SANYO

ENGINEERING SPECIFICATIONS

TFT COLOR LCD MODULE

TM035QV-67P06D

- 8.9cm (3.5 inch) diagonal
- Quarter VGA resolution (240 x 320 pixels)
- 6 bits x RGB interface
- With LED Backlight unit
- Glare surface type
- With touch panel

(TENTATIVE)

Ver.2 Sep. 25, 2003

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REVISION HISTORY

DATE	REVISION NO.	PAGE	DESCRIPTIONS
Jun.20 '03	Ver.1	-	Initial Release
Sep.25 '03	Ver.2	2,3,4,6	$V_{COM\ DC}$(typ.1.6V→1.85V), Ambient temperature Touch panel surface hardness(min.2H→3H)

MECHANICAL CHARACTERISTICS

Ta=25 degC

ITEM	SPECIFICATION	UNIT
Module size	66.2(W) x 91.0(H) x 4.7 Max.(t)	mm
Resolution	240 x R.G.B(H) x 320(W)	pixel
Sub pixel pitch	0.0745(W) x 0.2235(H)	mm
Pixel pitch	0.2235(W) x 0.2235(H)	mm
Active viewing area	53.64(W) x 71.52(H)	mm
Bezel opening area	57.6(W) x 75.0(H)	mm
Weight	50 ± 2	g
Touch panel	Glare type (Surface Hardness : 3H)	

ELECTRICAL ABSOLUTE MAXIMUM RATINGS

Ta=25 degC

ITEM		SYMBOL	MIN	MAX	UNIT	NOTE
Power supply voltage	Digital	V_{DD}	-0.3	4.0	V	
	Analog	V_{CC}	-0.3	6.0	V	
	Gate	V_{GH}	-0.3	44	V	
		V_{GL}	VGH-44	0.3	V	
Driving signal		V_{COM}	-1.5	5	V	
Input voltage	Digital	V_{IN}	V_{SS}-0.3	V_{DD}+0.3	V	
	γ Voltage	V_0-V_4	0	V_{CC}+0.3	V	Note 1
	Touch panel		0	7.0	V	
LED current		I_L	0	20	mA	

[Note 1] V_0,V_1,V_2,V_3,V_4

ENVIRONMENTAL ABSOLUTE MAXIMUM RATINGS

Ta=25 degC

ITEM	SYMBOL	CONDITIONS	MIN	MAX	UNIT	NOTE
Ambient temperature	T_{ST}	Storage	-20	60	degC	Note 1
	T_{OP}	Operation	-10	55		
Humidity	-	Ta=40 degC max.	-	85	%RH	No condensation Note 2
Vibration	-	Storage	-	TBD	G	
Shock	-	Storage	-	TBD	G	

[Note 1] Care should be taken so that the LCD module may not be subjected to the temperature beyond this specification.

[Note 2] Ta>40 degC : Absolute humidity shall be less than that of 85%RH/40 degC.

ELECTRICAL CHARACTERISTICS for LCD

V_{DD}=3.3V ,f_V=60Hz ,f_{CLK}=6MHz ,Ta=25 degC

ITEM		SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT	NOTE
Power supply voltage	Digital	V_{DD}		3.0	3.3	3.6	V	Note 1
	Analog	V_{CC}		4.75	5	5.25	V	
	Gate	V_{GH}		14.3	15	15.7	V	
		V_{GL}		-11	-10	-9	V	
Driving signal		$V_{COM\ AC}$		±2.4	±2.45	±2.5	V	Note 2
		$V_{COM\ DC}$		1.55	1.85	2.15	V	
Input voltage	High level	V_{IH}		0.8VDD	-	V_{DD}	V	
	Low level	V_{IL}		V_{SS}	-	0.2VDD	V	
Power supply current		I_{DD}	V_{DD}=3.3V	-	0.2	1.0	mA	Note 3
		I_{CC}	V_{CC}=5V	-	7.0	10	mA	
		I_{GH}	V_{GH}=15V	-	0.03	0.1	mA	
		I_{GL}	V_{GL}=-10V	-	0.07	0.2	mA	
		$I_{COM(AC)}$	V_{COMAC}= 2.45V	-	150	250	mA	Note 3 $I_{0\text{-}peak}$

*Recommended Control IC : LC272C1B-VD6/VC9(SANYO)

[Note 1] 1) Turn on or off the power supply with simultaneously or the following sequence.
Turn on :V_{DD} → VGL → VGH → VCC → (V0-V4) → Logic input
Turn off : Logic input → (V0-V4) → VCC → VGH → VGL → VDD

2) The input signal of “OE” Terminal(pin No.18) must be high voltage when turning on the power supply, and it is held until more than double vertical periods after VDD is turned on complete. After then it must be held low voltage.

[Note 2] VCOM AC should be alternated on VCOM DC every 1 horizontal period and 1 vertical period. VCOM DC bias should be adjusted so as to minimize flicker or maximum contrast every each module.(Condition:VGH=15V,VGL=-10V,VCC=5V)

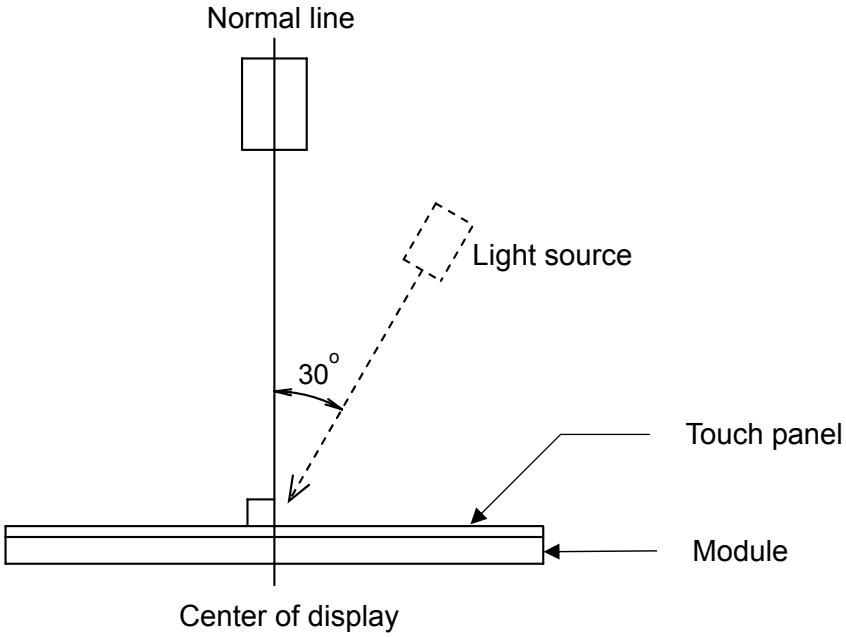
[Note 3] Typ. value : display pattern is 64 gray scale bar.

