PREPARED BY: DATE SPEC No. LD-21810 SHARP FILE No. APPROVED BY: DATE ISSUE: Sep. 01, 2009 PAGE : 22 pages MOBILE LIQUID CRYSTAL DISPLAY GROUP APPLICABLE GROUP SHARP CORPORATION MOBILE LIQUID CRYSTAL DISPLAY **SPECIFICATION GROUP** DEVICE SPECIFICATION FOR TFT-LCD Module MODEL No.

# These parts have corresponded with the RoHS directive.

LQ231U1LW31

☐ CUSTOMER'S APPROVAL	
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MOBILE LIQUID CRYSTAL DISPLAY GROUP
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# RECORDS OF REVISION

LQ231U1LW31

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#### 1. Application

This specification sheets applies to the color TFT-LCD module LQ231U1LW31.

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The device listed in these specification sheets was designed and manufactured for use in general electronic equipment.

In case of using the device for applications such as control and safety equipment for transportation (controls of aircraft, trains, automobiles, etc.), rescue and security equipment and various safety related equipment which require higher reliability and safety, take into consideration that appropriate measures such as fail-safe functions and redundant system design should be taken.

Do not use the device for equipment that requires an extreme level of reliability, such as aerospace applications, telecommunication equipment (trunk lines), nuclear power control equipment and medical or other equipment for life support.

SHARP assumes no responsibility for any damage resulting from the use of the device which does not comply with the instructions and the precautions specified in these specification sheets.

Confirm "11. Handling Precautions" item when you use the device.

Contact and consult with a SHARP sales representative for any questions about this device.

#### 2. Overview

This module is a color active matrix LCD module incorporating amorphous silicon TFT (<u>Thin Film Transistor</u>). It is composed of a color TFT-LCD panel, driver ICs, control circuit, power supply circuit and a back light unit. Graphics and texts can be displayed on a 1600× RGB× 1200 dots panel with about 16,777,216 colors by using LDI (<u>LVDS Display Interface</u>) and supplying +5.0V DC supply voltages for TFT-LCD panel driving and applying +12.0V DC supply voltage for LED backlight-driving DC/DC converter.

It is a wide viewing-angle-module, high brightness(500cd/m²) and high speed response specification. These LCD modules have corresponded with the RoHS directive.

#### 3. Mechanical Specifications

Parameter	Specifications	Unit
Display size	59 (23.1") Diagonal	cm
Active area	470.4 (H)× 352.8 (V)	mm
Pixel format	1600 (H)× 1200 (V)	Pixel
	(1  pixel = R+G+B  dots)	
Aspect ratio	4:3	
Pixel pitch	0.294 (H)× 0.294 (V)	mm
Pixel configuration	R, G, B vertical stripe	
Display mode	Normally black	
Unit outline dimensions *1	530.0(W)× 431.5(H) × 23.9(D)TYP	mm
Mass	4,500 (max)	g
Surface treatment (Haze value)	Anti-glare coating:	
	(Haze value 40%, Hardness 2H)	

<sup>\*1.</sup>Note: excluding back light cables and connecters.

The thickness of module (D) doesn't contain the projection.

Outline dimensions are shown in Fig.1.

#### 4. Input Terminals

#### 4-1. TFT-LCD panel driving

CN1 (Interface signals and +5.0V power supply)

Using connectors : FI-WE31P-HFE (Japan Aviation Electronics Industry, Limited)

Corresponding connectors : FI-W31M (Japan Aviation Electronics Industry, Limited)

: FI-C3-A3-15000(Contact)

Using LVDS receiver : Type contained in a control IC

(DS90CF386 (NS Corporation) or equivalent)

Corresponding LDI Transmitter: DS90C387 (NS Corporation) or equivalent)

Non-DC Balanced Mode

Table 4-1-1 LDI Interface signals

Pin No.	Symbol Symbol	Function	Remark
1	Vcc	+5V power supply	
2	Vcc	+5V power supply	
3	Vcc	+5V power supply	
4	Vcc	+5V power supply	
5	GND	GND	
6	GND	GND	
7	GND	GND	
8	NC	NC	
9	GMCH	Gamma control(High)	
10	GMCL	Gamma control(Low)	
11	RxO0-	Receiver signal of LDI (O0-)	LDI
12	RxO0+	Receiver signal of LDI (O0+)	LDI
13	RxO1-	Receiver signal of LDI (O1-)	LDI
14	RxO1+	Receiver signal of LDI (O1+)	LDI
15	RxO2-	Receiver signal of LDI (O2-)	LDI
16	RxO2+	Receiver signal of LDI (O2+)	LDI
17	RxO-	Receiver CLK of LDI(OC-)	LDI
18	RxO+	Receiver CLK of LDI(OC+)	LDI
19	RxO3-	Receiver signal of LDI (O3-)	LDI
20	RxO3+	Receiver signal of LDI (O3+)	LDI
21	RxE0-	Receiver signal of LDI (E0-)	LDI
22	RxE0+	Receiver signal of LDI (E0+)	LDI
23	RxE1-	Receiver signal of LVDS (E1-)	LDI
24	RxE1+	Receiver signal of LDI (E1+)	LDI
25	RxE2-	Receiver signal of LDI (E2-)	LDI
26	RxE2+	Receiver signal of LDI (E2+)	LDI
27	RxE3-	Receiver signal of LDI (E3-)	LDI
28	RxE3+	Receiver signal of LDI (E3+)	LDI
29	NC	NC	LDI
30	LVDSGND	LVDSGND	
31	LVDSGND	LVDSGND	

Note1: Resistance (RVR) between GMCL and GMCH enables Gamma adjustment.

(See Fig.4-5-1: RVR=OPEN recommended)

Note2: There is a possibility that trouble occurs in initial and long-term reliability when using it besides corresponding connector.

## 4-2. Data Mapping

## 1) 8 bit input

Table 4-2-1 and Fig4-2-2 shows the pin assignment of the input signals.

Table 4-2-1 LDI Input signals

	<u>OI Input signa</u> Data Signal	Input Data Pin (DS90C387)	Out put Dat a Pin (DS90CF386)	LCD Unit Data Signal
LSB	R0	R16	R16	RCO
	R1	R17	R17	RO1
	R2	R10	R10	RO2
	R3	R11	R11	RO3
	R4	R12	R12	RO4
	R5	R13	R13	RO5
1.60	R6	R14	R14	RO6
M\$B	R7	R15	R15	RO7
LSB	GO CO	G16	G16	GOO
	G1	G17	G17	GO1
	G2	G10	G10	GO2
	G	G11	G11	603
	G4	G12	G12	GO4
	Œ	G13	G13	GOS
1.65	G6	G14	G14	GO6
M\$B	G7	G15	G15	G07
LSB	B0	B16	B16	BCO
	B1	B17	B17	BO1
	B2	B10	B10	BO2
	B3	B11	B11	BO3
	B4	B12	B12	BO4
	B5	B13	B13	BC5
	B6	B14	B14	BO6
M\$B	B7	B15	B15	BO7
LSB		R16	R26	RE0
		R17	R27	RE1
		R10	R20	RE2
		R11	R21	RE3
		R12	R22	RE4
		R13	R23	RE5
		R14	R24	RE6
M\$B		R15	R25	RE7
LSB		G16	G26	Œ0
		G17	G27	Œ1
		G10	G20	Œ2
		G11	G21	Œ3
		G12	G22	Œ4
		G13	G23	Œ5
		G14	G24	Œ6
M\$B		G15	G25	Œ7
LSB		B16	B26	BE0
		B17	B27	BE1
		B10	B20	BE2
		B11	B21	BE3
		B12	B22	BE4
		B13	B23	BE5
		B14	B24	BE6
M\$B		B15	B25	BE7

