

TFT LCD Preliminary Specification

MODEL NO.: V216C1 - L02



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REVISION HISTORY

Version	Date	Page (New)	Section	Description
Ver 1.0	Mar. 06,06	All	All	Preliminary Specification was first issued.
Ver 1.0	Mar. 06,06	All	All	RoHS Compliance
Ver 1.0	Mar. 06,06			

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1. GENERAL DESCRIPTION

1.1 OVERVIEW

V216C1-L02 is a 21.66" TFT Liquid Crystal Display module with 6-I CCFL Backlight unit and 2Path-RSDS interface. This module supports 1440 x 900 WXGA+ format and displays 262144 colors(6-bit).

1.2 FEATURES

- High brightness (400 nits)
- High contrast ratio (1000:1)
- Fast response time (Gray to Gray average 6.5ms)
- High color saturation (NTSC 75%)
- WXGA+ (1440 x 900 pixels) resolution
- DE (Data Enable) only mode
- 2Path-RSDS interface

1.3 APPLICATION

- TFT LCD TVs, Multi-Function Monitors

1.4 GENERAL SPECIFICATIONS

ltem	Specification	Unit	Note	
Active Area	466.56x291.6	1 mm	(1)	
Bezel Opening Area	470.6x295.6	mm	(1)	
Driver Element	a-si TFT active matrix		-	
Pixel Number	1440 x R.G.B. x 900	pixel	-	
Pixel Pitch(Sub Pixel)	0.324	mm	-	
Pixel Arrangement	RGB vertical stripe	-	-	
Display Colors	16.2M			
Display Operation Mode	Transmissive mode / Normally black	-	-	
Surface Treatment	Hardness : 3H Anti-Glare coating (Haze 25%)	-	-	

1.5 MECHANICAL SPECIFICATIONS

Item		Min.	Тур.	Max.	Unit	Note
	Horizontal(H)	491.0	491.6	492.2	mm	(1)
Module Size	Vertical(V)	323.7	324.2	324.7	mm	(1)
	Depth(D)	20.63	21.43	22.23	mm	-
Weight		-	3600	-	gm.	-

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.



2. ABSOLUTE MAXIMUM RATINGS

2.1 ABSOLUTE RATINGS OF ENVIRONMENT

Itom	Symbol	Va	Linit	Noto		
liem	Symbol	Min.	Max.	Unit	Note	
Storage Temperature	T _{ST}	-20	+60	°C	(1)	
Operating Ambient Temperature	T _{OP}	0	+50	°C	(1), (2)	
Shock (Non-Operating)	S _{NOP}	-	50	G	(3), (5)	
Vibration (Non-Operating)	V _{NOP}	-	1.0	G	(4), (5)	

Note (1) Temperature and relative humidity range is shown in the figure below.

(a) 90 %RH Max. (Ta 40 °C).

- (b) Wet-bulb temperature should be 39 °C Max. (Ta > 40 °C).
- (c) No condensation.
- Note (2) The maximum operating temperature is based on the test condition that the surface temperature of display area is less than or equal to 60 °C with LCD module alone in a temperature controlled chamber. Thermal management should be considered in your product design to prevent the surface temperature of display area from being over 60 °C. The range of operating temperature may degrade in case of improper thermal management in your product design.
- Note (3) 11 ms, half sine wave, 1 time for $\pm X$, $\pm Y$, $\pm Z$.
- Note (4) 10 ~ 500 Hz, 10 min, 1 time each X, Y, Z.
- Note (5) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough
 - so that the module would not be twisted or bent by the fixture.



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2.2 ELECTRICAL ABSOLUTE RATINGS

2.2.1 TFT LCD MODULE

ltom	Symbol	Value		Linit	Noto
nem	Symbol	Min.	Max.	Unit	Note
	VAA	-0.3	+14.0	V	
	V33V	-0.3	+5.0	V	
Power Supply Voltage	VGH	-0.3	+30.0	V	-
	VGL	-12.0	+0.3	V	

2.2.2 BACKLIGHT UNIT

Itom	Symbol	Va	lue	Lloit	Note	
nem	Symbol	Min.	Max.	Unit		
Lamp Voltage	VL	-	3000	V _{RMS}	-	
Lamp Current	١L	-	7.5	mA _{RMS}		
Lamp Frequency	FL	20	80	KHz	-	