OPTICAL CHARACTERISTICS
with Touch Panel

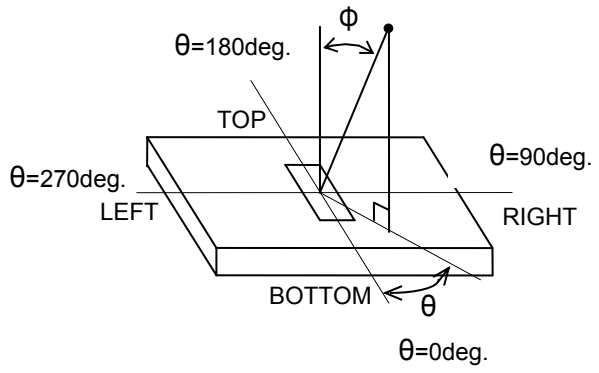
Ta=25 degC, VDD=3.3V, fv=60Hz,IL=18mA

ITEM		SYMBOL	CONDITIONS			MIN	TYP	MAX	UNIT	NOTE
			Back light	Other						
Brightness		B	On	Φ=0 deg.		(70)	(100)	-	cd/m^2	Note 5,7,8
Brightness uniformity		δ B	On	Φ=0 deg.		-	-	1.6	-	Note 6,7,8
Contrast ratio		CR	On	Φ=0 deg.		60	90	-	-	Note 2,8
			Off	Φ=0 deg.		-	12	-		
Viewing angle range		Φ	On	CR>2	Φ= 0 deg.	-	50	-	deg.	Note 1,2,4,8
					Φ= 90 deg.	-	40	-		
					Φ=180 deg.	-	50	-		
					Φ=270 deg.	-	40	-		
Response time	Rise	tr	On	Φ=0 deg.		-	10	-	ms.	Note 3,4,8
	Fall	tf				-	10	-		
White Chromaticity		x	Off	Φ=0 deg.		-	(0.315)	-	-	Note 9
		y				-	(0.356)	-		
		x	On	Φ=0 deg.		-	(0.302)	-	-	Note 4,8
		y				-	(0.310)	-		
Reflection Raito		R	Off	Φ=0 deg.		-	(8)	-	%	Note 4,9,10

The measuring method of Backllight Off is shown by the following figure.



[Note 1] Φ and θ

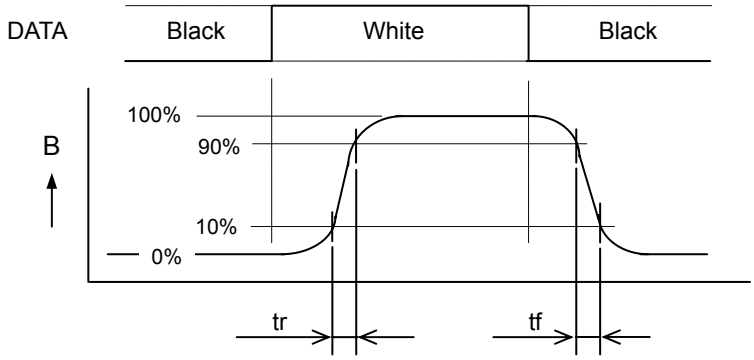


[Note 2] Contrast ratio "CR" is defined as :

$$CR = \frac{\text{Brightness at White}}{\text{Brightness at Black}}$$

Contrast ratio shall be the center of five points (point No.3 shown in Note 7).

[Note 3] Response time



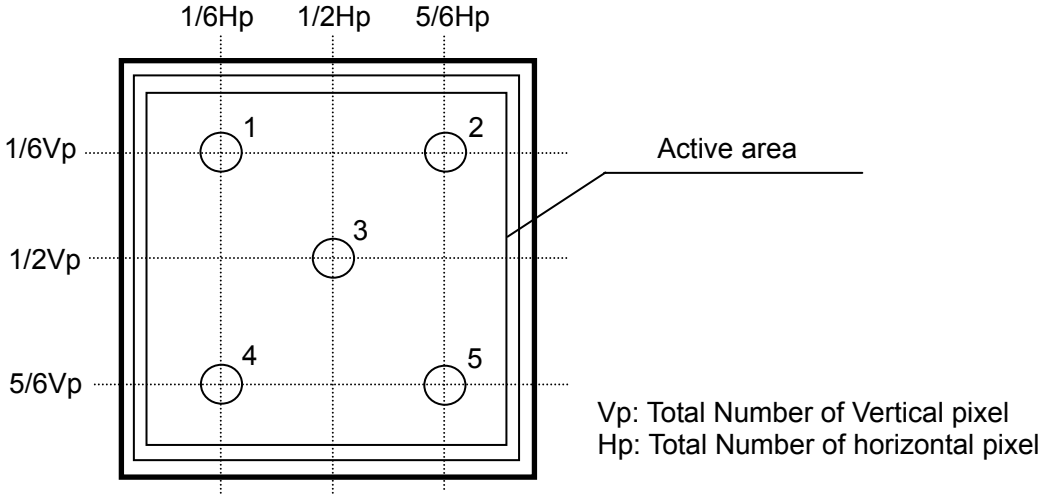
[Note 4]This shall be measured at center (point No.3 shown in Note 7).

