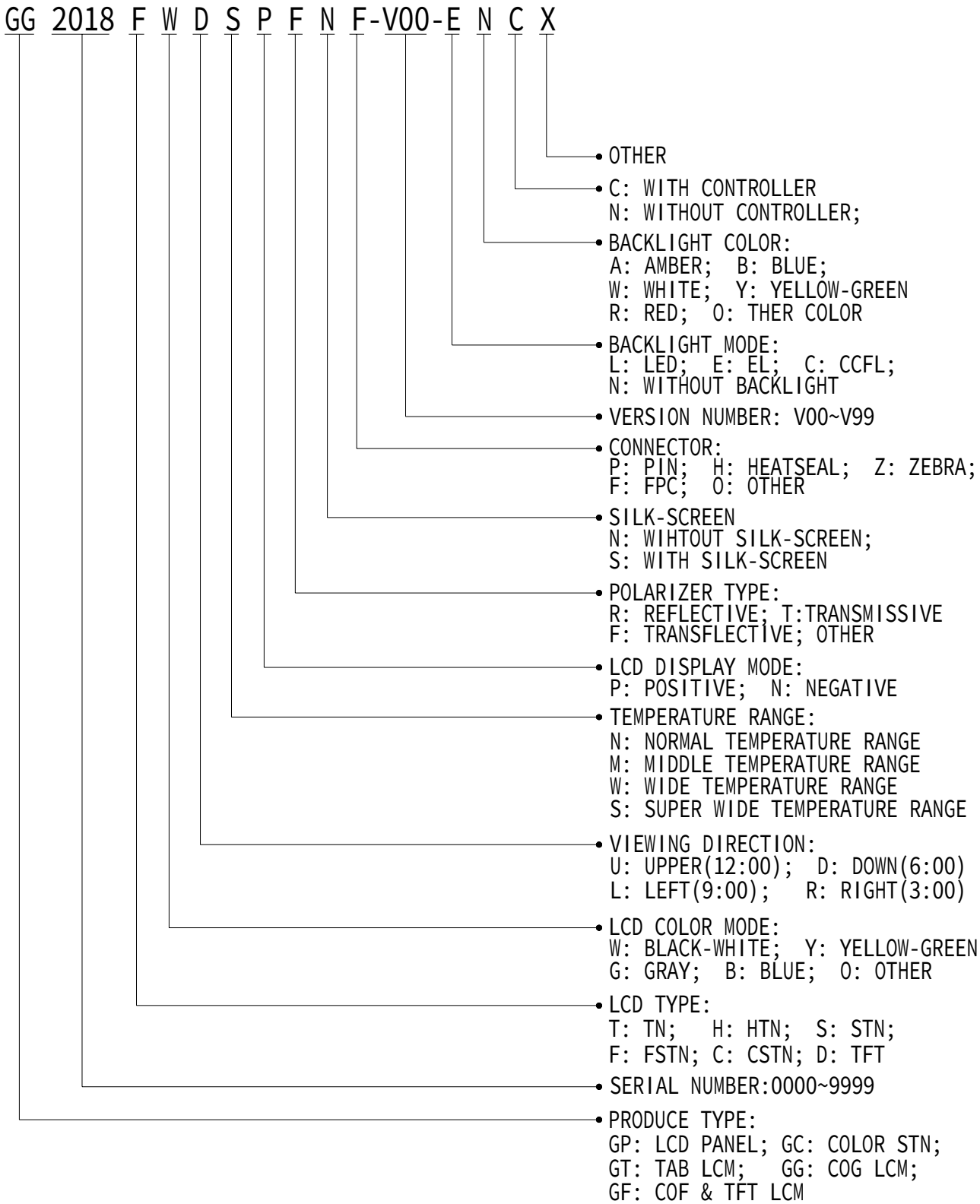
LCM Number System



1. GENERAL DESCRIPTION

The GG2018 is a 96 x 32 Dots Graphic LCD module. It has a FSTN panel composed of 96 segments and 32 commons. The LCM can be easily accessed by microcontroller via parallel interface.

