REVISIONS				
REV	**DESCRIPTION**	**DRAWN**	**DATE**	**APPROVED**
AA	DOCUMENT CREATED AND RELEASED PER PNR P00-0109	SJD	6/27/00	RWT 6/28/2000

1 GENERAL REQUIREMENTS:

1.1 PURCHASING - THIS IS A SOURCE CONTROLLED COMPONENT. REFER TO THE APPROVED COMPONENT LISTING (ACL) FOR AUTHORIZED MANUFACTURERS. IF A SPECIFICATION CONFLICT EXISTS, THIS COMPONENT DRAWING HAS PRIORITY OVER OTHER DOCUMENTS.

1.2 MANUFACTURER TESTING - MANUFACTURER SHALL GUARANTEE DEVICES SUPPLIED TO THIS DRAWING ARE CAPABLE OF MEETING THE ELECTRICAL AND MECHANICAL SPECIFICATIONS STATED WITHIN THIS DOCUMENT. BUT, MANUFACTURER DOES NOT NEED TO TEST TO THESE REQUIREMENTS UNLESS REQUESTED BY OEM.

1.3 ESD PROTECTION - ALL OEM COMPONENTS ARE TREATED AS ELECTROSTATIC SENSITIVE COMPONENTS. COMPONENTS SHALL BE WRAPPED OR PACKAGED TO PREVENT DAMAGE FROM ELECTROSTATIC DISCHARGE DURING TRANSIT AND HANDLING IN ACCORDANCE WITH ANSI/EIA 625 SECTION 8.

1.4 PART IDENTIFICATION - MANUFACTURER'S STANDARD MARKING (EXAMPLE, PART NUMBER AND DATE CODE) SHALL BE PERMANENT AND LEGIBLE IN ACCORDANCE WITH EIA-327-A, UNLESS WAIVED BY PURCHASE ORDER.

1.5 SHIPPING - IN ANY ONE SHIPMENT OF ANY PURCHASED ORDER, ALL DEVICES MUST BE OF ONLY ONE TYPE OF PACKAGE. EACH SHIPPING CONTAINER MUST HAVE A BAR CODE, CONFORMING TO ANSI / EIA-556 STANDARD, AND HUMAN READABLE DATA MARKED ON THE OUTSIDE OF THE CONTAINER. THE INFORMATION CONTAINED ON THE LABEL WILL CONFORM TO DOCUMENT #M0101, (OEM PACKAGING SPECIFICATION).

2 MECHANICAL REQUIREMENTS:

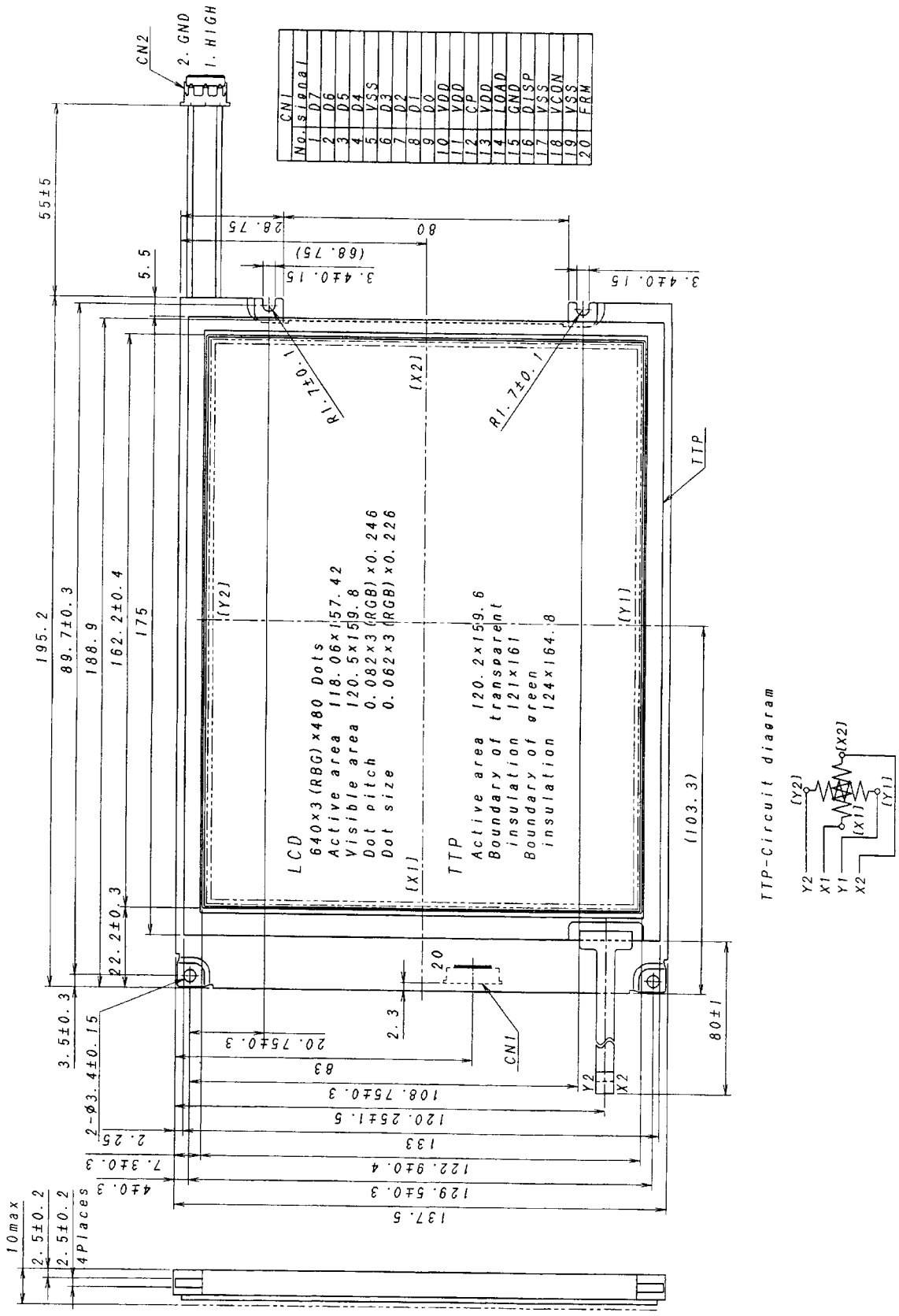
2.1 PACKAGING - The modules shall be supplied in an external box containing 40 units. Each module shall be protected from physical and electrostatic discharge (ESD) damage. A label on each external package shall include OEM's name, OEM's P/N, Manufacturer's P/N, quantity, and production lot number.