[Note 5] The brightness shall be measured at center (point No.3 shown in Note 7).

[Note 6] The brightness uniformity " δ B" is defined as :

$$\delta B = \frac{\text{Maximum brightness of five points}}{\text{Minimum brightness of five points}}$$

[Note 7] Measurement points



[Note 8] Measurement condition (Back light)

(1) Measurement equipment: BM-5A
(2) Ambient temperature Ta: 25 ± 2 degC
(3) LCD: All pixels are WHITE, VDD=3.3V, fV=60Hz
(4) IL=18 mA

[Note 9] The measurement shall be taken in a D65 light source.

[note10] Reflection Ratio is defined as :

$$R = \text{Reflectance Factor white board} \times \frac{\text{Lum center (on LCD surface)}}{\text{Lum white board}}$$

BACKLIGHT CHARACTERISTICS

Ta=25 degC

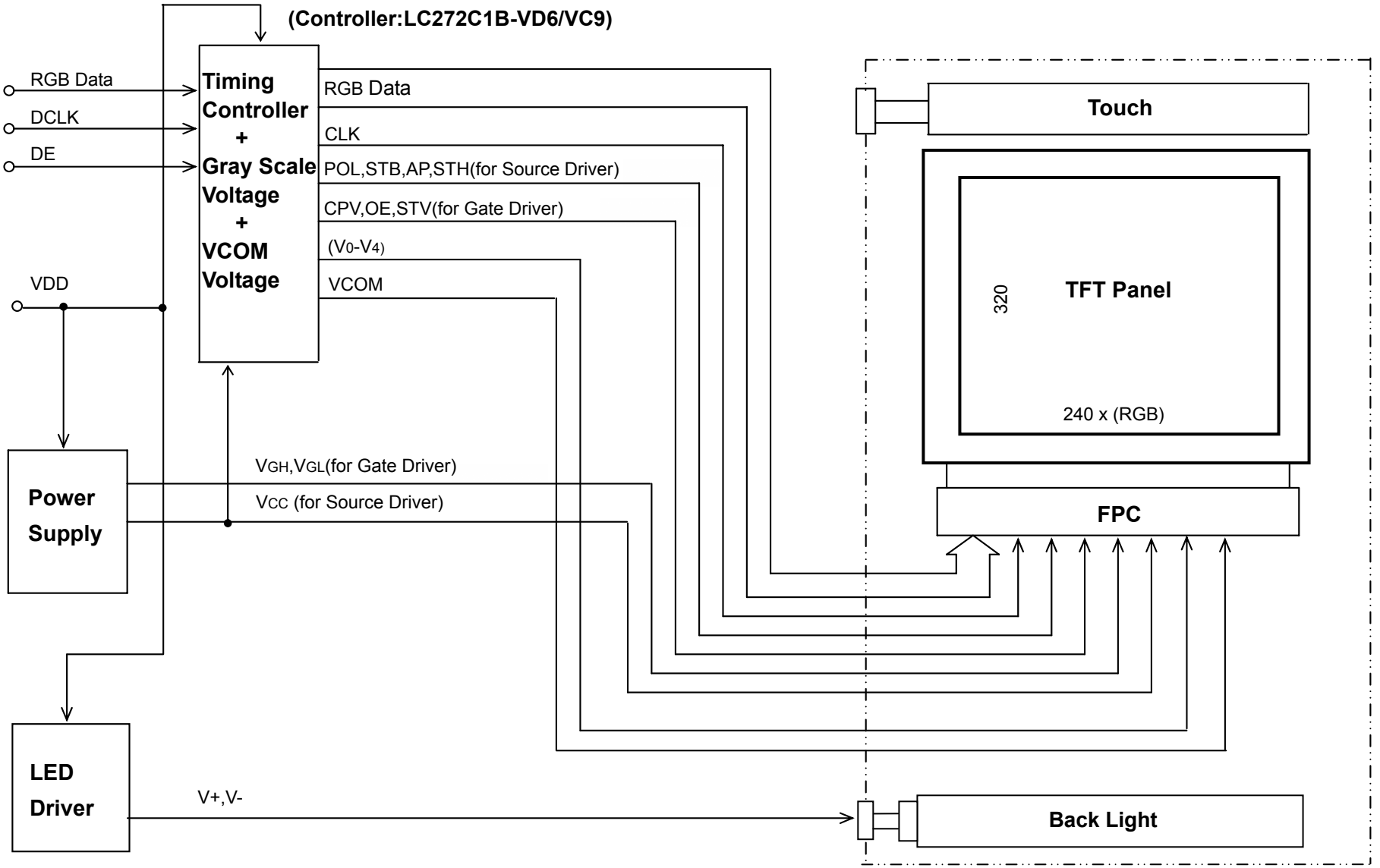
ITEM	SYM.	CONDITION	MIN	TYP	MAX	UNIT	NOTE
LED Current	I_L		-	18	20	mA	
LED Voltage	V_L		-	3.6	3.95	V	for LED1p ,I_L=18mA

TOUCH PANEL CHARACTERISTICS

Ta=25 degC

ITME		MIN	TYP	MAX	UNIT	NOTE
Input Voltage		4.5	5	5.5	V	
Resistance betweenterminal	X	400	540	1000	ohm	
	Y	200	330	650	ohm	
Linearity		-	-	1.5	%	
Chattering		-	-	10	ms	
Surface hardness		3	-	-	H	Hardness of pencil
Operation force		-	-	80	gf	
Insulation resistance		20	-	-	Mohm	DC25V