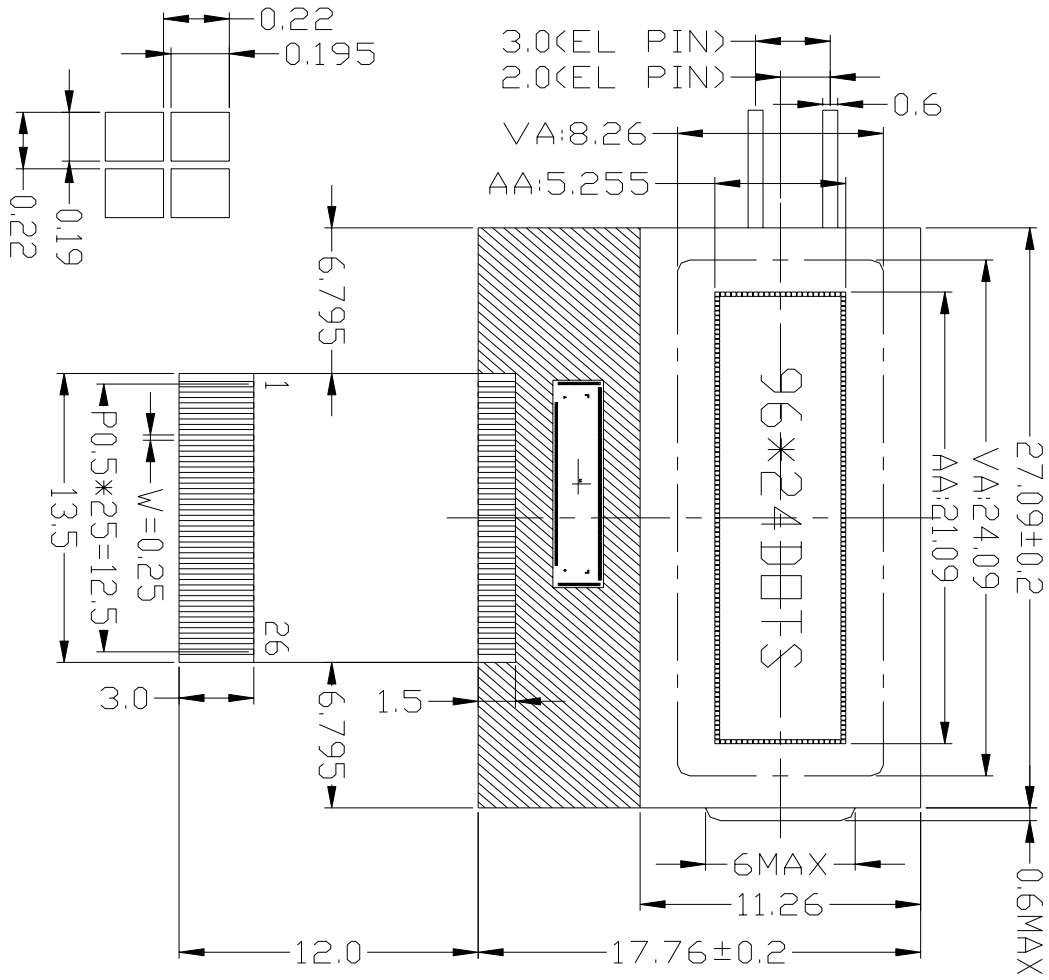
2. FEATURES

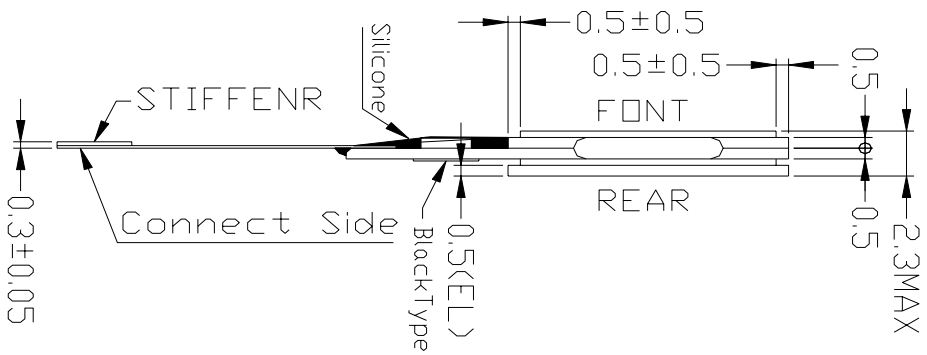
Display Mode	Transflective and positive
	FSTN module
Display Format	Graphic 96x32 dots
Input Data	8 bit parallel data input from MPU
Multiplexing Ratio	1/33 Duty
Bias	1/6 Bias
Viewing Direction	6 O'clock
Backlight	EL(Blue)

3. MECHANICAL SPECIFICATION

Item	Specifications	Unit
Dimensional outline	27.09 x 29.76(FPC)/17.76 x 2.3(max)	mm
Resolution	96segs x 32coms	dots
Active area	21.09(W) x 5.255(H)	mm
Dots pitch	0.22(W)×0.22(H)	mm
Dots size	0.19(W)×0.195(H)	mm

4. MECHANICAL DIMENSION





NO.	SYMBOL
1	V0
2	V4
3	V3
4	V2
5	V1
6	C2-
7	C2+
8	C1+
9	C1-
10	C3+
11	VOUT
12	VSS
13	VDD
14	D7
15	D6
16	D5
17	D4
18	D3
19	D2
20	D1
21	D0
22	E_RDB
23	RW_WRB
24	RS
25	/RES
26	/CS1

5. MAXIMUM RATINGS

Item	Symbol	Min	Max	Unit	Note
Supply voltage	V_{DD} - Vss	-0.3	4.0	V	
	V_{LCD}	-0.3	18.0	V	
Input Voltage	V_{IN}	-0.3	V_{DD}+0.3	V	
Operating temperature	T_{OPR}	-20	+70	℃	
Storage temperature	T_{STR}	-30	+80	℃	
Humidity	---	---	90	%RH	

6. ELECTRICAL CHARACTERISTICS

Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage	Logic	V_{DD}	---	---	3.0	---	V
Input Voltage	H level	V_{IH}	---	0.8V_{DD}	---	V_{DD}	V
	L level	V_{IL}		V_{SS}	---	0.2V_{DD}	
Current Consumption (LCD DRIVER)		I_{DD}	V_{DD}=3.0V; V_{LCD}=7.5V,T_{amb}=25℃;	---	---	1.2	mA
LCD Driving Voltage		V_{LCD}	Bias=1/6 VLCD=V0-VSS	---	7.5	---	V

7. MODULE FUNCTION DESCRIPTION

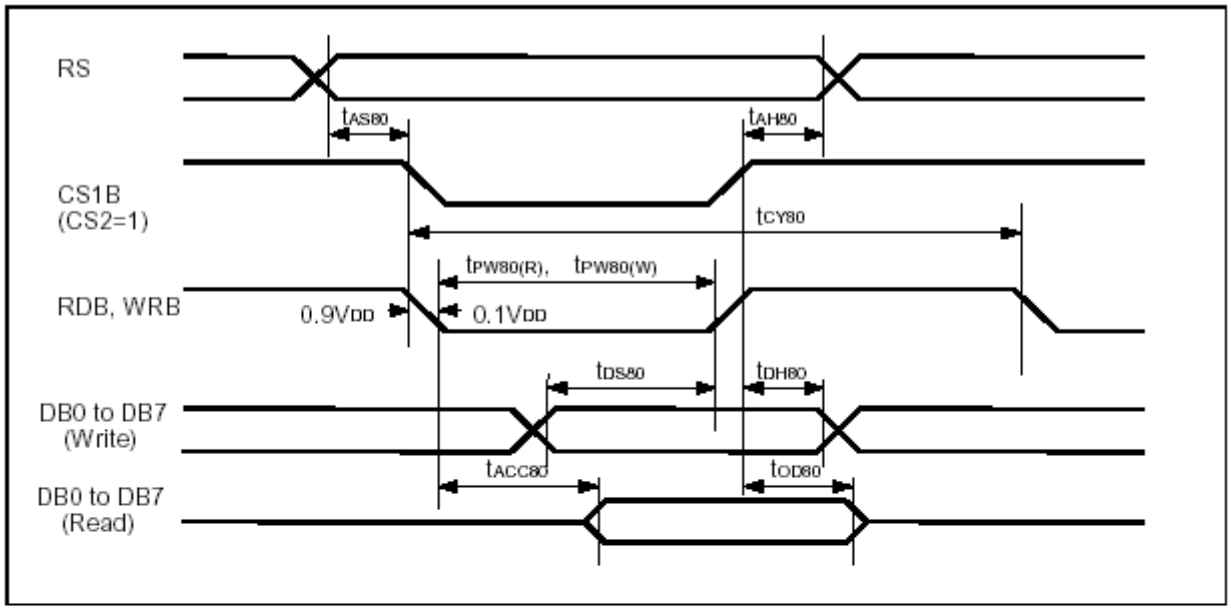
7.1. PIN DESCRIPTION

Pin No.	Symbol	Description
1	V0	This is multi-level power supply for liquid crystal driver, and must maintain the relative magnitudes shown below: V0 ≧V1 ≧V2 ≧V3 ≧V4 ≧Vss
2	V4	
3	V3	
4	V2	
5	V1	
6	CAP2-	DC/DC voltage converter. Connect a capacitor between this pin and CAP2+.
7	CAP2+	DC/DC voltage converter. Connect a capacitor between this pin and CAP2-.
8	CAP1+	DC/DC voltage converter. Connect a capacitor between this pin and CAP1-.
9	CAP1-	DC/DC voltage converter. Connect a capacitor between this pin and CAP1+.
10	CAP3+	DC/DC voltage converter. Connect a capacitor between this pin and CAP1-.
11	VOUT	DC/DC voltage converter. Connect a capacitor between this pin and VDD or VSS.
12	VSS	Power supply for Ground (0V).
13	VDD	Power supply for Positive (+3V).
14-21	D7-D0	8-bit bi-directional Data bus
22	E_RDB	this is active Low and Read signal input pin.
23	RW_WRB	this is active Low and Write signal input pin.
24	RS	Data/command select signal input, H: Data; L: Command
25	/RES	Reset signal input, Low active
26	/CS	Chip select signal input, Low active.

