First Edition
Sep 29, 2005

LCD Module Technical Specification

Final Revision
******

Type No. **T-51991GD015-MLW-AIN**

Approved by (Quality Assurance Division)

Checked by (ACI Engineering Division)

Prepared by (ACI Engineering Division)

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Revision History

Rev.	Date	Page	Comment

1.General Specifications

Operating Temp.	:	min. -10°C ~max. 60°C
Storage Temp.	:	min. -30°C ~max. 70°C
Dot Pixels	:	176×3 [R.G.B] (W) × 132 (H) dots
Dot Size	:	0.056 (W) × 0.168 (H) mm
Pixel Arrangement	:	RGB-Stripe
Color Depth	:	Degital 64k color
Viewing Area	:	31.92 (W) × 24.528 (H) mm
Outline Dimensions*	:	35.47 (W) × 33.18* (H) × 2.35** (D) mm * Without FPC **Without Hook
Weight	:	5.5g max.
LCD Type	:	ASS-23211 (TFT / Normally white-mode / Transflective)
Viewing Angle	:	4:30
TFT Driver	:	Controler driver R61506(RENESAS)
Data Transfer	:	8-bit parallel data transfer
Backlight	:	LED Backlight / White
Drawings	:	Dimensional Outline T-51991AI base
Lead free	:	Our product corresponds to lead free. Lead free is defined as below: The solder used in the LCD module. Electrical components (Terminal section) used in the LCD module. Any lead used within the electrical component does not apply to our module definition of lead free.

2.Electrical Specifications

2.1.Absolute Maximum Ratings

Parameter	Symbol	Conditions	Ratings	Units
LCD Supply Voltage	V_{DD}	-	-0.3 ~ +4.0	V
Logic I/O Voltage	V_{EE}	-	-0.3 ~ +4.0	V
Logic Input Voltage	V_{IN}	-	-0.3 < V_{DI} < V_{EE} + 0.3	V

2.2.DC Characteristics

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
LCD Supply Voltage	V_{DD}-V_{SS}	-	2.8	3.0	3.2	V
Logic I/O Voltage	V_{EE}-V_{SS}	-	2.7	3.3	3.6	V
LED Inout Current	I_{LED}	-	-	20	-	mA
“H” Level Input Voltage	V_{IH}	-	0.8 V_{EE}	-	-	V
“L” Level Input Voltage	V_{IL}	-	-	-	0.2V_{EE}	V
“H” Level Outout Voltage	V_{OH}	-	0.8 V_{EE}	-	-	V
“L” Level Output Voltage	V_{OL}	-	-	-	0.2V_{EE}	V
Power Consumption,Panel	P_{LCD}	-	-	3.1	4.5	mW
Power Consumption,Backlightl	P_B	-	-	144	168	mW
Power Consumption,Standby	P_S	-	-	-	30	μW

Note

1:The specified current and power consumption are under the conditions at V_{DD}=3.0V,V_{EE}=3.3V, Ta=25°C, and f_V=60Hz, 32 vertical stripe grayscale pattern is displayed and f_V is the frame frequency.

2:Input mode of D0~D7,RES,RS,RD,WR,CS

3: Output mode of D0~D7,FLM

4:LED Backlight assumptions typ.3.6V and max. 4.2V, 20mA, 2LED’s

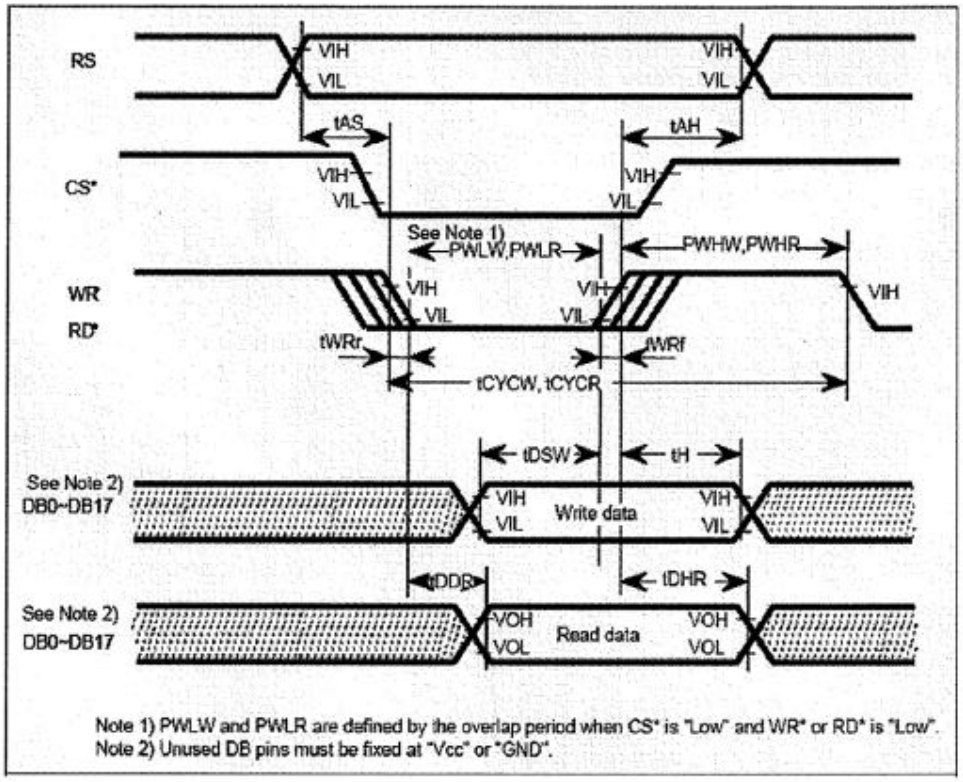
5:V_{EE} & V_{DD} are present; RES,RD,WR,CS are high;