2.2 MODULE PHYSICAL DIMENSIONS AND MARKING

2.2.1 Physical Dimensions - The module's physical dimensions shall be as shown on the following page.

2.2.2 Module Connectors – The CN1 LCD interface connector shall be equivalent to Molex P/N 52746-2090. The CN2 CCFT interface connector shall be equivalent to JST P/N BHR-03VS-1.

2.2.3 Module Marking – The following marking shall be stamped or labeled on each module with the Manufacturer's name, Manufacturer's P/N, OEM's P/N, Manufacturing lot date code, serial number, and black high voltage caution.


CN1
No. signal
1 D7
2 D6
3 D5
4 D4
5 VSS
6 D3
7 D2
8 D1
9 D0
10 VDD
11 CP
12 VDD
13 LOAD
14 GND
15 DISP
16 VSS
17 VCON
18 VSS
19 FRM
20 FRM
CN2
2. GND
1. HIGH
LCD
640×3(RBG)×480 Dots
Active area 118.06×157.42
Visible area 120.5×159.8
Dot pitch 0.082×3 (RGB) ×0.246
Dot size 0.062×3 (RGB) ×0.226
TTP
Active area 120.2×159.6
Boundary of transparent insulation 121×161
Boundary of green insulation 124×164.8
TTP
TTP-Circuit diagram
Y2
X1
Y1
X2
(X1)
(X2)
(Y1)
(Y2)
R1.7±0.1
R1.7±0.1
3.4±0.15
(68.75)
28.75
80
5.5
55±5
195.2
89.7±0.3
188.9
162.2±0.4
175
22.2±0.3
(103.3)
80±1
20
2.3
CN1
3.5±0.3
3.4±0.15
2-Ø3.4±0.15
20.75±0.3
83
108.75±0.3
120.25±1.5
133
2.25
7.3±0.3
122.9±0.4
4.0±0.3
129.5±0.3
137.5
10max
2.5±0.2
2.5±0.2
4Places

2.3 PINOUT AND SIGNAL DESCRIPTIONS - The pinout and signal descriptions of the module shall be as shown below.

CN1 LCD INTERFACE		
PIN NUMBER	**SIGNAL**	**DESCRIPTION**
1	D7	Display data
2	D6	Display data
3	D5	Display data
4	D4	Display data
5	VSS	GND (0V)
6	D3	Display data
7	D2	Display data
8	D1	Display data
9	D0	Display data
10	VDD	Power supply for logic
11	VDD	Power supply for logic
12	CP	Data shift clock
13	VDD	Power supply for logic
14	LOAD	Data latch signal
15	GND	GND (0V)
16	DISPON	Display control signal (H:on/L:off)
17	VSS	GND (0V)
18	VCON	Power supply for LCD driving (whiter at lower voltages)
19	VSS	GND (0V)
20	FRM	Frame initialize signal
CN2 CCFT INTERFACE		
PIN NUMBER	**SIGNAL**	**DESCRIPTION**
1	HIGH	Power supply for cold cathode tube (high voltage)
2	N.C.	No connect
3	GND	Power supply for cold cathode tube (ground)
TTP INTERFACE		
PIN NUMBER	**SIGNAL**	**DESCRIPTION**
1	X2	
2	Y1	
3	X1	
4	Y2	