LDI Interface block diagram(Single input → Dual output) A/D Board **CABLE** LCD LVDS TX PinNo. DS90C387 Graphic Controller Control IC(Built in LVDS) Note-1) (DS90CF386 or equivalent) 4 R16 3 R17 RO0 R16 R1 R17 RO<sub>1</sub> R10 R2 10 R10 RO2 R3 R11 R11 RO3 R12 RO4 R4 R12 RxO0- 50 RxO0+ 49 RxO0-R5 R13 R1 RO<sub>5</sub> R13 R2 R14 RxO0+ R6 R14 RO6 R7 R15 R15 RO7 G0 G16 G16 GO0 RxO1-47 Rx01-93 G1 G17 G17 GO<sub>1</sub> RxO1+ 46 Rx01+ G2 G10 G10 GO2 G3 G11 G11 GO3 G4 100 G12 GO4 G12 RxO2- 45 RxO2+ 44 G5 99 G13 RxO2-G13 GO5 N2 RxO2+ 96 G14 G14 G6 GO6 95 G7 G15 G15 GO7 B0 86 B16 B16 B<sub>0</sub>0 RxO3-39 RxO3+38 L1 RxO3-В1 85 B17 B17 B01 B2 92 B10 L2 RxO3+ B10 BO<sub>2</sub> 91 B11 B3 B11 BO3 90 B12 B4 B12 **BO4** B5 89 B13 B13 BO<sub>5</sub> B6 88 B14 **B14 BO6** В7 87 B15 B15 **BO7** M1 RxOC-M2 RxOC+ R16 R26 RE0 R17 R27 RE1 R10 R20 RE2 R11 R21 RE3 R12 R22 RE4 R13 RxE0- 37 RxE0+ 36 RxE0-R23 RE5 R14 ∎ | J2 RxE0+ R24 RE6 R15 R25 RE7 G16 GF<sub>0</sub> G26 RxE1- 34 RxE1+ 33 H1 RxE1-G17 G27 GE<sub>1</sub> | H2 RxE1+ G10 G20 GE2 G11 G21 GE3 G12 G22 GE4 RxE2- 32 RxE2+ 31 G1 RxE2-G23 GE<sub>5</sub> G13 ∏ G2 RxE2+ G14 G24 GE<sub>6</sub> G15 G25 GE7 B16 B26 BE0 ı RxE3- 29 RxE3+ 28 B17 E1 RxE3-**B27** BE1 | | E2 RxE3+ B10 B20 BF2 B11 B21 RF3 B12 B22 BF4 B13 B23 BE5 B14 B24 BE6 B15 B25 BE7 Note-2 Note-2 54 Hsync RxC- 42 F1 RxEC-Hsync Hsync Hsync

Note-1) Signal configuration

Vsync

CLOCK

DE

EVEN DATA(ROx,BOx,GOx: 1'st,3'rd,5th·····data)
ODD DATA(REx,GEx,BEx : 2'nd,4'th,6'th····data)

RxC+ 41

Note-2) Hsync, Vsync Not use.

Note-3) Use twisted differential cable (i npedance =  $100\Omega$ )

55 Vsync

11 CLKIN

56 DE

Note-4) DS90C387: Non-DC Balanced Mode

Figure 4-2-2 Interface pin assignment

I

F2

RxEC+

Vsync

DE

CLKOUT

Vsync

**CLOCK** 

DE

Table 4-2-3 LDI Input signals(Dual input)