2.3. AC Characteristics

2.3.1. Timing Characteristics

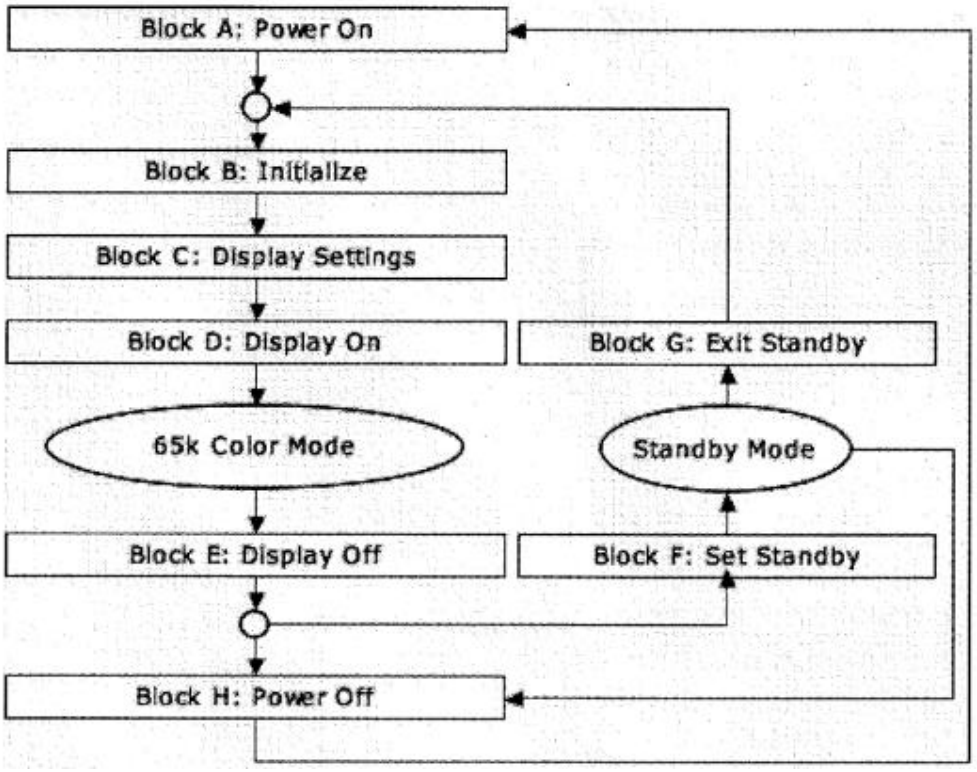
Parameter		Symbol	Min.	Max.	Units
Bus Cycle Time	Write	t_{CYCW}	140	-	ns
	Read	t_{CYCR}	500		ns
Write “Low” Level Pulse Width	Write	P_{WLW}	60	-	ns
Read “Low” Level Pulse Width	Read	P_{WLR}	250	-	ns
Write “High” Level Pulse Width	Write	P_{WHW}	100	-	ns
Read “High” Level Pulse Width	Read	P_{WHR}	200	-	ns
Write / Read rise/fall time		t_{WRr}, t_{WRf}	-	25	ns
Setup Time	Write(RS~CS,WR)	t_{AS}	50	-	ns
	Read(RS~CS,RD)		50		ns
Address Hold Time		t_{AH}	2	-	ns
Write Data Setup Time		t_{DSW}	60	-	ns
Write Data Hold Time		t_H	15	-	ns
Read Data Delay Time		t_{DDR}	-	80	ns
Read Data Hold Time		t_{DHR}	5	-	ns
Time from Read Cycle to Write			300	-	ns
Time from Write Cycle to Read			300	-	ns

Note: V_{DD}=2.80~3.20V. V_{EE}=2.70~3.60V



2.3.2. Software Flow & Register Settings

The M26 displays with the R61506 driver follow the basic software flowchart illustrated in Figure 3-3. Each display supplier will have specific register settings for each block, as shown in 3.7.2 and 3.7.3.



2.3.3. Block A : Power On Sequence

Step	Register	Setting	Operation
1	RESET=L		
2	Delay 1msec		
3	RESET=H		
4	Delay 2msec		

2.3.4. Block B : Initiaize Sequence

Step	Register	Setting	Operation
1	R00h	-	
2	R00h	-	
3	R00h	-	
4	R00h	-	
5	R00h	0001h	Start Oscillation
6	Delay 10msec		

2.3.5. Block C : Display Settings Sequence

Step	Register	Setting	Operation
1	R07h	0001h	REV=0, D=01 ; Display Control (1)
2	R17h	0001h	PSE=1 ; Power Sequence Control (1)
3	R10h	24C0h	SAP=010, BT=100, APE=1, AP=100, DK=0 ; Power Control (1)
4	R11h	0001h	DC1=000, DC0=000, VC=01 ; Power Control (2)
5	R12h	001Ah	PON=1, VRH=1010 ; Set VREG1 Voltage
6	R13h	0828h	VDV=1000, VCM=101000 ; Set VCOM Voltage
7	R12h	003Ah	PSON=1 ; Start Charge pumps
8	Delay 150msec		
9	R01h	0110h	SM=0, GS=0, SS=1, NL=1000 ; Set Display Direction
10	R03h	1030h	BGR=1, ID=11, AM=0 ; Set CF arrangement
11	R08h	0404h	FP=0100, BP=0100 ; Set front/back porch
12	R0Bh	000Ah	N0=00, SDT=00, DIV=00, RTN=1010 ; Set Frame Freq
13	R0Dh	5559h	CAW=1001, CBW=0101, CCW=0101, CDW=0101 ; Set waveform timing
14	R15h	0000h	VSEL=00 ; Set waveform timing
15	R30h	0000h	PKP0=000, PKP1=000 ; Set Gamma
16	R31h	0000h	PKP2=000, PKP3=000 ; Set Gamma
17	R32h	0303h	PKP4=011, PKP5=011 ; Set Gamma
18	R33h	0100h	PRP0=000, PRP1=001 ; Set Gamma
19	R34h	0404h	PKN0=100, PKN1=100 ; Set Gamma
20	R35h	0707h	PKN2=111, PKN3=111 ; Set Gamma
21	R36h	0707h	PKN4=111, PKN5=111 ; Set Gamma
22	R37h	0001h	PRN0=001, PRN1=000 ; Set Gamma
23	R38h	1F04h	VRP0=0100, VRP1=11111 ; Set Gamma
24	R39h	040Fh	VRN0=1111, VRN1=00100 ; Set Gamma