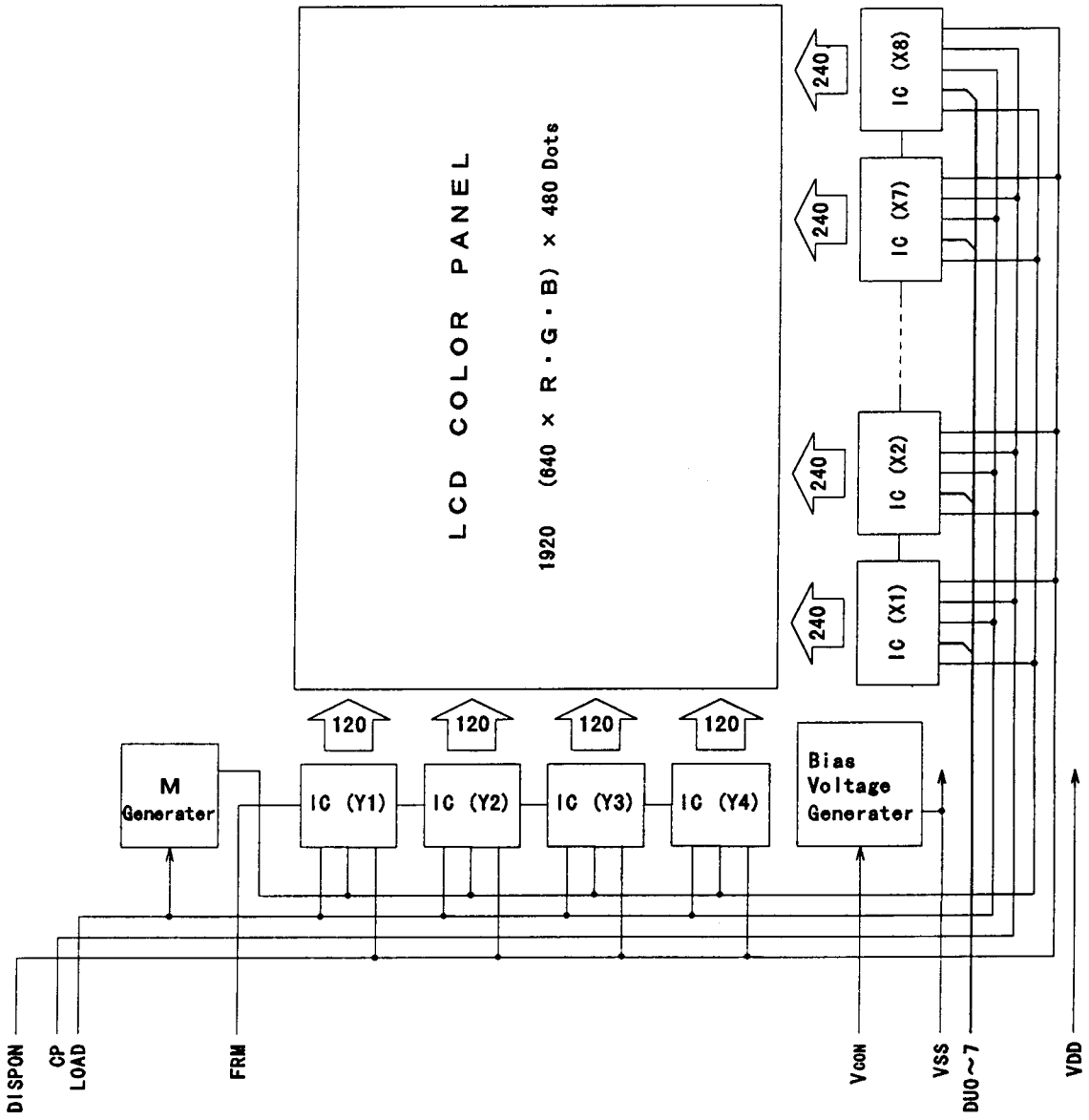
3 ELECTRICAL REQUIREMENTS:

3.1 FUNCTIONAL DESCRIPTION - This module is a 7.8 inch STN colored passive matrix type liquid crystal display (LCD) with a transparent touch panel (TTP). The display consists of 640 x 3(RGB) x 480 dots. The display is the transmissive type with a cold cathode fluorescent tube (CCFT) backlight.

