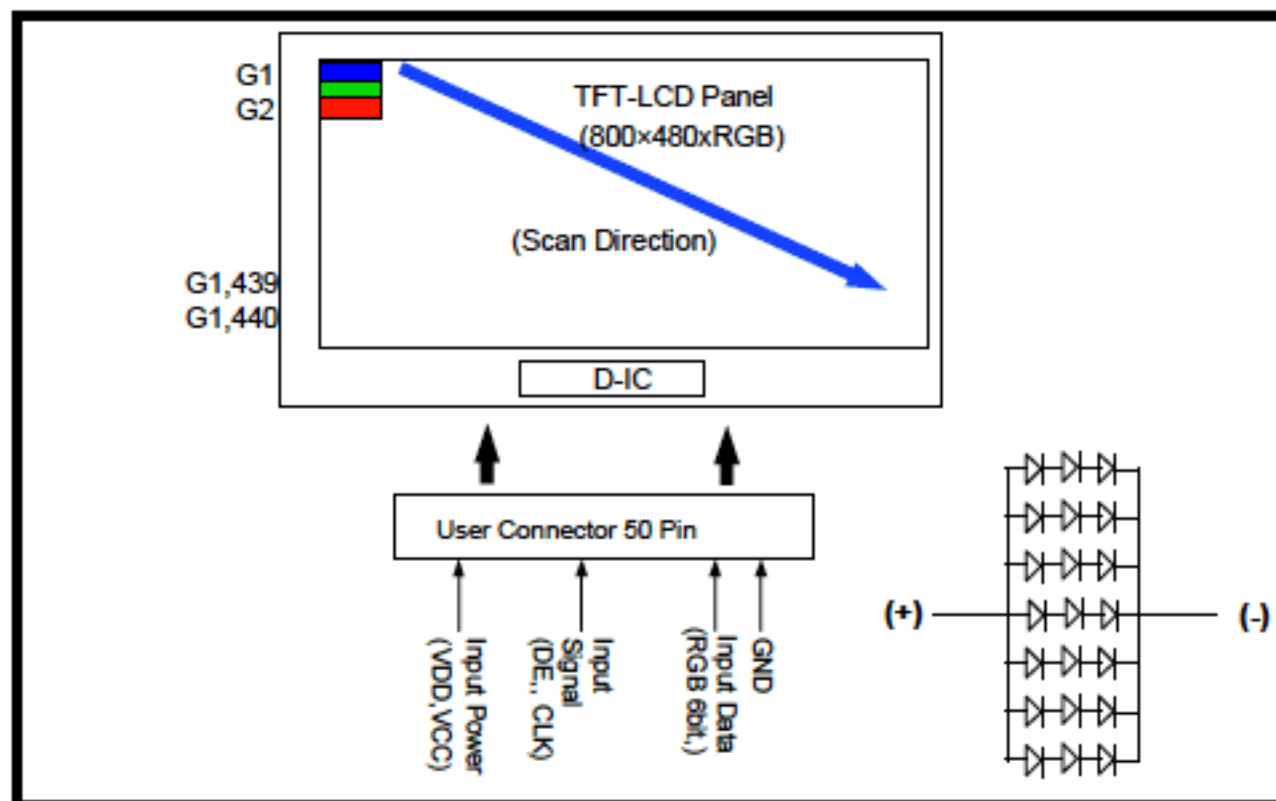


1. General Description

The LB070WV4 is a Color Active Matrix Liquid Crystal Display with an integral Light Emitting Diode(LED) backlight system. The matrix employs a-Si Thin Film Transistor as the active element. It is a transmissive type display operating in the normally white mode. This TFT-LCD has 7.0 inches diagonally measured active display area with WVGA resolution(800 horizontal by 480 vertical pixel array). Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in horizontal stripes. Gray scale or the brightness of the sub-pixel color is determined with a 6-bit gray scale signal for each dot, thus, presenting a palette of more than 262,144 colors.

The LB070WV4 has been designed to apply the interface method that enables low power, high speed, low EMI.

The LB070WV4 is intended to support applications where thin thickness, low power are critical factors and graphic displays are important. In combination with the vertical arrangement of the sub-pixels, the LB070WV4 characteristics provide an excellent flat display.



General Features

Active Screen Size	7.0 inches diagonal
Outline Dimension	165x104.6x5.1mm
Pixel Pitch	0.1893 mm × 0.1887 mm
Pixel Format	800 horiz. by 480 vert. Pixels RGB strip arrangement
Color Depth	6-bit, 262,144 colors
Luminance, White	400 cd/m ² (Typ.)
Power Consumption	TBDW(logic), 1.525W(BL)
Weight	TBDg(Typ)
Display Operating Mode	Transmissive mode, normally black
Surface Treatment	Anti-glare treatment of the front polarizer