7.2 TIMING CHARACTERISTICS

1.SYSTEM BUS READ/WRITE CHARACTERISTIC

Read / Write Characteristics (8080-series MPU)

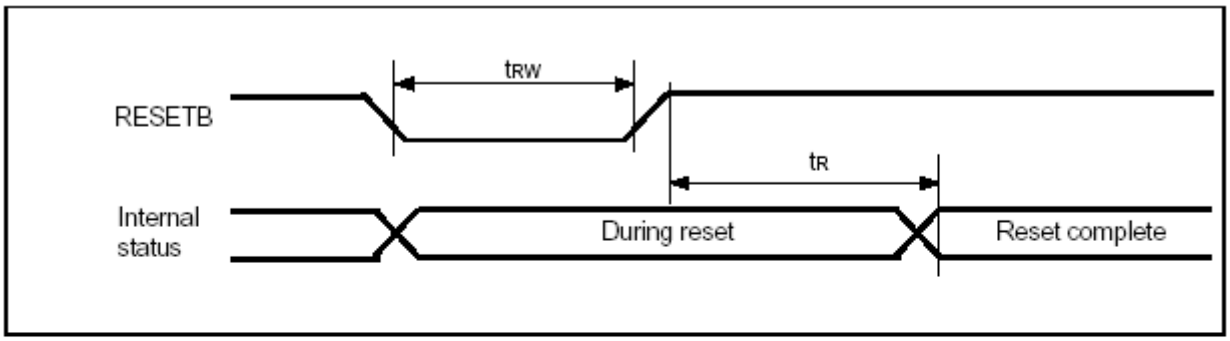


Read / Write Characteristics (8080-series MPU)

(VDD = 2.4 to 3.6V, Ta = -40 to +85°C)

Item	Signal	Symbol	Min.	Typ.	Max.	Unit	Remark
Address setup time Address hold time	RS	tAS80 tAH80	0 0	-	-	ns	
System cycle time	RS	tCY80	300	-	-	ns	
Pulse width (WRB)	RW_WRB	tPW80(W)	60	-	-	ns	
Pulse width (RDB)	E_RDB	tPW80(R)	60	-	-	ns	
Data setup time Data hold time	DB7 to DB0	tDS80 tDH80	40 15	-	-	ns	
Read access time Output disable time		tACC80 tOD80	- 10	-	140 100	ns	CL = 100 pF

2. RESET TIMING

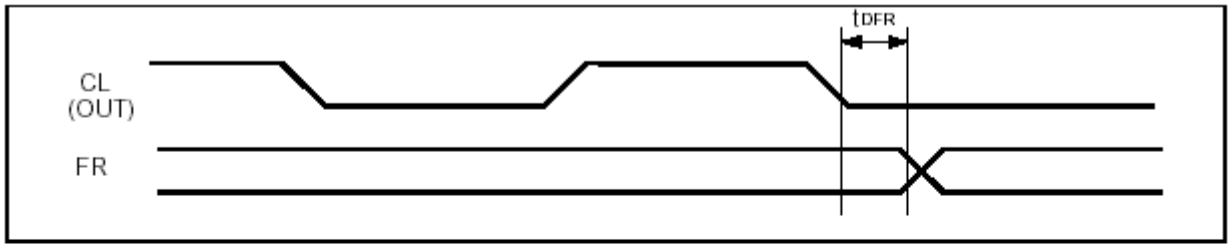


Reset Input Timing

(V_{DD} = 2.4 to 3.6V, Ta = -40 to +85°C)

Item	Signal	Symbol	Min.	Typ.	Max.	Unit	Remark
Reset low pulse width	RESETB	t_{RW}	1.0	-	-	ns	
Reset time	-	t_R	-	-	1.0	ns	

3. DISPLAY CONTROL TIMING



Display Control Output Timing

(V_{DD} = 2.4 to 3.6V, Ta = -40 to +85°C)

Item	Signal	Symbol	Min.	Typ.	Max.	Unit	Remark
FR delay time	FR	t_{DFR}	-	20	80	ns	C_L = 50 pF