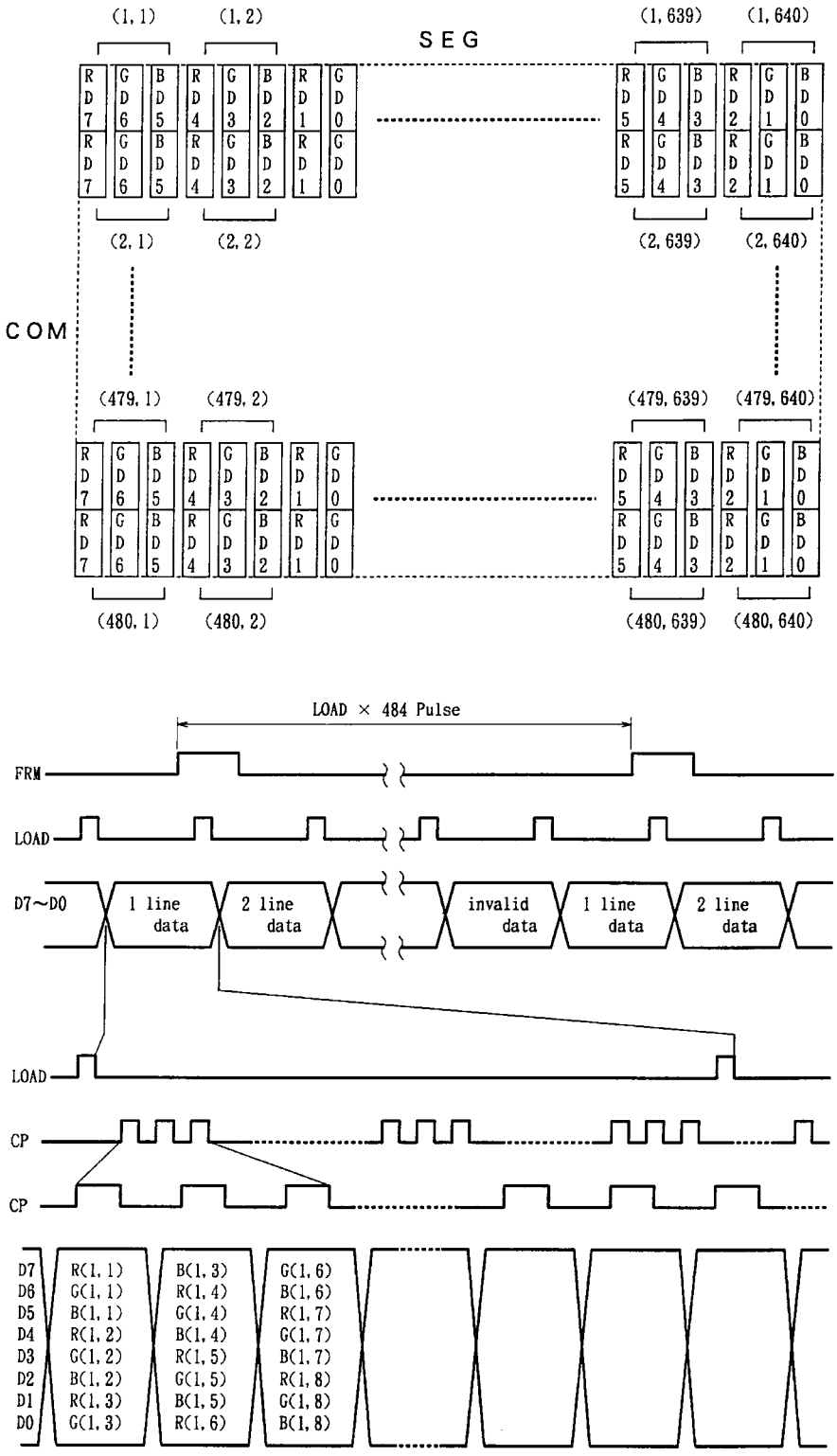
3.2 LCD TYPE AND DISPLAY PATTERN – The LCD type and display pattern characteristics shall be as shown in the table below.

LCD Type	Super twisted nematic (STN) colored passive matrix
Dot Format	640 x 3(RGB) x 480 Dots
Dot Gap	0.020 x 0.020 mm
Dot Pitch	0.082 x 0.246 mm
Dot Size	0.062 x 0.226 mm
LCD Active Area	118.06 x 157.42 mm
LCD Visible Area	120.5 x 159.8 mm
TTP Active Area	120.2 x 159.6 mm
TTP Boundary of Transparent Insulation	121 x 161 mm
TTP Boundary of Green Insulation	124 x 164.8 mm
Viewing Direction	6 O'clock
Viewing Mode	Transmissive
Backlight Type	One cold cathode fluorescent tube (CCFT)
Surface Polarizer	Glare
Surface Hardness	2H
Weight	230g typical

3.3 FUNCTIONAL BLOCK DIAGRAM - The functional block diagram is given below.



3.4 RELATIONSHIP BETWEEN DATA AND LIQUID CRYSTAL DISPLAY – The relationship between data



and the liquid crystal display is illustrated below.

3.5 DRIVING METHOD OF LCD MODULE – The driving method of the LCD module is provided below.

3.5.1 Connection of Power Supply and Signal Line – This module requires VDD and power supply for LCD drive (VCON). VCON must be adjustable. Select proper variable resistance to avoid big change of VCON by a little change of voltage. To avoid problems such as latch-up of circuit, minimize ripple of power supply and keep ratings below maximum including overshoot. For signal line, release signals in a way described in 3.4. However, AC converting signal is not necessary for the module.

3.5.2 ON/OFF of Power Supply and Signal - Driving liquid crystal molecular by DC current may cause serious damages to LCD including disorder of alignment and electrical decomposition. This module converts signals to AC using LOAD and FRM signals in driver signals. Therefore, regarding the timing of power ON/OFF and signal release, make sure to strictly comply with precautions in sequence for power supply described in 3.6.3.

3.5.3 Structure of LCD Screen - This module consists of I screen of 640 x 3(RGB) x 480 dots. The 640 x 3(RGB) side is called SEG (segment), and there are 8 LSI's in the positioning of lower screens. The 480 side is called COM (common), and there are 4 LSI's.

3.5.4 Signals and Driving Principles (Refer to 3.4) - Data is transferred using 8-bit parallel. Each LSI for SEG has an internal 240 ÷ 8 = 30 clock counter. When the LSI becomes disabled after 30 clocks, it functions to output the enable signal to next LSI. When the counter circuit is cleared by fall of LOAD signal, the first LSI (X1) becomes enabled.