2. Absolute Maximum Ratings

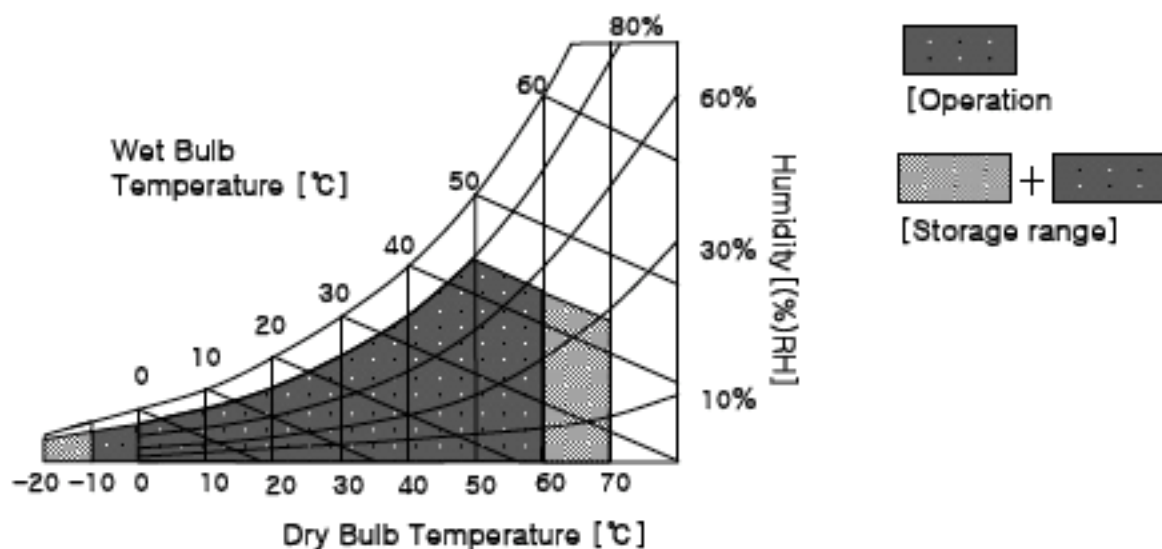
The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Values		Units	Notes
		Min	Max		
Power Input Voltage	VCC	0.0	3.6	Vdc	at $25 \pm 5^\circ\text{C}$
Storage Temperature	HST	-20	70	$^\circ\text{C}$	1
Operating Temperature	Ta	-10	60	$^\circ\text{C}$	1,2

Notes :

1. Maximum wet-bulb temperature is 46°C . Condensation of dew must be avoided, because it may cause electrical current leakage, and deterioration of performance and quality.
2. The operating temperature means that LCD Module guarantees operation of the circuit.
All the contents of Electro-optical specifications are guaranteed under the room temperature condition.



3. Electrical Specifications

3-1. Electrical Characteristics

The LB070WV4 requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second input which powers the LED, is typically generated by an LED Driver. The LCD don't include LED Driver.

Table 2. ELECTRICAL CHARACTERISTICS

Parameter		Symbol	Min	Typ	Max	Unit	Notes	
Logic Supply Voltage		VCC	3.0	3.3	3.6	V		
Digital Input Signal	High Level	V_{IH}	0.8VCC	-	VCC	V		
	Low Level	V_{IL}	0	-	0.2VCC	V		
Source Driver Supply Voltage		VDDP	(3.6)	(4.5)	(5.0)	V	TBD	
		VDDN	(-5.0)	(-4.7)	(-3.6)	V	TBD	
Gate Driver	TFT	Hi	(10)	(16)	(20)	V	TBD	
		Lo	(-15)	(-6.5)	(-5)	V	TBD	
Gamma Correction Voltage		DC	VREF0~5P	VSS+0.28	-	VDDP-0.28	V	TBD
			VREF0~5N	VDDN+0.28	-	VSS-0.28		
Color Filter Substrate Voltage		DC	VCOM	(-1)	(-0.6)	(-0.3)	V	TBD
Source Driver Supply Current		IDD2	-	(9)	(30)	mA	TBD	
Source Driver Supply Current		ISS2	-	(-9)	(-30)	mA	TBD	
Logic Supply Current		ICC	-	(4.9)	(10)	mA	TBD	
Gate Driver High Supply Current		IGH	-	(4.68)	(10)	mA	TBD	
Gate Driver Low Supply Current		IGL	-	(4.03)	(-10)	mA	TBD	

*** Note**

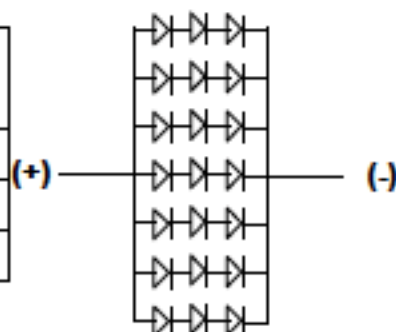
1. The specified current and power consumption are under the $V_{cc} = 3.3V$, $25^{\circ}C$, $f_v = 60Hz$ condition whereas "Mosaic Pattern" is displayed and f_v is the frame frequency.

Table 3. Backlight Unit

($T_a = 25^{\circ}C$)

ITEMS	SYMBOL	SPEC.			UNIT	REMARK
		Min	Typ	Max		
LED current	IL	-	22	30	mA	$t_a=25^{\circ}C$, per chain
LED voltage	VL	-	9.9	10.5	V	$t_a=25^{\circ}C$ ($\pm 10\%$)
LED power	PL	-	1.525	1.677	W	$t_a=25^{\circ}C$ - at 22mA

[LED Array Structure]



*** Note**

1. The permissible forward current of LED vary with environmental temperature.

3-2. Interface Connections

Table 4. MODULE CONNECTOR PIN CONFIGURATION (CN1)

No.	Symbol	Description	remark
1	VCOM	Voltage applied to Color Filter Substrate	
2	VGH	Gate Driver Positive Voltage	
3	VGL	Gate Driver Negative Voltage	Note1
4	VDDP	Power supply for source driver circuit and D/A converter circuit in positive polarity	
5	SVSS	System ground level for source output and Gamma circuit	
6	VCC	System power supply for internal logic circuit	
7	VCCL	System power supply for internal logic circuit. This pin is connected to voltage regulator IC internally.	Note2
8	DE	Data enable	
9	DOTCLK	Dot clock signal	
10	VSS	System ground	
11	R5	Red data 5[MSB]	
12	R4	Red data 4	
13	R3	Red data 3	
14	R2	Red data 2	
15	R1	Red data 1	
16	R0	Red data 0[LSB]	
17	VSS	System ground	
18	G5	Green data 5[MSB]	
19	G4	Green data 4	
20	G3	Green data 3	
21	G2	Green data 2	
22	G1	Green data 1	
23	G0	Green data 0[LSB]	
24	VSS	System ground	
25	B5	Blue data 5[MSB]	
26	B4	Blue data 4	
27	B3	Blue data 3	
28	B2	Blue data 2	
29	B1	Blue data 1	
30	B0	Blue data 0[LSB]	