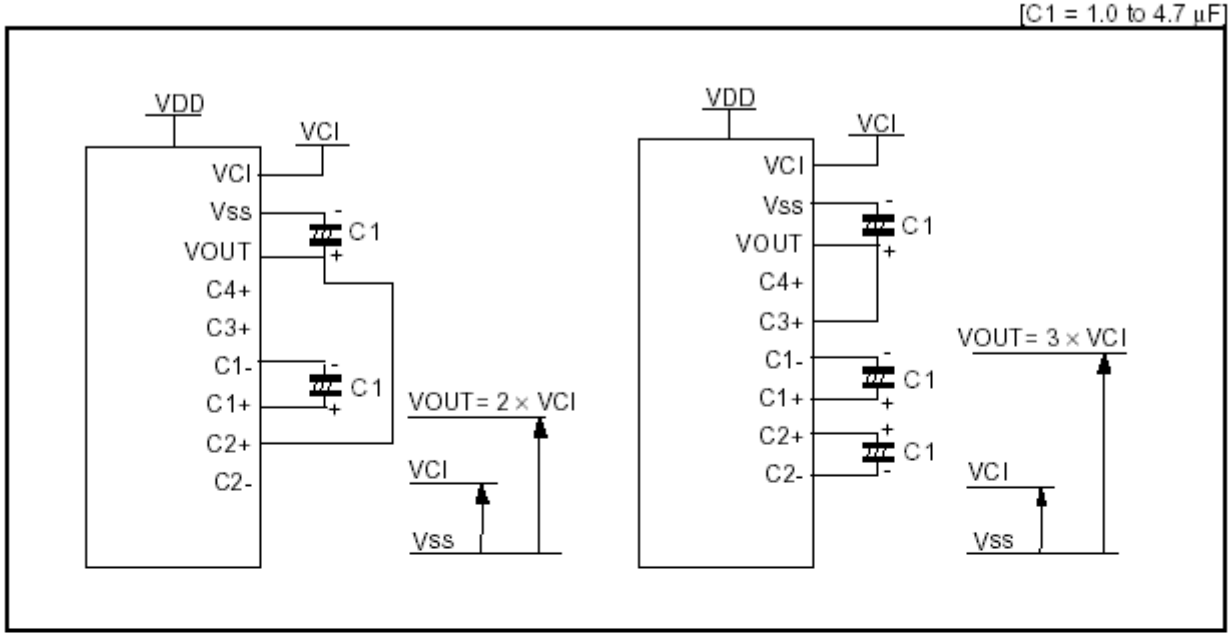
7.3 APPLICATION OF LCM

■Reference circuit

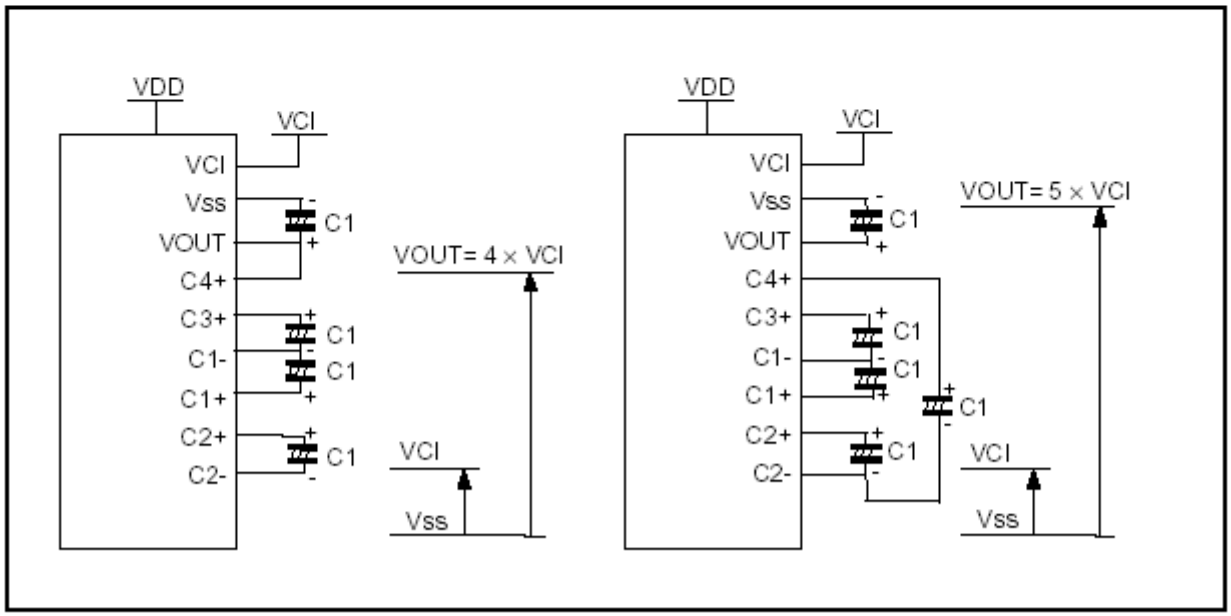
Voltage Converter Circuits

These circuits boost up the electric potential between VCI and Vss to 2, 3, 4 or 5 times toward positive side and boosted voltage is outputted from VOUT pin.

[C1 = 1.0 to 4.7 μF]



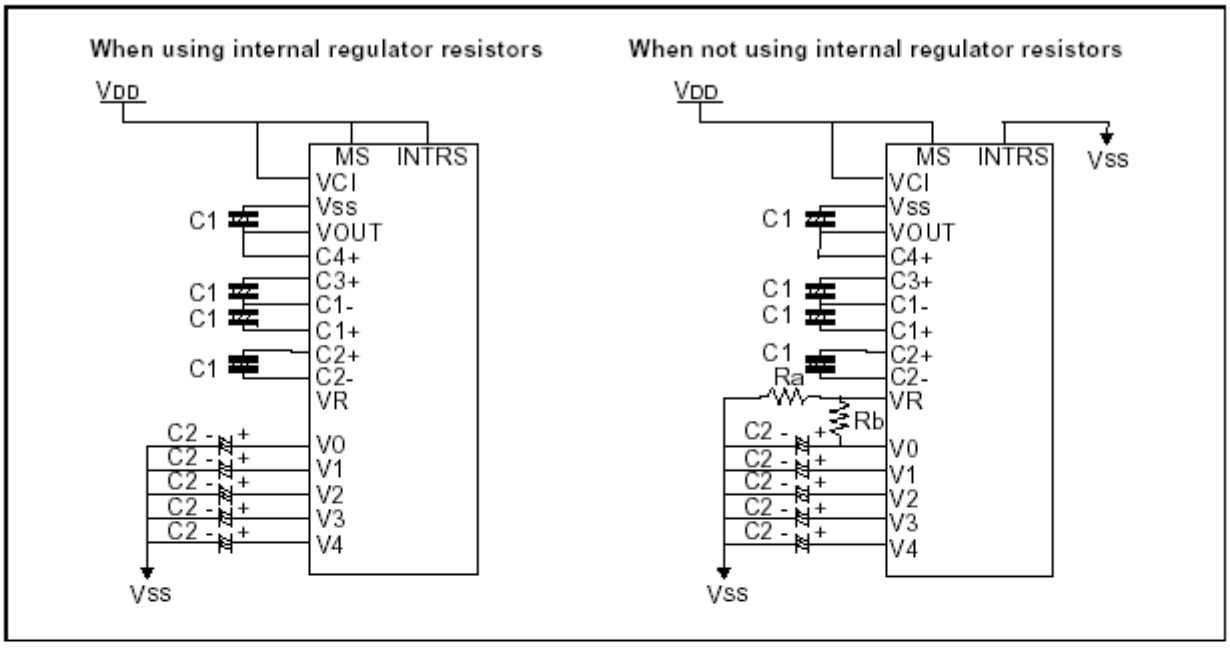
Two Times Boosting Circuit **Three Times Boosting Circuit**



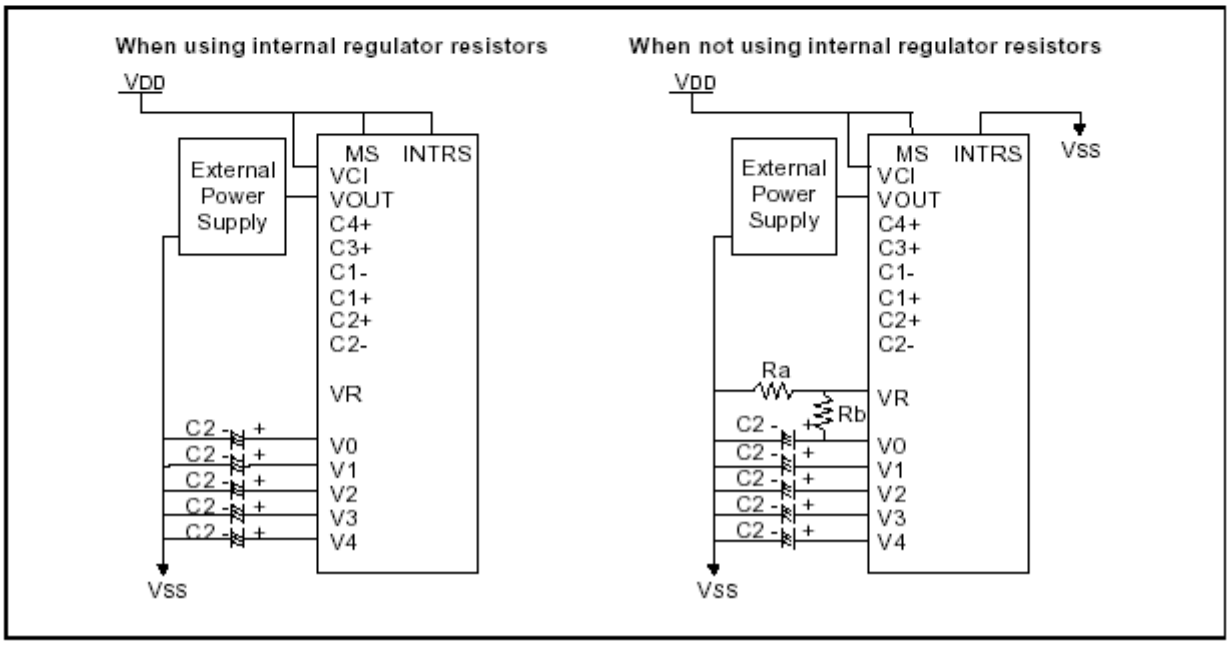
Four Times Boosting Circuit **Five Times Boosting Circuit**

* The VCI voltage range must be set so that the VOUT voltage does not exceed the absolute maximum rated value