FRM signal is the scanning signal that selects COM line. The signal shifts to the next line at fall of LOAD signal. This module is designed for 1/484 duty. Therefore, FRM signal is released every 1-frame time (1/70 Hz : 14. 3 ms), and LOAD signal is required of the time (1H = 14.3 ms/484) per each 484 divided equal time of 1 frame time. If the time division is unbalanced, I/484 duty cannot be carried out. This may degrade current consumption and display quality.

The 8-bit data is taken into XI LSI shift register at fall of CP signal. Then, the next CP signal shifts the data and takes in the next 8-bit data simultaneously. In this manner, after the total of 240 bits, which is equal to 30 clocks, XI becomes disabled and the enable signal is output to X2. In the same way, data of 640 x 3(RGB) dots is taken into the shift register. If this data is for the 1st line, FRM signal turns to H, and LOAD signal is input. By the fall of LOAD signal, the 1st line is selected and simultaneously the data of 640 x 3(RGB) dots is latched by latch circuit of XI to X8 LSI. Through the level shift circuit and analog switch circuit inside LSI, proper waveform of each data is output to LCD panel. At this time, lines other than 1st line has scanning signal of L. Therefore, non-selective waveform is applied to LCD panel although these lines have latch data in XI to X8. Then, when FRM signal turns to L, the above display data of the 2nd line is transferred to XI to X8 LSI as mentioned above. When LOAD signal is input, H data of FRM signal shifts to the 2nd line and selected. At the same time, display data is latched and displayed on LCD panel. The same mechanism repeats until 484th line to complete 1 frame. (Data of 481st line to 484th lines are not displayed.)

3.5.5 Recommendations – The frame frequency of this module is set to 70 Hz. Make sure to determine driving frequency of the CCFT backlight that avoids flickering. Regarding LOAD, make sure to keep constant intervals between rise and fall, and input without any intermission.

3.6 ELECTRICAL SPECIFICATIONS

3.6.1 Absolute Maximum Ratings (VDD ≥ VCON ≥ VSS = 0V)

PARAMETER	MNEMONIC	MINIMUM	TYPICAL	MAXIMUM	UNIT
Power Supply for Logic	VDD - VSS	0	-	6.0	V
Power Supply for LCD Drive	VCON - VSS	0	-	VDD	V
Input Logic Level	VIN	-0.3	-	VDD + 0.3	V

3.6.2 Recommended Operating Range (VDD > VCON > VSS = 0V)

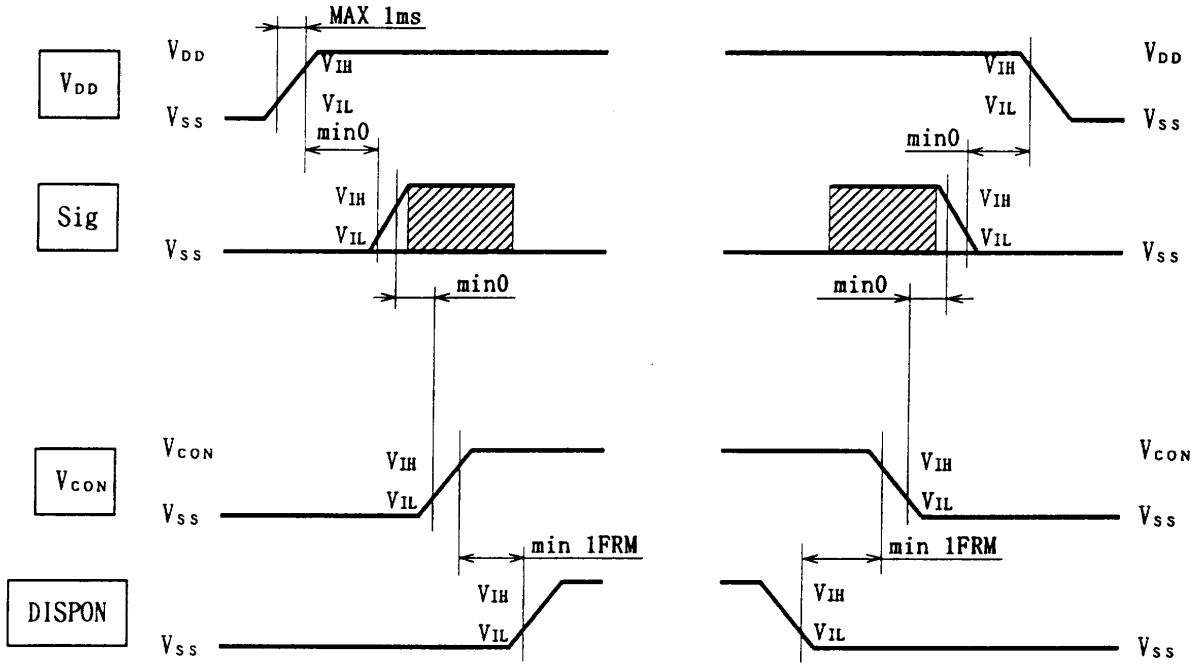
PARAMETER	MNEMONIC	MINIMUM	TYPICAL	MAXIMUM	UNIT
Power Supply for Logic(VSS=0V)	VDD - VSS	4.75 3.15	5.00 3.30	5.25 3.45	V V
Power Supply for LCD Drive	VCON - VSS	0.80	1.95	2.80	V
Frame Frequency	f(FRM)	60	70	120	Hz

