Product Specification Sheet

51.1cm(20.1") WSXGA+ Color TFT/LCD Module
M201Z2-M01 (P/N 000R000)

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. Preface

This document is the master design document of M201Z2-M01. This document consists of

- Functional Specifications
- Product Implementations
- Detailed Performance (former PSS description)

This document does not have detail design descriptions of each component. Please refer to appropriate component specifications for the detail of each component.

This document will be updated if major function changed or major design change occurs.

REVISION HISTORY

Revision	Date	Reason & Contents	Change Part from Previous Version
1	Jul/30/2003	Initial Release	Initial Release
2	October 29, 2003	Update weight and Iin specification, bezel gap, appearance drawings, interface timing, and power sequence	2.1 Test Items 1 of 6 2.2 Test Items 2 of 6 2.9 Appearance Specification 3.6 Mechanical Characteristics 3.8.2.2 Detailed Timing Characteristics 3.8.3.5 Power On/Off Sequence

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1. INTRODUCTION

1.1. Scope

This specification applies to the 51.11cm(20.12") Color TFT/LCD Module; M201Z2-M01. M201Z2-M01 module is designed for a display unit of a monitor application.

The screen format and electrical interface are intended to support the WSXGA+ (1680(H) x 1050(V)) screen. Supported color is native 24bit colors (8-bit per RGB-subpixels data driver). All input signals are TMDS (Transition Minimized Differential Signaling) interface compatible. This module does not contains an inverter card for backlight.

1.2. Applicability

This specification is applicable to the following devices.
LCD module:

- M201Z2-M01 000R000

The LCD module consists of the following components;

- A TFT displaying portion made of glass with an outer protective film.
- A Backlight unit using Cold Cathode Fluorescent Lamps (CCFLs).
- Associated electronics components (drivers, control circuits, and a DC-DC converter).
- Metal Bezel and Shield Cover.

2. Detailed Performance (PSS Description)

The test items and the criteria, which were written in PSS, are described here.

However, in which test phase the test should be performed, the number of the test samples or the ratio of the sampling inspections are not written here. Those details should be designed by each test plans and instructions.

The “Note” area can be used as the checklist and the sampling number memo.

Inspecting Conditions Definition:

Signal Timing:

Refer to the M201Z2-M01-PSS (This document) Timing Definition Page.

2.1. Test Items 1 of 6 (Initial Performance 1/3)

Table 1. Test Items 1 of 6 (Initial Performance 1/3)

Test Definitions						Criteria				Test Conditions									Memo
No.	EI No.	Name	Sub-Class	Symbol	Unit	min	typ	max	Uncountable criteria	Vin(V)	VBL(V)	Display Pattern / Level	Brightness Control	Contrast Control	Judge after	Test at 60Hz	Test at 50Hz	Note	
		Mechanical																	
1	-	Appearance	-	APR	-		->		Refer Appearance Specifications	-	-	-	-	-	-	-	-		
2	-	Dimension	-	DIM	-		->		Refer Dimension Specification	-	-	-	-	-	-	-	-		
3	-	Weight	-	WGT	g	2700	2850	3000		-	-	-	-	-	-	-	-		
		FOS																	
4	5-303	Image Stability	(1) (2) (3)	IST1 IST2 IST3	-		->		Within 5 seconds, No flickering, No image slippage	12.6+/-0.1 12.0+/-0.1 11.4+/-0.1	26.0+/-0.5	(*2)	MAX	-	15 sec	Yes	-		
5	5-301	Viewing Direction	-	VD	-		->		White saturation at 12 o'clock	12.0+/-0.1	26.0+/-0.5	L128 raster	MAX	-	-	Yes	-		
6	5-302	Image Quality	MURA W/B dots Etc.	FQ	-		->		Refer Limitation samples & Image Quality Specifications	12.0+/-0.1	26.0+/-0.5	Refer Image Quality Specifications	MAX	-	-	Yes	-		