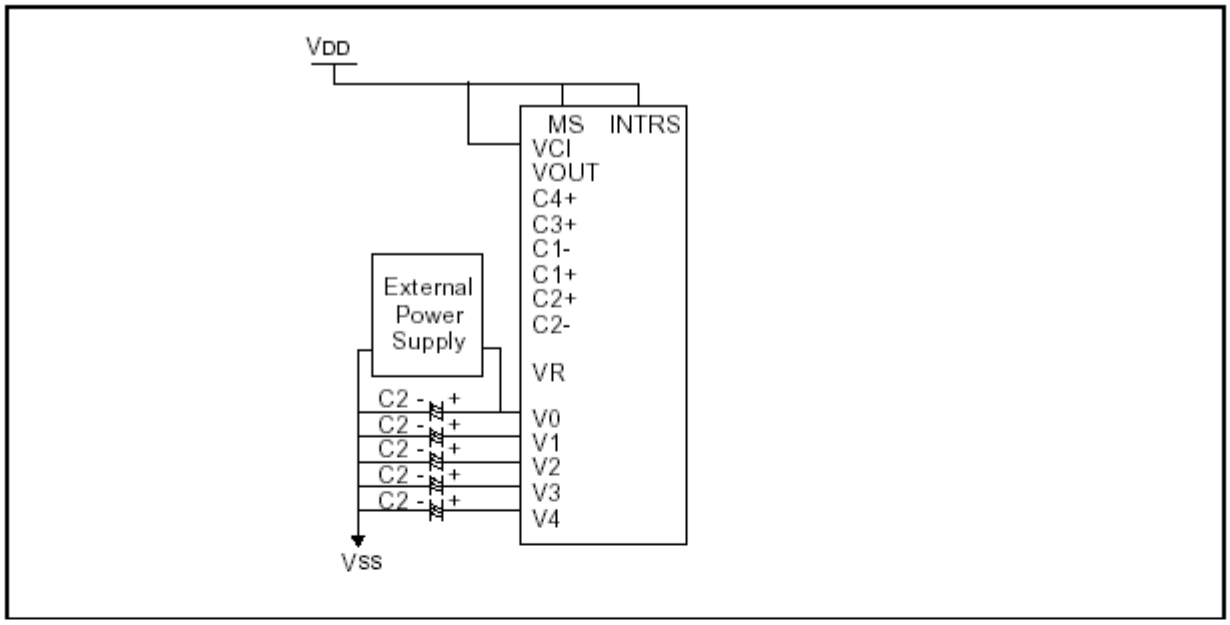
REFERENCE CIRCUIT EXAMPLES



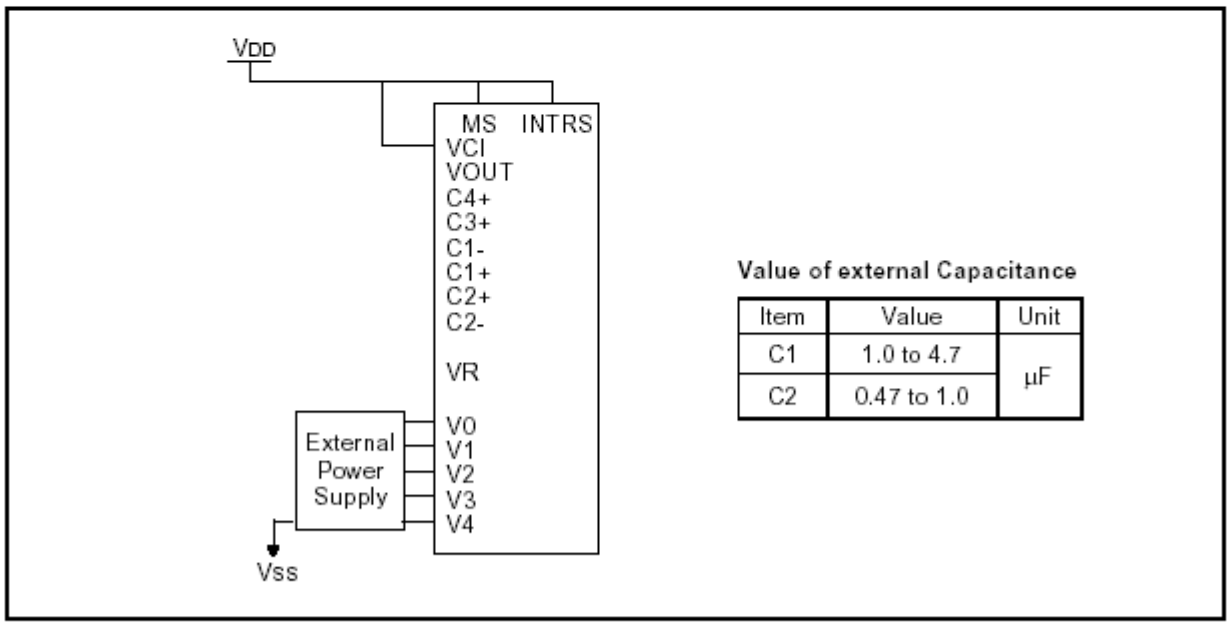
When Using all Internal LCD Power Circuits (VCI = VDD, 4-time V/C: ON, V/R: ON, V/F: ON)



When Using some Internal LCD Power Circuits (VCI = VDD, V/C: OFF, V/R: ON, V/F: ON)



When Using some Internal LCD Power Circuits (VCI = VDD, V/C: OFF, V/R: OFF, V/F: ON)



Value of external Capacitance

Item	Value	Unit
C1	1.0 to 4.7	µF
C2	0.47 to 1.0	

When Not Using any Internal LCD Power Supply Circuits

(VCI = VDD, V/C: OFF, V/R: OFF, V/F: OFF)

* C1 and C2 are determined by the size of the LCD being driven.
Select a value that will stabilize the liquid crystal drive voltage.

7.4 TABLE OF COMMAND

×: Don't care

Instruction	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description
Display ON / OFF	0	0	1	0	1	0	1	1	1	DON	Turn on/off LCD panel When DON = 0: display OFF When DON = 1: display ON
Initial display line	0	0	0	1	ST5	ST4	ST3	ST2	ST1	ST0	Specify DDRAM line for COM0
Set page address	0	0	1	0	1	1	P3	P2	P1	P0	Set page address
Set column address MSB	0	0	0	0	0	1	Y7	Y6	Y5	Y4	Set column address MSB
Set column address LSB	0	0	0	0	0	0	Y3	Y2	Y1	Y0	Set column address LSB
Read status	0	1	BUSY	ADC	ONOFF	RESETB	0	0	0	0	Read the internal status
Write display data	1	0	Write data								Write data into DDRAM
Read display data	1	1	Read data								Read data from DDRAM
ADC select	0	0	1	0	1	0	0	0	0	ADC	Select SEG output direction When ADC = 0: normal direction (SEG0→SEG131) When ADC = 1: reverse direction (SEG131→SEG0)
Reverse display ON / OFF	0	0	1	0	1	0	0	1	1	REV	Select normal / reverse display When REV = 0: normal display When REV = 1: reverse display
Entire display ON / OFF	0	0	1	0	1	0	0	1	0	EON	Select normal/entire display ON When EON = 0: normal display. When EON = 1: entire display ON
LCD bias select	0	0	1	0	1	0	0	0	1	BIAS	Select LCD bias
Set modify-read	0	0	1	1	1	0	0	0	0	0	Set modify-read mode
Reset modify-read	0	0	1	1	1	0	1	1	1	0	release modify-read mode
Reset	0	0	1	1	1	0	0	0	1	0	Initialize the internal functions
SHL select	0	0	1	1	0	0	SHL	×	×	×	Select COM output direction When SHL = 0: normal direction (COM0→COM63) When SHL = 1: reverse direction (COM63→COM0)
Power control	0	0	0	0	1	0	1	VC	VR	VF	Control power circuit operation
Regulator resistor select	0	0	0	0	1	0	0	R2	R1	R0	Select internal resistance ratio of the regulator resistor
Set reference voltage mode	0	0	1	0	0	0	0	0	0	1	Set reference voltage mode
Set reference voltage register	0	0	×	×	SV5	SV4	SV3	SV2	SV1	SV0	Set reference voltage register
Set static indicator mode	0	0	1	0	1	0	1	1	0	SM	Set static indicator mode
Set static indicator register	0	0	×	×	×	×	×	×	S1	S0	Set static indicator register
Power save	-	-	-	-	-	-	-	-	-	-	Compound Instruction of display OFF and entire display ON