3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD MODULE

3.1 TFT LCD MODULE							= 25 ± 2 °C
	Parameter			Value	Lloit	Noto	
Parameter		Symbol	Min.	Тур.	Max.	Unit	Note
		VAA	13.2	13.4	13.6	V	
Dowor Su	nnly Voltogo	V33V	3.2	3.3	3.4	V	
Power Su	ppry voltage	VGH	23.0	23.5	24.0	V	
		VGL	-5.9	-5.6	-5.3	V	
		IAA	-	-	300	mA	
Dowor Su	pply Current	133	-	-	100	mA	
rower Su	pply Cullent	IGH	-	-	10	mA	
		IGL	-10	-	-	mA	
Dene	Differential Input High Threshold Voltage	VDIFFRSDS	100	200	-	mV	-
RSDS Interface	Differential Input Low Threshold Voltage	VDIFFRSDS		-200	-100	mV	-
	Common Input Voltage	VCMRSDS	0.1	1.2	2.1	V	-
	Terminating Resistor	R _T	81.18	82	82.82	ohm	-
CMOS	Input High Threshold Voltage	V _{IH}	2.7	-	3.3	V	-
interface	Input Low Threshold Voltage	V _{IL}	0	-	0.7	V	-





3.2 BACKLIGHT UNIT

Ta = 25 ± 2 °C

Parameter	Symbol		Value	Lloit	Note	
Falametei	Symbol	Min.	Min. Typ. Max.			
Lamp Input Voltage	VL	-	766		V _{RMS}	l∟ = 7.0 mA
Lamp Current	ΙL	6.5	7	7.5	mA _{RMS}	-
	Vs		-	1500	V _{RMS}	Ta = 25 ⁰C
Lamp Turn On Voltage			-	1700	V _{RMS}	Ta = 0 ⁰C
Operating Frequency	FL	40	50	60	KHz	-
Lamp Life Time	L _{BL}	40000	50000	-	Hrs	-

Note (1) Lamp current is measured by utilizing high frequency current meters as shown below:



- Note (2) The voltage shown above should be applied to the lamp for more than 1 second after startup. Otherwise the lamp may not be turned on.
- Note (3) The lamp frequency may produce interference with horizontal synchronous frequency from the display, and this may cause line flow on the display. In order to avoid interference, the lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible.
- Note (4) The lifetime of a lamp is defined as the time in which it continues to operate under the condition Ta = $25 \pm 2 \degree C$ and $I_L = (6.5) \sim (7.5)$ mArms until one of the following events occurs:
 - (a) When the brightness becomes equal or less than 50% of its original value.
 - (b) When the effective discharge length becomes equal or less than 80% of its original value.(Effective discharge length is defined as an area that has equal or more than 70% brightness



compared to the brightness at the center point.)

Note (5) The waveform of the voltage output of inverter must be area-symmetric and the design of the inverter must have specifications for the modularized lamp. The performance of the Backlight, such as lifetime or brightness, is greatly influenced by the characteristics of the DC-AC inverter for the lamp. All the parameters of an inverter should be carefully designed to avoid producing too much current leakage from high voltage output of the inverter. When designing or ordering the inverter please make sure that a poor lighting caused by the mismatch of the Backlight and the inverter (miss-lighting, flicker, etc.) never occurs. If the above situation is confirmed, the module should be operated in the same manners when it is installed in your instrument.





4. BLOCK DIAGRAM



Note (1) Connector Part No.: (L:LG GF058-50S-LSS-AF-P2000) (R:LG GF058-20S-LSS-AF-P2000)or compatible





5. INTERFACE PIN CONNECTION

5.1 TFT LCD MODULE

CN1 Connector Pin Assignment

Pin No.	Symbol	Description	Note
1	GND	Ground	
2	BB2P	Right side RSDS data of Blue pixel 4.5 bits	
3	BB2N		
4	BB1P	Right side RSDS data of Blue pixel 3.2 bits	
5	BB1N		
6	BB0P	Right side RSDS data of Blue pixel 1.0 bits	
7	BB0N		
8	BG2P	Right side RSDS data of Green pixel 4.5 bits	
9	BG2N	······································	
10	BG1P	Right side RSDS data of Green pixel 3.2 bits	
11	BG1N	5	
12	BG0P	Right side RSDS data of Green pixel 1.0 bits	
13	BG0N		
14	GND	Ground	
15	BCKP	Right side RSDS data clock	
16	BCKN		
17	GND	Ground	
18	BR2P	Right side RSDS data of Red pixel 4,5 bits	
19	BR2N		
20	BR1P	Right side RSDS data of Red pixel 3,2 bits	
21	BR1N		
22	BROP	Right side RSDS data of Red pixel 1,0 bits	
23	BRON		
24	GND	Ground	
25	BSTH	Right side start pulse	
26	GND	Ground	
27	VAA	13.5V power supply	
28	VAA	13.5V power supply	
29	VAA	13.5V power supply	
30	V33V	3.3V power supply	
31	V33V	3.3V power supply	
32	VGL	-5.5V power supply	
33	VGL	-5.5V power supply	
34		Ground	
35	IP1	Latch Input	
36			
37	GND	Ground	
38	FB2P	Left side RSDS data of Blue pixel 4,5 bits	
39			
40	FBIP	Left side RSDS data of Blue pixel 3,2 bits	
41			
42		Left side RSDS data of Blue pixel 1,0 bits	
43	FBUIN		
44	FG2P	Left side RSDS data of Green pixel 4,5 bits	
45	FG2N		
40	FGIP	Left side RSDS data of Green pixel 3,2 bits	
4/	FGIN		





48	FG0P	Left side RSDS data of Green pixel 1.0 bits	
49	FG0N		
50	GND	Ground	

Note (1) Connector CN1 Part No.:LG-GF058-50S-LSS-AF-P2000 or equivalent.