7	5-3 04	Line Defects	-	LD	-		->		Invisible	12.0+/- 0.1	26.0+/- 0.5	L0,L31,L63,L95,L128,L159,L223,L254,L255 raster	MAX	-	-	Yes	-		
8	5-3 05	Pixel Defects	-	DD	-		->		Refer Image Quality Specifications	12.0+/- 0.1	26.0+/- 0.5	L0,L63,L255 raster	MAX	-	-	Yes	-		
9	5-3 06	Gray Scale (eye)	-	GL V	-		->		No contrary level [0deg V]	12.0+/- 0.1	26.0+/- 0.5	Gray Bar	MAX	-	-	Yes	-		
10	5-3 08	After Image	-	AI1	-		->		Invisible after 5 sec	12.0+/- 0.1	26.0+/- 0.5	Black Window 5 sec, then L128 raster	MAX	-	-	Yes	-		
11	5-3 10	Flickering (eye)	-	FL KV	-		->		Refer Image Quality Specifications	12.0+/- 0.1	26.0+/- 0.5	L192 Flicker Pattern	MAX	-	-	Yes	-		
12	5-3 11	Cross Talk (eye)	-	CK TV	-		->		Refer Image Quality Specifications	12.0+/- 0.1	26.0+/- 0.5	Refer Image Quality Specifications	MAX	-	-	Yes	-		
13	5-3 12	Finger Pressure	-	FP D	-		->		Vanish within 10 sec	12.0+/- 0.1	26.0+/- 0.5	L255 White raster	MAX	-	-	Yes	-		
14	5-3 15	Ripple	-	RP L	-		->		N/A-	-	-	-	-	-	-	-	-		
15	5-3 09	Image Sticking	Windo w	AI2	-		->		Invisible	12.0+/- 0.1	26.0+/- 0.5	Black Window 10H ON/14H OFF 5 cycle -> L128 raster	MAX	-	-	Yes	-		
15	5-3 09 5-3 13	Image Sticking	Check er	AI4	-		->		Vanish within 3 sec Vanish within 3 min Vanish	12.0+/- 0.1	26.0+/- 0.5	Checker 10 sec ->L128 raster Checker 30 min -> L128 raster Checker 72H ->L255 raster 24H -> L128 raster	MAX	-	-	Yes	-		

2.2. Test Items 2 of 6 (Initial Performance 2/3)

Table 2. Test Items 2 of 6 (Initial Performance 2/3)

Test Definitions						Criteria				Test Conditions									Memo
No.	EI No.	Name	Sub-Class	Symbol	Unit	min	Typ	max	Uncountable criteria	Vin(V)	VBL(V)	Display Pattern / Level	Brightness Control	Contrast Control	Judge after	Test at 60Hz	Test at 50Hz	Note	
Electrical																			
16	3-101	Vin current	-	Iin	A	0.43	0.46	0.48	+/- 4 sigma	12.0+/-0.1		L255 raster	Max	-	1 min	Yes	-		
17	3-101	VBL Current	(1)	IBL1	A	0.95	1.18	1.36	+/- 4 sigma		26.0+/-0.5	L255 raster	Max	-	2 min	Yes	-		
18	-	EEDID	-	EDID	-	-	-	-	N/A	-	-	-	-	-	-	-	-		
Optical																			
19	-	Brightness Control		BRR2	-				Brightness changes smoothly	12.0+/-0.1	26.0+/-0.5	L255 raster	Min to Max	-	-	Yes	-		
20	4-201	Maximum Brightness	Center 5 points	MXB	cd/m^2	210200	260250	310300	+/- 4 sigma	12.0+/-0.1	26.0+/-0.5	L255 raster	IBL=1.18[A]	-	60 min	Yes	-		
21	-	Brightness Control range	-	BRR	%	-	-	-	N/A	12.0+/-0.1	26.0+/-0.5	-	VDIM-IN=0 – 3[V]	-	60 min	-	-		

22	4-203	Gray Scale Measurement	GL(0) GL(31) GL(63) GL(95) GL(127) GL(159) GL(191) GL(223) GL(255)	GL M1	%	-0.753.07.516.530.046.066.0100	0.281.04.711.421.736.153.073.4100	0.401.256.015.028.046.065.082.0100	No contrary level [0deg V]	12.0+/-0.1	26.0+/-0.5	Specified raster	Max	-	30 min	Yes	-		
23	4-204	Brightness Uniformity	13 points	UNF	%	-	-	30	Refer to Uniformity Measurement Specifications	12.0+/-0.1	26.0+/-0.5	L255 raster	Max	-	60 min	Yes	-		
24	4-205	Contrast		CR	-	250	350		L255 / L00	12.0+/-0.1	26.0+/-0.5	Specified raster	Max	-	20 min	Yes	-		
25	-	Contrast Control Range	-	-	-	-	-	-	N/A	-	-	-	-	-	-	-	-		