BLOCK DIAGRAM



INTERFACE PIN CONNECTIONS

LCM : CN1

PIN NO.	SYMBOL	FUNCTION
1	GND	Ground
2	VCOM	Power supply of common electrode
3	GND	Ground
4	V0	Gamma control (for use of external gamma setting) Keep the following relation. $V_{SS}+0.1V \geqq V_4 \geqq V_3 \geqq V_2 \geqq V_1 \geqq V_0 \geqq V_{CC}-0.1V$ OR Non connection (for use of internal gamma setting)
5	V1	
6	V2	
7	V3	
8	V4	
9	GAM	Gamma selection switch(VDD:external, GND:internal)
10	COM	Non-connection
11	NC	Non-connection
12	INV	Data reversal signal(GND:Normal,VDD:Invert)
13	POL	Polarity reversal signal
14	STB	Data latch signal of source driver
15	AP	Power save signal of source driver
16	VDD	Power supply (3.3V)
17	CLK	Data clock
18	STH	Start signal of source driver
19	GND	Ground
20	B0	Blue data (LSB)
21	B1	Blue data
22	B2	Blue data
23	B3	Blue data
24	B4	Blue data
25	B5	Blue data(MSB)
26	G0	Green data (LSB)
27	G1	Green data
28	G2	Green data
29	G3	Green data
30	G4	Green data
31	G5	Green data (MSB)
32	R0	Red data (LSB)
33	R1	Red data
34	R2	Red data
35	R3	Red data
36	R4	Red data
37	R5	Red data (MSB)
38	GND	Ground
39	VCC	Power supply (5V)
40	CPV	Clock signal of gate driver
41	VGL	Power supply of gate driver(low level)
42	OE	Output enable of gate driver
43	VGH	Power supply of gate driver(High level)
44	STV	Start signal of gate driver
45	GND	Ground

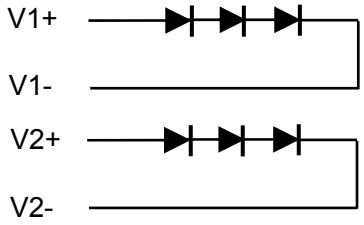
CN1 : FPC(Pitch 0.5mm)
Suitable mating connector: FH12S-45S-0.5SH(lower terminal type) (HIROSE)
FH12A-45S-0.5SH(upper terminal type) (HIROSE)

[Note 1] Valid synchronous signals are DCLK and DE. HSYNC and VSYNC are not used

Back Light : LEDCN1

PIN NO.	SYMBOL	FUNCTION
1	V1-	Ground(LED 1 cathode)
2	V1+	LED 1 voltage(anode)
3	V2-	Ground(LED 2 cathode)
4	V2+	LED 2 voltage(anode)

LEDCN1 : FPC(Pitch 0.5mm)
Suitable mating connector: 04FLH-SM1-TB (JST)



Circuits of Back Light

Touch Panel : TPCN1

PIN NO.	SYMBOL
1	RIGHT
2	BOTTOM
3	LEFT
4	TOP

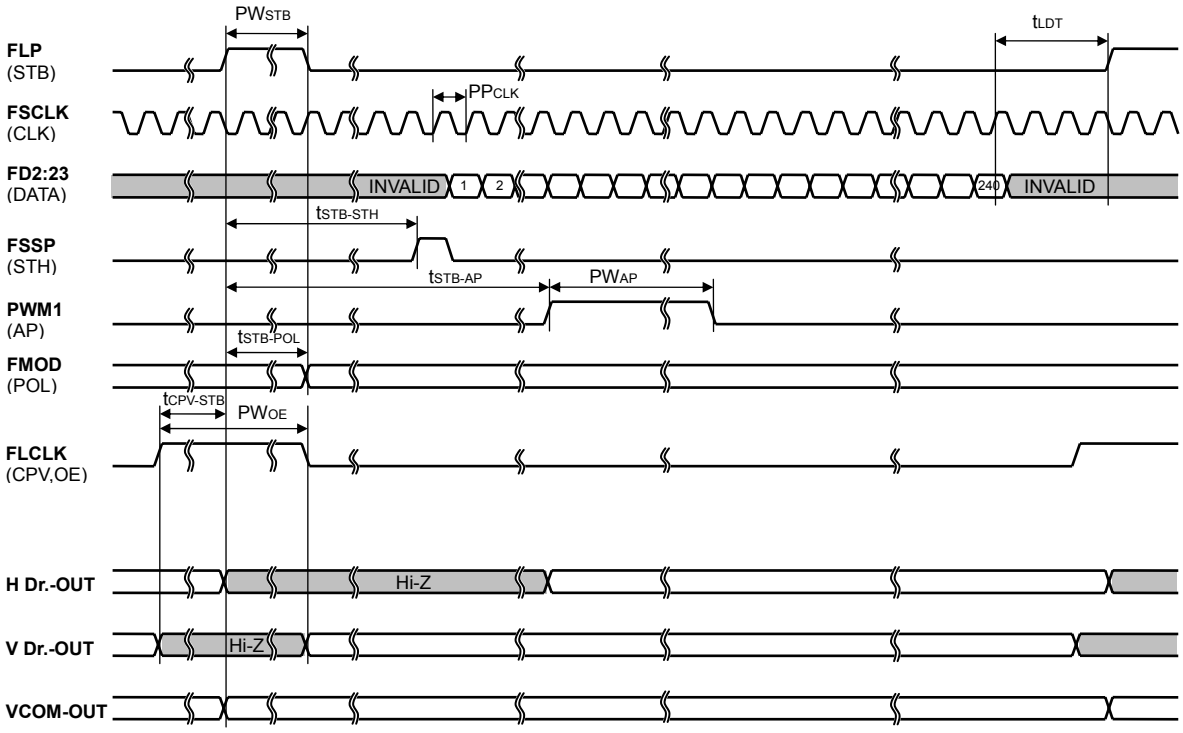
TPCN1:FPC(Pitch 1.0mm)