VGA-TFT         Data         Signal (DS90C387)         Output Data Pin (DS90CF386)         LCD Unit Data Signal           LSB RE1 RE1 RR17 RR17 RR17 RR17 RR2 RE2 RR2 RR10 RR2 RR2 RR2 RR2 RR10 RR2 RR2 RR2 RR2 RR2 RR2 RR2 RR2 RR2 RR	+- Z- 3 LI	JI Triput Signa	Is(Dual Input)	0	
RE1	VGA-TFT	Data Signal			LCD Unit Data Signal
RE2         R10         R10         R02           RE3         R11         R11         R03           RE4         R12         R12         R04           RE5         R13         R13         R05           RE6         R14         R14         R06           MSB         RE7         R15         R15         R07           LSB         GE0         G16         G16         G00         G01           GE1         G17         G17         G01         G01         G02         G01           GE3         G11         G11         G03         G04         G05         R04         G0	LSB	RE0	R16	R16	RCO
RE3         R11         R11         R08           RE4         R12         R12         R04           RE5         R13         R13         R05           RE6         R14         R14         R06           RE7         R15         R15         R07           LSB         GE0         G16         G16         G06           GE1         G17         G17         G01           GE2         G10         G10         G02           GE3         G11         G11         G08           GE4         G12         G12         G04           GE5         G13         G13         G05           GE6         G14         G14         G06           GE6         G14         G14         G06           BE1         B17         B17         B01           BE2         B10         B16         B16         B00           BE1         B17         B17         B01         B02           BE3         B11         B11         B03         B05           BE4         B12         B12         B04           BE5         B13         B13         B05		RE1	R17	R17	RO1
RE4         R12         R12         R04           RE5         R13         R13         R05           RE6         R14         R14         R14         R06           RE7         R15         R15         R07           LSB         GE0         G16         G16         G00           GE1         G17         G17         G01           GE2         G10         G10         G02           GE3         G11         G11         G03           GE4         G12         G12         G04           GE5         G13         G13         G05           GE6         G14         G14         G06           MSB         GE7         G15         G15         G07           LSB         BE0         B16         B16         B00         B00           BE1         B17         B17         B01         B00         B00           BE2         B10         B10         B02         B18         B19         B19         B00		RE2	R10	R10	RC2
MSB         RE5         R13         R14         R06           LSB         RE7         R15         R15         R07           LSB         GE0         G16         G16         G00           GE1         G17         G17         G01           GE2         G10         G10         G02           GE3         G11         G11         G03           GE4         G12         G12         G04           GE5         G13         G13         G05           GE6         G14         G14         G06           GE6         G14         G14         G06           BE1         B17         B17         B01           BE2         B10         B16         B16         B00           BE3         B11         B11         B08         B02           BE3         B11         B11         B08         B09           BE4         B12         B12         B10         B00           BE5         B13         B13         B06         B00           MSB         BE6         B14         B14         B06         B07           LSB         R00         R26 <td< td=""><td></td><td>RE3</td><td>R11</td><td>R11</td><td>RC8</td></td<>		RE3	R11	R11	RC8
MSB         RE6         R14         R14         RC6           RF7         R15         R15         RC7           LSB         GE0         G16         G16         G20           GE1         G17         G17         G01           GE2         G10         G10         G02           GE3         G11         G11         G02           GE4         G12         G12         G04           GE5         G13         G13         G05           GE6         G14         G14         G06           GE7         G15         G15         G07           LSB         BE0         B16         B16         B00           BE1         B17         B17         B01         B01           BE2         B10         B10         B02         B01           BE3         B11         B11         B03         B01           BE4         B12         B12         B04         B05           BE5         B13         B13         B05           MSB         BE7         B15         B15         B07           LSB         R01         R26         R26         R26 <td< td=""><td></td><td>RE4</td><td>R12</td><td>R12</td><td>RO4</td></td<>		RE4	R12	R12	RO4
MSB         RE7         R15         R15         R07           LSB         GE0         G16         G16         G30           GE1         G17         G17         G01           GE2         G10         G10         G02           GE3         G11         G11         G03           GE5         G13         G13         G05           GE6         G14         G14         G05           LSB         BE0         B16         B16         B00           BE1         B17         B17         B01         B02           BE3         B11         B11         B0         B02           BE3         B11         B11         B0         B04           BE5         B13         B13         B06         B06           BE6         B14         B14         B04         B06           BE7         B15         B15         B07           LSB         R00         R26         R26         R80           R01         R27         R27         R21         R2           R02         R20         R20         R22         R2           R03         R21         R2		RE5	R13	R13	RO5
LSB		RE6	R14	R14	RO6
GE1   G17   G17   G01     GE2   G10   G10   G02     GE3   G11   G11   G03     GE4   G12   G12   G04     GE5   G13   G13   G05     GE6   G14   G14   G06     LSB   BE0   B16   B16   B00     BE1   B17   B17   B01     BE2   B10   B10   B02     BE3   B11   B11   B03     BE4   B12   B12   B04     BE5   B13   B13   B05     BE6   B14   B14   B06     BE7   B15   B15   B07     LSB   ROD   R26   R26   RE0     ROI   R27   R27   RE1     ROB   ROB   R23   R23   RE5     ROB   ROT   R25   R24   R24   R26     ROB   G04   G22   G22   G24     G05   G23   G23   G25     G06   R01   R27   R27   R21     ROB   G07   G25   G25   G27     LSB   B00   B26   B26   B20     MSB   G07   G25   G25   G27   B21     LSB   B00   B26   B26   B20   B20   B22     LSB   B00   B26   B26   B26   B20     MSB   G07   G25   G25   G27   B21     LSB   B00   B26   B26   B26   B20   B22     LSB   B00   B26   B26   B26   B20     LSB   B01   B27   B27   B21   B23     LSB   B00   B26   B26   B20   B22   B24     LSB   B00   B26   B26   B26   B20   B22   B24     B03   B21   B21   B23   B25     B04   B22   B22   B24   B26     B05   B24   B24   B26   B26     B06   B24   B24   B26     B06   B24   B24   B26     G05   B23   B23   B25     B06   B24   B24   B26     B06   B24   B24   B26     B06   B26   B26   B26   B26     B07   B27   B27   B27   B27     LSB   B00   B26   B26   B26   B26   B26     B06   B24   B24   B26   B26   B26     B06   B26   B26   B26   B26   B26   B26     B07   B27   B27   B27   B27   B27     B08   B09   B26   B26   B26   B26   B26   B26     B08   B21   B21   B23   B25   B26     B08   B24   B24   B26   B26   B26   B26     B08   B26   B26   B26   B26   B26   B26   B26     B08   B21   B21   B23   B25   B26     B08   B24   B24   B24   B26   B26     B09   B26   B26   B26   B26   B26   B26   B26   B26   B26     B06   B24   B24   B24   B26   B26   B26   B26   B26     B07   B07   B07   B07   B07   B27	MSB	RE7	R15	R15	RO7
GE2   G10   G10   G02     GE3   G11   G11   G03     GE4   G12   G12   G04     GE5   G3   G3   G05     GE6   G14   G14   G05     GE7   G15   G15   G07     LSB   BE0   B16   B16   B00     BE1   B17   B17   B01     BE2   B10   B10   B02     BE3   B11   B11   B11   B03     BE4   B12   B12   B12   B04     BE5   B13   B13   B13   B05     BE6   B14   B14   B06     BE7   B15   B15   B15   B07     LSB   ROD   R26   R26   R20     ROB   ROB   R21   R21   R23     RO4   R22   R22   R22   R24     RO5   R23   R23   R25     RO6   R24   R24   R26     RO7   R25   R25   R27   G21     G02   G20   G20   G22   G24     G03   G21   G21   G23     G04   G22   G22   G24     G05   G24   G24   G26   B20     LSB   B00   B26   B27   B27   B21     LSB   B00   B26   B20   B20   B20     B03   B21   B21   B23     B04   B22   B22   B24     B05   B05   B24   B26   B26     B06   B24   B26   B26     B06   B24   B26   B26     B06   B28   B21   B21   B23     B06   B28   B23   B25     B06   B24   B26   B26     B06   B26   B26   B26     B07   B27   B27   B27     B17   B17   B17   B17   B17   B17     B18   B19   B26   B26   B26     B19   B10   B27   B27   B27     B10   B10   B27   B27   B27     B11   B12   B23   B26     B10   B10   B10   B10   B10   B10     B10   B	LSB	Œ0	G16	G16	G00
GE3         G11         G11         G08           GE4         G12         G12         G04           GE5         G13         G13         G05           GE6         G14         G14         G06           GE7         G15         G15         G07           LSB         BE0         B16         B16         B00           BE1         B17         B17         B01         B02           BE3         B11         B11         B0         B02           BE3         B11         B11         B08         B04         B08           BE5         B13         B13         B05         B04         B06         B06         B06         B06         B07         B06         B07         B06         B07         B06         B07         B06         B07         B07         B08         B09         B08<		Œ1	G17	G17	GO1
GE4		Œ2	G10	G10	GO2
GE5   G13   G13   G05     GE6   G14   G14   G06     GE7   G15   G15   G07     LSB		Œ3	G11	G11	GCB
GE6		Œ4	G12	G12	GO4
MSB   GE7   G15   G15   G07		Œ5	G13	G13	GO5
LSB		Œ6	G14	G14	G06
BE1	M\$B	Œ7	G15	G15	G07
BE1	LSB	BE0	B16	B16	BC0
BE2         B10         B10         B02           BE3         B11         B11         B03           BE4         B12         B12         B04           BE5         B13         B13         B05           BE6         B14         B14         B06           BE7         B15         B15         B07           LSB         RCD         R26         R26         RE0           RO1         R27         R27         RE1           RO2         R20         R20         RE2           RCB         R21         R21         R3           RCB         R21         R21         R3           RCB         R23         R23         R25           RCG         R24         R24         R26           RCG         R24         R24         R26           RCG         R24         R24         R26           RCG         R23         R23         R25           RCF         R25         R25         R27           LSB         GCO         G26         G26         G20           GCO         G27         G27         G21         G23           GCO </td <td></td> <td>BE1</td> <td></td> <td></td> <td>BO1</td>		BE1			BO1
BE3         B11         B11         B03           BE4         B12         B12         B04           BE5         B13         B13         B05           BE6         B14         B14         B06           BE7         B15         B15         B07           LSB         R00         R26         R26         RE0           R01         R27         R27         RE1           R02         R20         R20         RE2           R03         R21         R21         R23           R04         R22         R22         RE4           R06         R23         R23         RE5           R06         R24         R24         RE6           R07         R25         R25         R25           R25         R25         R25         RE7           LSB         G00         G26         G26         G20           G01         G27         G27         G21         G21           G02         G20         G20         G22         G24           G03         G21         G21         G23         G25           G05         G23         G23         G					
BE4         B12         B12         B04           BE5         B13         B13         B05           BE6         B14         B14         B06           BE7         B15         B15         B07           LSB         RO         R26         R26         RE0           RO1         R27         R27         RE1           RO2         R20         R20         RE2           RO3         R21         R21         RE3           RO4         R22         R22         RE4           RO5         R23         R23         R25           RC6         R24         R24         R26           RO5         R23         R23         RE5           RC6         R24         R24         R26           MSB         RO7         R25         R25         R25           RE7         LSB         GO0         G26         G26         G20           GO2         G20         G20         G22         G22           GO3         G21         G21         G23           GO4         G22         G22         G24           GO5         G23         G23         G2					
MSB         BES         B13         B13         BCS           MSB         BE6         B14         B14         B06           LSB         RCO         R26         R26         RE0           ROI         R27         R27         RE1           RCQ         R20         R20         RE2           RCB         R21         R21         RE3           RCM         R22         R22         RE4           RCG         R23         R23         RE5           RCG         R24         R24         RE6           MSB         RO7         R25         R25         RE7           LSB         GO0         Q26         Q26         G20         G20           GO1         Q7         Q7         Q7         Q1         Q2           GO2         Q20         Q20         Q22         Q24         Q24         Q24         Q26         Q24         Q24         Q26         Q25         Q25         Q25         Q25         Q27         Q27         Q27         Q27         Q24         Q24         Q24         Q24         Q24         Q24         Q24         Q26         Q22         Q22         Q24		BE4			BO4
MSB         BE7         B15         B15         B07           LSB         RO0         R26         R26         RE0           RO1         R27         R27         RE1           RO2         R20         R20         RE2           RCB         R21         R21         RE3           RO4         R22         R22         RE4           RC6         R23         R23         RE5           RC6         R24         R24         RE6           MSB         RO7         R25         R25         RE7           LSB         GO0         Q26         Q26         Q20         Q20           GO1         Q27         Q27         QE1         QE3           GO2         Q20         Q20         QE2         QE4           GO3         Q21         Q21         QE3         QE5           GO4         Q22         Q22         QE4         QE6           MSB         GO7         Q25         Q25         QE7         QE7           LSB         BO0         B26         B26         BE0         BE0           BO1         B27         B27         B21         B21         <					
LSB RO R26 R26 RE0  ROI R27 R27 RE1  RO2 R20 R20 RE2  RO3 R21 R21 R3  RO4 R22 R22 R22 RE4  RO5 R23 R23 R23 RE5  RO6 R24 R24 R24 RE6  SO1 G27 G27 G27  G30 G2 G20 G20 G22  G38 G21 G21 G21 G33  G34 G22 G22 G24  G35 G36 G24 G26  MBB G07 G25 G25 G27  LSB BO B26 B20 B20  BO4 B22 B22 B24  BC6 R24 B26  BC6 B24 B26  BC6 B24 B26  BC6 B24 B26  BC6 B22 B22 BE4  BC6 B26 B26  BC6 B26  BC7  BC7  BC8 B27  BC8 B27  BC9 B20 B20  BC9 BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 BC9  BC9 B		BE6	B14	B14	BC6
ROI         R27         R27         RE1           RO2         R20         R20         RE2           ROB         R21         R21         RE3           RO4         R22         R22         RE4           RO5         R23         R23         RE5           RC6         R24         R24         RE6           MSB         RO7         R25         R25         RE7           LSB         GO0         G26         G26         GE0           GO1         G27         G27         GE1           GO2         G20         G20         G22           GO3         G21         G21         G23           GO4         G22         G22         G24           GO5         G23         G23         G25           GO6         G24         G24         G26           MSB         GO7         G25         G25         G27           LSB         BO0         B26         B26         BE0           BO1         B27         B27         BE1           BO2         B20         B20         BE2           BO3         B21         B21         BE3	M\$B				
ROI         R27         R27         RE1           RO2         R20         R20         RE2           ROB         R21         R21         RE3           RO4         R22         R22         RE4           RO5         R23         R23         RE5           RC6         R24         R24         RE6           MSB         RO7         R25         R25         RE7           LSB         GO0         G26         G26         GE0           GO1         G27         G27         GE1           GO2         G20         G20         G22           GO3         G21         G21         G23           GO4         G22         G22         G24           GO5         G23         G23         G25           GO6         G24         G24         G26           MSB         GO7         G25         G25         G27           LSB         BO0         B26         B26         BE0           BO1         B27         B27         BE1           BO2         B20         B20         BE2           BO3         B21         B21         BE3	LSB	RCO	R26	R26	RE0
RO2         R20         R20         RE2           RO3         R21         R21         RE3           RO4         R22         R22         RE4           RO5         R23         R23         RE5           RO6         R24         R24         RE6           MSB         RO7         R25         R25         RE7           LSB         GO0         G26         G26         GE0           GO1         G27         G27         G21         G21           GO2         G03         G21         G21         G23           GO3         G23         G23         G25           GO5         G23         G23         G25           GO6         G24         G24         G26           MSB         GO7         G25         G25         G27           LSB         BO0         B26         B26         BE0           BO1         B27         B27         BE1           BO2         B20         B20         BE2           BO3         B21         B21         BE3           BO4         B22         B22         BE4           BO5         B23         B					
RCB         R21         R21         RE3           RC4         R22         R22         RE4           RC5         R23         R23         RE5           RC6         R24         R24         RE6           RC7         R25         R25         RE7           LSB         GC0         G26         G26         GE0           GC1         G27         G27         GE1         GE1           GC2         G20         G20         G20         GE2           GC3         G21         G21         G23         G23           GC6         G24         G24         G24         G26           MSB         GC7         G25         G25         GE7           LSB         BC0         B26         B26         BE0           BC1         B27         B27         BE1           BC2         B20         B20         BE2           BC3         B21         B21         BE3           BC4         B22         B22         BE4           BC5         B23         B23         B24         BE6		RO2	R20	R20	RE2
RO4         R22         R22         RE4           RC5         R23         R23         RE5           RC6         R24         R24         RE6           RC7         R25         R25         RE7           LSB         GC0         G26         G26         GE0           GC1         G27         G27         GE1           GC2         G20         G20         GE2           GC3         G21         G21         GE3           GC4         G22         G22         GE4           GC5         G23         G23         GE5           GC6         G24         G24         GE6           MSB         GO7         G25         G25         GE7           LSB         BO0         B26         B26         BE0           BO1         B27         B27         BE1           BO2         B20         B20         BE2           BO3         B21         B21         BE3           BO4         B22         B22         BE4           BC5         B24         B24         BE6		RO3	R21	R21	
MSB         RC6         R24         R24         RE6           RO7         R25         R25         RE7           LSB         GO         G26         G26         G20           GO1         G27         G27         GE1           GO2         G20         G20         G21           GO3         G21         G21         G23           GO4         G22         G22         G24           GO5         G23         G23         G25           GC6         G24         G24         G26           MSB         GO7         G25         G25         G27           LSB         BO0         B26         B26         BE0           BO1         B27         B27         BE1           BO2         B20         B20         BE2           BO3         B21         B21         BE3           BO4         B22         B22         BE4           BC5         B23         B23         BE5           BC6         B24         B24         BE6		RO4	R22	R22	RE4
MSB         RO7         R25         R25         RE7           LSB         GOO         G26         G26         GEO           GO1         G27         G27         GE1           GO2         G20         G20         GE2           GO3         G21         G21         GE3           GO4         G22         G22         GE4           GO5         G23         G23         GE5           GO6         G24         G24         GE6           MSB         GO7         G25         G25         GE7           LSB         BO0         B26         B26         BE0           BO1         B27         B27         BE1           BO2         B20         B20         BE2           BO3         B21         B21         BE3           BO4         B22         B22         BE4           BO5         B23         B23         BE5           BO6         B24         B24         BE6		RO5	R23	R23	RE5
LSB GOO G26 G26 GEO  GOI G27 G27 GE1  GO2 G20 G20 G20  GO3 G21 G21 G23  GO4 G22 G22 G24  GO5 G23 G23 G23  GC5 G23 G25  GO6 G24 G24 G24  LSB GO7 G25 G25 G27  LSB BOO B26 B26 B26 BEO  BOI B27 B27 BE1  BO2 B20 B20 B20  BC3 BC4 B22 B22 BE4  BO5 B23 B23 BE5  BC6 B24 B24 B26  BC6 BE6		RC6	R24	R24	RE6
GOI   G27   G27   GE1     GO2   G20   G20   GE2     GOB   G21   G21   GE3     GO4   G22   G22   GE4     GO5   G23   G23   GE5     GO6   G24   G24   G26     LSB   BO0   B26   B26   BE0     BO1   B27   B27   BE1     BO2   B20   B20   BE2     BO3   B21   B21   BE3     BO4   B22   B22   BE4     BO5   B23   B23   BE5     BO6   B24   B24   BE6	M\$B	RO7	R25	R25	RE7
GOI   G27   G27   GE1     GO2   G20   G20   GE2     GOB   G21   G21   GE3     GO4   G22   G22   GE4     GO5   G23   G23   GE5     GO6   G24   G24   G26     LSB   BO0   B26   B26   BE0     BO1   B27   B27   BE1     BO2   B20   B20   BE2     BO3   B21   B21   BE3     BO4   B22   B22   BE4     BO5   B23   B23   BE5     BO6   B24   B24   BE6	LSB	G00	G26	G26	Œ0
GO2   G20   G20   GE2					
GC3   G21   G21   GE3     GO4   G22   G22   GE4     GC5   G23   G23   GE5     GC6   G24   G24   GE6     GC7   G25   G25   GE7     LSB   BO0   B26   B26   BE0     BO1   B27   B27   BE1     BO2   B20   B20   BE2     BO3   B21   B21   BE3     BO4   B22   B22   BE4     BO5   B23   B23   BE5     BC6   BC6   BC6     GE5   GE7     GE6   GE6     GE6   GE7     GE7   GE7     GE8   GE7     GE9   GE9   GE9     GE9   GE9   GE9   GE9     GE9   GE9   GE9   GE9     GE9   GE9   GE9   GE9     GE9   GE9   GE9   GE9     GE9   GE9   GE9   GE9     GE9   GE9   GE9   GE9     GE9   GE9   GE9   GE9     GE9   GE9   GE9   GE9     GE9   GE9   GE9   GE9     GE9   GE9   GE9   GE9     GE9   GE9   GE9   GE9     GE9   GE9   GE9   GE9     GE9   GE9   GE9   GE9     GE9   GE9   GE9   GE9     GE9   GE9   GE9   GE9     GE9   GE9   GE9   GE9     GE9   GE9   GE9   GE9     GE9   GE9   GE9   GE9     GE9   GE9   GE9   GE9   GE9     GE9   GE9   GE9   GE9   GE9     GE9   GE9   GE9   GE9   GE9   GE9     GE9   GE9   GE9   GE9   GE9   GE9   GE9     GE9   GE9   GE9   GE9   GE9   GE9   GE9   GE9     GE9   GE9   GE9   GE9   GE9   GE9   GE					
GO4 G22 G22 GE4 GO5 G23 G23 GE5 GO6 G24 G24 GE6 GO7 G25 G25 GE7  LSB BO0 B26 B26 B26 BE0 BO1 B27 B27 BE1 BO2 B20 B20 BE2 BO8 B21 B21 BE3 BO4 B22 B22 B24 BO5 B26 B26 BE6					
MSB         GC6         G24         G24         GE6           GO7         G25         G25         GE7           LSB         BO0         B26         B26         BE0           BO1         B27         B27         BE1           BO2         B20         B20         BE2           BO3         B21         B21         BE3           BO4         B22         B22         BE4           BO5         B23         B23         BE5           BO6         B24         B24         BE6			G22	<b>©</b> 22	Œ4
MSB         GC6         G24         G24         GE6           GO7         G25         G25         GE7           LSB         BO0         B26         B26         BE0           BO1         B27         B27         BE1           BO2         B20         B20         BE2           BO3         B21         B21         BE3           BO4         B22         B22         BE4           BO5         B23         B23         BE5           BO6         B24         B24         BE6		GOS	G23	<b>©</b> 3	Œ5
LSB BOO B26 B26 BE0  BOI B27 B27 BE1  BO2 B20 B20 B20 BE2  BO3 B21 B21 BE3  BO4 B22 B22 B22 BE4  BO5 B23 B23 B25  BO6 B24 B24 B26	]		G24	G24	Œ6
LSB         BO         B26         B26         BE0           BO1         B27         B27         BE1           BO2         B20         B20         BE2           BO3         B21         B21         BE3           BO4         B22         B22         BE4           BO5         B23         B23         BE5           BO6         B24         B24         BE6	M\$B			<b>G</b> 25	Œ7
BO1         B27         B27         BE1           BO2         B20         B20         BE2           BO3         B21         B21         BE3           BO4         B22         B22         BE4           BO5         B23         B23         BE5           BO6         B24         B24         BE6	LSB	BCO	B26	B26	BE0
BO2         B20         B20         BE2           BO3         B21         B21         BE3           BO4         B22         B22         BE4           BC5         B23         B23         BE5           BC6         B24         B24         BE6					
BCB         B21         B21         BE3           BO4         B22         B22         BE4           BC5         B23         B23         BE5           BC6         B24         B24         BE6					
BO4         B22         B22         BE4           BO5         B23         B23         BE5           BO6         B24         B24         BE6					
BC5 B23 B23 BE5 BC6 B24 B24 BE6					
BO6 B24 B24 BE6					
M\$B BO7 B25 BE7					
	M\$B	BO7	B25	B25	BE7