3.6.3 Electrical Characteristics – The electrical characteristics shall be as specified below. (Ta = 0 to 40°C, VDD = 5.0V ± 0.25V, or VDD = 3.3V ± 0.15V, VSS = 0V)

PARAMETER	MNEMONIC	CONDITIONS	MIN	TYP	MAX	UNIT
Input High Voltage	VIH		0.8VDD	-	VDD	V
Input Low Voltage	VIL		0	-	0.2VDD	V
Current Consumption (Ta = 25°C) VCON = VOPR f(FRM) = 70 HZ Display pattern: Checker Pattern	IDD IDD IDD Rush	VDD-VSS=5.0V VDD-VSS=3.3V Power On	- - -	100 150 -	150 220 1.5A(Peak) x 10 ms	mA mA -
Shift Clock Frequency	fcpx		-	-	20.0	MHz
Operating Voltage	VOPR= VCON–VSS	Ta = 0°C Ta = 25°C Ta = 40°C	0.80 - -	- 1.95 -	- - 2.80	V V V

Notes: 1. Definition of VOPR: VCON – VSS at the time of setting VCON to get optimum contrast under VSS = GND condition.

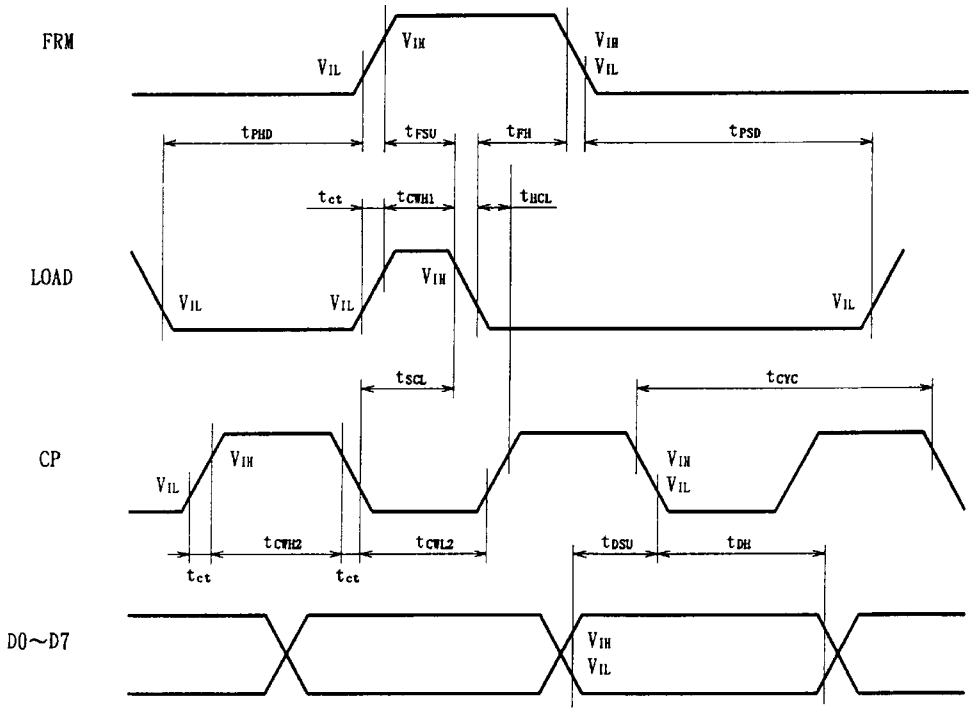
2. The power supply sequence shall comply with the figure below.



3.6.4 Switching Characteristics – The switching characteristics shall be as specified below. (Ta = 0 to 40°C, VDD = 5.0V ± 0.25V, or VDD = 3.3V ± 0.15V, VSS = 0V, VIH = 0.8VDD, and VIL = 0.2VDD)

PARAMETER	MNEMONIC	CONDITIONS	MIN	TYP	MAX	UNIT
Clock Cycle Time	tcyc	50	-	-	-	ns
Clock Pulse Width (High Lebel)	tcwh2	16	-	-	-	ns
Clock Pulse Width (Low Lebel)	tcwl2	16	-	-	-	ns
Clock Hold Time	thcl	110	-	-	-	ns
Clock Set Up Time	tscl	110	-	-	-	ns
Rise/Fall Time	tct	-	-	-	25 (See Note)	ns
Load Pulse Width (High Lebel)	tcwh1	150	-	-	-	ns
Data Set Up Time	tdsu	15	-	-	-	ns
Data Hold Time	tdh	15	-	-	-	ns
Frame Set Up Time	tfsu	120	-	-	-	ns
Frame Hold Time	tfh	200	-	-	-	ns
Load Set Up Time	tpsd	10	-	-	-	ns
Load Hold Time	tphd	120	-	-	-	ns

Notes: 1. tct < ½{tcyc – (tcwh2 + tcwl2)}



3.6.5 CCFT Electrical Characteristics – The CCFT electrical characteristics shall be as specified below. The measurement shall be conducted 10 minutes after CCFT is turned on in windless environment.