2.3. Test Items 3 of 6 (Initial Performance 3/3)

Table 3. Test Items 3 of 6 (Initial Performance 3/3)

Test Definitions						Criteria				Test Conditions									Memo
No.	EI No.	Name	Sub-Class	Symbol	Unit	min	Typ	Max	Uncountable criteria	VDD(V)	VBL(V)	Display Pattern / Level	Brightness Control	Contrast Control	Judge after	Test at 60Hz	Test at 50Hz	Note	
Optical (continued)																			
25	4-210	Viewing Cone(U/D) Viewing Cone(L/R)	H, V=0, +/-20 =0, +/-40 =0, +/-60 =0, +/-85 H, V=+/-20, 0 =+/-40, 0 =+/-60, 0 =+/-85, 0	VA	-	160 85 35 15 160 85 35 15	- - - - - - - -	- - - - - - - -	Value of Contrast	12.0+/-0.1	26.0+/-0.5	L00 /L255 raster	Max	-	30 min	Yes	-		
26	4-211 (1)	Response time(1)	Rise Fall	Ton1 Toff1	ms	- -	13 13	20 20	Rise : 10% -> 90% Fall : 90% -> 10%	12.0+/-0.1	26.0+/-0.5	L00 /L255 raster	Max	-	-	Yes	-		
27	4-213	Cross Talk Ratio		CTKM	%		->		AS RECORD	12.0+/-0.1	26.0+/-0.5	L00/L128 Window	Max	-	-	Yes	-		

28	4-215	Color Coordinate	Red x y Green x y Blue x y	CHRR CHRG CHRB	-	0.610 0.300 0.260 0.570 0.120 0.030	0.640 0.330 0.290 0.600 0.150 0.060	0.670 0.360 0.320 0.630 0.180 0.090	MCPD-7000 is the standard equipment	12.0+/-0.1	26.0+/-0.5	L255 R raster L255 G raster L255 B raster	Max	-	120	Yes	-		
29	4-216	White Balance	x y	WHB	-	0.283 0.299	0.313 0.329	0.343 0.359	MCPD-7000 is the standard equipment	12.0+/-0.1	26.0+/-0.5	L255 raster	Max	-	120	Yes			
30	4-214	Gloss	-	GLOS	G.U.	-	-	80	-	-	-	-	-	-	-	-	-		
31		Brightness Ratio and Viewing Cone	H,V=+/-50, 0 =0, +/-50	B	%	35 35	45 45	- -	Brightness Ratio with (H=0,V=0)	12.0+/-0.1	26.0+/-0.5	L255 raster	Max	-	120	Yes			
32		White Point Shift and Viewing Cone	H,V=+/-85, 0 =0, +/-85	Sx Sy Sx Sy	-	-	-	0.04 0.04 0.04 0.04	Value of white point shift with (H=0, V=0) L255	12.0+/-0.1	26.0+/-0.5	L255 raster	Max	-	120	Yes			

33		White Point Shift and Viewing Cone	H,V=+/-85, 0V V =0, +/-85 H H	Sx Sy Sx Sy	-	-0.05 -0.05 -0.05 -0.05	-	0.08 0.08 0.05 0.05	Value of white point shift with (H=0, V=0) L0	12.0+/-0.1	26.0+/-0.5	L0 raster	Max	-	120	Yes			

(*1) A: Critical, B: Important, C: Slight
(*2) Color Bar and either WAKU or WAKU Characters

2.4. Test Items 4 of 6 (Thermal)

Table 4. Test Items 4 of 6 (Thermal)