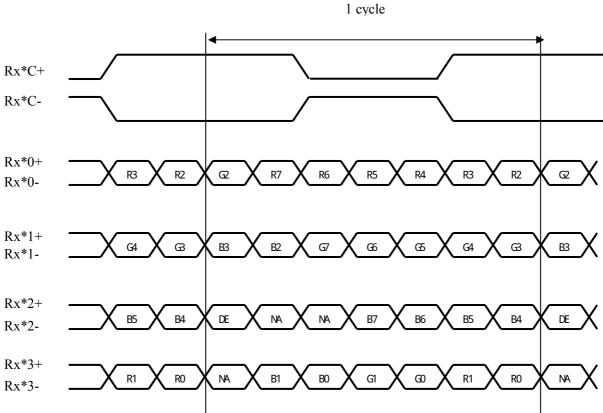
A/D Board   CABLE   LCD		LDI Int	erface	bl ock	di agr	an(i Dual	i nput :	→ Dual	out put	)	
Caraphic controller											
Caraphic controller		•								•	
Caraphic controller				>.							
RE1	O	allan D' No									
RE1				J38/	•			(D2900		or equivalen	
RE2											
RE3			R10								
RE5	RE3	9	R11						R11		
RE6		8	R12	DO.0	F0		D.	DO0			
RE7		6									
GE0				11200	70		1\2	TXXXX			
GE2			G16								
GE3		93					P1	Rx01-			
GE4		2		RxO1+	46		P2	RxO1+			
GE5		100									
GE6				RxO2-	45		N1	RxO2-			
BEO			G14						G14		
BE1											
BE2				D <sub>v</sub> O2	20		1 1	D <sub>v</sub> O2			
BE3			B17 B10	R <sub>2</sub> O3+	38						
BE4   90 B12   B13   B13   B13   B14   B15   B14   B06   B15   B15   B14   B06   B15   B15   B15   B15   B16   B15   B16   B15   B07   B16   B16   B15   B07   B16   B				11200	00			TXXXX			
BE6   BE7   B15   B15   B15   B15   B15   B07   B15   B15   B07   B15   B15   B07   B15   B07   B15   B07   B15   B15   B07   B15   B07   B15   B15   B07   B15   B07   B15   B07   B15   B15   B15   B15   B15   B15   B07   B15   B15											
ROO		89	B13								
Mil RxOC-   MZ   R26   R27   R21   R20   R22   R21   R23   R22   R24   R25   R27   R25   R27   R20   R22   R21   R23   R22   R24   R26   R27   R20   R22   R24   R26   R25   R25   R27   R26											
ROO	BE/	87	Віз				М1	RvOC-	ВІЭ		
RO0							M2	RxOC+			
RO2 RO3 81 R21 R21 R23 RXE0- R22 R23 RE5 R64 R05 79 R23 RXE0- R23 RE5 R06 78 R24 RXE0+ R26 R27 R24 R26 R27 R26 R27 R27 R27 R25 R26 R27 R26 R27 R27 R26 R27 R27 R27 R27 R27 R28 R29			R26								
RO3			R27								
RO4 RO5 F79 R23 RXE0- R06 F8 R24 RXE0+ R25 RE6 RO7 R07 R25 RE6 RO7 RO00 RE6 RO26 RO1 RE6 RO27 RXE1- RC2 RE7 RE6 RC36 RE7 RE7 RE6 RC36 RE7 RE7 RE6 RC7 RC7 RC9											
RO5						l					
RO6   78   R24   RxE0+   36   J2   RxE0+   R25   RE7				RxE0-	37		i    J1	RxE0-			
GO0		78	R24	RxE0+					R24		RE6
GO1											
GO2				DvE1_	24	I	╎│╻₁	DvE1_			
GO3				R <sub>x</sub> F1+	33						
GO5					-		H				
GO6   GO7   GO24   RxE2+   GO7   GO5   G			G22				!				
GO7					32						
BO0       58       B26       B27       RxE3-       B27       BE1         BO2       64       B20       RxE3+       RxE3-       B27       BE1         BO3       63       B21       B22       B21       B23         BO5       61       B23       B22       B24       B23       B24       B25         BO7       59       B25       B25       B25       B27       Note         Note       Hsync       F1       RxEC-       Hsync       Note         Vsync       55       Vsync       RxC-       F2       RxEC-       Hsync       Note         Vsync       55       Vsync       RxC-       F2       RxEC-       Hsync       Note         CLOCK       11       CLKIN       CLKOUT       CLKOUT       42       CLOCK				KXEZ+	।		G2	KXEZ+			
BO1							!				
BO2	BO1	57	B27	RxE3-	29		E1	RxE3-	B27		BE1
BO3	BO2	64	B20	RxE3+	28		E2	RxE3+	B20		BE2
BO5		63	B21								
BO6   B07   S09   B25   B25		62	B22								
Note		60	B24								
Note         Hsync         54 Hsync         RxC-         42         F1 RxEC-         Hsync         71 Hsync           Vsync         55 Vsync         RxC+         41         F2 RxEC+         Vsync         70 Vsync           DE         56 DE         DE         69 DE           CLOCK         11 CLKIN         CLKOUT         42 CLOCK		59	B25								
Hsync       54 Hsync       RxC- 42         F1 RxEC- Hsync       71       Hsync       70       Vsync       70       Vsync       70       Vsync       70       DE       69       DE       0E											_
Vsync         55 Vsync         RxC+ 41         F2 RxEC+ Vsync         70         Vsync           DE         56 DE         DE         69         DE           CLOCK         11 CLKIN         CLKOUT         42         CLOCK		<b>-</b> -	ļ.,	Б ^	40		i	DE.O			
DE         56 DE         DE         69 DE           CLOCK         11 CLKIN         CLKOUT         42 CLOCK				KXU-	42 41						
CLOCK 11 CLKIN CLKOUT 42 CLOCK				TXU+	41		FZ	HXEU+			
		11	CLKIN			! 		C			
											_