CN2 Connector Pin Assignment

Pin No.	Symbol	Description	Note
1	GND	Ground	
2	GND	Ground	
3	FCKP	Right side RSDS data clock	
4	FCKN		
5	GND	Ground	
6	FR2P	Left side RSDS data of Red pixel 4.5 bits	
7	FR2N		
8	FR1P	Left side RSDS data of Red pixel 3.2 bits	
9	FR1N		
10	FR0P	Left side RSDS data of Red pixel 1.0 bits	
11	FR0N		
12	GND	Ground	
13	FSTH	Left side start pulse	
14	STV	Gate driver side start pulse	
15	CKV	Gate driver shift clock	
16	OE	Gate driver output enable control	
17	GND	Ground	
18	VGH	23.5V power supply	
19	VGH	23.5V power supply	
20	GND	Ground	
Note (1) Co	nnector CN2 P	Part No.:LG-GF058-20S-LSS-AF-F2000 or equivalent.	

5.2 BACKLIGHT UNIT

Pin	Symbol	Description	Color
1	HV1	High Voltage	Blue or Dark Blue
2	LV	Ground	White

Note (1) Connector Part No.: BHSR-02VS-1 (JST) or equivalent

Note (2) Matching Connector Part No.: SM02-BHSS-1-TB (JST) or equivalent



5.3 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 8-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of color versus data input.

Color		Data Signal																	
		Red					Green					Blue							
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Basic	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Colors	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Red(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(1)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Scale	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Of	Red(61)	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Red	Red(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(1)	Ō	Ō	Õ	0	0	0	0	0	Õ	Õ	Ō	1	0	0	0	0	0	0
	Green(2)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Gray							r I				Ŧ			1		1	07		:
Scale							÷												
Of 📃	Green(61)	0	0	0	0	0	0		1			0	1	0	0	0	0	0	0
Green	Green(62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	Green(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Croy	Blue(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Scolo	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Of	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Blue	Blue(61)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
Diue	Blue(62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

Note (1) 0: Low Level Voltage, 1: High Level Voltage



6. INTERFACE TIMING

6.1 INPUT SIGNAL TIMING SPECIFICATIONS

The input signal timing specifications are shown as the following table and timing diagram.

Signal	Item	Symbol	Min.	Тур.	Max.	Unit	Note
RSDS Receiver Clock	Frequency	1/Tc	-	45	(56)	MHz	
PSDS Bacoliver Data	Setup Time	Tlvsu	-	-	-	ps	
RSDS Receiver Data	Hold Time	Tlvhd	-	-	-	ps	
	Frame Rate	Fr	-	60	75	Hz	
Vertical Active Display Term	Total	Τv	(907)	926	(1050)	Th	Tv=Tvd+Tvb
Vertical Active Display Term	Display	Tvd	900	900	900	Th	-
	Blank	Tvb	(7)	26	(105)	Th	-
	Total	Th	(750)	800	(960)	Тс	Th=Thd+Thb
Horizontal Active Display Term	Display	Thd	720	720	720	Тс	-
	Blank	Thb	(30)	80	(240)	Тс	-





6.2 POWER ON/OFF SEQUENCE

To prevent a latch-up or DC operation of LCD module, the power on/off sequence should be as the diagram below.



Power ON/OFF Sequence

- Note (1) The supply voltage of the external system for the module input should be the same as the definition of V33V,VAA,VGL and VGH.
- Note (2) Apply the lamp voltage within the LCD operation range. When the backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become abnormal screen.
- Note (3) In case of V33V=off level, please keep the level of input signals on the low or keep a high impedance.
- Note (4) T5 should be measured after the module has been fully discharged between power off and on period.
- Note (5) Interface signal shall not be kept at high impedance when the power is on.



7. OPTICAL CHARACTERISTICS

7.1 TEST CONDITIONS

Item	Symbol	Value	Unit		
Ambient Temperature	Ta	25±2	°C		
Ambient Humidity	Ha	50±10	%RH		
Supply Voltage	V _{CC}	5.0	V		
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS				
Lamp Current	IL	7.0±0.5	mA		
Oscillating Frequency (Inverter)	Fw	52 ± 3	KHz		
Frame rate	F,	60	Hz		

7.2 OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown in 7.2. The following items should be measured under the test conditions described in 7.1 and stable environment shown in Note (6).