Test Definitions					Criteria			Test Conditions									Memo
EI No.	Name	Sub-Class	Symbol	Unit	at 50 deg	at0 deg	Uncountable criteria	VDD(V)	VBL (V)	Display Pattern / Level	Brightness Control	Contrast Control	Judge after	Test at 60Hz	Test at 50Hz	Note	
7-502	Gray Scale (eye)	-	BRV	-	->	->	No contrary level	12.0+/-0.1	26.0+/-0.5	Same as No.9 of Table 1	MAX	N/A	<-	Yes	-		
7-501	Contrast Ratio	-	CR	-	> 200	> 150		12.0+/-0.1	26.0+/-0.5	Same as No24 of Table 2	MAX	N/A	<-	Yes	-		
7-501	Response Time	Rise Fall	Ton1 Toff1	Ms	< 30 < 30	< 100 < 100	ON: 10% -> 90% OFF: 90% -> 10%	12.0+/-0.1	26.0+/-0.5	Same as No26 of Table 3	MAX	N/A	<-	Yes	-		
7-502	Image Stability (1)		IST1	-	->	->	Same as Initial Performance	12.0+/-0.1	26.0+/-0.5	Same as No.4 of table 1	MAX	N/A	<-	Yes	-		
7-502	Image Stability (2)		IST2	-	->	->	Same as Initial Performance	12.0+/-0.1	26.0+/-0.5	Same as No.4 of table 1	MAX	N/A	<-	Yes	-		
7-502	Image Stability (3)		IST3	-	->	->	Same as Initial Performance	12.0+/-0.1	26.0+/-0.5	Same as No.4 of table 1	MAX	N/A	<-	Yes	-		
7-502	Image Quality		FQ	-	->	->	No degradation Refer to Image Quality Specifications	12.0+/-0.1	26.0+/-0.5	Same as No.6 of table 1	MAX	N/A	<-	Yes	-		
5-304	Line Defect		LD	-	->	->	Invisible	12.0+/-0.1	26.0+/-0.5	Same as No.7 of table 1	MAX	N/A	<-	Yes	-		

5-311	Cross Talk (eye)		CTKV	-	->	->	No significant degradation compared to nominal temperature	12.0+/-0.1	26.0+/-0.5	Same as No.12 of table 1	MAX	N/A	<-	Yes	-		
-	Afterimage			-	->	->	No significant degradation compared to nominal temperature	12.0+/-0.1	26.0+/-0.5	Same as No.10 of table 1	MAX	N/A	<-	Yes	-		
-	Flicker (eye)		FLKV	-	N/A	N/A	No significant degradation compared to nominal temperature	12.0+/-0.1	26.0+/-0.5	Same as No.11 or table 1	MAX	N/A	<-	Yes	-		
-	Brightness			-	->	->	No significant degradation compared to nominal temperature	12.0+/-0.1	26.0+/-0.5	Same as No.20 of table 2	MAX	N/A	<-	Yes	-		

2.5. Test Items 5 of 6 (Reliability, Mechanical, Environmental)

Table 5. Test Items 5 of 6 (Reliability, Mechanical, Environmental)

Test Definitions					Criteria							Test Conditions						Memo
EI No.	Name	Sub-Class	Symbol	Unit	Appearance	Image Quality	Dot Defects	Line Defects	Max Brightness	Damage / Operation Failure	Uncountable criteria	Temp	Humidity	Operating	Conditions	Time / Cycles	Note	
	Thermal																	
9-502	Thermal Shock (non-Operating)	-	-	-	(*3)	(*3)	-	(*3)	(*3)	None	(*1)	-	-	No	-20(0.5H) / 60(0.5H)	Judge at 100 cycles, (Continue to 200 cycles)		
9-505	Hot Start	-	-	-	-	-	-	(*3)	-	None	(*1)	50+/-2	Nominal	Yes	50deg(1H) ->ON/OFF (*4)	5 cycles		
9-506	Cold Start	-	-	-	-	-	-	(*3)	-	None	(*1)	0+/-3	Nominal	Yes	0deg(1H) ->ON/OFF (*4)	5 cycles		
	Mechanical																	
9-602	Shock	50G	-	-	(*3)	(*3)	(*3)	(*3)	(*3)	None	(*1)	Nominal	Nominal	No	50G,11ms,Half Sine(6dir)	1 cycles/dir		
9-603	Vibration	-	-	-	(*3)	(*3)	(*3)	(*3)	(*3)	None	(*1)	Nominal	Nominal	No	1.5G,10-200-10Hz 30min var / cycles(3dir)	30min/dir		
	Electrical																	
9-701	ESD (connector pins)									None	(*1)	Nominal	Nominal	No	EI 9-701, A3 (*5)	3 cycles/cond		