25	R40h	0000h	SCN=0000 ; Set gate scan position
26	R41h	0000h	VL=00000000 ; Set vertical scroll
27	R42h	8300h	SE=10000011, SS=00000000 ; Set 1st screen driving position
28	R44h	AF00h	HEA=10100000, HAS=00000000 ; Set Window address (Horizontal)
29	R45h	8300h	VEA=10000011, VSA=00000000 ; Set window address (Vertical)
30	R21h	0000h	AD=0000000000000000 ; Set RAM Address
31	R22h	-	Select RAM access Register
32	Write CGRAM (repeat 176x132 times)		

2.3.6. Block D : Display On Sequence

Step	Register	Setting	Operation
1	R02h	0600h	FLD=01, B/C=0
2	R07h	0021h	VON=0, GON=1, DTE=0, D=01 ; Display Control (1)
3	Delay 1msec		
4	R07h	0072h	VON=1 ; Display Control (1)
5	Delay 100msec		
6	R02h	0700h	FLD=01, B/C=1; Set LCD driving waveform
7	R07h	0077h	REV=1, D=11 ; Display Control (1)
	65K Color Mode		

2.3.7. Block E : Display Off Sequence

Step	Register	Setting	Operation
1	R07h	0072h	REV=0, D=10 ; Display Control (1)
2	Delay 40msec		
3	R07h	0001h	VON=0, GON=0, DTE=0, D=01 ; Display Control (1)
4	Delay 1msec		
5	R07h	0000h	D=00 ; Display Control (1)

2.3.8. Block F : Power Off Sequence

Step	Register	Setting	Operation
1	R10h	0480h	SAP=000, AP=000 ; Stop Op-Amps
2	R12h	0000h	PSON=0, PON=0 ; Stop Charge Pumps
3	Delay 20msec		
4	R10h	0400h	APE=0 ; Stop Power Circuit

2.3.9. Block G : Set Standby Sequence

Step	Register	Setting	Operation
1	R10h	24C1h	STB=1 ; Set Standby
2	Standby Mode		

2.3.10. Block H : Exit Standby Sequence

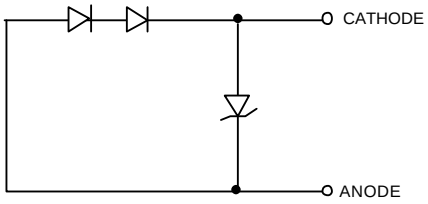
Step	Register	Setting	Operation
1	None	-	Exit Sequence is same as Table 2, Table 3, and Table 4
2	Delay		

3.Backlight Specifications

3.1. Absolute Maximum Ratings (2 chip)

Ta=25°C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Foward Current	I_F	-	-	-	30	mA
Reverse Voltage	V_R	-	-	-	10.0	V
LED Power Dissipation	P_D	-	-	-	240	mW



3.2. Operating Characteristics

Ta=25°C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Foward Voltage	V_F	I_F=20mA	5.2	6.4	7.0	V

4.Optical Specifications

4.1. Backlight Off

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	Remark
Viewing angle range	θ_{LEFT}	CR≥2	35	-	-	° (degree)	Note1,2,3
	θ_{UP}		35	-	-	° (degree)	Note1,2,3
	θ_{RIGHT}		35	-	-	° (degree)	Note1,2,3
	θ_{DOWN}		35	-	-	° (degree)	Note1,2,3
Contrast Ratio	CR	Optimal	10	-	-	-	Note1,2,6
Reflectivity	R	Optimal	5.5	-	-	%	Note1,4,6
Response Rise Time	τr	θ=0°	-	10	15	ms	Note1,5,7
Response Fall Time	τd	Ta=25°C	-	20	30	ms	Note1,5,7
White Chromaticity	X	CIE	0.292	0.312	0.332	-	Note1,6
	Y		0.311	0.331	0.351	-	Note1,6
Red Chromaticity	X	CIE	0.418	0.438	0.458	-	Note1,6
	Y		0.297	0.327	0.357	-	Note1,6
Green Chromaticity	X	CIE	0.285	0.305	0.325	-	Note1,6
	Y		0.369	0.389	0.409	-	Note1,6
Blue Chromaticity	X	CIE	0.199	0.219	0.239	-	Note1,6
	Y		0.219	0.239	0.259	-	Note1,6

Note 1 :The testing conditions are illustrated in Figure 4-1 and taken at Ta=25°C in a dark room with a D65 light source. The display is oriented landscape with the driver on the right.
The photodetector is CS-1000.

Note 2 : The definition of contrast ratio is shown in Section 4.2.1

Note 3 : The definition of viewing angle is shown in Section 4.2.2

Note 4 : The definition of reflectivity is shown in Section 4.2.3

Note 5 : The definition of response time is shown in Section 4.2.4

Note 6 : Critical optical characteristics.

Note 7 : The measuring equipment are TOPCON BM-7

4.2. Backlight On

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	Remark
Viewing angle range	θ_{LEFT}	CR≥5	35	40	-	Degrees	Note1,2,3
	θ_{UP}		30	35	-	Degrees	Note1,2,3
	θ_{RIGHT}		30	35	-	Degrees	Note1,2,3
	θ_{DOWN}		20	25	-	Degrees	Note1,2,3
Contrast Ratio	CR	Optimal	70	80	-	-	Note2,6,13
Brightness	Y	Optimal	120	150	-	cd/m^2	Note6,12,13
Brightness Uniformity	Y	Optimal	-	-	20	%	Note5,12,13
Gamma				2.2			Note7
Flicker	F		-	-	-30	dB	Note8
Cross Talk	D_{SHA}	Optimal			4	%	Note9
Viewing Direction				4:30		o'clock	Note10
Response Rise Time	τr	θ=0°	-	15	20	ms	Note5,13
Response Fall Time	τd	Ta=25°C	-	25	35	ms	Note5,13
White Chromaticity	X	CIE		0.305		-	Note6,11,13
	Y			0.335		-	Note6,11,13
Red Chromaticity	X	CIE		0.531		-	Note6,11,13
	Y			0.335		-	Note6,11,13
Green Chromaticity	X	CIE		0.329		-	Note6,11,13
	Y			0.530		-	Note6,11,13
Blue Chromaticity	X	CIE		0.158		-	Note6,11,13
	Y			0.153		-	Note6,11,13

Note 1 :The testing conditions are illustrated in Figure 4-2 and taken at Ta=25°C in a dark room using ELDIM EZ contrast 160R system. The display is oriented landscape with the driver on the right.

