Dopoint Hi-Tech Limited

DP470FHDI

Specification

DP	470	FHD	I

DOPOINT

Size

Pixel
A:640*480
B:800*480
C:800*600
D:1024*600
E:1024*768
F:1280*768
G:1280*800
H:1280*1024
HD:1366*768
J:1600*1200
K:1920*1200
FHD:1920*1080

Mode
T: TN
I: IPS

Product Order Number	Description
DP470FHDI-XXXX	• IPS Normally Black • 0°C to +50°C Operating Temperature • Viewing Angle L/R/U/D - 89/89/89/89 • Luminance – 2000 cd/m² • Contrast Ratio – 1300:1
DP470FHDI-TXXX	Resistive + Capacitive Touch by Optical Bonding
DP470FHDI-HXXX	Extended temp (Add Heater by Optical Bonding) -40°C to +80°C Operating Temperature
DP470FHDI-EXXX	Integrated Front Optical EMI Filter by Optical Bonding
DP470FHDI-ARAG	Anti-Reflective + Anti-Glare Surface Treatment
DP470FHDI-NVIS	Integrated NVIS Optical Filter

Sunlight Readable LCDs With Optical Bonding + Touch Integration

Dopoint Hi-Tech Limited

DP470FHDI

Specification

1. General Description

The DP470FHDI is a Color Active Matrix Liquid Crystal Display with an integral Light Emitting Diode (LED) Local Block backlight system. The matrix employs a-Si Thin Film Transistor as the active element.
It is a transmissive display type which is operating in the normally black mode. It has a 46.96 inch diagonally measured active display area with WUXGA resolution (1080 vertical by 1920 horizontal pixel array).
Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arrayed in vertical stripes.
Gray scale or the luminance of the sub-pixel color is determined with a 10-bit gray scale signal for each dot.
Therefore, it can present a palette of more than 1.06Bilion colors. It has been designed to apply the 10-bit 4-port LVDS interface. It is intended to support Public Display where high brightness, super wide viewing angle, high color gamut, high color depth and fast response time are important.
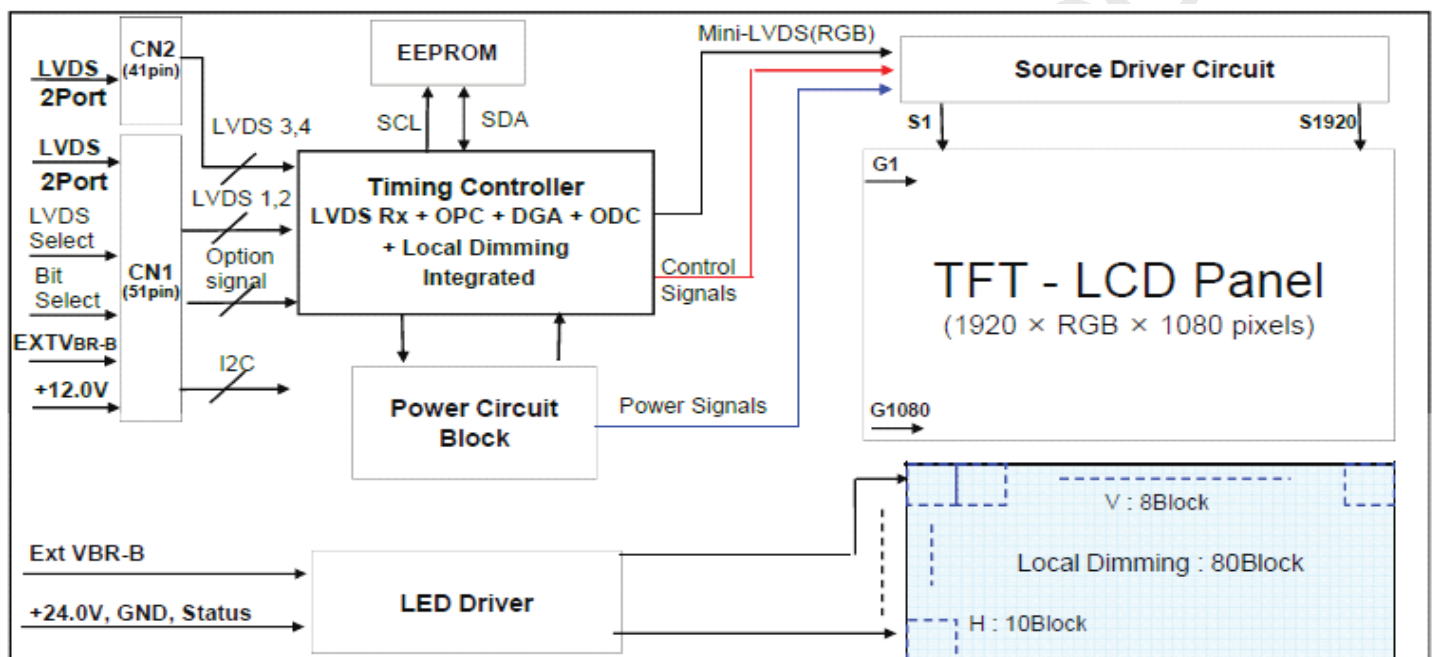
Active Screen Size	46.96 inch (1192.78mm) diagonal
Outline Dimension	1070.8(H) x 615.2(V) x 69.9 mm(D) (Typ.)
Pixel Pitch	0.5415 mm x 0.5415 mm
Pixel Format	1920 horiz. by 1080 vert. Pixels, RGB stripe arrangement
Color Depth	10Bit (D), 1.07 Billion colors
Luminance, White	2000 cd/m² (Center 1point ,Typ.)
Viewing Angle	Viewing angle free (CR>10) : R/L 178 (Min.), U/D 178 (Min.)
Power Consumption	Total 223 Watt (Typ.) [Logic=9 Watt, Backlight=214Watt]
Weight	12.0Kg (Typ.)
Display Mode	Transmissive mode, Normally black
Surface Treatment	Hard coating(3H), Anti-reflection treatment of the front polarizer (Reflectance ＜ 2%), QWP
Possible Display Type	Landscape and Portrait Enabled

Sunlight Readable LCDs With Optical Bonding + Touch Integration

DP470FHDI

Specification

2. Absolute Maximum Ratings

The following items are maximum values which, if exceeded, may cause faulty operation or damage to the LCD module.

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Value		Unit	Remark
			Min	Max		
Power Input Voltage	LCM	V_{LCD}	-0.3	+14.0	V_{DC}	
	Backlight inverter	V_{BL}	-0.3	+27.0	V_{DC}	
ON/OFF Control Voltage		VON/OFF	-0.3	+5.5	V_{DC}	
Brightness Control Voltage		V_{BR}	0	+5.5	V_{DC}	
Operating Temperature		T_{OP}	0	+50	°C	2,3
Storage Temperature		T_{ST}	-20	+60	°C	2,3
Front Panel Temperature		T_{SUR}	-	+68	°C	4
Bottom Chassis Temperature		T_{Bot}	-	65	%RH	5
Operating Ambient Humidity		H_{OP}	10	90	%RH	2,3
Storage Humidity		H_{ST}	10	90	%RH	2,3

Note

1. Ambient temperature condition (Ta = 25 ± 2 °C)

2. Temperature and relative humidity range are shown in the figure below.

Wet bulb temperature should be Max 39°C, and no condensation of water.

3. Gravity mura can be guaranteed below 50°C condition.

4. The maximum operating temperatures is based on the test condition that the surface temperature of display area is less than or equal to 68°C with LCD module alone in a temperature controlled chamber. Thermal management should be considered in final product design to prevent the surface temperature of display area from being over 68℃. The range of operating temperature may be degraded in case of improper thermal management in final product design.

5. Active cooling system is required for panel cooling and stable operation

Sunlight Readable LCDs With Optical Bonding + Touch Integration

DP470FHDI
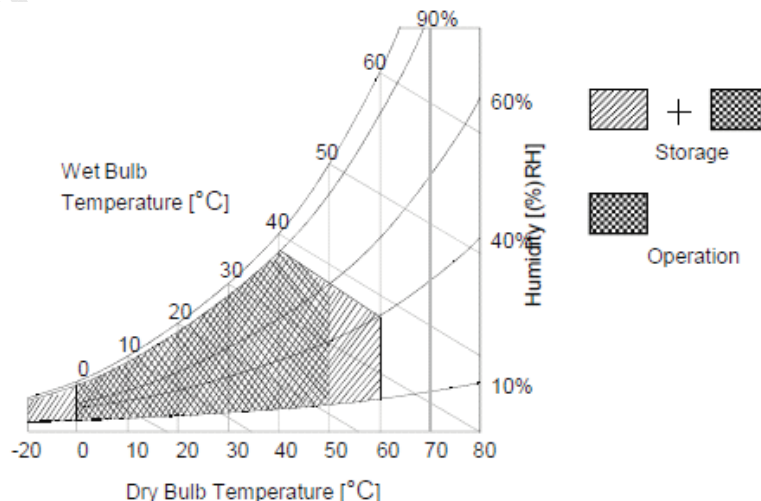
Specification

3. Electrical Specifications

3-1. Electrical Characteristics

It requires two power inputs. One is employed to power for the LCD circuit. The other Is used for the LED backlight and LED Driver circuit.