No.	Symbol	Description	remark
31	VSS	System ground	
32	RESETB	Reset input pin. Initialize IC when low, and must be reset after power on.	
33	V8N	Voltage for negative gamma correction	
34	V5N		
35	V4N		
36	V3N		
37	V2N		
38	V1N		
39	V0N		
40	V8P	Voltage for positive gamma correction	
41	V5P		
42	V4P		
43	V3P		
44	V2P		
45	V1P		
46	V0P		
47	VSS	System ground	
48	L/R	LEFT/RIGHT scan control input	Note3
49	VDDN	Power supply for source driver circuit and D/A converter circuit in negative polarity	
50	VCOM	Voltage applied to Color Filter Substrate	

(Connector Type : 50Pin 0.5mm pitch)

*** Note1**

Connect a schottky diode(V_{BR} : 30V) from this pin to SVSS for protection.

*** Note2**

Connect a capacitor(4.7uF/6.3V) from this pin to VSS.

*** Note3**

MODE	L/R
Normal Mode	Logic "L"
Left/Right Reverse Mode	Logic "H"

Table 5. LED CONNECTOR PIN CONFIGURATION (CN2)

Pin No.	Symbol	Description
-	LED1	Current Sink For LED1
+	VLED(9.6V)	Power Line For LED

3-3. Signal Timing Specifications

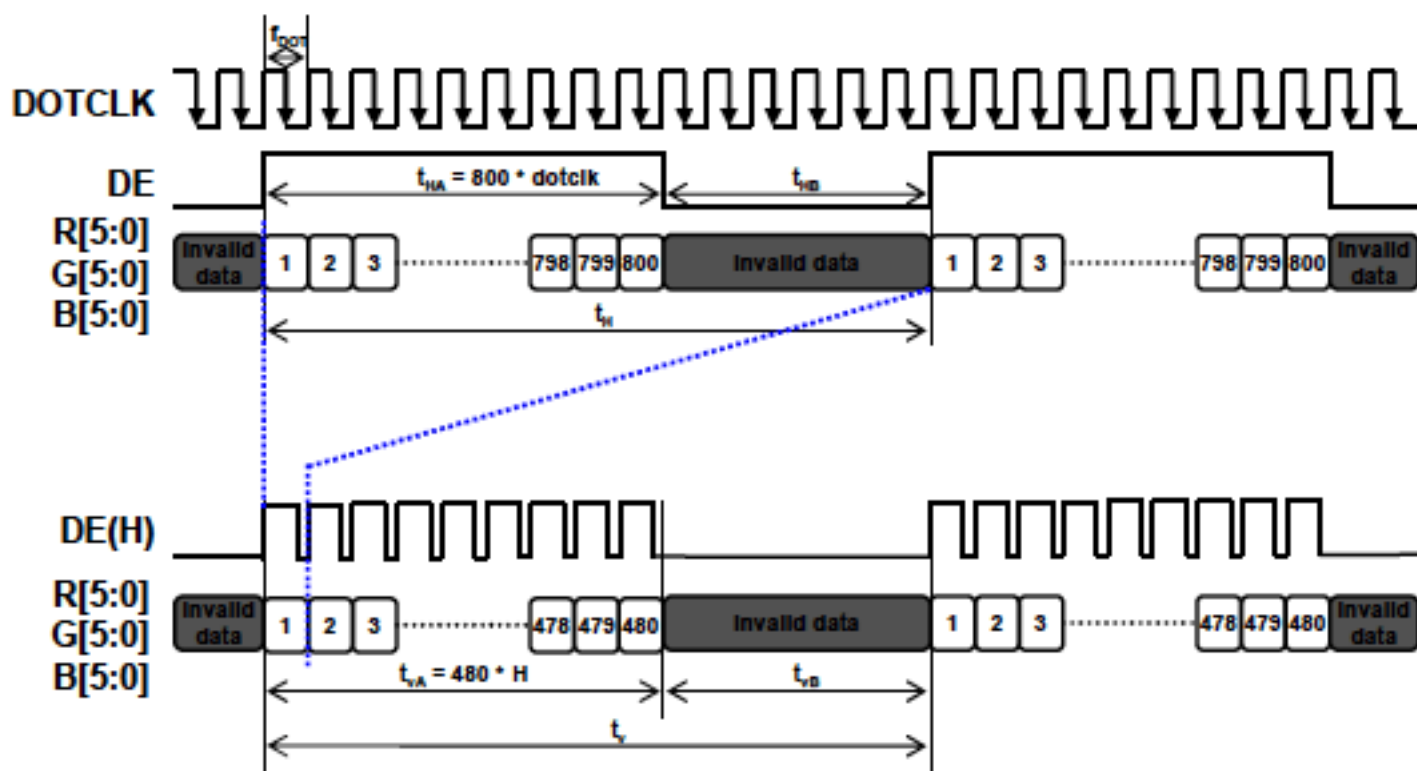
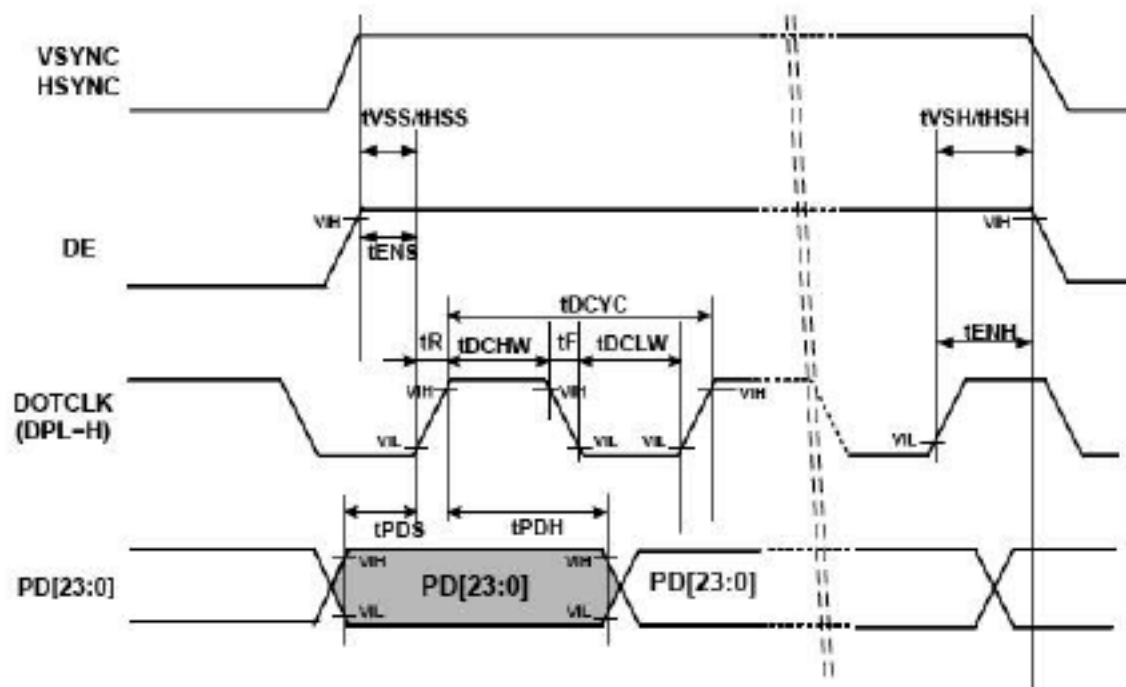
This is the signal timing required at the input of the User connector. All of the interface signal timing should be satisfied with the following specifications for its proper operation.