Item		Symbol	Condition	Min.	Тур.	Max.	Unit	Note
Contras	t Ratio	CR		(800)	(1000)		-	Note(2)
Response time		Gray to gray(Average)			(6.5)	(12)		Note(3)
Center Lumina	ance of White	L _C			(400)		cd/m ²	Note(4)
White Va	ariation	δW				(1.3)	-	Note(7)
Cross	Talk	СТ				(4)	%	Note(5)
	Pod	Rx	$\theta_x=0^\circ, \ \theta_Y=0^\circ$		(0.654)		-	
	Reu	Ry	Viewing Normal Angle		(0.333)		-	Noto(6)
	Green Blue	Gx			(0.285)		-	
Color		Gy			(0.605)		-	
Coloi		Bx			(0.142)		-	NOLE(0)
Chiomaticity		By 🤳			(0.070)		-	
	White	Wx			(0.313)		-	
		Wy			(0.329)		-	
	Color	Gamut			(75)		%	NTSC
Viewing Angle	Horizontal	θ_x +		(80)	(88)			
	Horizontal	θ _x -		(80)	(88)		Dea	Nata (4)
	Vertical	θ _Y +	5κ≥20	(80)	(88)		Deg.	NOLE(1)
		θγ-		(80)	(88)]	



Note (1) Definition of Viewing Angle (θx , θy):

Viewing angles are measured by Eldim EZ-Contrast 160R



Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.



CR = CR (5), where CR (X) is corresponding to the Contrast Ratio of the point X at the figure in Note (7).



. The driving signal means the signal of gray level 0, 63, 127, 191, 255.

Gray to gray average time means the average switching time of gray level 0,63,127,191,255 to each other.



Note (4) Definition of Luminance of White L_C:

Measure the luminance of gray level 255 at center point.

 $L_{C} = L$ (5), where L (x) is corresponding to the luminance of the point X at the figure in Note (7).

Note (5) Definition of Cross Talk (CT):

 $CT = |Y_B - Y_A| / Y_A \times 100$ (%)

Where:

 Y_A = Luminance of measured location without gray level 0 pattern (cd/m²)

 Y_B = Luminance of measured location with gray level 0 pattern (cd/m²)



Note (6) Measurement Setup:

The LCD module should be stabilized at given temperature for 1 hour to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 1 hour in a windless room.



Note (7) Definition of White Variation (δW):

Measure the luminance of gray level 255 at 5 points

18



δW = Maximum [L (1), L (2), L (3), L (4), L (5)] / Minimum [L (1), L (2), L (3), L (4), L (5)]



Active Area





8. PRECAUTIONS

8.1 ASSEMBLY AND HANDLING PRECAUTIONS

- (1) Do not apply rough force such as bending or twisting to the module during assembly.
- (2) It is recommended to assemble or to install a module into the user's system in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
- (3) Do not apply pressure or impulse to the module to prevent the damage of LCD panel and Backlight.
- (4) Always follow the correct power-on sequence when the LCD module is turned on. This can prevent the damage and latch-up of the CMOS LSI chips.
- (5) Do not plug in or pull out the I/F connector while the module is in operation.
- (6) Do not disassemble the module.
- (7) Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.
- (8) Moisture can easily penetrate into LCD module and may cause the damage during operation.
- (9) High temperature or humidity may deteriorate the performance of LCD module. Please store LCD modules in the specified storage conditions.
- (10) When ambient temperature is lower than 10°C, the display quality might be reduced. For example, the response time will become slow, and the starting voltage of CCFL will be higher than that of room temperature.

8.2 SAFETY PRECAU

- (1) The startup voltage of a Backlight is approximately 1000 Volts. It may cause an electrical shock while assembling with the inverter. Do not disassemble the module or insert anything into the Backlight unit.
- (2) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.
- (3) After the module's end of life, it is not harmful in case of normal operation and storage.



9. PACKAGING

9.1 PACKING SPECIFICATIONS

- (1) 5 LCD TV modules / carton
- (2) carton dimensions :596(L) X 330 (W) X 435 (H)
- (3) Weight : approximately 22Kg (5 modules per carton)

9.2 PACKING Method

Figures 9-1 and 9-2 are the packing method



Figure.9-1 packing method



Corner Protector:L1250*50*50mm L1130*50*50mm Pallet:L1000*W1200*H140mm Pallet Stack:L1000*W1200*H1445mm Gross:412kg





Preliminary

10. MECHANICAL CHARACTERISTICS