Table 2. ELECTRICAL CHARACTERISTICS

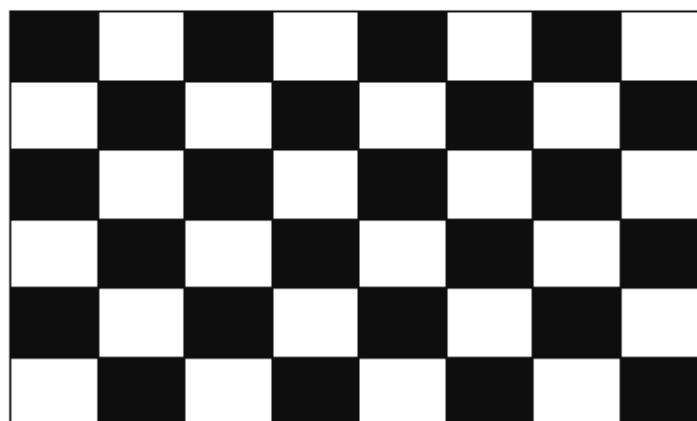| Parameter	Symbol	Value			Unit	Note
		Min	Typ	Max		
Circuit :						
Power Input Voltage	V_{LCD}	10.8	12.0	13.2	V_{DC}	
Power Input Current	I_{LCD}	-	755	980	mA	1
		-	1067	1387	mA	2
Power Consumption	P_{LCD}		9.0	11.7	Watt	1
Rush current	I_{RUSH}	-	-	5.0	A	3

Note 1. The specified current and power consumption are under the V_{LCD}=12.0V, Ta=25 ± 2°C, f_V=120Hz condition whereas mosaic pattern(8 x 6) is displayed and f_V is the frame frequency.
2. The current is specified at the maximum current pattern.
3. The duration of rush current is about 2ms and rising time of power input is 0.5ms (min.).

White : 1023 Gray
Black :   0 Gray

Mosaic Pattern(8 x 6)

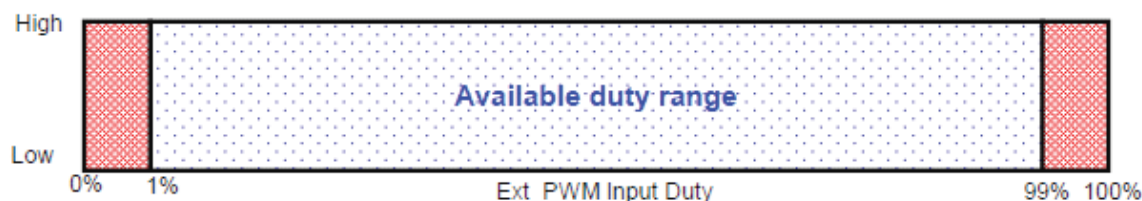**Sunlight Readable LCDs With Optical Bonding + Touch Integration**

DP470FHDI

Specification

Table 3. ELECTRICAL CHARACTERISTICS (Continue)

Parameter			Symbol	Values			Unit	Notes
				Min	Typ	Max		
LED Driver :								
Power Supply Input Voltage			VBL	22.8	24.0	25.2	Vdc	1
Power Supply Input Current			IBL	-	8.89	9.6	A	Ext V_{BR-B} = 100%
Power Supply Input Current (In-Rush)			Irush	-	-	13	A	VBL = 22.8V Ext v_{BR-B} = 100% 4
Power Consumption			PBL	-	214	231	W	Ext v_{BR-B} = 100%
Input Voltage for Control System Signals	On/Off	On	V on	2.5	-	5.0	Vdc	
		Off	V off	-0.3	0.0	0.7	Vdc	
	Brightness Adjust		ExtV_{BR-B}	10	-	100	%	On Duty (With Local Dimming)
				1	-	100	%	On Duty (W/O Local Dimming)
	PWM Frequency for NTSC & PAL	PAL			100		Hz	3
		NTSC			120		Hz	3
	Pulse Duty Level (PWM)	High Level		2.5	-	5.0	Vdc	HIGH : on duty LOW : off duty
		Low Level		0.0	-	0.7	Vdc	
	VSYNC, SIN, SCLK , Reverse (Local Dimming)	High Level		2.7	3.3	3.6	Vdc	
		Low Level		-0.3	0.0	0.4	Vdc	
Life Time				30,000	50,000		Hrs	2

Notes :
1. Electrical characteristics are determined after the unit has been 'ON' and stable for approximately 60 minutes at 25±2°C. The specified current and power consumption are under the typical supply Input voltage 24Vand VBR (Ext V_{BR-B} : 100%), it is total power consumption.
2. The life time is determined as the time which luminance of the LED is 50% compared to that of initial value at the typical LED current (Ext V_{BR-B} :100%) on condition of continuous operating in LCM state at 25±2°C.
3. LGD recommend that the PWM freq. is synchronized with One time harmonic of Vsync signal of system. Though PWM frequency is over 120Hz (max 252Hz), function of LED Driver is not affected.
4. The duration of rush current is about 200ms.
5. Even though inrush current is over the specified value, there is no problem if I²T spec of fuse is satisfied.
6. Ext_PWM Signal have to input available duty range.
   Between 99% and 100% ExtV_{BR-B} duty have to be avoided. (99% < ExtV_{BR-B} < 100%)
   But Ext V_{BR-B} 0% and 100% is possible.

Sunlight Readable LCDs With Optical Bonding + Touch Integration

Dopoint Hi-Tech Limited

DP470FHDI

Specification

3-2. Interface Connections

This LCD module employs three kinds of interface connection, 51-pin, 41-pin and 10-pin connector is used for the module electronics and 14-pin, 12-pin connector is used for the integral backlight system.

3-2-1. LCD Module

- LCD Connector : FI-R51S-HF(manufactured by JAE) or compatible
- Mating Connector : FI-R51HL(JAE) or compatible

Table 4-1. MODULE CONNECTOR(CN1) PIN CONFIGURATION

No	Symbol	Description	No	Symbol	Description
1	NC	No Connection or Ground	27	Bit Select	'H' or NC= 10bit(D) , 'L' = 8bit
2	NC	Note 4	28	R2AN	SECOND LVDS Receiver Signal (A-)
3	NC	Note 4	29	R2AP	SECOND LVDS Receiver Signal (A+)
4	NC	Note 4	30	R2BN	SECOND LVDS Receiver Signal (B-)
5	NC	Note 4	31	R2BP	SECOND LVDS Receiver Signal (B+)
6	NC	Note 4	32	R2CN	SECOND LVDS Receiver Signal (C-)
7	LVDS Select	'H' =JEIDA , 'L' or NC = VESA	33	R2CP	SECOND LVDS Receiver Signal (C+)
8	NC	Note 4	34	GND	Ground
9	NC	Note 4	35	R2CLKN	SECOND LVDS Receiver Clock Signal(-)
10	L-DIM Enable	'H' Only, Note 5	36	R2CLKP	SECOND LVDS Receiver Clock Signal(+)
11	GND	Ground	37	GND	Ground
12	R1AN	FIRST LVDS Receiver Signal (A-)	38	R2DN	SECOND LVDS Receiver Signal (D-)
13	R1AP	FIRST LVDS Receiver Signal (A+)	39	R2DP	SECOND LVDS Receiver Signal (D+)
14	R1BN	FIRST LVDS Receiver Signal (B-)	40	R2EN	SECOND LVDS Receiver Signal (E-)
15	R1BP	FIRST LVDS Receiver Signal (B+)	41	R2EP	SECOND LVDS Receiver Signal (E+)
16	R1CN	FIRST LVDS Receiver Signal (C-)	42	NC or GND	No Connection or Ground
17	R1CP	FIRST LVDS Receiver Signal (C+)	43	NC or GND	No Connection or Ground
18	GND	Ground	44	GND	Ground
19	R1CLKN	FIRST LVDS Receiver Clock Signal(-)	45	GND	Ground
20	R1CLKP	FIRST LVDS Receiver Clock Signal(+)	46	GND	Ground
21	GND	Ground	47	NC	No connection
22	R1DN	FIRST LVDS Receiver Signal (D-)	48	VLCD	Power Supply +12.0V
23	R1DP	FIRST LVDS Receiver Signal (D+)	49	VLCD	Power Supply +12.0V
24	R1EN	FIRST LVDS Receiver Signal (E-)	50	VLCD	Power Supply +12.0V
25	R1EP	FIRST LVDS Receiver Signal (E+)	51	VLCD	Power Supply +12.0V
26	NC or GND	NC or Ground	-	-	-

Note:

1. All GND (ground) pins should be connected together to the LCD module's metal frame.

2. All VLCD (power input) pins should be connected together.

3. All input levels of LVDS signals are based on the EIA 644 Standard.

4. These pins are reserved only for LGD (Do not connect)

5. All evaluation was verified based on L-DIM "H" and should keep "H" status during the operation.

Sunlight Readable LCDs With Optical Bonding + Touch Integration

DP470FHDI

Specification

-LCD Connector (CN2) : FI-RE41S-HF (manufactured by JAE) or compatible

- Mating Connector : FI-RE41HL or compatible

Table 4-2. MODULE CONNECTOR(CN2) PIN CONFIGURATION

No	Symbol	Description	No	Symbol	Description
1	NC	No connection	22	RE3N	THIRD LVDS Receiver Signal (E-)
2	NC	No connection	23	RE3P	THIRD LVDS Receiver Signal (E+)
3	NC	No connection	24	GND	Ground
4	NC	No connection	25	GND	Ground
5	NC	No connection	26	RA4N	FORTH LVDS Receiver Signal (A-)
6	NC	No connection	27	RA4P	FORTH LVDS Receiver Signal (A+)
7	NC	No connection	28	RB4N	FORTH LVDS Receiver Signal (B-)
8	NC	No connection	29	RB4P	FORTH LVDS Receiver Signal (B+)
9	GND	Ground	30	RC4N	FORTH LVDS Receiver Signal (C-)
10	RA3N	THIRD LVDS Receiver Signal (A-)	31	RC4P	FORTH LVDS Receiver Signal (C+)
11	RA3P	THIRD LVDS Receiver Signal (A+)	32	GND	Ground
12	RB3N	THIRD LVDS Receiver Signal (B-)	33	RCLK4N	FORTH LVDS Receiver Clock Signal(-)
13	RB3P	THIRD LVDS Receiver Signal (B+)	34	RCLK4P	FORTH LVDS Receiver Clock Signal(+)
14	RC3N	THIRD LVDS Receiver Signal (C-)	35	GND	Ground
15	RC3P	THIRD LVDS Receiver Signal (C+)	36	RD4N	FORTH LVDS Receiver Signal (D-)
16	GND	Ground	37	RD4P	FORTH LVDS Receiver Signal (D+)
17	RCLK3N	THIRD LVDS Receiver Clock Signal(-)	38	RE4N	FORTH LVDS Receiver Signal (E-)
18	RCLK3P	THIRD LVDS Receiver Clock Signal(+)	39	RE4P	FORTH LVDS Receiver Signal (E+)
19	GND	Ground	40	GND	Ground
20	RD3N	THIRD LVDS Receiver Signal (D-)	41	GND	Ground
21	RD3P	THIRD LVDS Receiver Signal (D+)	-		

Note : 1. All GND(ground) pins should be connected together to the LCD module's metal frame.