Table 6. TIMING TABLE

*** 60Hz Framerate ***

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Frame frequency		50	60	70	Hz	
DCLK	Frequency	fCLK	31.95	33.26	34.60	MHz
	Period	tDCYC	28.90	30.06	31.30	ns
	DOTCLK rise/fall time	tR, tF	-	-	3	ns
	High Level Width	tDCHW	10	-	-	ns
	Low Level Width	tDCLW	10	-	-	ns
DE	Setup Time	tENS	10	-	-	ns
	Hold Time	tENH	5	-	-	ns
DATA	Setup Time	tPDS	10	-	-	ns
	Hold Time	tPDH	5	-	-	ns
Horizontal	Horizontal display area	t _{HA}	-	800	-	CLK
	Horizontal Blank Period	t _{HB}	(175)	256	(304)	CLK
	Horizontal Period	t _H	(975)	1056	(1104)	CLK
Vertical	Horizontal display area	t _{VA}	-	480	-	Line
	Horizontal Blank Period	t _{VB}	(25)	45	(50)	Line
	Horizontal Period	t _V	(505)	525	(530)	Line

3-4. Signal Timing Waveforms



3-5. Color Input Data Reference

The brightness of each primary color (red, green and blue) is based on the 6-bit gray scale data input for the color ; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

Table 7. COLOR DATA REFERENCE

Color		Input Color Data																	
		RED						GREEN						BLUE					
		MSB		LSB				MSB		LSB				MSB		LSB			
		R 5	R 4	R 3	R 2	R 1	R 0	G 5	G 4	G 3	G 2	G 1	G 0	B 5	B 4	B 3	B 2	B 1	B 0
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
RED	RED (00)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED (01)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
					
	RED (62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED (63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN (00)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN (01)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
					
	GREEN (62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	GREEN (63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
BLUE	BLUE (00)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BLUE (01)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
					
	BLUE (62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	BLUE (63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