INTERFACE SIGNAL TIMING PARAMETERS

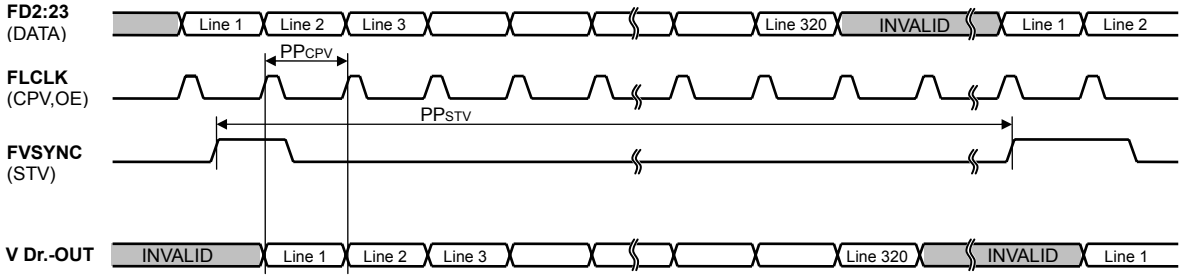
Timing characteristic (Ta=25degC, VDD=3.3V, VCC=5.0V)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Clock frequency	PP_{CLK}	5.4	-	7.2	MHz
Last data timing	t_{LDT}	2	-	-	CLK
STB frequency	PP_{STB}	16.5	-	20.0	kHz
STB pulse width	PW_{STB}	550	-	-	ns
STB-STH time	$t_{STB-STH}$	4	-	-	CLK
STB-AP time	t_{STB-AP}	10	-	-	us
AP pulse width	PW_{AP}	15	-	-	us
STB-POL time	$t_{STB-POL}$	40	-	-	ns
CPV-STB time	$t_{CPV-STB}$	1	3	-	us
STV frequency	PP_{STV}	50	-	65	Hz
Clock frequency	PP_{CPV}	16.5	-	20	kHz

Horizontal timing chart



Vertical timing chart



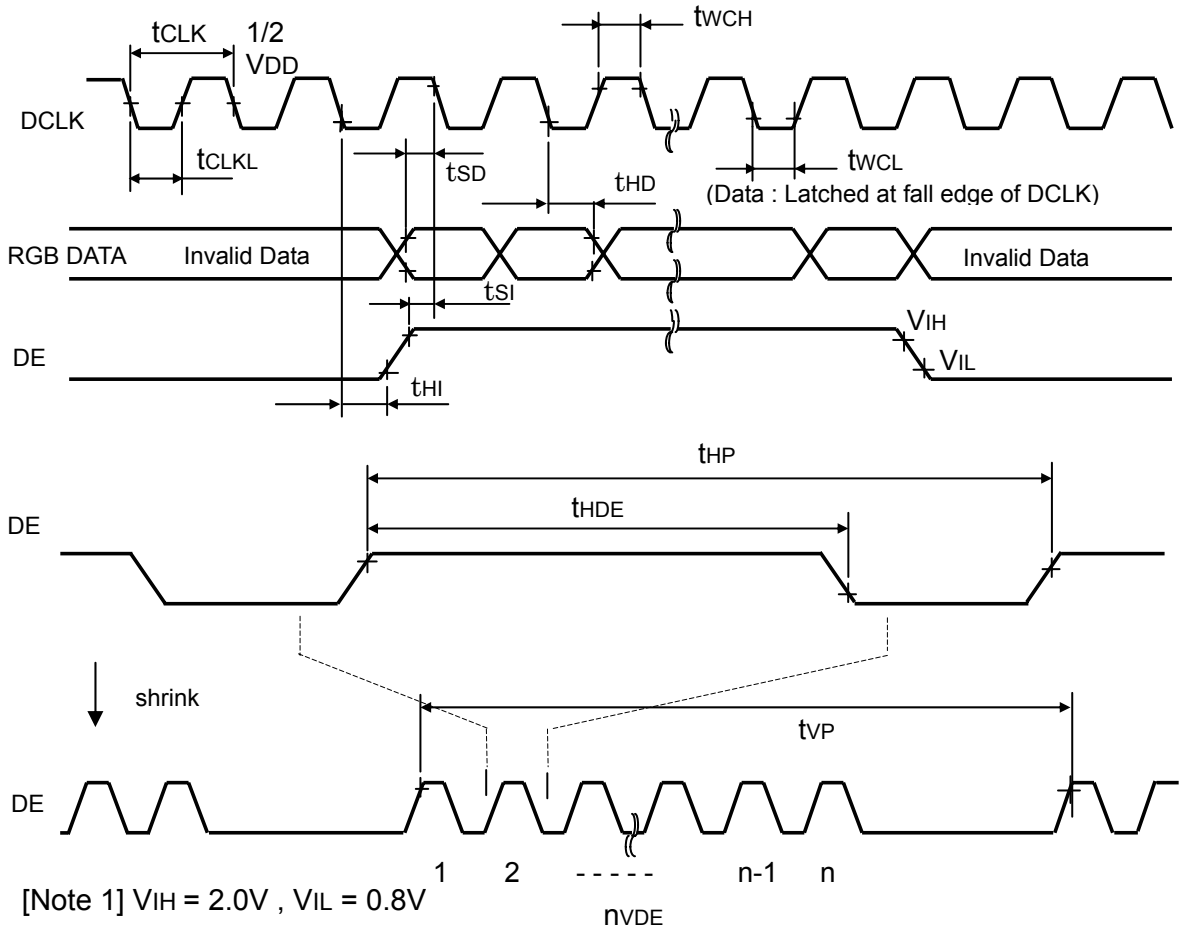
INTERFACE SIGNAL TIMING PARAMETERS (DE_MODE)
FOR TIMING CONTROLLER(LC272IB-VD6/VC9)

PARAMETER		SYMBOL	MIN	TYP	MAX	UNIT	NOTE
DCLK	Frequency	f_{CLK}	-	-	10	MHz	$t_{CLK}=1/f_{CLK}$
	Width-Low	t_{WCL}	10	-	-	ns	
	Width-High	t_{WCH}	10	-	-	ns	
	Duty	D	0.40	0.50	0.60	-	$D=t_{CLKL}/t_{CLK}$
DE	Setup Time	t_{SI}	10	-	17	ns	for DCLK
	Hold Time	t_{HI}	10	-	17	ns	
	Horiz. Period	t_{HP}	261	-	480	t_{CLK}	
	Horiz. DE	t_{HDE}	-	240	-	t_{CLK}	
	Vert. Period	t_{VP}	NVDE+5	-	4095	t_{HP}	fv=60Hz Typ.
	Vert. DE	n_{VDE}	128	320	-	n	
DATA	Setup Time	t_{SD}	10	-	-	ns	for DCLK
	Hold Time	t_{HD}	10	-	-	ns	