Note 2 : The definition of contrast ratio is shown in Section 4.2.1

Note 3 : The definition of viewing angle is shown in Section 4.2.2

Note 4 : The definition of response time is shown in Section 4.2.4

Note 5 : The definition of brightness & brightness uniformity is shown in Section 4.2.5.

Note 6 : Critical optical characteristics.

Note 7 : The gray scale linearity or gamma value is specified in Section 4.3.

Note 8 : The flicker level is specified in Section 4.4.

Note 9 : The cross talk is specified in Section 4.5.

Note 10 : The viewing / rubbing direction is the direction of least color inversion.

Note 11 : The color coordinate tolerance is plotted in Section 4.6.

Note 12 : Brightness may also be referred to as luminance.

Note 13 : The measuring equipment are TOPCON BM-7.

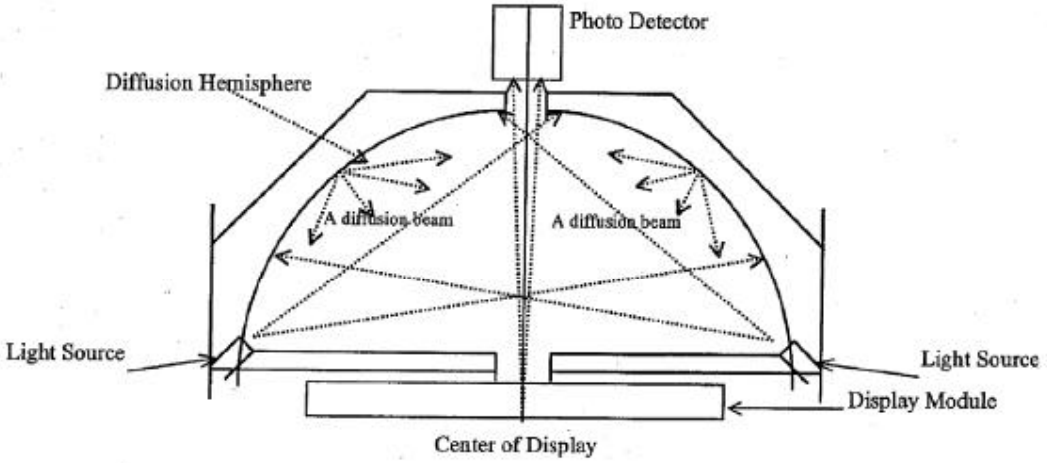


Figure 4-1: Optical Test Setup – Backlight Off (D65 Light Source)

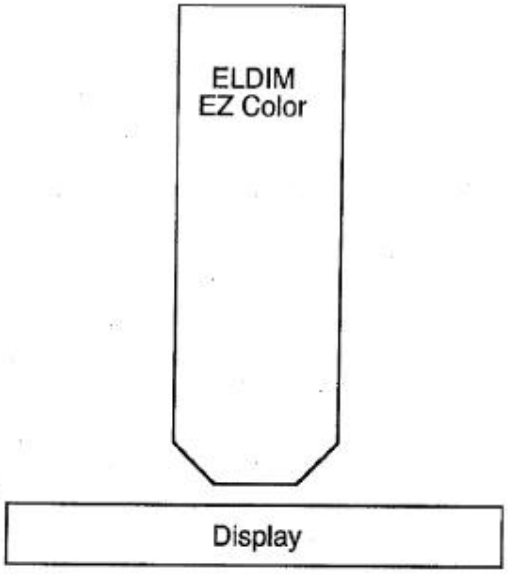


Figure 4-2: Optical Test Setup – Backlight On

4.2. Optical Definitions

4.2.1. Definition of Contrast Ratio

$$\text{Contrast Ratio (CR)} = \frac{\text{Photo detector output with all pixels white}}{\text{Photo detector output with all pixels black}}$$

4.2.2. Definition of Viewing Angles

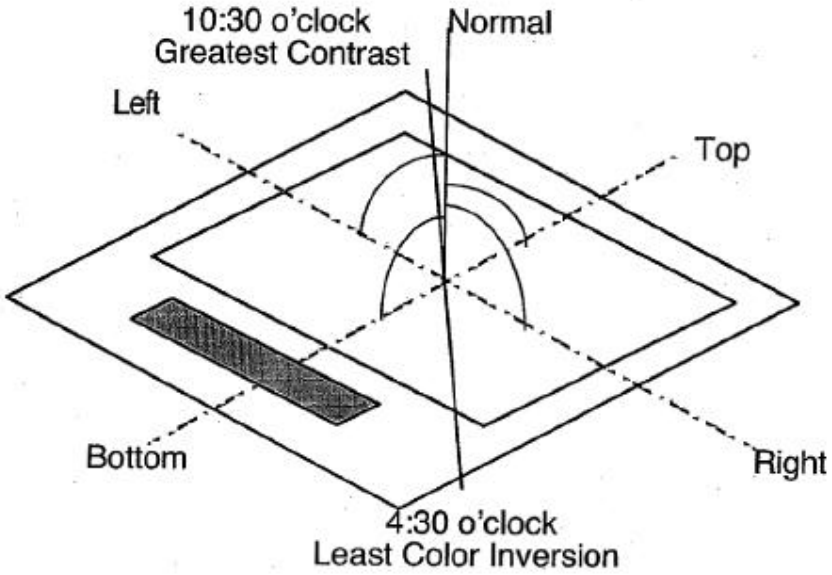


Figure 4-3: Viewing Angle Definitions

4.2.3. Definition of Reflectivity

The reflectivity measurement is taken using the set-up in Figure 4-1.

$$\text{Reflectivity} = \frac{\text{Light detected level of the reflection by the display with all pixels white}}{\text{Light detected level of the reflection by the reflective standard}}$$

4.2.4. Definition of Response Time

Figure 4-4 shows the response time characteristics for the display. Rise Time (τ_r) is the time required for the luminance level or reflectivity to reach 10% of minimum from 90% brightness or reflectivity respectfully, when the display is switched from an all-white to an all-black screen. Decay Time (τ_d) is the time required for the luminance level or reflectivity to reach 90% brightness or reflectivity respectfully from 10%, when the display is switched from an all-black to an all-white screen.