9-702	ESD (screen)									None	(*1)	Nominal	Nominal	No		5 cycles/cond		
-	Electro Magnetic Susceptibility	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	ESD (Operating)	-	-	-	As Record (*6)							Nominal	Nominal	Yes	(*6)			
	Others																	
9-802	Gas	-	-	-	(*3)	(*3)	-	(*3)	(*3)	None	(*1)	-	-	No	G1 Environment	500H		
9-901	Atmospheric pressure	-	-	-	(*3)	(*3)	-	(*3)	(*3)	None	(*2)	Nominal	Nominal	Yes	B1(67.4kPa=505.5mmHg), (*4)	8H		
9-902	Open/Short Test	-	-	-	-	-	-	-	-	-	No Safety Problem (No smoke)	Nominal	Nominal	Yes	Refer EI	-		

(*1) Measurement / Judgment should be performed at the start and the end of these tests.
(*2) Measurement / Judgment should be performed at the start, the middle and the end of these tests.
(*3) Same as Initial Performance
(*4) Display patterns to be L00 / L255 raster, A/B/C/W Gray Bar, Black Window, Checker.
(*5) GND pin to non-GND pin.
(*6):

Condition	Criteria	Note
(1) Direct +/-4kV, Air +/- 8kV	Level A'	No functions error. Transient screen quality degradation.
(2) Direct +/- 8kV, Air +/- 15kV	Level B	No function error. Some performance degradation allowed. No data lost. Self-recoverable. No hardware failure.
(3) Direct +/- 15kV	Level C	Temporary performance degradation. Recovery by operator is acceptable. No hardware failure.

2.6. Test Items 6 of 6 (Life)

Table 6. Test Items 6 of 6 (Life)

Test Definitions		Criteria										Test Conditions				Memo
EI No.	Name	Appearance	Image Quality	Dot Defects	Line Defects	Max Brightness (%)	Color shift dx < .025 dy < .035	Contrast	Resp. Time	Time [H]	Judgment at	Temp (deg)	Humidity (%)	Conditions	Display Pattern	
8-204	THB (1)	O O O O O O	O (*6) (*6) (*6) (*6) (*6)	O (*3) (*3) (*3) (*3) (*3)	O O O O O O	100 - - > 70 > 70 > 70	- - - - - -	- - - - - -	- - - - - -	0 100 200 300 500 1,000	300H (continue to 1,000H)	50	80	12.0 +/-0.1V Max Brightness	Aging Pattern	
8-204	THB (2)	O (*2) (*2) (*2) O	O (*2) (*2) (*2) O	O (*2) (*2) (*2) O	O (*2) (*2) (*2) O	- - - - -	- - - - -	- - - - -	- - - - -	0 100 200 300 600	300H (continue to 500H)	60	90	12.0 +/-0.1V Backlight ON (*1)(*2)(*5)	Aging Pattern	

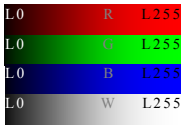
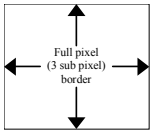
8-201	Life	O - - - - O O As rec As rec	O O O O O O O As rec As rec	O - - - - O O As rec As rec	O O O O O O O As rec As rec	100 - - - > 80 > 70 - As rec >60(*8)	O - - - - O - As rec As rec	O - - - - O - As rec As	- - - - - - - - -	0 24 48 72 96 300 500 1,000 2,000	300H (*4) (continue to 2,000H)	Nominal	Nominal	12.0 +/-0.1V Max Brightness	Aging Pattern	
8-202	High Temp Operation	(*9)	(*9)	(*9)	(*9)	(*9)	(*9)	(*9)	(*9)	0 100 200 300 500	300H (continue to 500H)	65	dry	12.0 +/-0.1V Backlight OFF (*1)(*5)	Aging Pattern	
8-203	Low Temp Operation	O - O -	O - O -	O - O -	O - O -	100 - >60 >50	- - - -	O - O -	- - - -	0 96 240 500	240H (continue to 500H) No abnormal CFL discharge	0	Nominal	12.0 +/-0.1V Max Brightness	Aging Pattern	
8-205	ON/OFF cycles	O O	O O	O O	O O	100 >50	- -	O O	- -	0 End	167H	Nominal	Nominal	10sec ON/10sec OFF continue to 30,000 cyc	Aging Pattern	
8-302	Storage (Hot)	O O	O O	O O	O O	Same as Initial Performance	- -	- -	- -	0 240	240H	65	35	-	-	
8-303	Storage (Cold)	O O	O O	O O	O O	Same as Initial Performance	- -	- -	- -	0 240	240H	-20	Nominal	-	-	