Instruction	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description
NOP	0	0	1	1	1	0	0	0			*Non-Operation command*
Test Instruction_1	0	0	1	1	1	1	×	×	×	×	*Don't use this instruction*
Test Instruction_2	0	0	1	0	0	1	×	×	×	×	*Don't use this instruction*

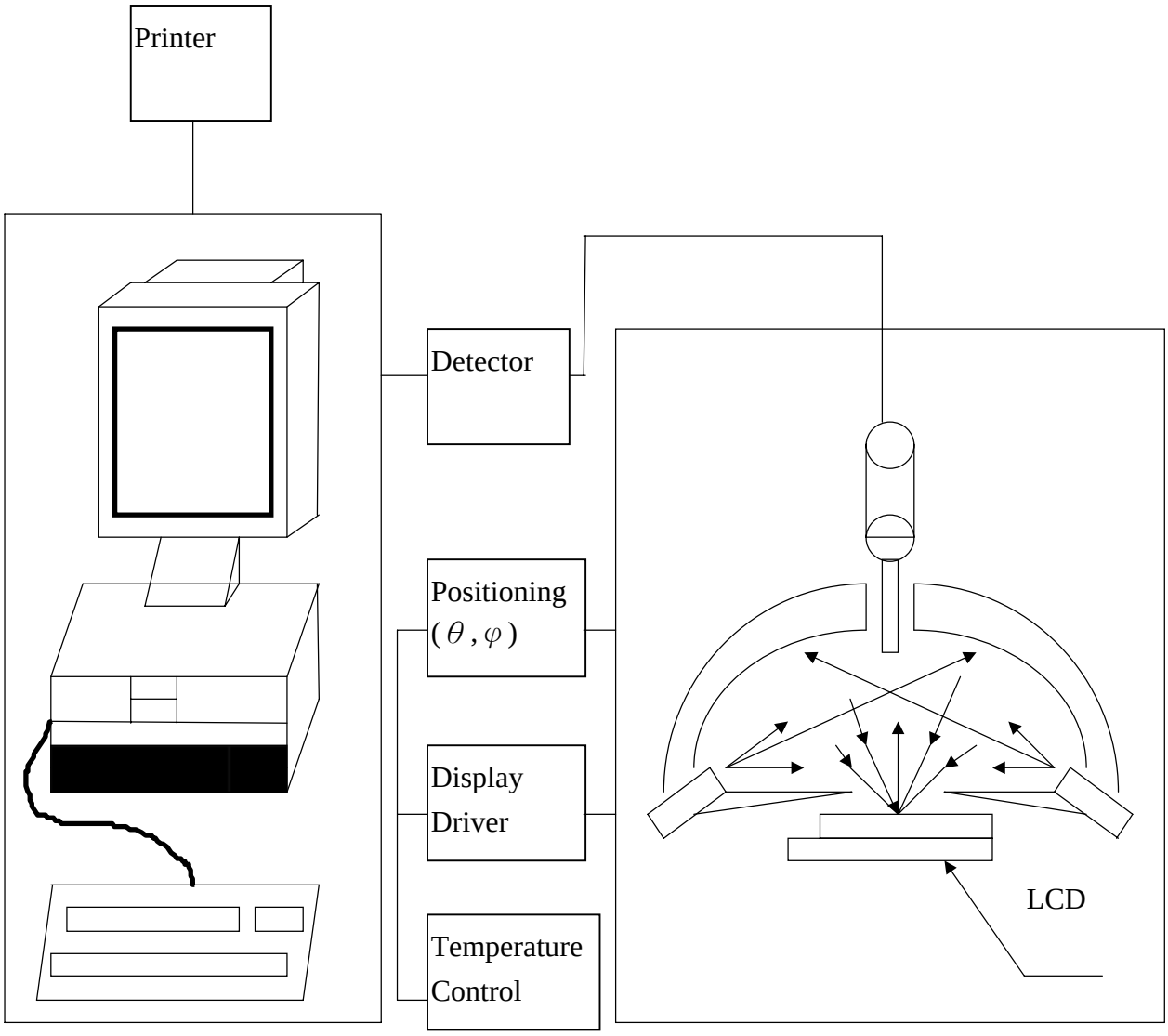
8. ELECTRO-OPTICAL CHARACTERISTICS

Item	Symbol	Condition	Temp	Min	Typ.	Max	Units	Note
LCD driving voltage	V_{LCD}	$\theta = \phi = 0$	0℃	7.4	7.7	8.0	V	NOTE1
			25℃	7.2	7.5	7.8		
			50℃	7.0	7.3	7.6		
Response Time	Rise Time (Tr)	$\theta = \phi = 0$	0℃	---	---	--	msec	NOTE2
	Decay Time (Tf)			---	----	---		
	Rise Time (Tr)		25℃	---	225	340		
	Decay Time (Tf)			---	240	360		
	Rise Time (Tr)		50℃	---	---	--		
	Decay Time (Tf)			---	---	--		
Contrast Ratio	Cr	$\theta = \phi = 0$	25℃	5	10	---	---	NOTE4

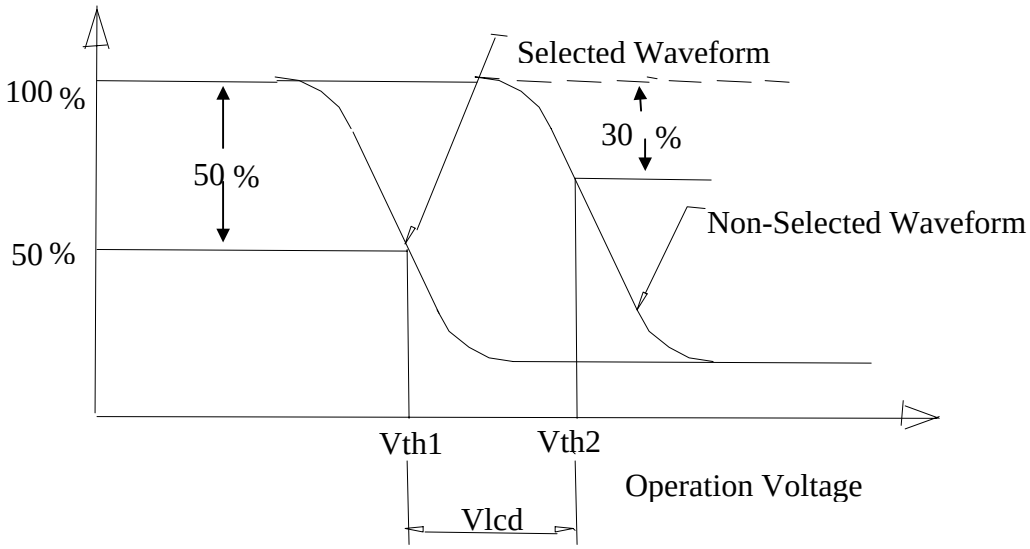
Viewing Angle Range	θ (ϕ = 0°) (6”)	ϕ = 90° (3”)	ϕ =180° (12”)	ϕ =270° (9”)	備註
θ (25℃) CR≥2	45	30	20	35	Deg NOTE3