Note-1 Hsync, Vsync Not use Note-2 Use twisted differential cable ( impedance =  $100\Omega$  )

Note-3 DS90C387: Non-DC Balanced Mode

Figure 4-2-4 Interface pin assignment

## 4-3. Input signal timing chart



0 or E

DE : Display Enable NA : Not Available

### 4-4. Backlight

CN2

Using connector : S12B-PH-SM4-TB (JST)

Corresponding connector: PHR-12 (JST) (Cable: AWG#24 recommended)

Pin No.	Symbol	Function	Remark
1	$ m V_{LED}$	+12.0V LED Backlight power supply	
2	$V_{\mathrm{LED}}$	+12.0V LED Backlight power supply	
3	$V_{\mathrm{LED}}$	+12.0V LED Backlight power supply	
4	$V_{\mathrm{LED}}$	+12.0V LED Backlight power supply	
5	$V_{ m LED}$	+12.0V LED Backlight power supply	
6	LED GND	LED GND	
7	LED GND	LED GND	
8	LED GND	LED GND	
9	LED GND	LED GND	
10	LED GND	LED GND	
11	Vent	BL ON/OFF	
12	Vvr	Brightness control	

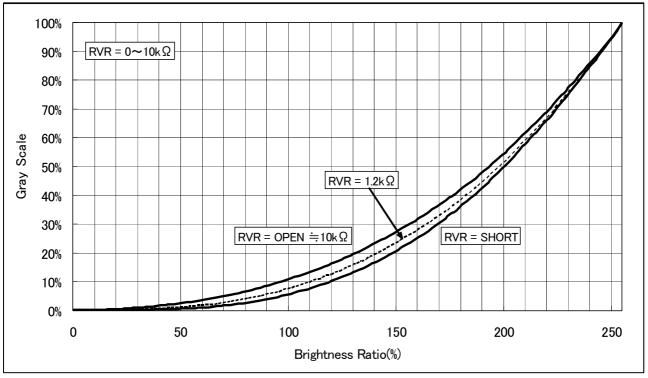


Figure 4-5-1 Gamma characteristics

Note) Fig.4-5-1 shows reference characteristics but dose not guarantee it.

#### 5. Absolute Maximum Ratings

Parameter	Symbol	Condition	Terminal Symbol	Ratings		Unit	Remark
Supply voltage	Vcc	Ta=25℃	Vcc	-0.3	~ +6.0	V	[Note1]
LED Supply voltage	$ m V_{LED}$	Ta=25℃	$ m V_{LED}$	-0.3	~ +14.0		
Input voltage	$\mathbf{V}_{\mathrm{L}}$	Ta=25°C	LVDS input signal	-0.3	3 ~ +3.6	V	
	Vent	Ta=25℃	Vent	-0.3	-0.3 ~ VLED		
	Vvr	Ta=25℃	Vvr		0 ~ 4.0	V	
LED temperature	$T_{LED}$	-	-		+90	°C	[Note2]
Storage temperature	$T_{STG}$	Ambient	-	-20	0 ~ +65	°C	【Note1】
Operating temperature	T <sub>OPA</sub>	Ambient	-	min 0		°C	[Note1]
		Panel surface (Active area)	-	max	+ 60		

[Note1] Humidity: 90%RH Max. ( $Ta \le 40$ °C)

Maximum wet-bulb temperature at 39°C or less. (Ta>40°C)

No condensation.