2. LVDS pin (pin No. #22,23,38,39) are used for 10Bit(D) of the LCD module.

If used for 8Bit(R), these pins are no connection.
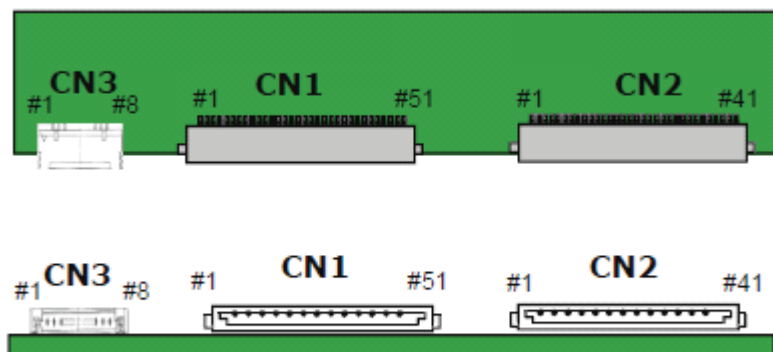
Rear view of LCM

Sunlight Readable LCDs With Optical Bonding + Touch Integration

DP470FHDI

Specification

3-2-2. Backlight Module

Master / Slave
 -LED Driver Connector
  : 20022WR-14B2(Yeonho) / 20022WR-12B2(Yeonho)

Mating Connector
 : 20022HS-14 / 20022HS-12

Table 5. INVERTER CONNECTOR PIN CONFIGULATION

Pin No	Symbol	Description	Master 14pin	Slave 12pin	Note
1	VBL	Power Supply +24.0V	VBL	VBL	
2	VBL	Power Supply +24.0V	VBL	VBL	
3	VBL	Power Supply +24.0V	VBL	VBL	
4	VBL	Power Supply +24.0V	VBL	VBL	
5	VBL	Power Supply +24.0V	VBL	VBL	
6	GND	B/Light Ground	GND	GND	
7	GND	B/Light Ground	GND	GND	
8	GND	B/Light Ground	GND	GND	1
9	GND	B/Light Ground	GND	GND	
10	GND	B/Light Ground	GND	GND	
11	Status	Status	Status	-	5
12	VON/OFF	B/Light ON/OFF control	VON/OFF	Don't care	4
13	EXT VBR-B	External PWM	EXT VBR-B		
14	GND	-		GND	

Notes : 1. GND should be connected to the LCD module's metal frame.
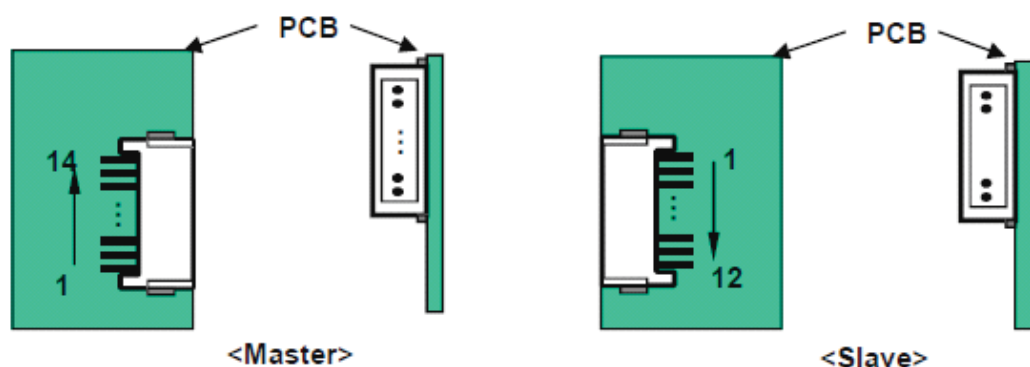   2. High : on duty / Low : off duty, Pin#13 can be opened. (if Pin #13 is open , EXTVBR-B is 100%)
         3. #14 of Input CNT Must be Connected to Backlight Ground.
         4. Each impedance of pin #12 and 13 is over 50 [KΩ] and over 50 [KΩ].
         5. Normal : Low (under 0.7V) / Abnormal : High (upper 3.0V)

◆ Rear view of LCM

<Master>   <Slave>

Sunlight Readable LCDs With Optical Bonding + Touch Integration

DP470FHDI

Specification

3-3. Signal Timing Specifications

Table 6 shows the signal timing required at the input of the LVDS transmitter. All of the interface signal timings should be satisfied with the following specification for normal operation.

Table 6. TIMING TABLE (DE Only Mode)

ITEM		Symbol	Min	Typ	Max	Unit	Note
Horizontal	Display Period	tHV	480	480	480	tCLK	1920 / 4
	Blank	tHB	40	70	200	tCLK	1
	Total	tHP	520	550	680	tCLK	
Vertical	Display Period	tVV	1080	1080	1080	Lines	
	Blank	tVB	20 (228)	45 (270)	86 (300)	Lines	1
	Total	tVP	1100 (1308)	1125 (1350)	1166 (1380)	Lines	

ITEM		Symbol	Min	Typ	Max	Unit	Note
Frequency	DCLK	fCLK	66.97	74.25	78.00	MHz	
	Horizontal	fH	121.8	135	140	KHz	2
	Vertical	fV	108 (95)	120 (100)	122 (104)	Hz	2 NTSC : 108~122Hz (PAL : 95~104Hz)

Note:

1. The input of HSYNC & VSYNC signal does not have an effect on normal operation (DE Only Mode).
If you use spread spectrum of EMI, add some additional clock to minimum value for clock margin.
2. The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rate and the horizontal frequency
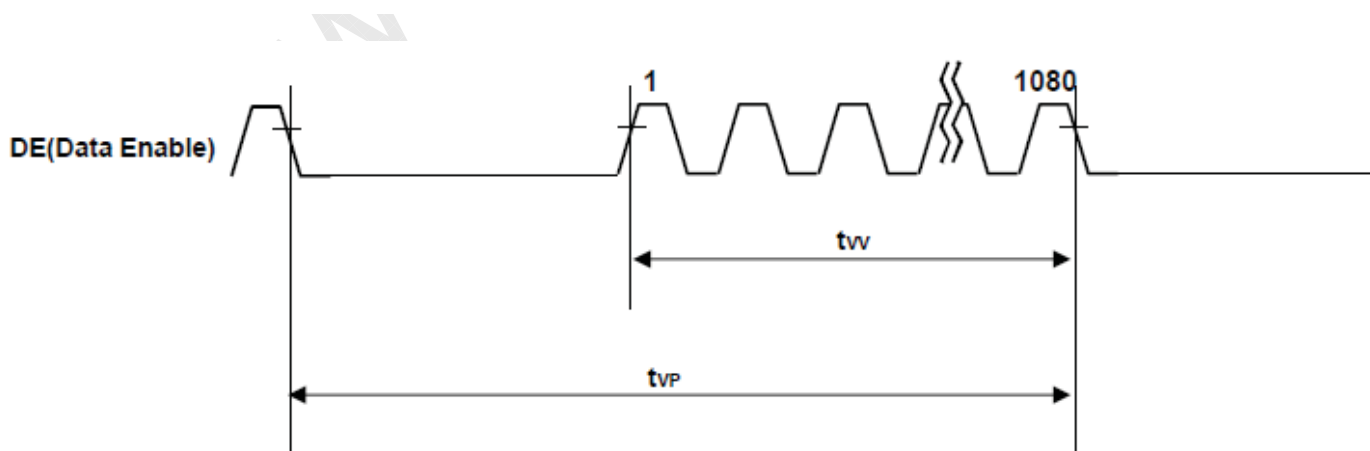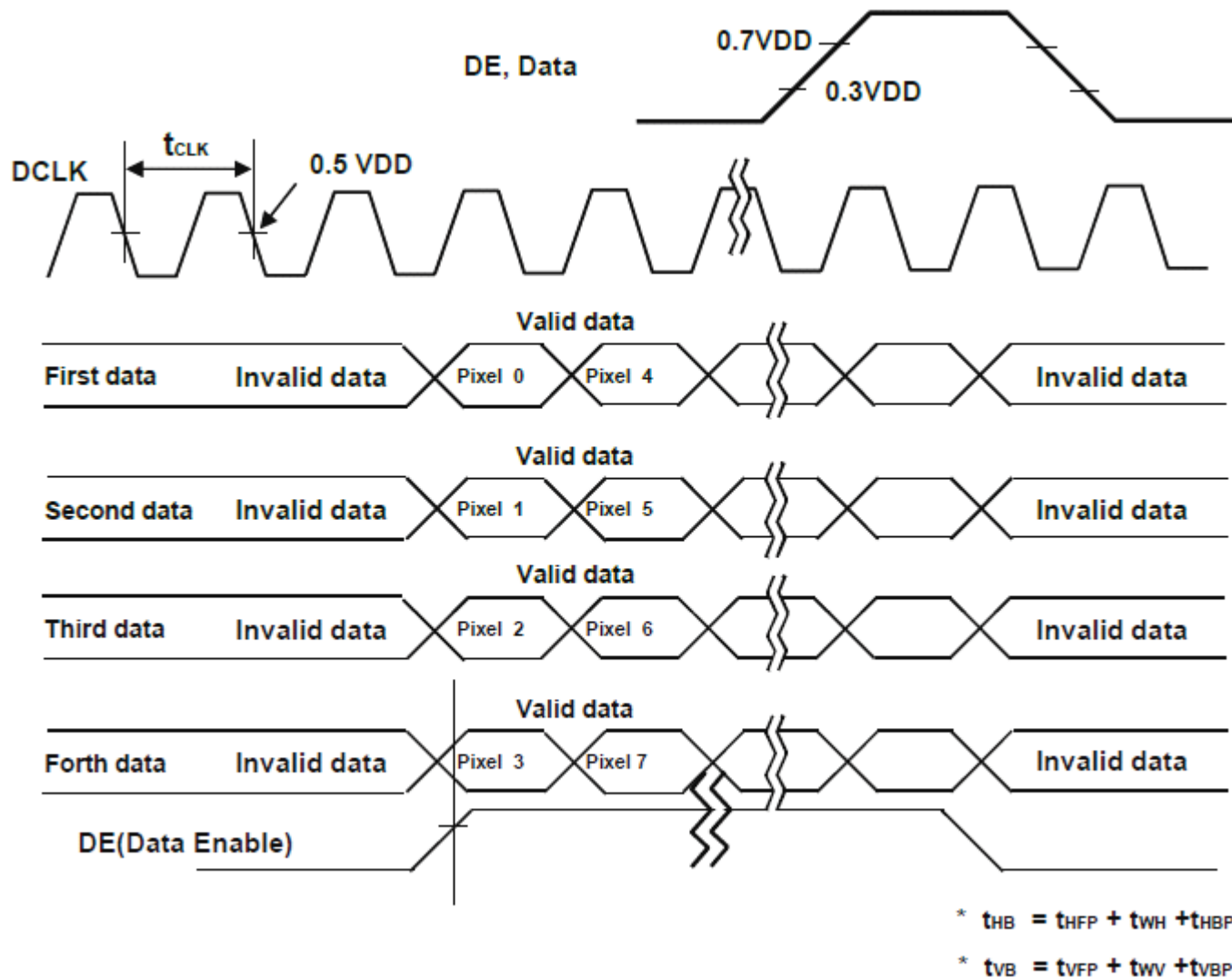※ Timing should be set based on clock frequency.

Sunlight Readable LCDs With Optical Bonding + Touch Integration

Dopoint
Hi-Tech Limited

DP470FHDI

Specification

3-4. LVDS Signal Specification

3-4-1. LVDS Input Signal Timing Diagram

$$* \ t_{HB} = t_{HFP} + t_{WH} + t_{HBP}$$

$$* \ t_{VB} = t_{VFP} + t_{WV} + t_{VBP}$$

Sunlight Readable LCDs With Optical Bonding + Touch Integration

Dopoint Hi-Tech Limited

DP470FHDI

Specification

3-4-2. LVDS Input Signal Characteristics

1) DC Specification

$\# \ V_{CM} = \{(LVDS \ +) + (\ LVDS \ -)\}/2$
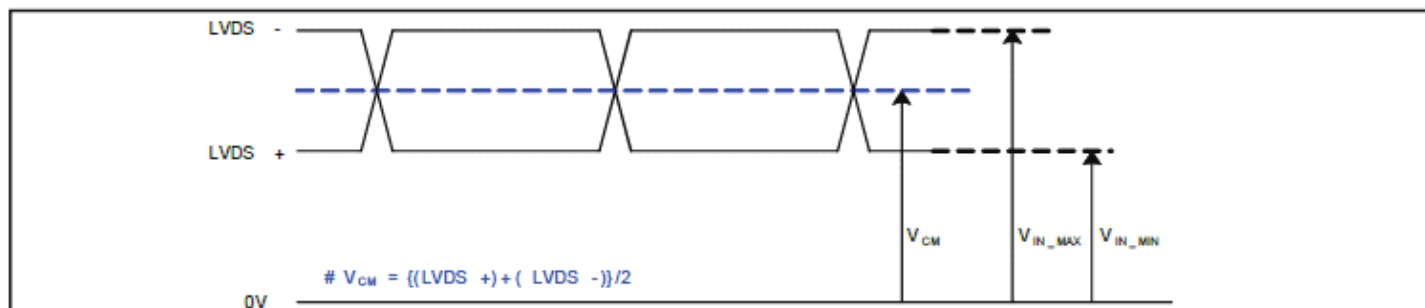
Description	Symbol	Min	Max	Unit	Note
LVDS Common mode Voltage	V_{CM}	1.0	1.5	V	-
LVDS Input Voltage Range	V_{IN}	0.7	1.8	V	-
Change in common mode Voltage	ΔVCM		250	mV	-

2) AC Specification

$(F_{clk} = 1/T_{clk})$
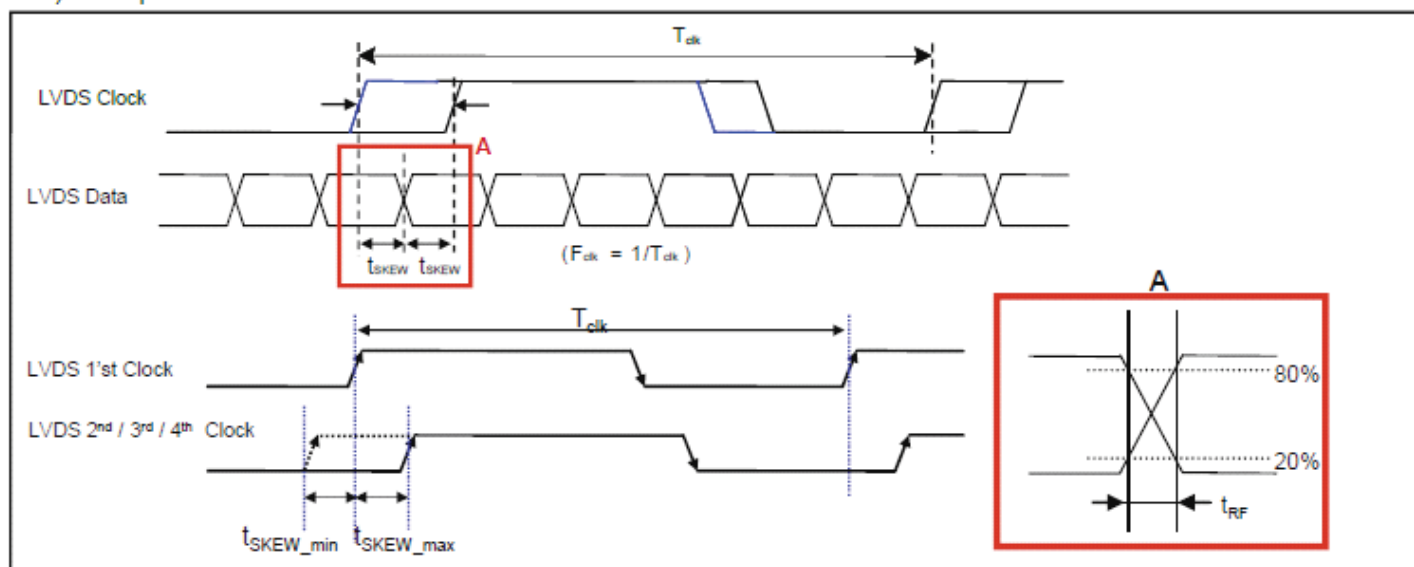
| Description		Symbol	Min	Max	Unit	Note
LVDS Differential Voltage	High Threshold	V_{TH}	100	300	mV	3
	Low Threshold	V_{TL}	-300	-100	mV	
LVDS Clock to Data Skew Margin		t_{SKEW}		$|(0.25*T_{clk})/7|$	ps	-
LVDS Clock/DATA Rising/Falling time		t_{RF}	260	$|(0.3*T_{clk})/7|$	ps	2
Effective time of LVDS		t_{eff}	±360		ps	-
LVDS Clock to Clock Skew Margin (Even to Odd)		t_{SKEW_EO}		$1/7* T_{clk}$	T_{clk}	-

Note　1. All Input levels of LVDS signals are based on the EIA 644 Standard.
　　　2. If t_{RF} isn't enough, t_{eff} should be meet the range.
　　　3. LVDS Differential Voltage is defined within t_{eff}