[Note 1] f_H (Horizontal Frequency) = $1/T_{hp}$
f_V (Vertical Frequency) = $1/T_{vp}$

INTERFACE SIGNAL TIMING DIAGRAM (DE_MODE)

*Refer to Timing Controller(LC272IB-VD6/VC9)



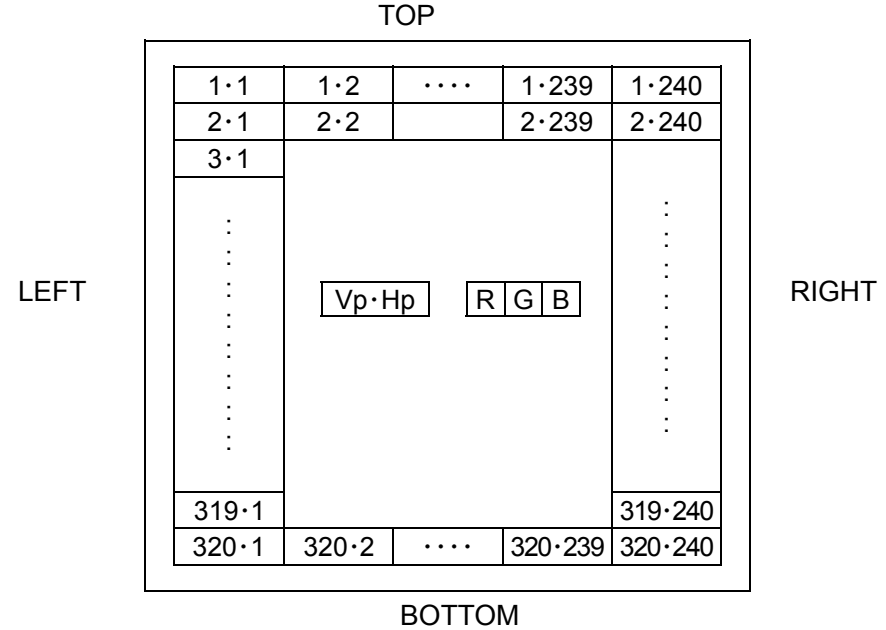
[Note 1] V_{IH} = 2.0V , V_{IL} = 0.8V

RELATIONSHIP BETWEEN INPUT DATA AND DISPLAY COLOR

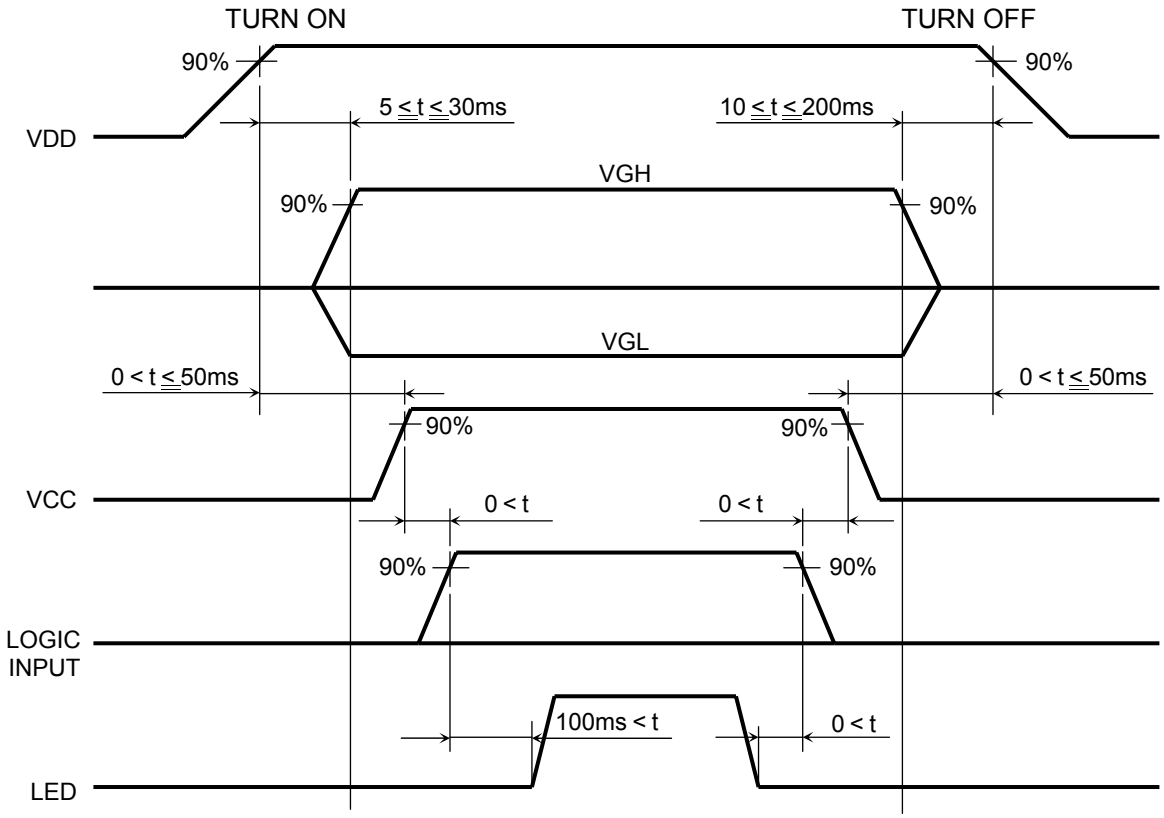
DISPLAY COLOR \ INPUT DATA		R DATA						G DATA						B DATA					
		MSB					LSB	MSB					LSB	MSB					LSB
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
BASIC COLOR	BLACK	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	RED(63)	H	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L
	GREEN(63)	L	L	L	L	L	L	H	H	H	H	H	H	L	L	L	L	L	L
	BLUE(63)	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H
	CYAN	L	L	L	L	L	L	H	H	H	H	H	H	H	H	H	H	H	H
	MAGENTA	H	H	H	H	H	H	L	L	L	L	L	L	H	H	H	H	H	H
	YELLOW	H	H	H	H	H	H	H	H	H	H	H	H	L	L	L	L	L	L
	WHITE	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
RED	BLACK	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	RED(1)	L	L	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L
	RED(2)	L	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L
	:	:						:						:					
	:	:						:						:					
	RED(61)	H	H	H	H	L	H	L	L	L	L	L	L	L	L	L	L	L	L
	RED(62)	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	L
	RED(63)	H	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L
GREEN	BLACK	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	GREEN(1)	L	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L
	GREEN(2)	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L
	:	:						:						:					
	:	:						:						:					
	GREEN(61)	L	L	L	L	L	L	H	H	H	H	L	H	L	L	L	L	L	L
	GREEN(62)	L	L	L	L	L	L	H	H	H	H	H	L	L	L	L	L	L	L
	GREEN(63)	L	L	L	L	L	L	H	H	H	H	H	H	L	L	L	L	L	L
BLUE	BLACK	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	BLUE(1)	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H
	BLUE(2)	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L
	:	:						:						:					
	:	:						:						:					
	BLUE(61)	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	L	H
	BLUE(62)	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	L
	BLUE(63)	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H