● For panel only

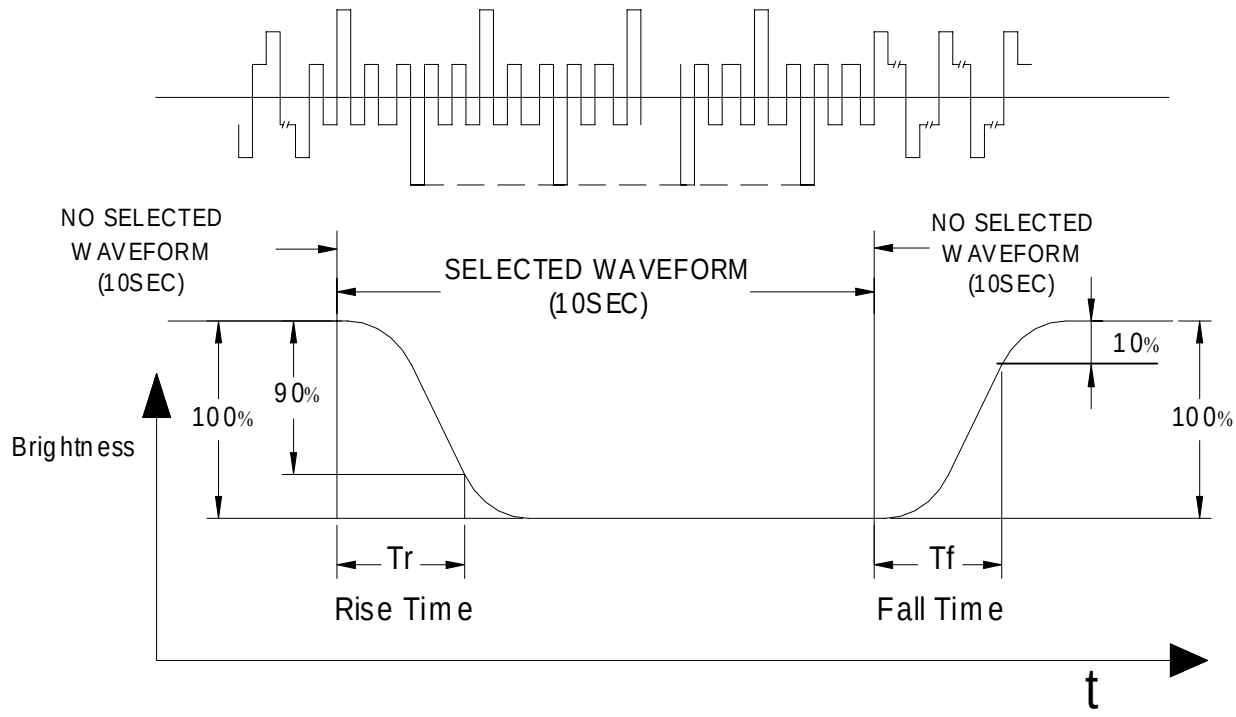
- **Electro-Optical Characteristics Measuring Equipment(DMS501)**



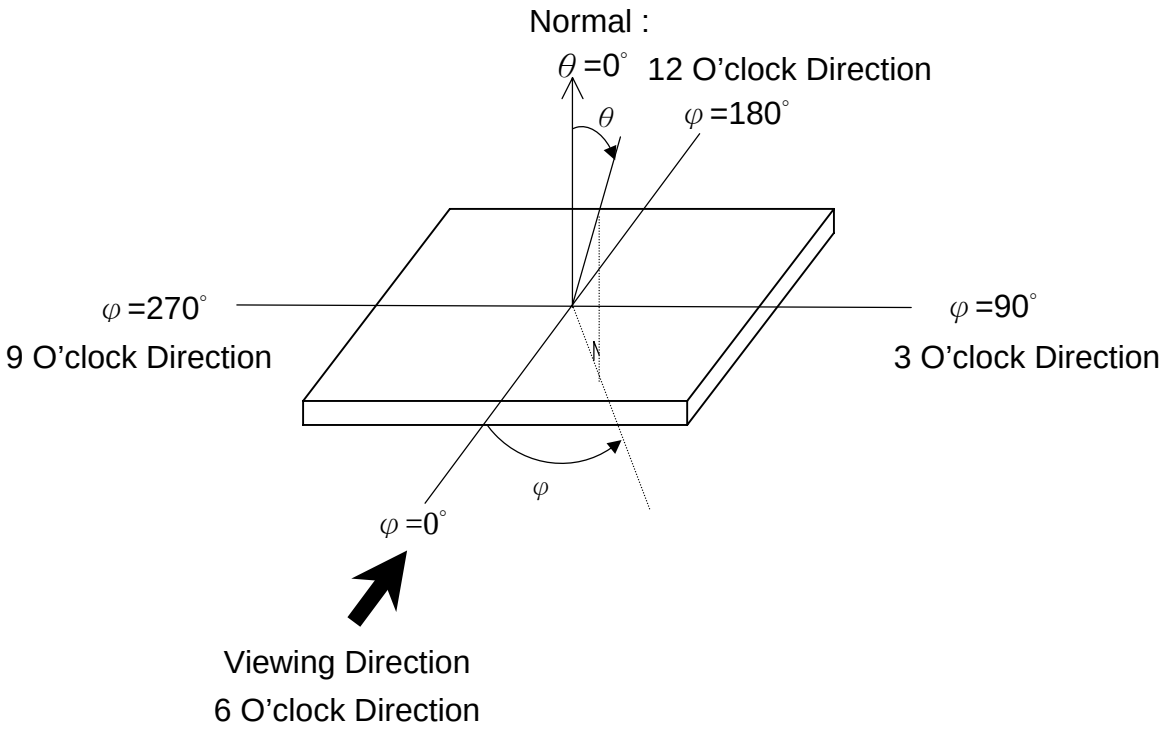
- **Note 1. Definition of Driving Voltage(Vlcd) :**