3-6. Power Sequence

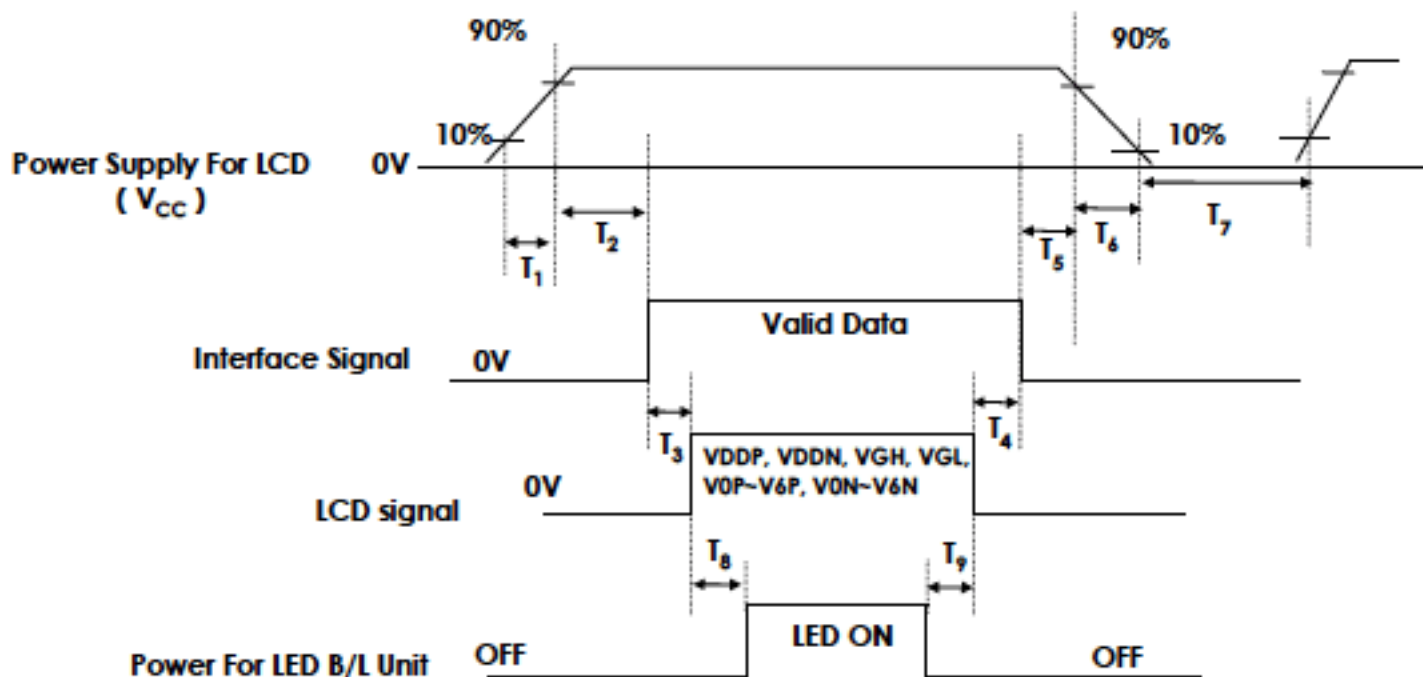


Table 8. POWER SEQUENCE TABLE

Parameter	Value			Units
	Min.	Typ.	Max.	
T_1	0.5	-	10	(ms)
T_2	1	-	50	(ms)
T_3	100	-	-	(ms)
T_4	50	-	-	(ms)
T_5	0	-	50	(ms)
T_6	0	-	10	(ms)
T_7	400	-	-	(ms)
T_8	100	-	-	(ms)
T_9	150	-	-	(ms)

Note)

1. Please avoid floating state of interface signal at invalid period.
2. When the interface signal is invalid, be sure to pull down the power supply for LCD V_{CC} to 0V.
3. LED power must be turn on after power supply for LCD and interface signal are valid.

3-7. Reset timing

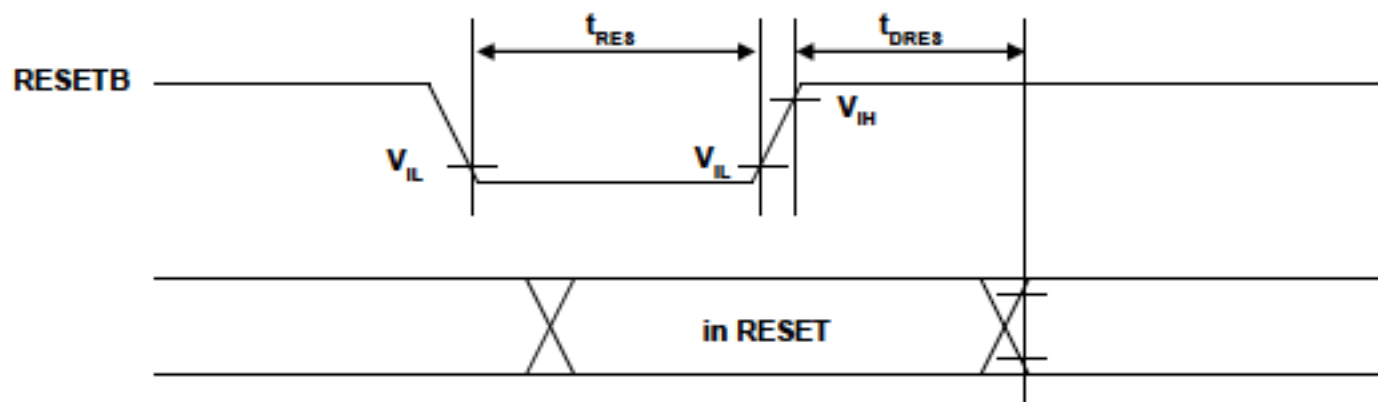


Table 9. RESET TIMING TABLE

Items	Symbol	Unit	Min	Typ	Max
RSETB low pulse width	t_{RES}	us	500	-	-
RSETB exit delay time	t_{DRES}	us	-	-	500

4. Optical Specifications

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 5 minutes in a dark environment at 25°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 presents additional information concerning the measurement equipment and method.