PARAMETER	**MNEMONIC**	**CONDITIONS**	**MIN**	**TYP**	**MAX**	**UNIT**
Starting Voltage (See Note 1)	Vs	Ta = 25°C, IL=6mA Ta = 0°C, IL=6mA	- -	- -	880 1155	Vrms
Operating Voltage	Es	Ta = 25°C, IL=6mA	-	430	-	Vrms
Lamp Current (See Note 2)	IL	Max. Dimmer Min. Dimmer	- 2.0	- -	6.0 -	mA
Power Consumption	WL	Ta = 25°C, IL=6mA	-	2.58	-	Vrms
Discharge Stabilization Time	Ts	Ta = 25°C, IL=6mA	-	-	3	sec
Current Life	LT	Ta = 25°C, IL=6mA, 50% of Initial Chromaticity (See Note 3)	10,000	-	-	Hour
Operating Frequency Range	-		50	-	80	KHz

Note:

1. Inverter should be designed to be matched with the lamp characteristics. (Inverter's output voltage without the load should be kept higher than the maximum value of the CCFT's starting voltage.)

2. The panel surface temperature should be kept less than 60°C when the lamp current is at the maximum level. (Maximum lamp current should be less than 6 mA.)

3. For the current life specifications, there shall be no significant color temperature change.

3.6.6 Optical Characteristics – The optical characteristics shall be as specified below. (Ta = 25°C, Frame Frequency = 70 Hz)

PARAMETER	MNEMONIC	CONDITIONS	MIN	TYP	MAX	UNIT
Response Time	ton toff	$\theta = 0°, \phi = 0°$, Vcon – Vss = Vmax (See Note Below) Ta = 25°C, measure at the center of display	- -	200 150	300 200	ms
Vertical Viewing Angle	θ	CR ≥ 1.5, Vcon – Vss = Vmax (See Note Below) Ta = 25°C, measure at the center of display	-30	-	+20	degree
Horizontal Viewing Angle	ϕ	CR ≥ 1.5, Vcon – Vss = Vmax (See Note Below) Ta = 25°C, measure at the center of display	-45	-	+45	degree
Contrast Ratio	CR	$\theta = 0°, \phi = 0°$, Vcon – Vss = Vmax (See Note Below) Ta = 25°C, measure at the center of display	20	30	-	-
Brightness	B	$\theta = 0°, \phi = 0°$, Vcon – Vss = Vmax (See Note Below) IL = 4mA, measuring distance = 40 cm	35	60	-	cd/m^2
Brightness Uniformity	ΔB	$\theta = 0°, \phi = 0°$, Vcon – Vss = Vmax (See Note Below) IL = 4mA, measuring distance = 40 cm	70	-	-	%
Unit Color Tone	White	$\theta = 0°, \phi = 0°$, Vcon – Vss = Vmax (See Note Below) Measure at the center of display	-	X = 0.330 Y = 0.330	-	-

Note: Definition of Vmax is Vcon – Vss at the time of setting Vcon to get maximum contrast under Vss = GND condition. Measure the brightness after turning on the module for 20 minutes. The brightness measurement is the average brightness

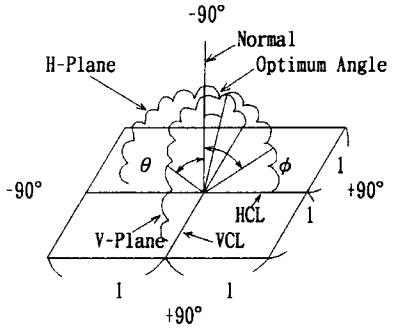
from nine points on a grid of 49 mm, 0 mm, and –49 mm above/below the horizontal center line and 68 mm, 0 mm, and –68 mm to the right/left of the vertical center line.

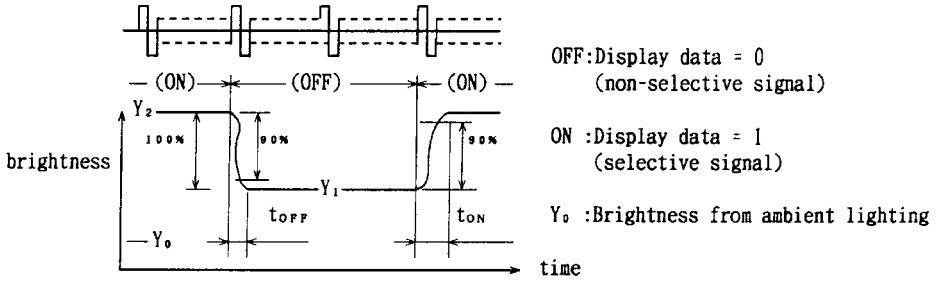
3.7 TEST MEASUREMENT METHOD FOR ELECTRICAL AND OPTICAL CHARACTERISTICS

3.7.1 Measurement Condition – Before measuring characteristics, the module shall be kept under the following conditions for 4 hours before and after each test. Temperature shall be 25 ± 1°C, humidity shall be 40 to 70% RH, and altitude shall be 650 to 850 mmHg.