Sunlight Readable LCDs With Optical Bonding + Touch Integration

DP470FHDI
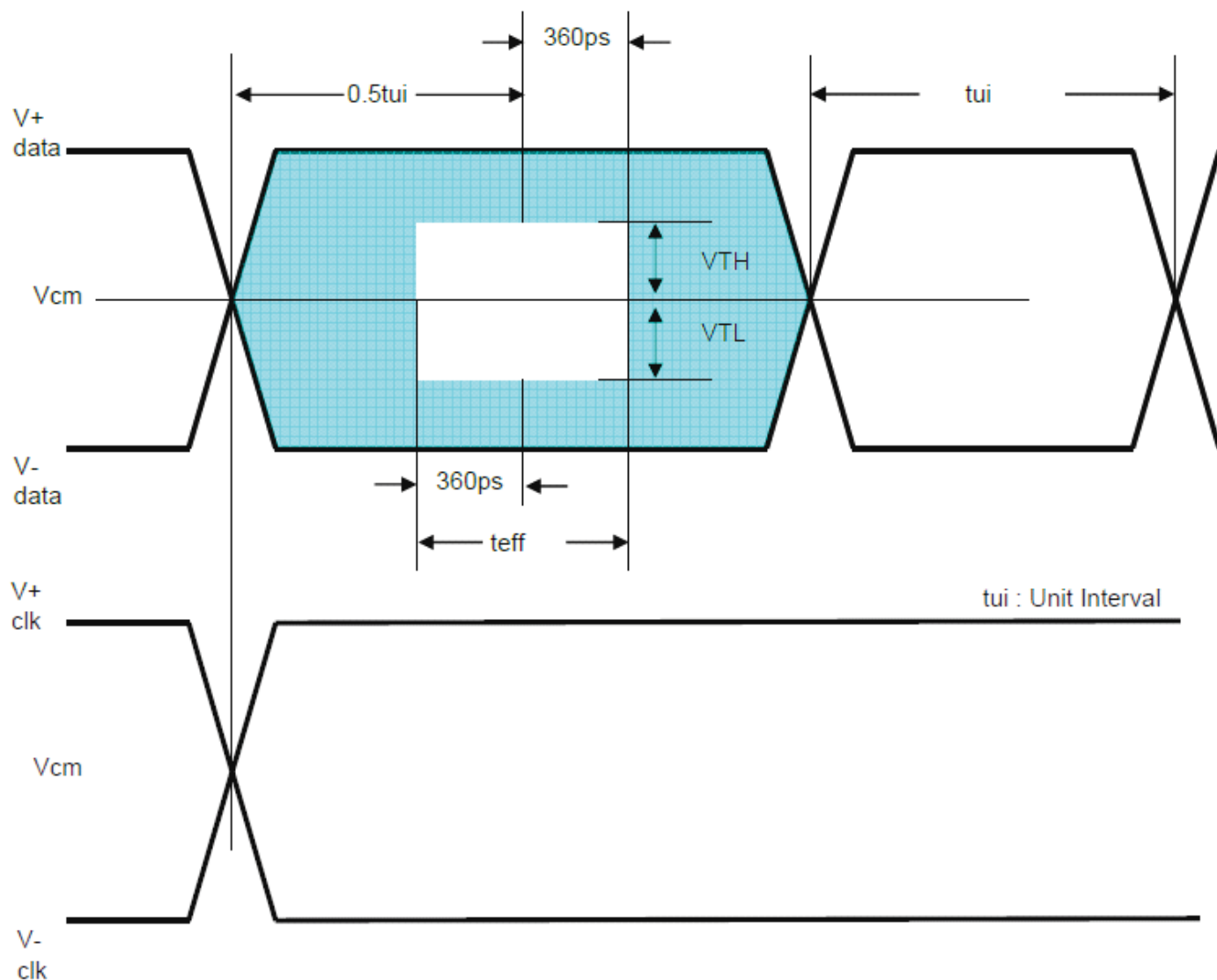
Specification

* This accumulated waveform is tested with differential probe

Sunlight Readable LCDs With Optical Bonding + Touch Integration

DP470FHDI

Specification

3-5. Color Data Reference

The brightness of each primary color(red,green,blue) is based on the 10bit gray scale data input for the color. The higher binary input, the brighter the color. Table 7 provides a reference for color versus data input.

Table 7. COLOR DATA REFERENCE

Color		Input Color Data		
		RED (MSB R9 R8 R7 R6 R5 R4 R3 R2 R1 R0 LSB)	GREEN (MSB G9 G8 G7 G6 G5 G4 G3 G2 G1 G0 LSB)	BLUE (MSB B9 B8 B7 B6 B5 B4 B3 B2 B1 B0 LSB)
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 0 0 0 0 0 0
	Red (1023)	1 1 1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0
	Green (1023)	0 0 0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0 0 0
	Blue (1023)	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1 1 1
	Cyan	0 0 0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1
	Magenta	1 1 1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0 0 0	1 1 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 1 1 1 1	0 0 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 1 1 1 1 1 1
RED	RED (0000)	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 0 0 0 0 0
	RED (0001)	0 0 0 0 0 0 0 0 0 1	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0
	...	...	...	...
	RED (1022)	1 1 1 1 1 1 1 1 1 0	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0
	RED (1023)	1 1 1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0
GREEN	GREEN (0000)	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 0 0 0 0 0
	GREEN (0001)	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 1	0 0 0 0 0 0 0 0 0 0
	...	...	...	...
	GREEN (1022)	0 0 0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1 1 0	0 0 0 0 0 0 0 0 0 0
	GREEN (1023)	0 0 0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0 0 0
BLUE	BLUE (0000)	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 0 0 0 0 0
	BLUE (0001)	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 0 0 0 0 1
	...	...	...	...
	BLUE (1022)	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1 1 0
	BLUE (1023)	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1 1 1

Sunlight Readable LCDs With Optical Bonding + Touch Integration

Dopoint Hi-Tech Limited   **DP470FHDI**

Specification

3-6. Power Sequence

3-6-1. LCD Driving circuit
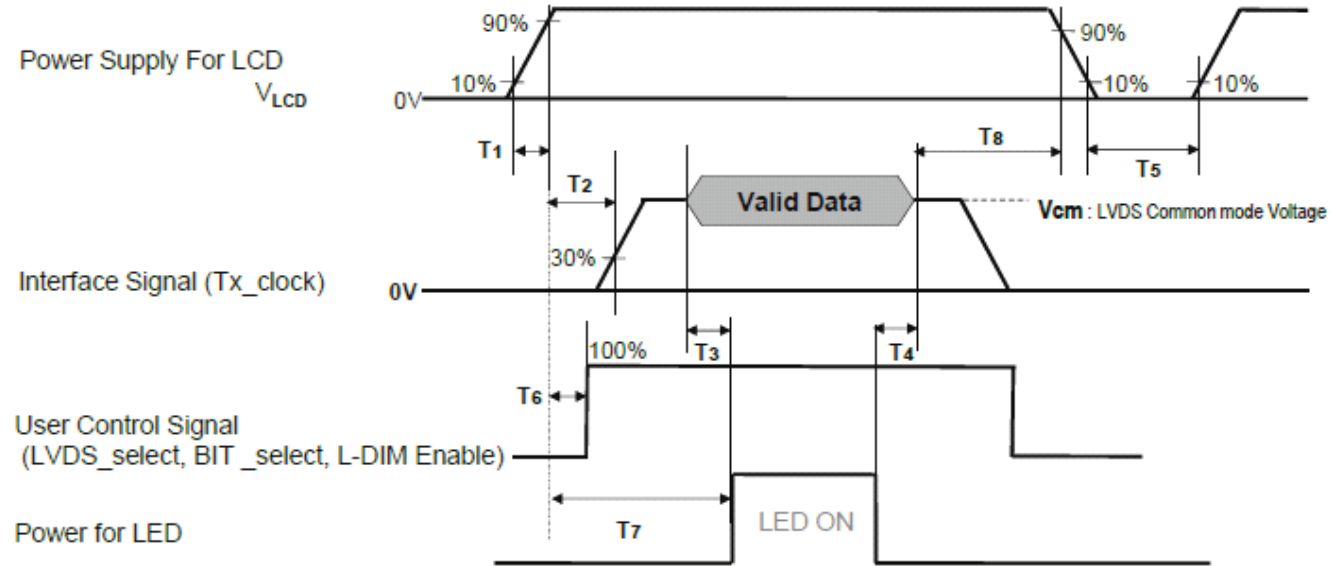
Table 8. POWER SEQUENCE

Parameter	Value			Unit	Notes
	Min	Typ	Max		
T1	0.5	-	20	ms	1
T2	0	-	-	ms	2
T3	200	-	-	ms	3
T4	200	-	-	ms	3
T5	1.0	-	-	s	4
T6	-	-	T2	ms	5
T7	0.5	-	-	s	6
T8	100	-	-	ms	7

Note:

1. Even though T1 is over the specified value, there is no problem if I2T spec of fuse is satisfied.

2. If T2 is satisfied with specification after removing LVDS Cable, there is no problem.

3. The T3 / T4 is recommended value, the case when failed to meet a minimum specification, abnormal display would be shown. There is no reliability problem.

4. T5 should be measured after the Module has been fully discharged between power off and on period.

5. If the on time of signals (Interface signal and user control signals) precedes the on time of Power (VLCD), it will be happened abnormal display. When T6 is NC status, T6 doesn't need to be measured.

6. If there is no abnormal display, no problem.

7. It is recommendation specification that T8 has to be 100ms as a minimum value.

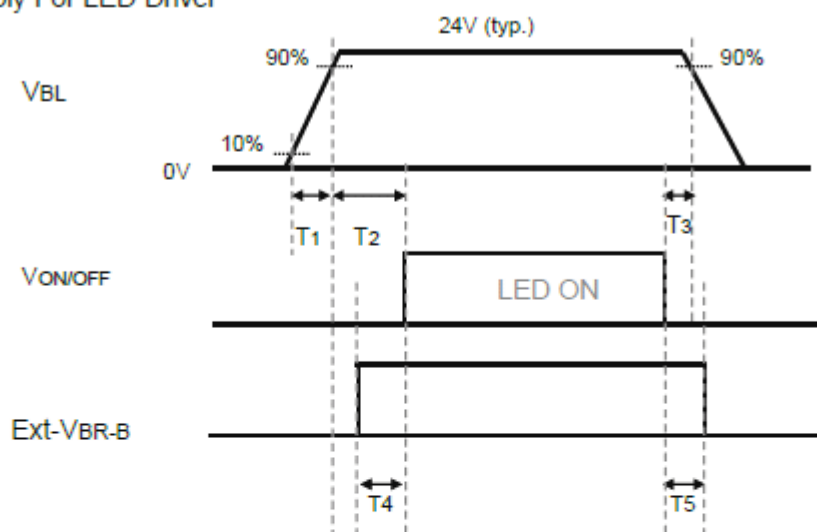※ Please avoid floating state of interface signal at invalid period.