FIG. 1 Optical Characteristic Measurement Equipment and Method

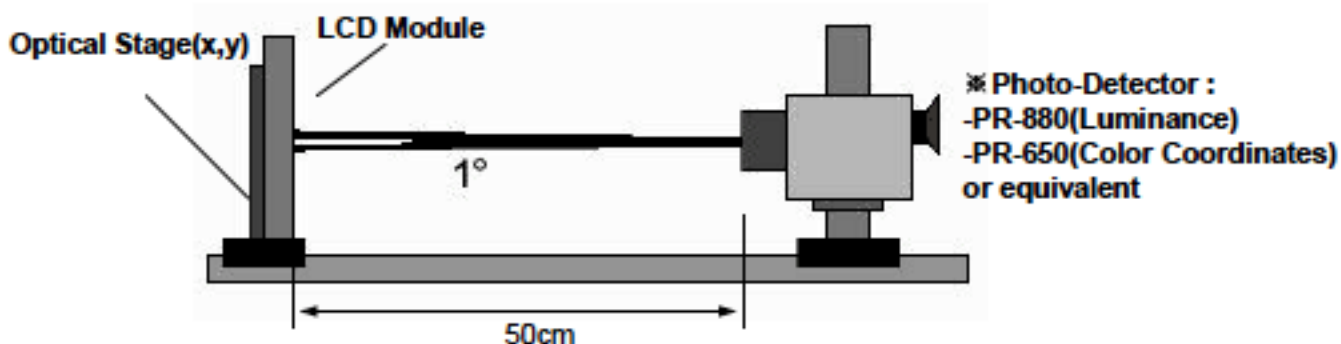


Table 10. OPTICAL CHARACTERISTICS

Ta=25°C, VCC=3.3V, fv=60Hz, fCLK= 33.26MHz, ILED = 22.0mA

Parameter	Symbol	Values			Units	Notes
		Min	Typ	Max		
Contrast Ratio	CR	500	700	-		1
Surface Luminance, white	L _{WH}	320	400	-	cd/m ²	2
Luminance Variation	δ_{WHITE}	-	1.20	1.40		3
Response Time	Tr		30	50		4
Color Coordinates						2
: RED	RX	TBD	TBD	TBD		
:	RY	TBD	TBD	TBD		
: GREEN	GX	TBD	TBD	TBD		
:	GY	TBD	TBD	TBD		
: BLUE	BX	TBD	TBD	TBD		
:	BY	TBD	TBD	TBD		
: WHITE	WX	0.263	0.313	0.363		
:	WY	0.279	0.329	0.379		
Viewing Angle						5
: x axis, right($\Phi=0^\circ$)	Θ_r	75	85	-	degree	
: x axis, left ($\Phi=180^\circ$)	Θ_l	75	85	-	degree	
: y axis, up ($\Phi=90^\circ$)	Θ_u	75	85	-	degree	
: y axis, down ($\Phi=270^\circ$)	Θ_d	75	85	-	degree	
Gray Scale						6

Product Specification

Note)

1. Contrast Ratio(CR) is defined mathematically as

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

2. Surface luminance is measured at the center point(L_1) of the LCD with all pixels displaying white at the distance of 50cm by PR-880. Color Coordinates are measured at the center point(L_1) of the LCD with all pixels displaying red, green, blue and white at the distance of 50cm by PR-650. For more information, refer to the FIG 1 and FIG 2.
3. Luminance uniformity is measured for 9 point For more information see FIG 2.

$$\delta_{\text{WHITE}} = \text{Maximum}(L1, L2, \dots, L9) \div \text{Minimum}(L1, L2, \dots, L9)$$
4. Response time is the time required for the display to transition from white to black (Rise Time, Tr_R) and from black to white(Decay Time, Tr_D). For additional information see FIG 3.
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 surface. For more information see FIG 4.
6. Gray scale specification

Gray Level	Luminance [%] (Typ)
L0	TBD
L7	TBD
L15	TBD
L23	TBD
L31	TBD
L39	TBD
L47	TBD
L55	TBD
L63	TBD

FIG. 2 Luminance

<measuring point for surface luminance & measuring point for luminance variation>