[Note2] The measurement point refers to Fig. 1.

[Note3] There is a possibility of causing deterioration in the irregularity and others of the screen and the display fineness when preserving or using it in more than 60°C.

[ Note4 ] When ambient temperature is more than 50°C, please cool the back side of the LCD module by a fan.

#### 6. Electrical Characteristics

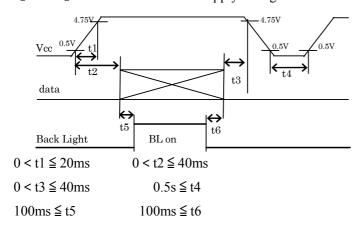
#### 6-1. TFT-LCD panel driving

Ta = +25°C

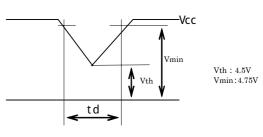
arameter		Symbol	Min.	Тур.	Max.	Unit	Remark
Supply voltage		$V_{CC}$	+4.75	+5.0	+5.25	V	[Note2]
Current dissipation	Vcc=5.0V	$I_{CC}$	-	1100	1800	mA	【Note3】
Input voltage for LDI	LDI signal	$V_{\mathrm{L}}$	0	-	2.4	V	
Permissive input ripple voltage		$V_{RP}$	-	-	100	mVp-p	Vcc=+5.0V
Differential input threshold	High	$V_{_{\mathrm{TH}}}$	-	-	V <sub>CM</sub> +100	mV	$V_{CM}=+1.2V$
voltage							
	Low	$V_{_{\mathrm{TL}}}$	$V_{CM}$ $-100$	-	-	mV	【Note1】
Terminal resistor		$R_{T}$	-	100	-	Ω	Differential
							input

[Note1]  $V_{CM}$ : Common mode voltage of LDI driver.

[Note2] On-off condition for supply voltage



Vcc-dip conditions



- 1) Vth ≤ Vcc < Vmin td ≦ 20ms
- 2) Vcc<Vth

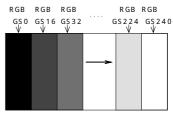
Vcc-dip conditions should also follow the on-off conditions for supply voltage.

#### [Note3] Current dissipation

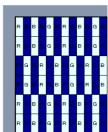
Standard value: 16-gray-bar pattern

(Measurement condition Vcc=+5.0V, 1/Tc=81MHz, Ta=25°C)

Refer to Chapter 8 for RGB each gray scale



Maximum value: vertical 2dot checker (0/256-255/256) (Measurement condition Vcc=+4.75V, 1/Tc=81MHz, Ta=25°C)



### 6-2. Backlight

The backlight system is an edge-lighting type with white-LED.

(It is usually required to measure under the following condition: Ta=25°C± 2°C)

Parameter	Symbol	Min.	Тур.	Max.	Unit	Remark
Supply voltage	$V_{ m LED}$	11.4	12.0	12.6	V	
Current dissipation	$I_{LED}$	-	5.0	5.8	A	$V_{LED} = 12.0V$
						$V_{Vr} = 0V$
Brightness Control Voltage	V <sub>VR</sub>	0	-	3.5	V	[Note1]
LED ON/OFF Low Voltage	V <sub>cnt</sub> L	0	_	1.0	V	【Note2】
LED ON/OFF High Voltage	V <sub>ent</sub> H	4.5	_	$ m V_{LED}$	V	[Note2]
LED life time	-	30,000	50,000	-	h	LED only

The reference LED life time is 30,000h defined by below.

(Continuous turning on at LED Junction temperature (Tj) 100°C,

LED Current (If) = 150mA (equal to Max.Brightness)

A state only for LED)

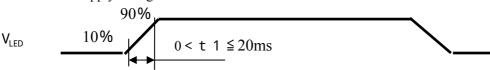
When a brightness of LED surface became 50% of the specifications minimum.

[Note1]  $V_{VR}$  input :0V= Max.Brightness 3.5V=Min. Brightness

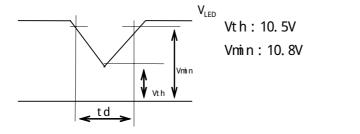
[Note2]  $V_{cnt}$  input: Low or OPEN = BL turn on High = BL turn off

[Note3]

On-off condition for supply voltage



 $V_{\text{LED}}\text{-dip conditions}$ 



- 1)  $Vth \leq V_{LED} < Vmin$  $td \leq 20ms$
- 2) V<sub>LED</sub><Vt h

### 7. Timing characteristics of input signals

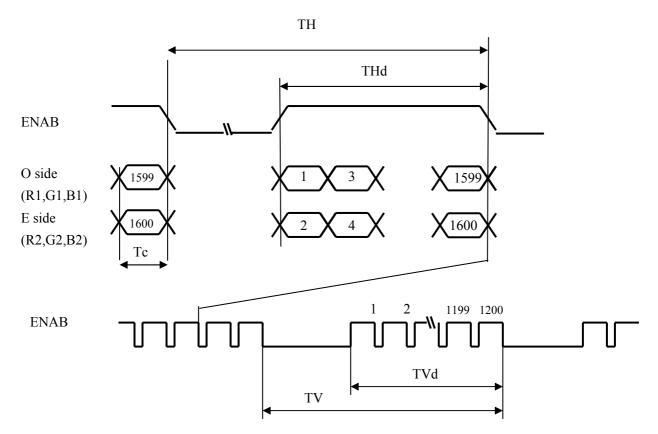
### 7-1. Timing characteristics

Parameter		Symbol	Min.	Тур.	Max.	Unit	Remark
Clock signal	Frequency	1/Tc	77.18	81	85	MHz	
ENAB signal	Horizontal period	TH	865	1080	1130	clock	[Note2]
			11.3	13.3	14.65	μs	
	Horizontal period (High)	THd	800	800	800	clock	
	Vertical period	TV	1220	1250	1280	line	[Note1]
			15.9	16.7	17.5	ms	[Note2]
	Vertical period (High)	TVd	1200	1200	1200	line	

[Note1] In case of using the long vertical period, the deterioration of display quality, flicker etc. may occur.

[Note2] The horizontal display position is determined by ENAB signal and the input data corresponding to the rising edge of DCLK is displayed at the left end of the active area.

Regarding the vertical display position, the data starting form following ENAB rising is displayed at the top of the active area in case of no rising ENAB more than 2003clk from ENAB rising.

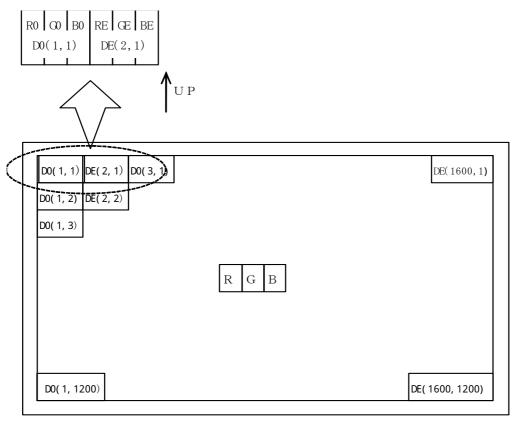


## 7-2. Input Data Signals and Display Position on the screen

Display position of input data (H, V)

Two pixels data is sampled at the same time.

- \* DO (odd 1 data): RO0 ~ RO7, GO0 ~ GO7, BO0 ~ BO7
- ★ DE (even 1 data): RE0 ~ RE7, GE0 ~ GE7, BE0 ~ BE7



## 8. Input Signals, Basic Display Colors and Gray Scale of Each Color

#### 8-1. 8bit input

1	. out m	8bit input																								
				Data signal																						
	Colors &	Gray	DΛ	D 1	D2	D?	D 4	D 5	D.e	D.7	CO	C1	G2	G2	G4	G5	G6	67	DΛ	D 1	D2	D2	D4	D.f	D.e	D7
	Gray scale	Scale	R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	В0	B1	В2	В3	B4	В5	В6	В7
Basic Color	Black	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Green	-	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Cyan	-	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Red	-	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	-	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	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	1	1	1	1	1	1
	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Û	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ìray	Darker	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sca	仓	$\downarrow$	↓						<b>V</b>					↓												
le of	Û	$\downarrow$	$\downarrow$					↓					$\downarrow$													
Gray Scale of Red	Brighter	253	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Û	254	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	255	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$G_1$	Û	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale of Green	Darker	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scale	仓	$\downarrow$	<b>V</b>						$\downarrow$					$\downarrow$												
e of	Û	$\leftarrow$	↓					$\downarrow$					↓													
Gree	Brighter	253	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0
n	Φ	254	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Green	255	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Û	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Gray Scale of Blue	Darker	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Scal	Û	<b>\</b>	↓					<b>V</b>					↓													
le of	ΰ	$\downarrow$	$\downarrow$						$\downarrow$						$\downarrow$											
f Blu	Brighter	253	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1
е	Φ	254	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
	Blue	255	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

0 : Low level voltage,

1 : High level voltage.