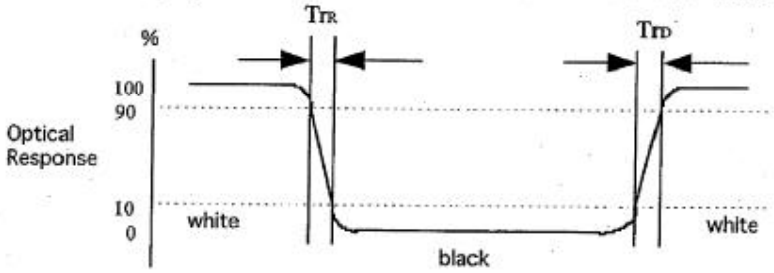


Figure 4-4: Response Time Definition

4.2.5. Definition of Brightness & Brightness Uniformity

The brightness measurement is taken at point B5.

$$\text{Brightness Uniformity} = 1 - \frac{\text{Minimum Photo detector output for B1-B9 with all pixels white}}{\text{Maximum Photo detector output for B1-B9 with all pixels white}}$$

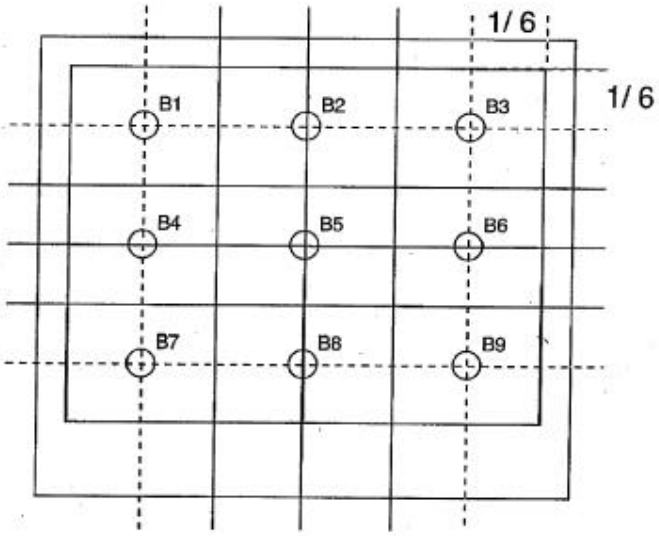


Figure 4-5: Brightness measurement points

4.3. Gray Scale Linearity or Gamma Value

The display luminance, L_G, is measured at the different gray scales, G_{min}, ..., G_{max}. The exponential fitting is used to determine the gamma ( ) value, which should be an intrinsic or uncorrected characteristic.

$$L_G \sim G \ .$$

4.4. Flicker

NO VISUAL FLICKER WILL BE ALLOWED. The flicker level should be measured with horizontal stripes (every other pixel), a checker pattern (every other pixel) and a middle gray level. The frame frequency of the panel should be set to 60Hz and V_{DD} is set to 3.0 V. The output signal of a photometer is sent to an FFT analyzer. The flicker is essentially a ratio of the powers in the frequency spectrum at 30 Hz (P_x) and 0 Hz (P_0), *i.e.*, θ

$$F = 10 \text{ Log } (P_x / P_0).$$

4.5. Cross-talk

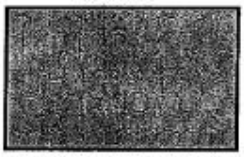
The following measurement method for cross-talk is to be used during the development and initial qualification of the display design. Apple approved visual test patterns and limit samples may be used in production along with limit samples measured at or below the maximum of the specification. Two luminance values are measured at center spot with 50 x 50 pixels. The cross-talk, D_{SHA}, is defined as,

$D_{SHA} = (L_B - L_A)/L_B \bullet 100\%$,
Where, L_A = Luminance in Pattern A
L_B = Luminance in Pattern B.