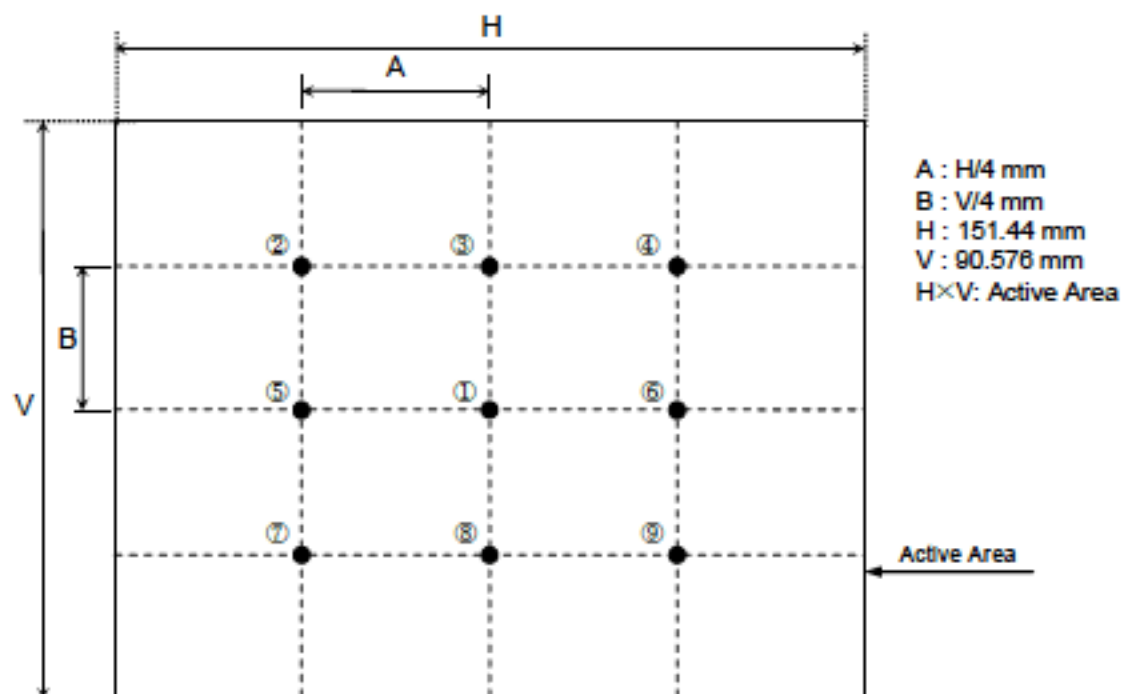


FIG. 3 Response Time

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

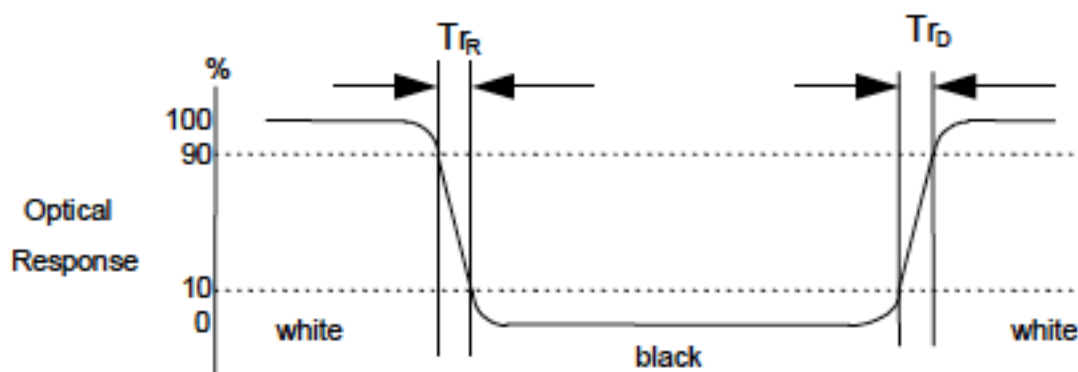
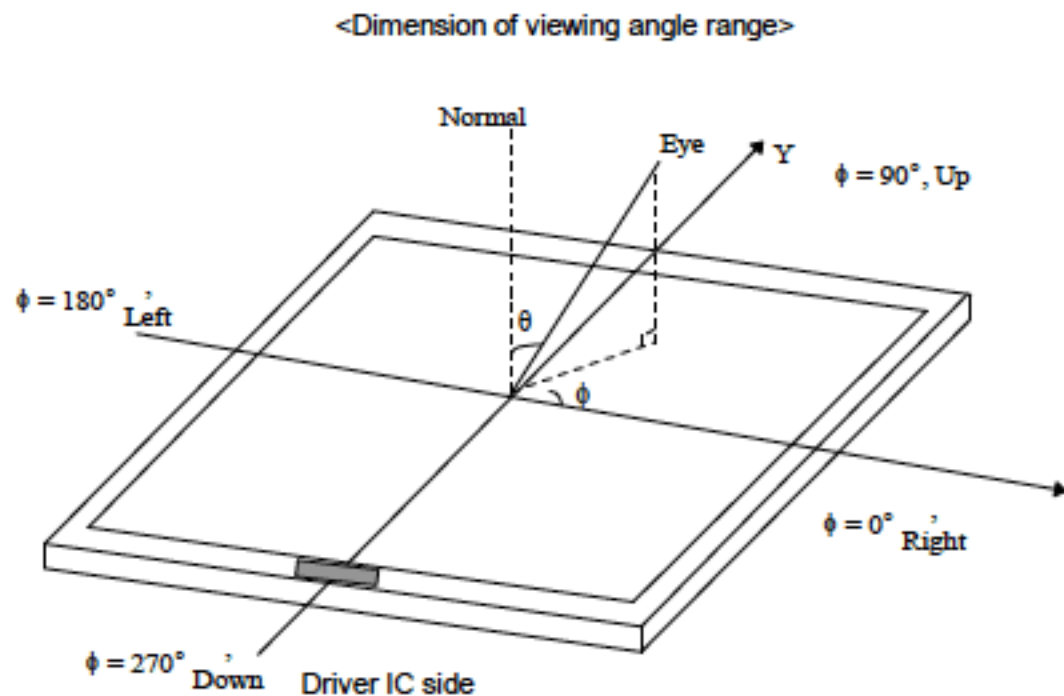