※ When the power supply for LCD (VLCD) is off, be sure to pull down the valid and invalid data to 0V.

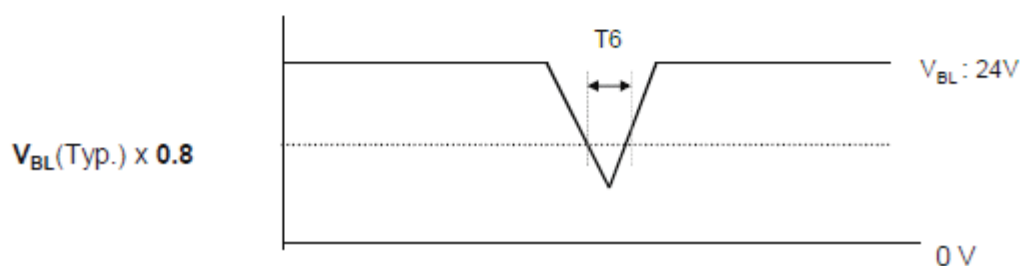**Sunlight Readable LCDs With Optical Bonding + Touch Integration**

DP470FHDI

Specification

3-6-2. Sequence for Inverter

3-6-3. Deep condition for Inverter

Table 9. Power Sequence for LED DRIVER

Parameter	Values			Units	Remarks
	Min	Typ	Max		
T1	20	-	-	ms	1
T2	500	-	-	ms	
T3	10		-	ms	
T4	0	-	-	ms	
T5	0	-	-	ms	
T6	-	-	10	ms	V_{BL}(Typ) x 0.8

Notes :

1. T1 describes rising time of 0V to 24V and this parameter does not applied at restarting time.
   Even though T1 is over the specified value, there is no problem if I^2T spec of fuse is satisfied.

Sunlight Readable LCDs With Optical Bonding + Touch Integration

DP470FHDI

Specification

4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable in a dark environment at 25±2°C. The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of Φ and θ equal to 0 °.

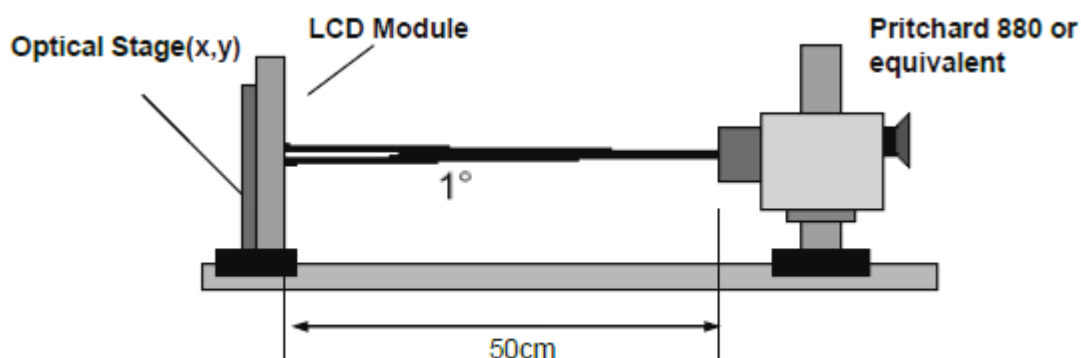FIG. 1 shows additional information concerning the measurement equipment and method.

FIG. 1 Optical Characteristic Measurement Equipment and Method

Ta= 25±2°C, V_{LCD}=12.0V, fv=120Hz, Dclk=74.25MHz, ExtVBR-B=100%

Table 11. OPTICAL CHARACTERISTICS

Parameter		Symbol		Value			Unit	Note
				Min	Typ	Max		
Contrast Ratio		CR		1000	1300	-		1
Surface Luminance, white		L_{WH}		1600	2000	-	cd/m²	2
Luminance Variation		δ_{WHITE}	5P	-	-	1.3		3
Response Time	Gray-to-Gray	G to G		-	10	15	ms	4
Color Coordinates [CIE1931]	RED	Rx			0.643			
		Ry			0.337			
	GREEN	Gx			0.309			
		Gy		Typ -0.03	0.604	Typ +0.03		
	BLUE	Bx			0.153			
		By			0.062			
	WHITE	Wx			0.279			
		Wy			0.292			
Viewing Angle (CR>10)								
Color Temperature					10,000		K	
Color Gamut					72		%	
	x axis, right(φ=0°)	θr		89	-	-		
	x axis, left (φ=180°)	θl		89	-	-	degree	5
	y axis, up (φ=90°)	θu		89	-	-		
	y axis, down (φ=270°)	θd		89	-	-		
Gray Scale				-	-	-		6

Sunlight Readable LCDs With Optical Bonding + Touch Integration

DP470FHDI

Specification

Note : 1. Contrast Ratio(CR) is defined mathematically as :

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

It is measured at center 1-point.

2. Surface luminance are determined after the unit has been 'ON' and 1 Hour after lighting the backlight in a dark environment at 25±2°C. Surface luminance is the luminance value at center 1-point across the LCD surface 50cm from the surface with all pixels displaying white. For more information see the FIG. 1.

3. The variation in surface luminance , δ WHITE is defined as :

$$\delta \text{ WHITE(5P)} = \text{Maximum}(L_{on1}, L_{on2}, L_{on3}, L_{on4}, L_{on5}) / \text{Minimum}(L_{on1}, L_{on2}, L_{on3}, L_{on4}, L_{on5})$$

Where L_{on1} to L_{on5} are the luminance with all pixels displaying white at 5 locations . For more information, see the FIG. 2.

4. Response time is the time required for the display to transition from G(N) to G(M) (Rise Time, Tr_R) and from G(M) to G(N) (Decay Time, Tr_D). For additional information see the FIG. 3. (N<M)

5. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD module surface. For more information, see the FIG. 4.

6. Gray scale specification
   Gamma Value is approximately 2.2. For more information, see the Table 11.

Table 11. GRAY SCALE SPECIFICATION

Gray Level	Luminance [%] (Typ)
L0	0.0625
L15	0.27
L31	1.04
L47	2.49
L63	4.68
L79	7.66
L95	11.5
L111	16.1
L127	21.6
L143	28.1
L159	35.4
L175	43.7
L191	53.0
L207	63.2
L223	74.5
L239	86.7
L255	100

Sunlight Readable LCDs With Optical Bonding + Touch Integration

DP470FHDI

Specification

Measuring point for surface luminance & luminance variation

A : H / 4 mm
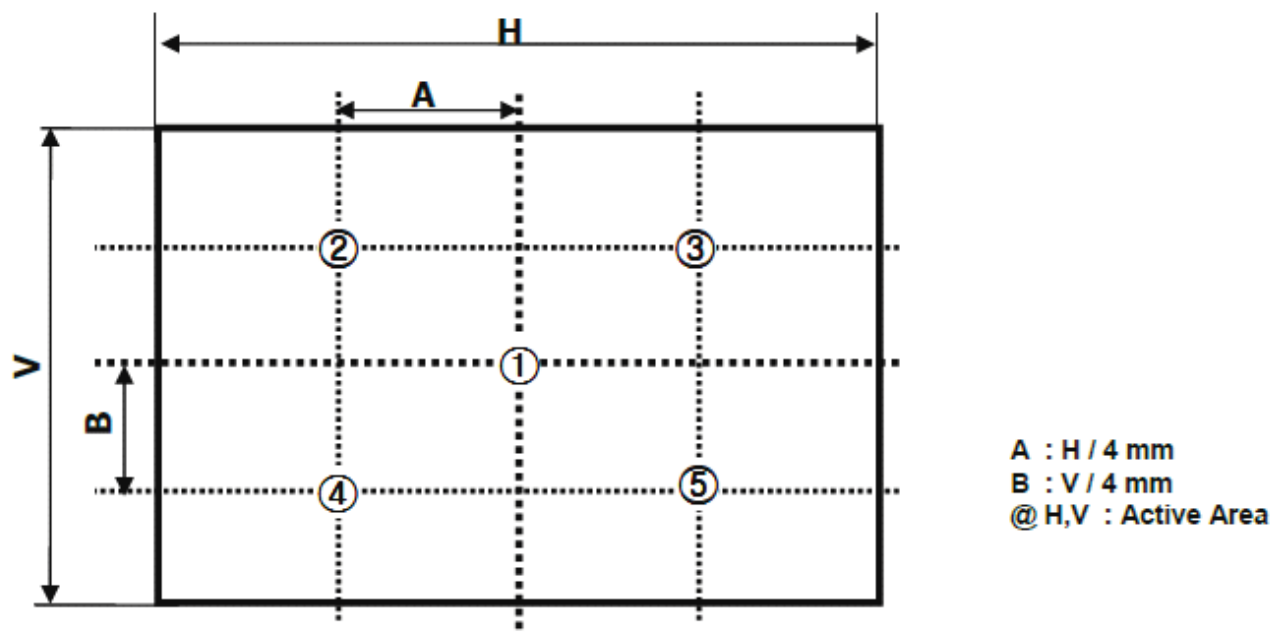B : V / 4 mm
@ H,V : Active Area