3.7.2 Measuring Points of Characteristics – Measure at the following points, turning ON/OFF only the area of 15 to 20 mm from the center of the effective area.

3.7.3 Response Time (ton, toff) – Set the measuring equipment (LCD-7000) to 25°C, and place the LCD module to the Normal ($\theta = 0°$, $\phi = 0°$). Apply the voltage at VMAX of 3.7.4 and repeat display data = 1 (selective signal) and display data = 0 (non-selective signal) continuously as shown below. Read the ton and toff from changes in brightness shown on a memory-scope.





3.7.4 Measurement of Driving Voltage (VMAX) and Contrast Ratio (CR) – Set the measuring equipment to 25°C, and place the LCD module at Normal position ($\theta = 0°$, $\phi = 0°$) against color-difference meter (CS-100). Display selective data (Screen: White) and non-selective data (Screen: Black) of specified duty ratio alternately, and measure brightness at each data. Increase voltage gradually and measure brightness Y2 at selective state and Y1 at non-selective state. Calculate contrast ratio {CR = (Y2 – Y0)/(Y1 – Y0)} at each voltage and determine voltage which gives the maximum CR as VMAX = VCON – VSS.

3.7.5 Measurement of Vertical Viewing Angle ($\phi = 0°$) – Set the measuring equipment (LCD-7000) to 25°C, and apply the above VMAX to the LCD module. Then change the θ angle ($\phi = 0°$) against the color-difference meter (CS-100) measure brightness at selective state Y2 and non-selective state Y1 and calculate CR = (Y2 – Y0)/(Y1 – Y0). Angles above CR ≥ 1.5 is defined as the vertical viewing angle.

3.7.6 Measurement of Horizontal Viewing Angle ($\theta = 0°$) – Set the measuring equipment (LCD-7000) to 25°C, and apply the above VMAX to the LCD module. Then change the ϕ angle ($\theta = 0°$) against the color-difference meter (CS-100), measure brightness at selective state Y2 and non-selective state Y1, and calculate CR = (Y2 – Y0)/(Y1 – Y0). Angles above CR ≥ 1.5 is defined as the horizontal viewing angle.

3.7.7 Measurement of Color Tones – Set the measuring equipment to 25°C, and place the LCD module at Normal ($\theta = 0°$) against color-difference meter (CS-100). Turn on the backlight applying specified current. Measure color tone with color-difference meter (CS-100) applying VMAX, 60 minutes after turning on the backlight.

4 ENVIRONMENTAL REQUIREMENTS: The environmental ratings shall be as specified below.

MNEMONIC	PARAMETER	MINIMUM	MAXIMUM	UNIT
T_{STG}	Storage Temperature Range	-20	60	°C
Ta	Operating Ambient Temperature Range	0	45	°C
RH	Relative Humidity (no dew condensation)	5	90	%

Notes: 1. When the display is moved from storage temperature to operating temperature, it shall recover normal display characteristics within 4 hours.

2. Display quality degrades when operating temperature exceeds 40°C.

3. The LCD module does not expose to sunshine.

5 QUALITY and RELIABILITY REQUIREMENTS: The quality and reliability requirements are listed below. Unless otherwise specified, the module shall operate normally after each test, Ta = 25°C, Frame Frequency = 70 Hz, absolute humidity shall never exceed 40°C, 95%RH, and VOPR is the best voltage at high contrast at every temperature.

5.1 LOAD LIFE – In the thermal chamber at 40 ± 2 °C, display the black/white checkered pattern under VDD = 5 ± 0.25 V, V = VOPR for 500 ± 24 hours.

5.2 HIGH TEMPERATURE EXPOSURE – In the thermal chamber at 60 +0°C, -4°C, expose the module without applying any load for 240 + 24hr, -0hr.

5.3 LOW TEMPERATURE EXPOSURE - In the thermal chamber at -20 +4°C, -0°C, expose the module without applying any load for 240 + 24hr, -0hr.

5.4 HUMIDITY EXPOSURE - In the thermal chamber at 40 +0°C, -4°C, 85 to 90% RH, expose the module without applying any load for 240 + 24hr, -0hr.

5.5 HEAT SHOCK - In the thermal chamber, expose the module without applying any load for 1 hr each at -20 ± 2°C and 60 ± 2°C (1 cycle). Conduct 50 cycles.

5.6 VIBRATION – 10 to 100 Hz, 0.4 G peak. Conduct the vibration test 1 Hr/cycle in each of 3 axes.

5.7 SHOCK – 50 G, 6 ms half-sine pulse. Conduct the shock test 3 times for each of 3 axes. Make sure to conduct the test on the complete set.

5.8 CCFT LIGHTING LIFE AT NORMAL TEMPERATURE – Continuous lighting for 10000 hr or longer at normal temperature under 6 mA tube current. The module's final luminance shall be at least ½ the initial.

5.9 CCFT LIGHTING LIFE AT LOW TEMPERATURE – Continuous lighting for 350 hr or longer at 0°C temperature under 6 mA tube current. The module's final luminance shall be at least ½ the initial.