[Note 1] Color(n) --- 'n' indicates gray scale step.

RELATIONSHIP BETWEEN INPUT DATA AND DISPLAY POSITION



POWER ON/OFF SEQUENCE REQUIREMENT



Turn on :VDD → VGL → VGH → VCC → Logic input
Turn off : Logic input → VCC → VGH → VGL → VDD

When the power is off, logic input must be kept at either low level or high impedance.

PRECAUTIONS (INSTRUCTIONS FOR SAFE AND PROPER USE)

1. Instructions for safety

(1) Please do not disassemble or modify LCD module to avoid the possibility of electric shock, damage of electronic components, scratch at display surface and invasion of foreign particles. In addition, such activity may result in fire accident due to burning of electronic component.
LCD module disassembled or modified by customer is out of warranty.

(2) Please be careful in handling of LCD module with broken glass.
When the display glass breaks, please pay attention not to injure your fingers. The display surface has the plastic film attached, which prevents dispersion of glass pieces, however touching broken edge will injure your fingers.

(3) Please do not touch the fluid flown out of broken display glass.
If the fluid should stick to hand or clothes, wipe off with soap or alcohol immediately and then wash it with water. If the fluid should get in eyes, wash eyes immediately with pure water for more than 15 minutes and then consult the doctor.

(4) Please be careful to electric shock.
Before handling LCD module, please switch off the power supply.

2. Instructions for designing

(1) Mounting of LCD
Please fix LCD module at all mounting flanges shown in this specification for installation onto system. The used screws should have proper dimensions.
Furthermore, designing of mounting parts should be adequate so that LCD module is not warped or twisted, to achieve good display quality.

(2) Mounting of LCD
Please give careful consideration in designing which doesn't press down a Touch panel for installation onto system. If must be press it down that please leave it from the Bezel opening area more than 2mm.

(3) Noise on power line
Spike noise contained in power line causes abnormal operation of driving circuit and abnormal display. To avoid it, spike noise should be suppressed below VDD +/- 200mVp-p. (In any case, absolute maximum rating should be kept.)

(4) Power sequence
Before LCD module is switched on, please make sure that power supply and input signals of system, testing equipment, etc. meet the recommended power sequence.

(5) Absolute maximum rating
Absolute maximum rating specified in this specification has to be kept in any case. It shows the maximum that cannot be exceeded.
Exceeding it may cause burning or non-recoverable break of electronic components in circuit. Please make system design so that absolute maximum rating is not exceeded even if ambient temperature input signal and components are varied.

(6) Protection for power supply
Please study to adapt protection for power supply against trouble of LCD module, depending on usage condition of system.

(7) Protection cover and cut-off filter for ultraviolet rays
When LCD module is used under severe condition like outdoor, it is recommended to use transparent protection cover over display surface to avoid scratches and invasion of dust and water. In addition, when LCD module is exposed to direct sun light for long time, use of cut-off filter for ultraviolet rays is also recommended. Please be careful not to get condensation.

3. Instructions for use and handling

(1) Protection against Static electricity
Semiconductors are easily damaged by static discharge. LCD module should be handled on conductive mat by person grounded with wrist strap etc. to avoid getting static electricity. Please be careful not to generate static electricity during operation.

(2) Protection against dust and stain
LCD module should be handled in circumstance as clean as possible.
It is recommended to wear fingerstalls or ductless and soft gloves before handling to avoid getting dust or stain on display surface.

(3) Protection film for display surface
It is recommended to remove protection film at nearly final process of assembling to avoid getting scratch or dust. To remove film, please pick up its edge with dull-head tweezers or cellophane tape at first and then remove film gradually taking more than 3 seconds. If film is removed quickly, static electricity may be generated and may damage semiconductors or electronic components.

(4) Contamination of display surface
When display surface of Touch panel is contaminated, please wipe the surface softly with cotton swab or clean cloth.

(5) Water drop on LCD surface
Please do not leave LCD module with water drop. When the display surface gets water drop, please wipe it off with cotton swab or soft cloth immediately, otherwise display surface will be deteriorated.
If water gets in inside of LCD module, circuit may be damaged.

(6) Please make sure that LCD module is not warped or twisted at installation into system. Even temporary warp or twist may be the cause for failure.

(7) Mechanical stress
Please be careful not to apply strong mechanical stress like drop or shock to LCD module. Such stress may cause break of display glass may be the cause for failure.

(8) Pressure to display surface
Please be careful not to apply strong pressure to display surface. Such pressure may cause scratches at surface or may be the cause of failure.

(9) Protection against scratch
Please be careful not to hit, press or rub the display surface with hard material like tools. In addition, please do not put heavy or hard material on display surface, and do not stack LCD modules. Touch Panel at front surface can be easily scratched.