Pattern A

Pattern A
Gray Scale = 31 in center
Black in surrounding area

Pattern B



Pattern B
Gray Scale = 31 full screen

4.6. White Chromaticity Area

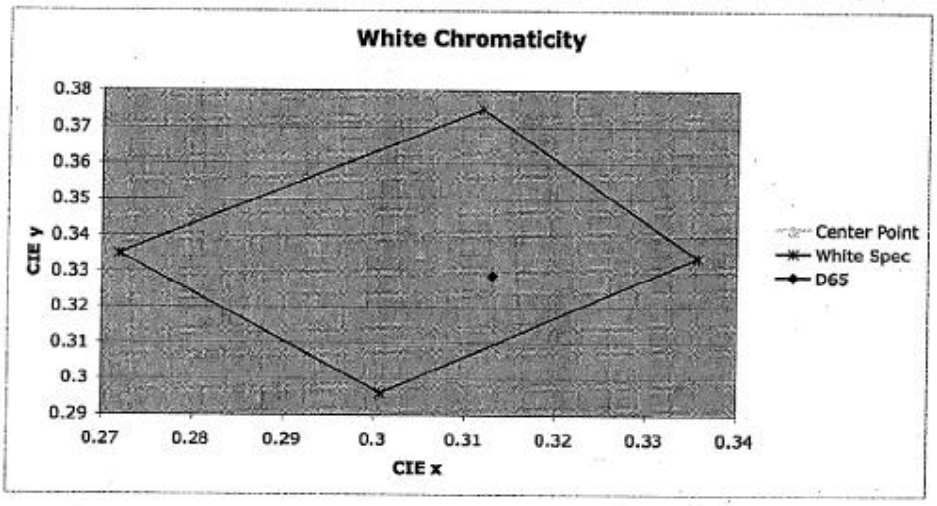


Figure 4-6: Transmissive White Chromaticity Area

Table 4.6.1: Transmissive White Chromaticity Data Points

x	Y
0.301	0.296
0.272	0.335
0.312	0.375
0.336	0.334

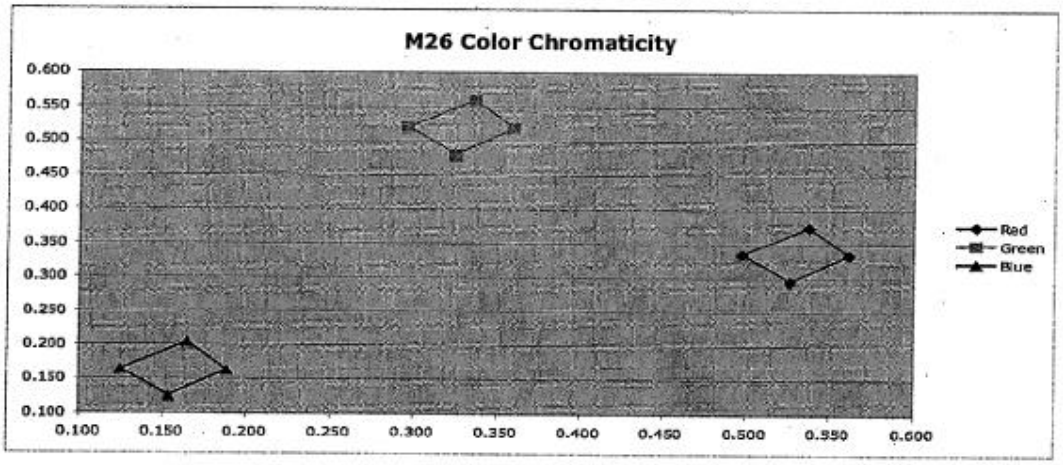
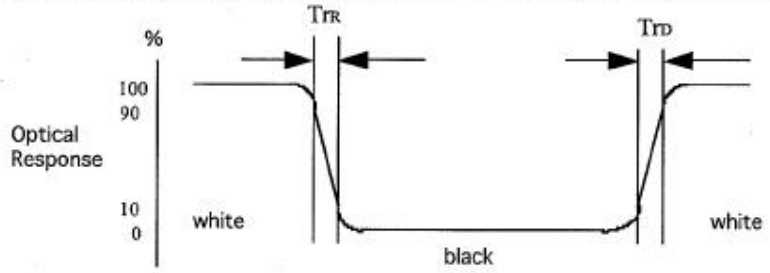


Figure 4-7: Transmissive Color Chromaticity Area

Figure 4-4 shows the response time characteristics for the display. Rise Time (τ_r) is the time required for the luminance level or reflectivity to reach 10% of minimum from 90% brightness or reflectivity respectfully, when the display is switched from an all-white to an all-black screen. Decay Time (τ_d) is the time required for the luminance level or reflectivity to reach 90% brightness or reflectivity respectfully from 10%, when the display is switched from an all-black to an all-white screen.



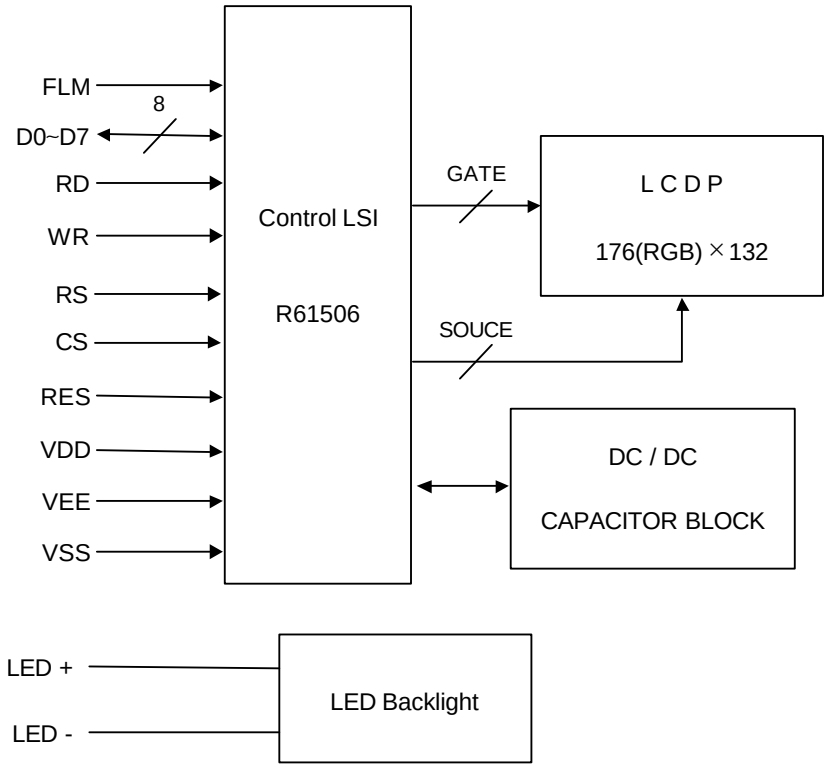
5.I/O Terminal

5.1. Pin Assignment

CN1

No.	Symbol	I/O	Function
1	LED+	-	LED Anode
2	LED-	-	LED Cathode
3	FLM	O	First Line Marker(Indicates Start of Frame)
4	VSS	-	GND
5	D7	I/O	Data Bus(8-bit MSB)
6	D6	I/O	Data Bus
7	D5	I/O	Data Bus
8	D4	I/O	Data Bus
9	D3	I/O	Data Bus
10	D2	I/O	Data Bus
11	D1	I/O	Data Bus
12	D0	I/O	Data Bus(LSB)
13	RD	I	Read Control Input L:Active
14	WR	I	Write Control Input L:Active
15	RS	I	Reister Select Input
16	CS	I	Chip Select Input L:Active
17	RES	I	Reset Signal Input L:Active
18	VSS	-	GND
19	VEE	-	Logic I/O Supply
20	VDD	-	LCD Power Supply
21	Display ID	-	Display Version (No Conection)
22	Display ID	-	Display Version (No Conection)

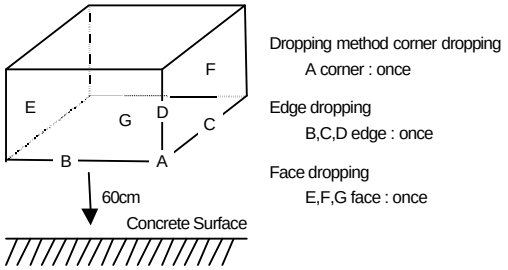
5.2. Block Diagram



6.Test

No change on display and in operation under the following test condition.