Each basic color can be displayed in 256 gray scales of red, 256 gray scales of green, and 256 gray scales of blue from 8 bit data signals. According to the combination of total 24 bit data signals, 16,777,216 color display can be achieved on the screen.

### 9. Optical Characteristics

Ta=25°C, Vcc=+5.0V

								1 23 C, VCC 13.0 V
Parameter		Symbol	Condition	Min.	Тур.	Max.	Unit	Remark
Viewing	Horizontal	θ 21,θ 22		85	-	-	Deg.	
angle	Vertical	θ 11,θ 12	CR > 10	85	-	-	Deg.	
range	All direction	θ		ı	80	-	Deg.	
Contrast ratio		CRn	Optimum	350	600	-		[ Note2,4 ]
			viewing					
			angle					
Response Time		τr+τd		-	12	-	ms	[Note3(Condition2),4,5]
$(Black \rightarrow White \rightarrow Black)$								
Response Time		τ avg		-	8	-	ms	Average response time
Rise or decay								
(Gray scale)								
Chromaticity of		X		0.257	0.292	0.337		【Note4】
White		у		0.290	0.315	0.370		
Chromaticity of		X	θ =0°	-	0.629	-		
Red		У		-	0.362	-		
Chromaticity of		naticity of x		-	0.322	-		
Green		у		-	0.610	-		
Chromaticity of		X		ı	0.149	-		
Blue		у		ı	0.108	-		
Luminance of white		$Y_{LI}$		400	500	-	cd/m <sup>2</sup>	【Note4】
White Uniformity		δw		-	-	1.33		[Note5]

<sup>\*</sup> The measurement shall be executed 30 minutes after lighting at rating.

The optical characteristics shall be measured in a dark room or equivalent state with the method shown

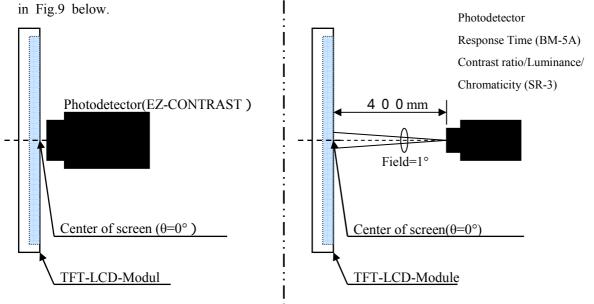
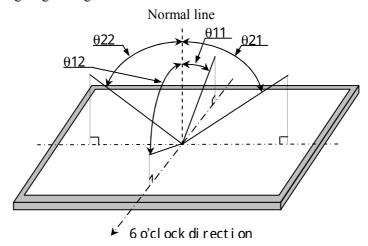


Fig9-1 Viewing angle measurement method

Fig9-2 Luminance/Contrast ratio/Response time/Chromaticity

Fig9 Optical characteristics measurement method

#### [Note1] Definitions of viewing angle range:

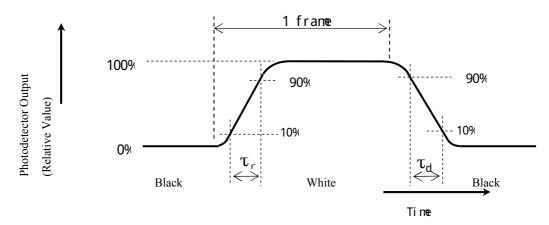


### [ Note2 ] Definition of contrast ratio:

The contrast ratio is defined as the following.

## [ Note3 ] Definition of response time:

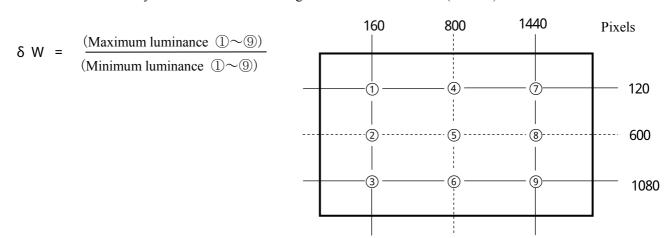
The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".



[Note4] This shall be measured at center of the screen.

#### [Note5] Definition of white uniformity:

White uniformity is defined as the following with nine measurements ( $(1) \sim 9$ ).



#### 10. Display dignity

The item concerning externals and the display dignity is decided by the shipment inspection standard book..

#### 11. Handling Precautions

- a) Be sure to turn off the power supply when inserting or disconnecting the cable.
- b) Be sure to design the cabinet so that the module can be installed without any extra stress such as warp or twist.
- c) Since the front polarizer is easily damaged, pay attention not to scratch it.
  - Blow away dust on the polarizer with antistatic  $N_2$  blow. It is undesirable to wipe off because a polarizer is sensitive.
  - It is recommended to peel off softly using the adhesive tape when soil or finger oil is stuck to the polarizer. When unavoidable, wipe off carefully with a cloth for wiping lenses.
- d) Wipe off water drop immediately. Long contact with water may cause discoloration or spots.
- e) When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.
- f) Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface. Handle with care.
- g) Since CMOS LSI is used in this module, take care of static electricity and set the human earth when handling. Observe all other precautionary requirements in handling components.
- h) Since there is a circuit board in the module back, stress is not added at the time of a design assembly. If stress is added, there is a possibility that circuit parts may be damaged.
- i) Protection film is attached to the module surface to prevent it from being scratched. Peel the film off slowly, just before the use, with strict attention to electrostatic charges. Blow off 'dust' on the polarizer by using ionized nitrogen.
- j) The polarizer surface on the panel is treated with Anti-Glare for low reflection. In case of attaching protective board over the LCD, be careful about the optical interface fringe etc. which degrades display quality.
- k) Do not expose the LCD panel to direct sunlight.
   Lightproof shade etc. should be attached when LCD panel is used under such environment.
   If a light strong against a LCD panel is irradiated, it may lead to degradation of the panel characteristic and display grace may get worse.
- 1) Connect GND to 4 place of mounting holes to stabilize against EMI and external noise.
- m) When handling LCD modules and assembling them into cabinets, please be noted that long-term storage in the environment of oxidization or deoxidization gas, and the use of such materials as reagent, solvent, adhesive, resin, etc. which generate these gasses, may cause corrosion, discoloration, degradation of display grace, and abnormalities of operation.
- n) When install LCD modules in the cabinet, please tighten with "torque = max 0.441 N· m (max 4.5kgf· cm). Be sure to confirm it in the same condition as it is installed in your instrument.
- o) Liquid crystal contained in the panel may leak if the LCD is broken. Rinse it as soon as possible if it gets inside your eye or mouth by mistake.
- p) Notice: Never dismantle the module, because it will cause failure. Moreover, please do not peel off and do not cut the tapes pasted to the product. However, the tape fixed panel protection film is excluded.
- q) Be careful when using it for long time with fixed pattern display as it may cause afterimage. (Please use a screen saver etc., in order to avoid an afterimage.)
- r) Adjusting volume has been set optimally before shipment, so do not change any adjusted value. If adjusted value is changed, the specification may not be satisfied.
- s) If a minute particle enters in the module and adheres to an optical material, it may cause display non-uniformity issue, etc. Therefore, fine-pitch filters have to be installed to cooling and inhalation hole if you intend to install a fan.
- t) The LED used for this product is very sensitive to the temperature. Luminance decreases rapidly when it is used for a long time under the environment of the high temperature. Please consult our company when it is used under the environment like the above mentioned.
- u) Epoxy resin (amine series curing agent), silicone adhesive material (dealcoholization series and oxime series), tray forming agent (azo compound) etc, in the cabinet or the packing materials may induce abnormal display with polarizer film deterioration regardless of contact or noncontact to polarizer film.
   Be sure to confirm the component of them.

## 12. Packing form

Product countries / Areas	JAPAN
Piling number of cartons	8 (MAX)
Packing quantity in one carton	2pcs
Carton size [mm]	630(W) × 515(D) × 195(H)
Total mass of one carton filled with full modules	11kg
Packing form is shown	Page 22 (Fig.2)

### 13 . Reliability test items

No	Test item	Conditions	
1	High temperature storage test	Ta = 65°C 240h	
2	Low temperature storage test	Ta = -20°C 240h	
3	High temperature	Ta = 40°C; 90%RH 240h	
	& high humidity operation test	(No condensation)	
4	High temperature operation test	Ta = 60°C 240h (Panel surface: Activ Area)	
5	Low temperature operation test	Ta = 0°C 240h	
6	Vibration test	Waveform : Sine wave	
		Frequency: 10 ~ 57Hz/Vibration width (one side): 0.076mm	
		: $57 \sim 500$ Hz/Gravity : $9.8$ m/s <sup>2</sup>	
		Sweep time: 11minutes	
		Test period : 3 hours	[Note]
		(1 hour for each direction of $X,Y,Z$ )	
7	Shock test	Max. gravity: 147m/s <sup>2</sup>	
		Pulse width: 6ms, sine half-wave	
		Direction: $\pm X$ , $\pm Y$ , $\pm Z$ ,	
		once for each direction.	