- **Note 2. Definition of Optical Response Time :**

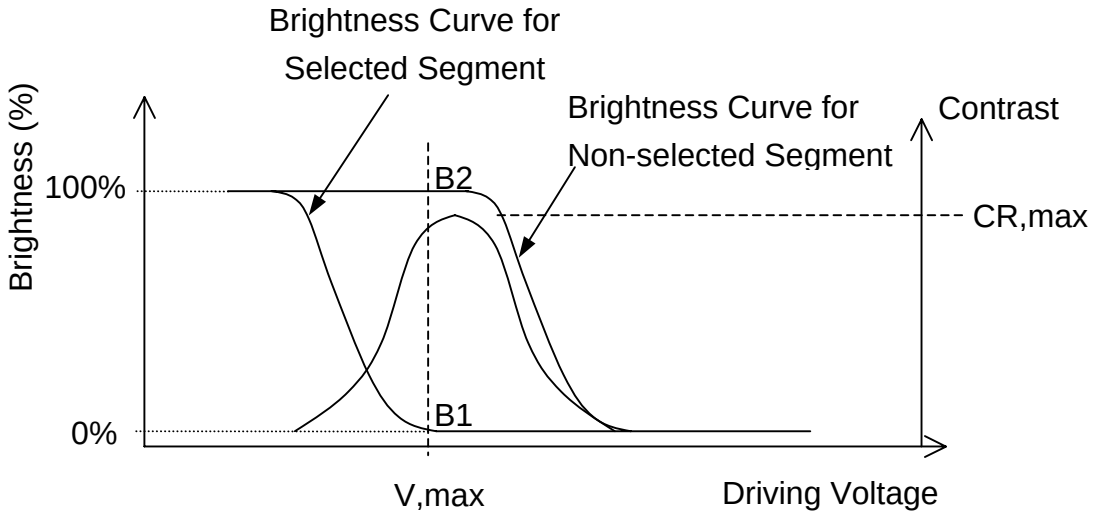


- **Note 3. Definition of Viewing Angle θ and ϕ :**



- **Note 4. Definition of Contrast ratio(CR) :**

$$CR = \frac{\text{Brightness of Non-selected Segment (B2)}}{\text{Brightness of Selected Segment (B1)}}$$



9. RELIABILITY

9.1. MTBF

The LCD module shall be designed to meet a minimum MTBF value of 50000 hours with normal. (25°C in the room without sunlight)

9.2. TESTS

NO.	ITEM	CONDITION	CRITERION
1	High Temperature Operating	70℃ 120Hrs	◦ No Defect Of Operational Function In Room Temperature Are Allowable. ◦ IDD of LCM in Pre-and post-test should follow specification
2	Low Temperature Operating	-20℃ 120Hrs	
3	High Temperature/ Humidity Non-Operating	70℃ ,90%RH ,120 Hrs	
4	High Temperature Non-Operating	80℃ 120Hrs	
5	Low Temperature Non-Operating	-30℃ 120Hrs	
6	Temperature Cycling Non-Operating	-20℃(30Min)↔ 70℃(30Min) 10 CYCLES	

Notes: Judgments should be mode after exposure in room temperature for two hours.

10. PRECAUTIONS FOR USING LCD MODULES

10.1. HANDLING PRECAUTIONS

(1) The display panel is made of glass. Do not subject it to a mechanical shock or impact by dropping it.

(2) If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.

(3) Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

(4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

(5) If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten a cloth with one of the following solvents:

- Isopropyl alcohol
- Ethyl alcohol

(6) Solvents other than those above mentioned may damage the polarizer.
Especially, do not use the following:

- Water
- Ketone
- Aromatic solvents

(7) Extra care to minimize corrosion of the electrode. Water droplets, moisture condensation or a current flow in a high-humidity environment accelerates corrosion of the electrode.

(8) Install the LCD Module by using the mounting holes. When mounting the LCD Module, make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.

(9) Do not attempt to disassemble or process the LCD Module.

(10) NC terminal should be open. Do not connect anything.

(11) If the logic circuit power is off, do not apply the input signals.

(12) To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

- Be sure to ground the body when handling he LCD Module.
- Tools required for assembling, such as soldering irons, must be properly grounded.
-To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions.

-The LCD Module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.

10.2. STORAGE CONDITIONS

When storing, avoid the LCD module to be exposed to direct sunlight of fluorescent lamps. For stability, to keep it away form high temperature and high humidity environment (The best condition is : 23±5°C, 45±20%RH). ESD protection is necessary for long-term storage also.

10.3. OTHERS

Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.

If the LCD Module have been operating for a long time showing the same display patterns the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be recovered by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.

To minimize the performance degradation of the LCD Module resulting from destruction caused by static electricity etc. exercise care to avoid holding the following sections when handling the modules.

- Exposed area of the printed circuit board.
- Terminal electrode sections.

11. Using LCD modules

12.1 LIQUID CRYSTAL DISPLAY MODULES

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

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

(2) Do not touch, push or rub the exposed polarizers with anything harder than a 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, 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 ether. 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 polarizers. After products are tested at low temperature they must be warmed up in a container before coming is contacting with room 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 area 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.

12.2 INSTALLING LCD MODULE

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.

12.3 ELECTRO-STATIC DISCHARGE CONTROL

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

(1) Make certain that you are grounded when handing LCM.
(2) Before removing 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 workbenches to the ground potential.
(6) To reduce the generation of electro-static discharge, be careful that the air in the work is not too dried. A relative humidity of 50%-60% is recommended.

12.4 PRECAUTIONS FOR OPERATION

(1) Viewing angle varies with the change of liquid crystal driving voltage (Vo). Adjust Vo to show the best contrast.
(2) Driving the LCD in the voltage above the limit will shorten its lifetime.
(3) Response time is greatly delayed at temperature below the operating temperature range. However, this does not mean the LCD will 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 on.
(5) Condensation on terminals can cause an electrochemical reaction disrupting the terminal circuit. Therefore, this product must be used and stored within the specified condition of 23±5°C, 45±20%RH.
(6) When turning the power on, input each signal after the positive/negative voltage becomes stable.

12.5 SAFETY

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

13. REVISION HISTORY

Version	Revise record	Date
1.0	Original version	05-01-01
2.0	Change specification format	05-11-19

SAMPLE APPROVED REPORT
(样品确认单)

SAMPLE MODEL NO. (样品型号)	GG2018
SAMPLE SERIES NUMBER NO. (样品序号)	
SAMPLE QUANTITY (样品数量)	
COLOR/TYPE (底色/类型)	FSTN/POSITIVE
VIEWING DIRECTION (视角)	6:00
DRIVING METHOD (驱动参数)	1/33Duty, 1/6Bias
LOGIC VOLTAGE (IC 工作电压)	3.0V
LCD VOP (LCD 驱动电压)	7.5V
OPERATING TEMP. (操作温度) ℃	-20~70
STORAGE TEMP. (储存温度) ℃	-30~80
POLARIZER----FRONT (首偏光片)	TRANSMISSIVE
POLARIZER----BACK (后偏光片)	TRANSFLECTIVE
CONTROLLER/DRIVER IC(控制/驱动 IC)	S6B0724
BACKLIGHT COLOR/TYPE (背光源类型/颜色)	NONE
DRAWING REV/NO./QUANTITY (图纸版本/数量)	
SPECIFICATION (规格书　份数)	

REMARKS：
(备注)
WRIT BY：_____ DATE：_____ APROV BY：_____ DATE：_____

CUSTOMER'S APPROVAL (客户确认)：

1） FUNCTION （功能）： ☐ OK ☐ N.G.
2） DRIVER CONDITION （驱动条件）： ☐ OK ☐ N.G.
3） DISPLAY MODE （显示模式）： ☐ OK ☐ N.G.
4） VIEWING ANGLE （视角）： ☐ OK ☐ N.G.
5） BACKLIGHT （背光源）： ☐ OK ☐ N.G.
6） DISPLAYING PATTERN （显示效果）： ☐ OK ☐ N.G.

CUSTOMER'S CONCLUSIONS (客户意见)：_____
_____
_____

CUSTOMER'S SIGNATURE（客户签名）：_____ DATE (日期)：_____