FIG. 2 5 Points for Luminance Measure

Response time is defined as the following figure and shall be measured by switching the input signal for "Gray(N)" and "Gray(M)".
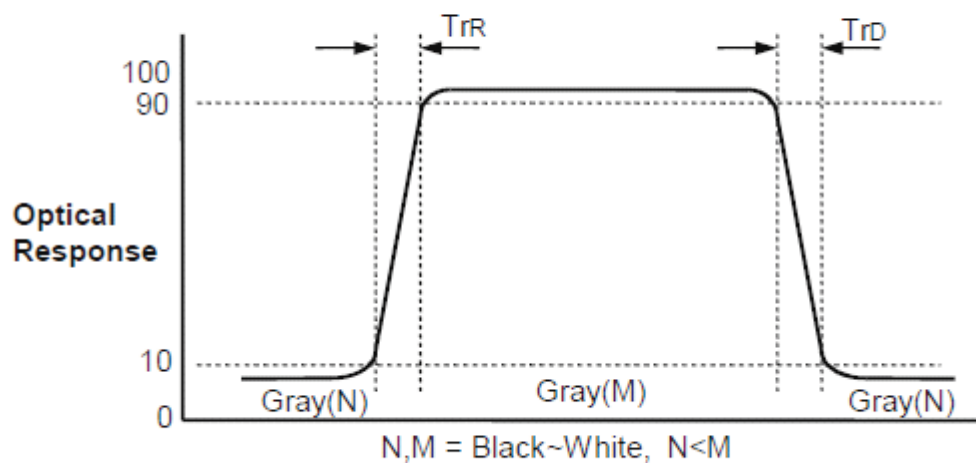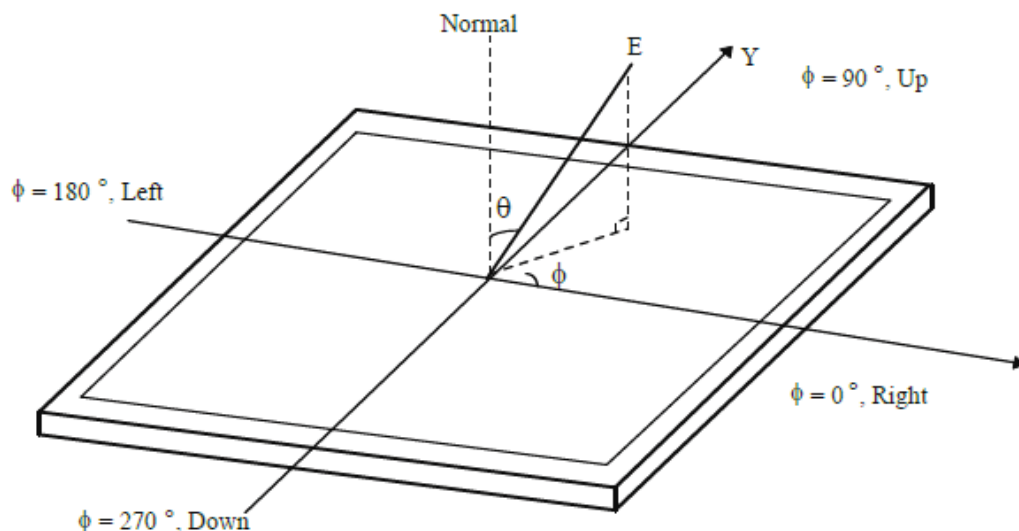

FIG. 3 Response Time

Sunlight Readable LCDs With Optical Bonding + Touch Integration

DP470FHDI

Specification

Dimension of viewing angle range

FIG. 4 Viewing Angle

5. Mechanical Characteristics

Table 12 provides general mechanical characteristics.
Table 12. MECHANICAL CHARACTERISTICS

Item		Value
Outline Dimension	Horizontal	1070.8 mm
	Vertical	615.2 mm
	Depth	69.9 mm
Bezel Area	Horizontal	1048.8 mm
	Vertical	593.2 mm
Active Display Area	Horizontal	1039.7 mm
	Vertical	584.8 mm
Weight		12.0 Kg (Typ.), 13.5 Kg (Max.)

Note : Please refer to a mechanical drawing in terms of tolerance at the next page.
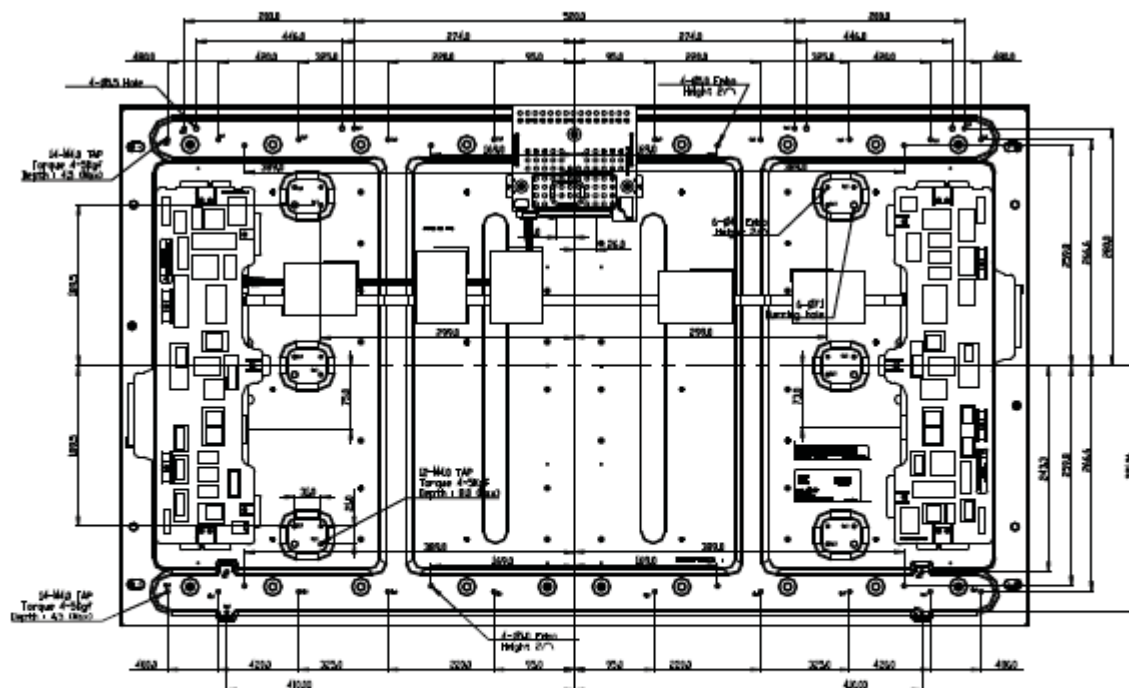
	Color No.	Maker
Black Spray	Acron #2200 Semi-Gloss LGD Black	Kunsul Chemical industry

Sunlight Readable LCDs With Optical Bonding + Touch Integration

DP470FHDI

Specification

[FRONT VIEW]

Sunlight Readable LCDs With Optical Bonding + Touch Integration

DP470FHDI

Specification

[REAR VIEW]

ITEM	TAP	Max Depth (mm)	Torque (kgf·cm)	NOTES
(a)	M4	4.5	4~5	
(b)	M4	4.5	4~5	
(c)	M4	8	4~5	

Sunlight Readable LCDs With Optical Bonding + Touch Integration

DP470FHDI

Specification

6.Reliability

Table 13. ENVIRONMENT TEST CONDITION

No.	Test Item	Condition
1	High temperature storage test	Ta= 60°C 240h
2	Low temperature storage test	Ta= -20°C 240h
3	High temperature operation test	Ta= 50°C 50%RH 240h
4	Low temperature operation test	Ta= 0°C 240h
5	Vibration test (non-operating)	Wave form : random Vibration level : 1.0Grms Bandwidth : 10-300Hz Duration : X,Y,Z, Each direction per 10 min
6	Shock test (non-operating)	Shock level : 50Grms Waveform : half sine wave, 11ms Direction : ±X, ±Y, ±Z One time each direction
7	Humidity condition Operation	Ta= 40 °C ,90%RH
8	Altitude　operating storage / shipment	0 - 15,000 ft 0 - 40,000 ft

Note：Before and after Reliability test, LCM should be operated with normal function.

7. International Standards

7-1. Safety

a) UL 60950-1, Underwriters Laboratories Inc.

Information Technology Equipment - Safety - Part 1：General Requirements.

b) CAN/CSA C22.2 No.60950-1-07, Canadian Standards Association.

Information Technology Equipment - Safety - Part 1：General Requirements.

c) EN 60950-1, European Committee for Electro technical Standardization (CENELEC).

Information Technology Equipment - Safety - Part 1：General Requirements.

d) IEC 60950-1, The International Electro technical Commission (IEC).

Information Technology Equipment - Safety - Part 1：General Requirements.

(Including report of IEC60825-1:2001 clause 8 and clause 9)

Notes

1.　Laser (LED Backlight) Information

Sunlight Readable LCDs With Optical Bonding + Touch Integration

DP470FHDI
Specification

Class 1M LED Product
IEC60825-1 : 2001
Embedded LED Power (Class1M)

2. Caution
: LED inside.
Class 1M laser (LEDs) radiation when open.
Do not open while operating.

7-2. EMC

a) ANSI C63.4 "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz." American National Standards Institute (ANSI), 2003.

b) CISPR 22 "Information technology equipment – Radio disturbance characteristics – Limit and methods of measurement." International Special Committee on Radio Interference (CISPR), 2005.

c) CISPR 13 "Sound and television broadcast receivers and associated equipment – Radio disturbance characteristics – Limits and method of measurement." International Special Committee on Radio Interference (CISPR), 2006.