Conditions: Unless otherwise specified, tests will be conducted under the following condition.
Temperature: 20±5°C
Humidity : 65±5%RH
tests will be not conducted under functioning state.

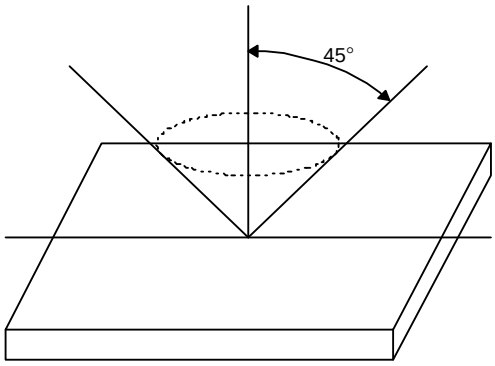
No.	Parameter	Conditions	Notes
1	High Temperature Operating	50°C, 500hrs (operation state)	
2	Low Temperature Operating	-10°C, 500hrs (operation state)	1
3	High Temperature Storage	70°C, 500hrs	2
4	Low Temperature Storage	-30°C, 500hrs	1,2
5	Damp Proof Test Operating	50°C, 90%RH, 240hrs	
6	Damp Proof Test Storage	70°C, 85%RH, 500hrs	
7	Thermal Shock Test	-30°C (30min) ↔ 70°C (30min) 100 cycles	
8	Shock Test	To be measured after dropping from 60cm high on the concrete surface in packing state. 	

Note 1 :No dew condensation to be observed.
Note 2 :The function test shall be conducted after 4 hours storage at the normal Temperature and humidity after removed from the test chamber.
Note 3 :Vibration test will be conducted to the product itself without putting it in a container.

7.Appearance Standards

7.1. Viewing distance and angle

The distance between the eyes and the sample shall be 35±5cm.
All directions for inspecting the sample should be within 45°against perpendicular line.



7.2. Ambient illumination

2000-3000 Lux at the surface of the LCM panel for reflective mode.
The ambient is 100-150 Lux when backlight is on.

7.3. Ambient temperature

20-25°C

7.4. Standards

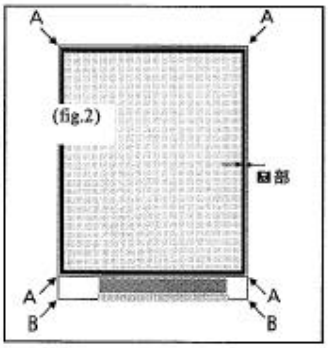
<table>
<tr><th>No.</th><th>Parameter</th><th>Criteria</th></tr>
<tr><td>1</td><td>Bright and
Black Dot</td><td>
<table>
<tr><th colspan="2">Acceptable Number</th><th>Testing Pattern</th></tr>
<tr><td>Bright Dot</td><td>0</td><td>8/64 gray level pattern</td></tr>
<tr><td>Dark Dot</td><td>2*</td><td>White pattern</td></tr>
<tr><td>Joined
Dark Dot</td><td>1 Pair MAX
(1 pair : 1 black dot count).
The two defective dots are
allowed to be side by side,
but not head to tail.
3 dots or more is not allowed</td><td>White pattern</td></tr>
</table>
*Defect distance 5mm or more
</td></tr>
<tr><td>2</td><td>Dark / Bright Spot
(foreign substance)
Bright Line(light lint) /
Dark Line
(dark lint / hair)
Polarizer Scratches
Polarizer Dent,
Bubbles</td><td>
(1) Dark / Bright Spot
<table>
<tr><th>Dimension (mm)</th><th>Acceptable Number</th></tr>
<tr><td>D ≤ 0.15</td><td>Disregard</td></tr>
<tr><td>0.15 < D ≤ 0.3</td><td>2</td></tr>
<tr><td>0.3 < D</td><td>0</td></tr>
</table>
D = (Long + Short) / 2

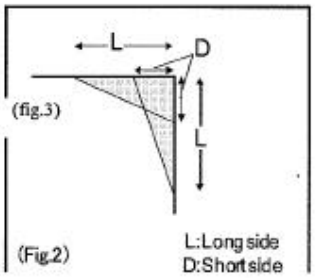
(2) Bright Line / Dark Line
<table>
<tr><th>X(mm)</th><th>Y(mm)</th><th>Acceptable Number</th></tr>
<tr><td>—</td><td>W<0.02</td><td>Disregard</td></tr>
<tr><td>L≤2.0</td><td>0.02≤W≤0.15</td><td>2</td></tr>
</table>
X : Length Y : Width

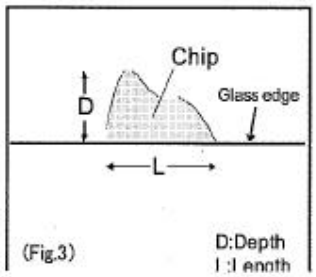
(3) Polarizer Scratches
W≤0.05mm, L≤2.0mm, N≤2

(4) Polarizer Dent, Bubbles
0.15mm ≤ D ≤ 0.3mm, N≤3

Maximum allowable number of visual defects are eights.
</td></tr>
</table>

<table>
<tr><th>No.</th><th>Parameter</th><th>Criteria</th></tr>
<tr><td>3</td><td>Polarizer Dirts</td><td>If the stains are removed easily from LCDP surface, the module is not defective.</td></tr>
<tr><td>4</td><td>Chipped Glass</td><td>
<table>
<tr><th>Items</th><th>Inspection criteria
(Acceptable level)</th><th>note</th></tr>
<tr><td>Chip on glass corner
(Part A)</td><td>L <= 5mm , D <= 1mm
L + D <= 5mm
*BM (black mask) is not affected.</td><td>fig.1-A
fig.2</td></tr>
<tr><td>Chip on the
terminal glass(Part B)</td><td>L <= 3mm , D <= 3mm
*FPC and patterns are not affected</td><td>fig.1-B
fig.2</td></tr>
<tr><td>Chip on glass edge</td><td>L <= 10mm , D <= 1mm
*BM (black mask) is not affected</td><td>fig.3</td></tr>
</table>
(fig.1)