### [ Note ]

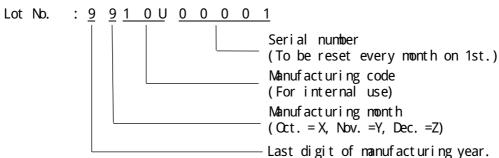
A gap of panel shall not occur by vibration or the shock.

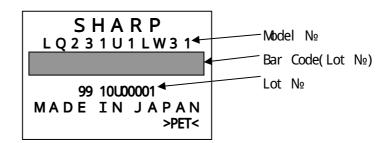
## 【Result Evaluation Criteria】

Under the display quality test conditions with normal operation state, these shall be no change which may affect practical display function.

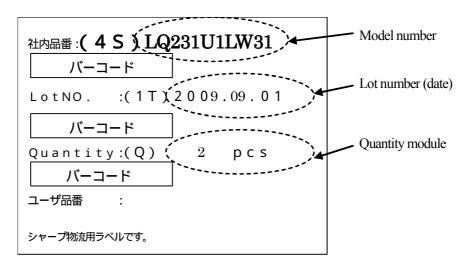
#### 14. Others

#### 14-1. Lot No. Label





#### 14-2. Packing box Label



- 14-3. The chemical ozone depleting substance is not used.
- 14-4. If any problem occurs in relation to the description of this specification, it shall be resolved through discussion with spirit of cooperation.

The figure left below (cardboard box recycling symbol mark) is written to the packing box.

And, the figure right below is written to the packing box of the settlement for the RoHS restriction.

\* R.C. (RoHS Compliance) means it suits the RoHS directive.

This LCD module is compliant with RoHS Directive.



Cardboard box • Recycling symbol mark



Mark for RoHS directive

15 . Range of storage temperature and humidity environmental condition

Temperature  $0 \sim 40^{\circ}$ C

Relative humidity 90% and below

( Note ) • Please manage as average value of the storage temperature and humidity environment referring to the following condition.

Summer 20 ~ 35°C 85% and below, Winter 5 ~ 15°C 85% and below

Please manage within 240 hours in total at the time kept under the environment of 40°C 90%RH.

#### Direct sunlight

Please keep it in the state of wrapping or the darkroom so that direct sunshine should not strike directly into the product.

## Ambient atmosphere

Please do not keep it in the place with the danger of the generation of the causticity gas and the volatile solvent.

#### Dewy condensation prevention

• Please do not put the wrapping box directly on the floor, and keep it on palette or rack to avoid dewy condensation.

Moreover, please put it in a constant direction correctly to improve ventilation under the palette.

- Please separate from the wall in the storage warehouse and keep it.
- Please pay attention that ventilation is improved, and set up the ventilator etc. in the warehouse.
- Please manage so that there is no rapid temperature change more than natural environment.

#### Storage period

Please keep within one year under the above-mentioned storage condition.

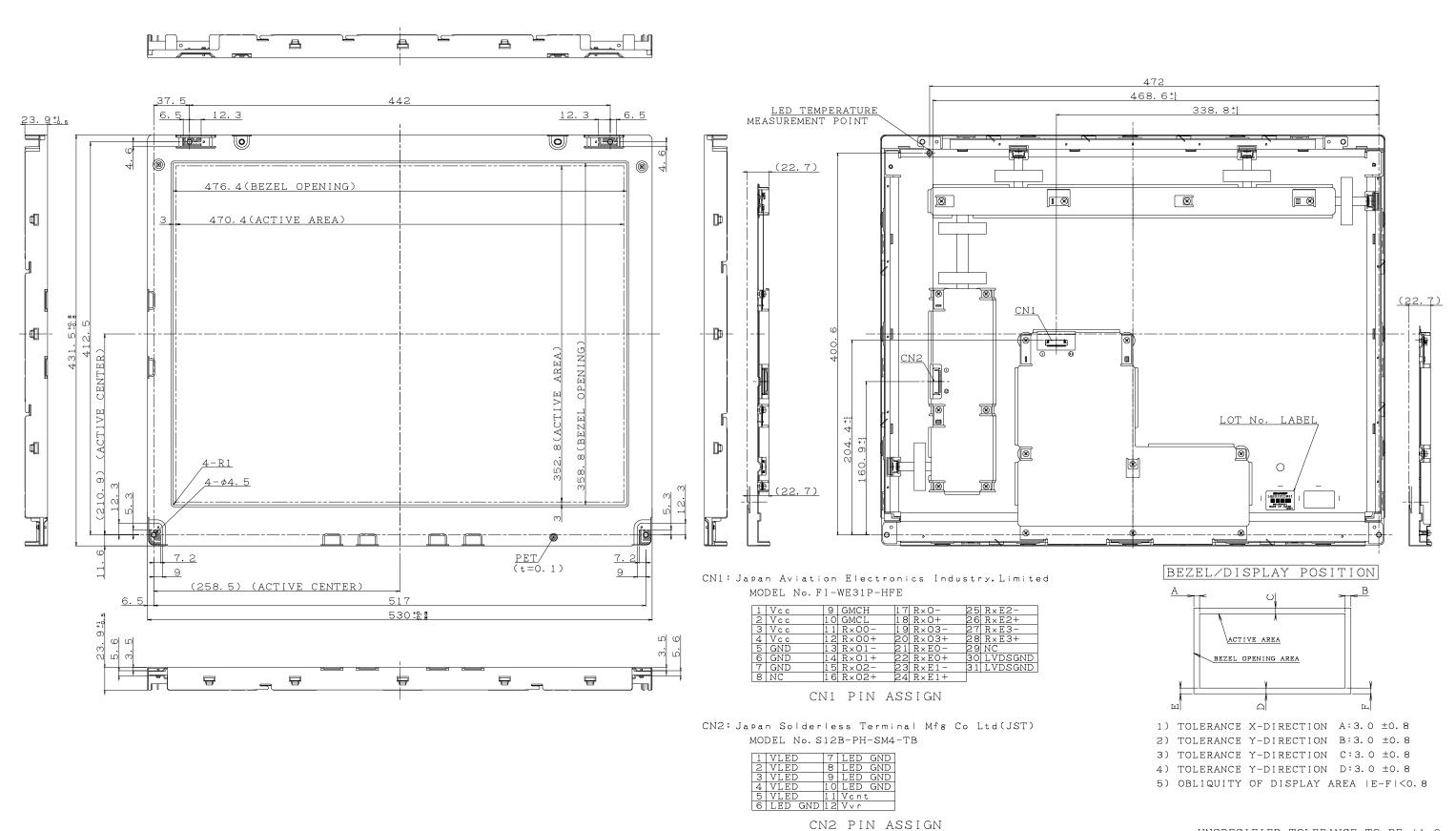


Fig1; LQ231U1LW31 Outline dimensions

UNSPECIFIED TOLERANCE TO BE ±1.0 UNIT:mm

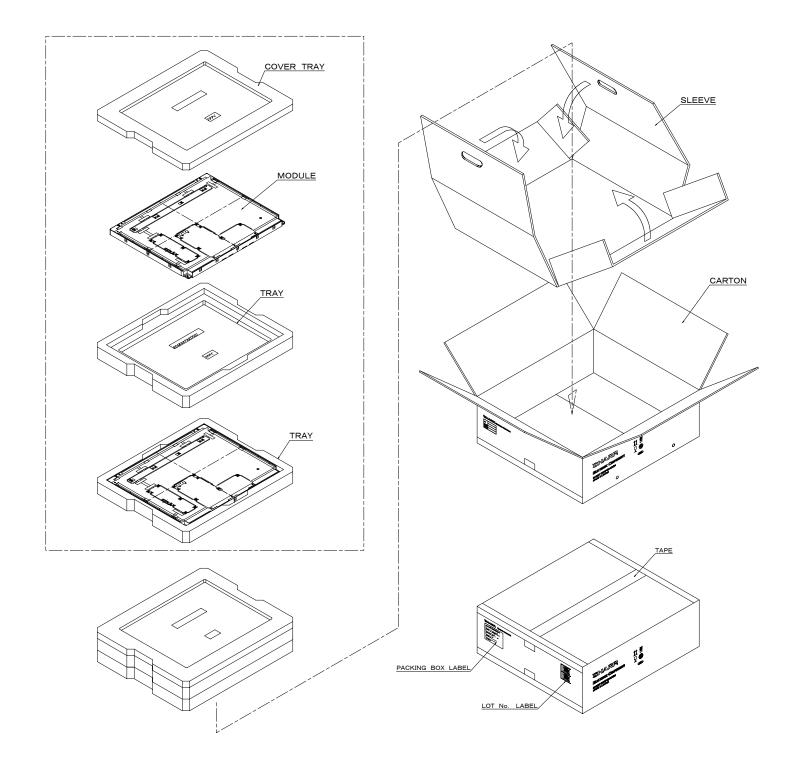


Fig2:Packing Form