(10) Plugging in of connector
Please be careful not to apply strong stress to connector part of LCD module at plugging in or out, because strong stress may damage the inside connection. At plugging in connector, place LCD module on the flat surface and hold the backside of connector on LCD module. Please make sure that connector is plugged in correctly. Insecure connection may be the cause for failure during operation.
In addition, please be careful not to put the connecting cable between cabinet of system and LCD module at installing LCD module into system.

(11) Handling of FPC (Flexible Printed Circuit)
Please be careful not to pull or scratch FPC, because FPC or soldered part of FPC may be damaged consequently.

(12) Switching off before plugging in connector
Please make sure that power is switched off before plugging in connector.
If power is on at plugging in or out, circuit of LCD module may be damaged.
When LCD is switched on for test or inspection, please make sure that power supply and input signals of driving system meet the specified power sequence.

(13) Temperature dependence of LCD display
Response speed (optical response) of LCD display is dependent on temperature. Under low temperature, response speed is slower.
Also brightness and chromaticity change slightly depending on temperature.

(14) Condensation
LCD module may get condensation on its display surface and inside in the circumstance where temperature changes much in short time.
Condensation can cause deterioration or failure. Therefore, please be careful not to get condensation.

(15) Remaining of image
Displaying the same pattern for long time may cause remaining of image even after changing the pattern. This is not failure but will disappear with time.

4. Instructions for storage and transportation

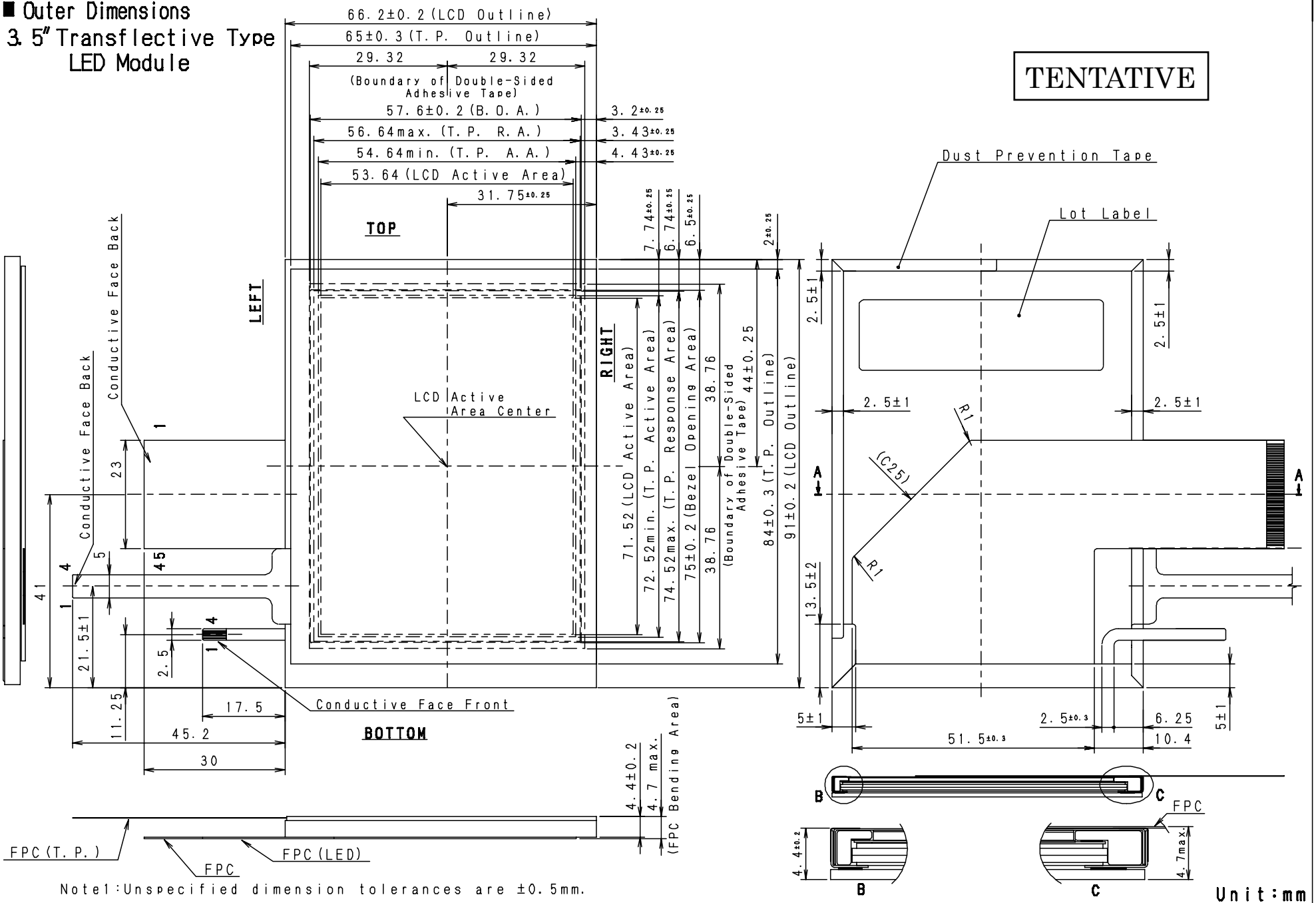
(1) Storage
Please store LCD module in the dark place of room temperature and low humidity in original packing condition, to avoid condensation that may cause failure.
Since sudden temperature change may cause condensation, please store in circumstance of stable temperature.

(2) Stacking number
Since excessive weight causes deformation and damage of carton box, please stack only up to the number stated on carton box for storage and transportation.

(3) Handling
Since LCD module consists of glass and precise electronic components, it will be damaged by excessive shock and drop. Therefore, please handle the carton box carefully to minimize shock at loading, reloading and transportation.

■ Outer Dimensions
3.5″ Transflective Type
LED Module

TENTATIVE



Note1 : Unspecified dimension tolerances are ±0.5mm.

Unit : mm