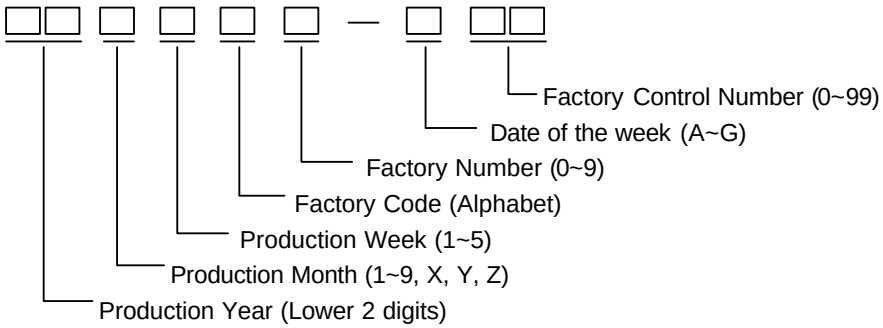




</td></tr>
</table>

8.Code System of Production Lot

The production lot of module is specified as follows.



9.Type Number

The type number of module is specified as follows.

T-51991AI

10.Applying Precautions

Please contact us when questions and/or new problems not specified in this Specifications arise.

11.Precautions Relating Product Handling

The Following precautions will guide you in handling our product correctly.

1) Liquid crystal display devices
   1. The liquid crystal display device panel used in the liquid crystal display module is made of plate glass. Avoid any strong mechanical shock. Should the glass break handle it with care.
   2. The polarizer adhering to the surface of the LCD is made of a soft material. Guard against scratching it.

2) Care of the liquid crystal display module against static electricity discharge.
   1. When working with the module, be sure to ground your body and any electrical equipment you may be using. We strongly recommend the use of anti static mats (made of rubber), to protect work tables against the hazards of electrical shock.
   2. Avoid the use of work clothing made of synthetic fibers. We recommend cotton clothing or other conductivity-treated fibers.
   3. Slowly and carefully remove the protective film from the LCD module, since this operation can generate static electricity.

3) When the LCD module alone must be stored for long periods of time:
   1. Protect the modules from high temperature and humidity.
   2. Keep the modules out of direct sunlight or direct exposure to ultraviolet rays.
   3. Protect the modules from excessive external forces.

4) Use the module with a power supply that is equipped with an overcurrent protector circuit,since the module is not provided with this protective feature.

5) Do not ingest the LCD fluid itself should it leak out of a damaged LCD module. Should hands or clothing come in contact with LCD fluid, wash immediately with soap.

6) Conductivity is not guaranteed for models that use metal holders where solder connections between the metal holder and the PCB are not used. Please contact us to discuss appropriate ways to assure conductivity.

7) For models which use CFL:
   1. High voltage of 1000V or greater is applied to the CFL cable connector area. Care should be taken not to touch connection areas to avoid burns.
   2. Protect CFL cables from rubbing against the unit and thus causing the wire jacket to become worn.
   3. The use of CFLs for extended periods of time at low temperatures will significantly shorten their service life.

8) For models which use touch panels:
   1. Do not stack up modules since they can be damaged by components on neighboring modules.
   2. Do not place heavy objects on top of the product. This could cause glass breakage.

9) For models which use COG,TAB,or COF:
   1. The mechanical strength of the product is low since the IC chip faces out unprotected from the rear. Be sure to protect the rear of the IC chip from external forces.
   2. Given the fact that the rear of the IC chip is left exposed, in order to protect the unit from electrical damage, avoid installation configurations in which the rear of the IC chip runs the risk of making any electrical contact.

10) Models which use flexible cable, heat seal, or TAB:
   1. In order to maintain reliability, do not touch or hold by the connector area.
   2. Avoid any bending, pulling, or other excessive force, which can result in broken connections.

11) In case of buffer material such as cushion / gasket is assembled into LCD module, it may have an adverse effect on connecting parts (LCD panel-TCP / HEAT SEAL / FPC / etc., PCB-TCP / HEAT SEAL / FPC etc., TCP-HEAT SEAL, TCP-FPC, HEAT SEAL-FPC, etc.,) depending on its materials.
   Please check and evaluate these materials carefully before use.

12) In case of acrylic plate is attached to front side of LCD panel, cloudiness (very small cracks) can occur on acrylic plate, being influenced by some components generated from polarizer film..
   Please check and evaluate those acrylic materials carefully before use.

12.Warranty

This product has been manufactured to your company's specifications as a part for use in your company's general electronic products. It is guaranteed to perform according to delivery specifications. For any other use apart from general electronic equipment, we cannot take responsibility if the product is used in medical devices, nuclear power control equipment, aerospace equipment, fire and security systems, or any other applications in which there is a direct risk to human life and where extremely high levels of reliability are required. If the product is to be used in any of the above applications, we will need to enter into a separate product liability agreement.

1. We cannot accept responsibility for any defect, which may arise from additional manufacturing of the product (including disassembly and reassembly), after product delivery.

2. We cannot accept responsibility for any defect, which may arise after the application of strong external force to the product.

3. We cannot accept responsibility for any defect, which may arise due to the application of static electricity after the product has passed your company's acceptance inspection procedures.

4. When the product is in CFL models, CFL service life and brightness will vary According to the performance of the inverter used, leaks, etc. We cannot accept responsibility for product performance, reliability, or defect, which may arise.

5. We cannot accept responsibility for intellectual property of a third party, which may arise through the application of our product to your assembly with exception to those issues relating directly to the structure or method of manufacturing of our product.

6. Optrex will not be held responsible for any quality guarantee issue for defect products judged as Optrex-origin longer than 2 (two) years from Optrex production or 1(one) year from Optrex, Optrex America, Optrex Europe delivery which ever comes later.