7-3. Environment

a) RoHS, Directive 2002/95/EC of the European Parliament and of the council of 27 January 2003

8. Packing

8-1. Information of LCM Label

a) Lot Mark

| A | B | C | D | E | F | G | H | I | J | K | L | M |

A,B,C : SIZE(INCH)   D : YEAR
E : MONTH   F ~ M : SERIAL NO.

Note
1. YEAR

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Mark	A	B	C	D	E	F	G	H	J	K

2. MONTH

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mark	1	2	3	4	5	6	7	8	9	A	B	C

b) Location of Lot Mark

Sunlight Readable LCDs With Optical Bonding + Touch Integration

DP470FHDI

Specification

Serial No. is printed on the label. The label is attached to the backside of the LCD module.

This is subject to change without prior notice.

8-2. Packing Form

a) Package quantity in one Pallet : 11 pcs

b) Pallet Size : 1300mm(W) X 1140mm(D) X 125.5mm(H)

9. Precautions

Please pay attention to the followings when you use this TFT LCD module.

9-1. Mounting Precautions

(1) You must mount a module using specified mounting holes (Details refer to the drawings).

(2) You should consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to t h e

module. And the case on which a module is mounted should have sufficient strength so that external

force is not transmitted directly to the module.

(3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer.

Transparent protective plate should have sufficient strength in order to the resist external force.

(4) You should adopt radiation structure to satisfy the temperature specification.

(5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former

generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break

by electro-chemical reaction.

(6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB

pencil lead. And please do not rub with dust clothes with chemical treatment.

Do not touch the surface of polarizer for bare hand or greasy cloth.(Some cosmetics are detrimental

to the polarizer.)

(7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like

chamois soaks with petroleum benzine. Normal-hexane is recommended for cleaning the adhesives

used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause

chemical damage to the polarizer.

(8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes

deformations and color fading.

(9) Do not open the case because inside circuits do not have sufficient strength.

9-2. Operating Precautions

(1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage :

V=±200mV(Over and under shoot voltage)

(2) Response time depends on the temperature.(In lower temperature, it becomes longer.)

(3) Brightness depends on the temperature. (In lower temperature, it becomes lower.)

And in lower temperature, response time(required time that brightness is stable after turned on)

becomes longer

(4) Be careful for condensation at sudden temperature change.Condensation makes damage to polarizer or

electrical contacted parts. And after fading condensation, smear or spot will occur.

(5) When fixed patterns are displayed for a long time, remnant image is likely to occur.

Sunlight Readable LCDs With Optical Bonding + Touch Integration

DP470FHDI
Specification

(6) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference.

(7) Please do not give any mechanical and/or acoustical impact to LCM. Otherwise, LCM can't be operated its full characteristics perfectly.

(8) A screw which is fastened up the steels should be a machine screw.

(if not, it can causes conductive particles and deal LCM a fatal blow)

(9) Please do not set LCD on its edge.

(10) The conductive material and signal cables are kept away from LED driver inductor to prevent abnormal display, sound noise and temperature rising.

9-3. Electrostatic Discharge Control

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

9-4. Precautions for Strong Light Exposure

Strong light exposure causes degradation of polarizer and color filter.

9-5. Storage

When storing modules as spares for a long time, the following precautions are necessary.

(1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.

(2) The polarizer surface should not come in contact with any other object.

It is recommended that they be stored in the container in which they were shipped.

(3) Storage condition is guaranteed under packing conditions.

(4) The phase transition of Liquid Crystal could be recovered if the LCM is released at the normal condition after the low or over the storage temperature.

9-5. Storage

9-6. Handling Precautions for Protection Film

(1) The protection film is attached to the bezel with a small masking tape.

When the protection film is peeled off, static electricity is generated between the film and polarizer.

This should be peeled off slowly and carefully by people who are electrically grounded and with well ionblown equipment or in such a condition, etc.

Ver 1.0 29 /37

blown (2) When the module with protection film attached is stored for a long time, sometimes there remains a very

small amount of glue still on the bezel after the protection film is peeled off.

(3) You can remove the glue easily. When the glue remains on the bezel surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normalhexane.

9-7. Appropriate Condition for Public Display

- Generally large-sized LCD modules are designed for consumer applications (TV).

Accordingly, a long-term display like in Public Display (PD) application, can cause uneven display including image sticking. To optimize module's lifetime and function, several operating usages are required.

1. Normal operating condition

Sunlight Readable LCDs With Optical Bonding + Touch Integration

DP470FHDI

Specification

- Temperature: 0 ~ 40℃

- Operating Ambient Humidity : 10 ~ 90 %

- Display pattern: dynamic pattern (Real display)

Note) Long-term static display can cause image sticking.

2. Operating usages under abnormal condition

a. Ambient condition

- Well-ventilated place is recommended to set up PD system.

b. Power and screen save

- Periodical power-off or screen save is needed after long-term display.

3. Operating usages to protect against image sticking due to long-term static display

a. Suitable operating time: under 18 hours a day.

b. Static information display recommended to use with moving image.

- Cycling display between 5 minutes' information(static) display and 10 seconds' moving image.

c. Background and character (image) color change

- Use different colors for background and character, respectively.

- Change colors themselves periodically.

d. Avoid combination of background and character with large different luminance.

1) Abnormal condition just means conditions except normal condition.

2) Black image or moving image is strongly recommended as a screen save.

4. Lifetime in this spec. is guaranteed only when PD is used according to operating usages.

5. Module should be turned clockwise based on front view when used in portrait mode.

Sunlight Readable LCDs With Optical Bonding + Touch Integration

DP470FHDI

Specification

APPENDIX-I

■ Pallet Ass'y
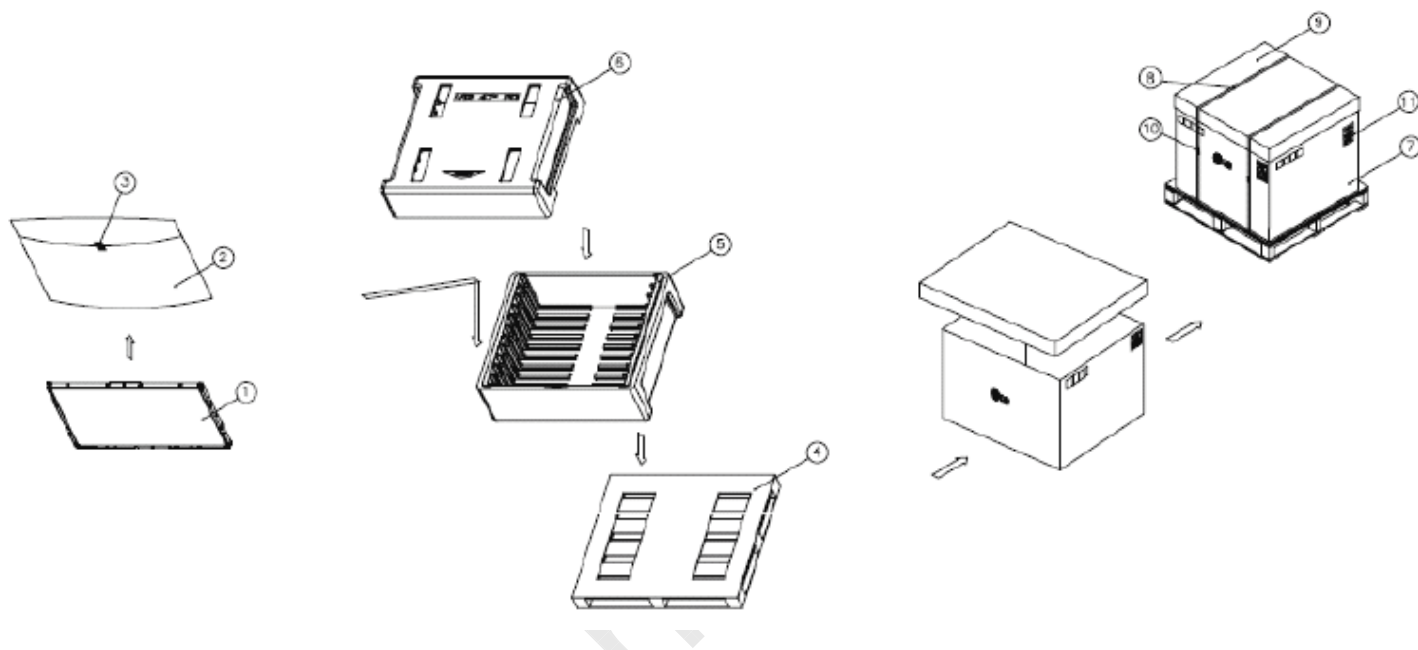
NO.	DESCRIPTION	MATERIAL
1	LCD Module	47" LCD
2	BAG	AL Bag
3	TAPE	MASKING 20MMX50M
4	PALLET	Plywood 1300X1140X125.5mm
5	PACKING,BOTTOM	EPS
6	PACKING,TOP	EPS
7	ANGLE,PACKING	PAPER
8	BAND	PP
9	ANGLE,COVER	PAPER
10	BAND	STEEL OR PP
11	LABEL	YUPO 80G 100X70

Sunlight Readable LCDs With Optical Bonding + Touch Integration

Dopoint Hi-Tech Limited

DP470FHDI

Specification

APPENDIX- II-1

■ LCM Label

Sunlight Readable LCDs With Optical Bonding + Touch Integration