FIG. 4 Viewing angle



Product Specification

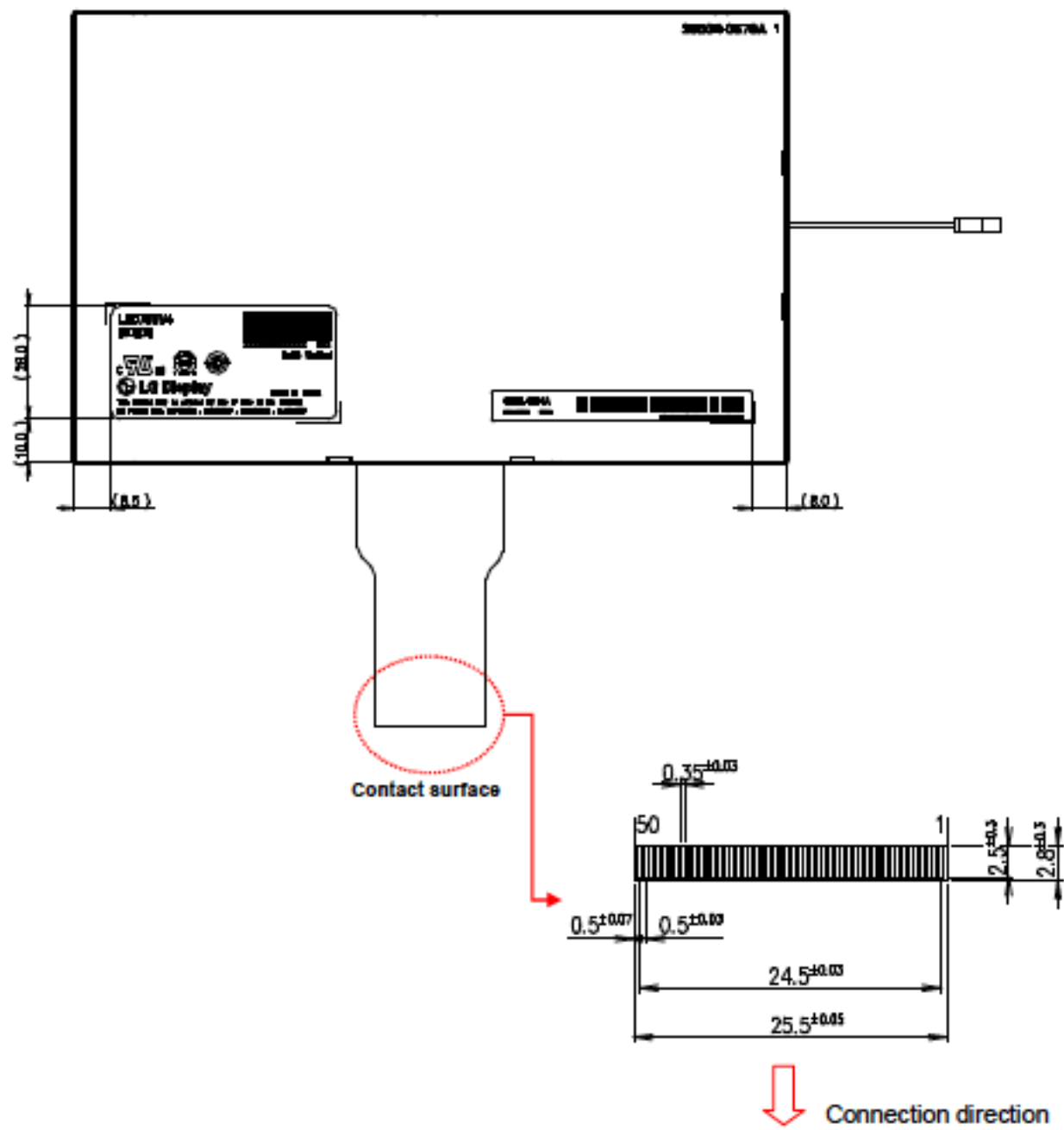
5. Mechanical Characteristics

The contents provide general mechanical characteristics for the model LB070WV4. In addition the figures in the next page are detailed mechanical drawing of the LCD.

Outline Dimension	Horizontal	165 mm(Typ)
	Vertical	104.6 mm(Typ)
	Depth	5.1 mm (Typ.)
Bezel Area	Horizontal	153.84 mm (Typ.)
	Vertical	92.98 mm (Typ.)
Active Display Area	Horizontal	151.44 mm (Typ.)
	Vertical	90.576 mm (Typ.)
Weight	TBD	
Surface Treatment	Anti-glare treatment of the front polarizer	

<REAR VIEW>

Note) Unit:[mm], General tolerance: ± 0.3 mm



6. Reliability

Environment test condition

No.	Test Item	Conditions
1	High Temperature Storage Test	Ta=+70℃ 240h
2	Low Temperature Storage Test	Ta=-20℃ 240h
3	High Temperature Operation Test	Ta=+60℃ 240h
4	Low Temperature Operation Test	Ta=-10℃ 240h
5	High Temperature and High Humidity Operation Test	Ta=50℃ 80%RH 240h
6	Packing Drop	1Corner, 3Edge, 6Face
7	Packing Vibration	Random 1.5Grms Z direction 60min
8	Thermal Shock Test	-30℃(0.5h) ~ 80℃(0.5h) / 100 cycles
9	Shock Test(non-operating)	Half sine wave, 180G, 2ms 1 times shock of each six faces
10	Vibration Test(non-operating)	Random vibration, 3 ~ 100Hz, 1.0Grms, 3 axis, 0.5hour/axis
11	Electro Static Discharge Test	- Panel Surface / Top Case: 150pF, 150Ω (Air : ±15kV , Contact : ±8kV) - FPC input terminal : 100pF ±200V 0Ω

※ Ta= Ambient Temperature, Tp= Panel Temperature

{ Result Evaluation Criteria }

There should be no change which might affect the practical display function when the display quality test is conducted under normal operating condition.

7. International Standards

7-1. Safety

- a) UL 60950, Third Edition, Underwriters Laboratories, Inc., Dated Dec. 11, 2000.
Standard for Safety of Information Technology Equipment, Including Electrical Business Equipment.
- b) CAN/CSA C22.2, No. 60950, Third Edition, Canadian Standards Association, Dec. 1, 2000.
Standard for Safety of Information Technology Equipment, Including Electrical Business Equipment.
- c) EN 60950 : 2000, Third Edition
IEC 60950 : 1999, Third Edition
European Committee for Electrotechnical Standardization(CENELEC)
EUROPEAN STANDARD for Safety of Information Technology Equipment Including Electrical Business Equipment.

7-2. EMC

- a) ANSI C63.4 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electrical Equipment in the Range of 9kHz to 40GHz." American National Standards Institute(ANSI), 1992
- b) C.I.S.P.R. "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." International Special Committee on Radio Interference.
- c) EN 55022 "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." European Committee for Electrotechnical Standardization.(CENELEC), 1998
(Including A1: 2000)