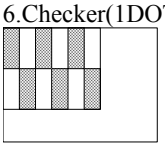
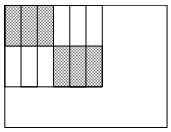
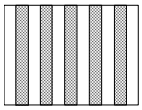
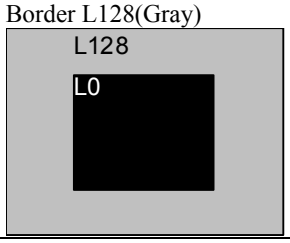
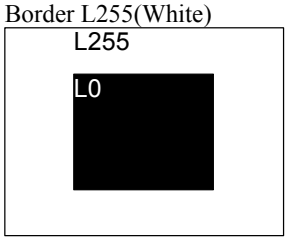
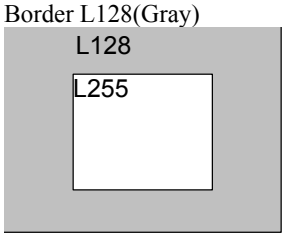
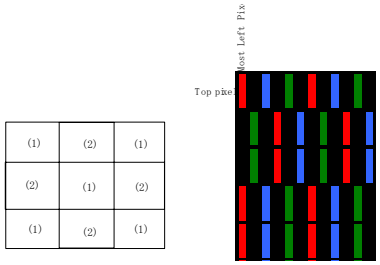
-	High Humidity Storage	O	(*7)	O	O	-	-	-	-	0 24 100	24H 100H	30	95	-	-	

(*1) Backlight is not included in the criteria of judgment.
(*2) If some defect, which depends on plastic/mold warpage, occurred, final judgment should be considered also with the result of THB(1).
(*3) No increase of dot defects. If observed, the judgment shall be done after the failure analysis.
(*4) At 300H judgment, Image Quality should be checked also at the half (slow) speed frame rate. Image sticking (ICON) test should be done.
(*5) Backlight brightness should be controlled not to go over the NI temp of liquid crystal.
(*6) Backlight sheet wrinkles should be judged at 50deg/80% environment. After the test, left on 3 days under nominal temperature, nominal humidity, the wrinkles should be invisible from 0deg V direction.
(*7) After the test, left on 1 day under nominal temperature, nominal humidity, the mura caused by the sheet wrinkles should be invisible.
(*8) Estimated value at 30,000H should be bigger than 50%.
(*9) No illegal operation under nominal temperature.

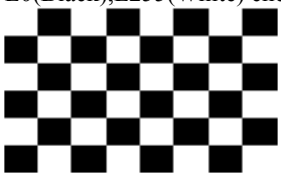
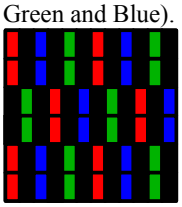
2.7. Pattern Definition

Table 7. Pattern Definition

<table>
<tr><td colspan="3">1.Gray Raster
L0 to L255 Full Screen Same level
L0 Raster is called Black raster, L255 raster is called White raster</td></tr>
<tr><td colspan="3">2.R, G, B Raster
L0 to L255 Full each R, G, B</td></tr>
<tr><td colspan="3">3.Gray Bar
Gradational vertical region L0 to L255 level White</td></tr>
<tr><td>4.Color Bar
 
</td><td>5. Waku
 

white line on black screen</td><td>6.Checker(1DOT On/Off)
 
Subpixel On/Off</td></tr>
<tr><td>7.Pixel checker
 
Full Pixel On/Off</td><td>8.Vertical Stripe
  </td><td>9.Window
Center area L0(Black)
Border L128(Gray)
 
</td></tr>
<tr><td>10.Black Window
Center area L0(Black)
Border L255(White)
 
</td><td>11.Crosstalk Window
Center area L255(White)
Border L128(Gray)
 
</td><td>12. Flicker Pattern
 

(1) & (2) are opposite
L192, L0 subpixel checker
Horizontally-subpixel/Vertically-double pixel checker.
First On/Off inversion is between 1’st line and 2’nd line as shown the above picture.</td></tr>
</table>

13.Image Sticking Pattern L0(Black),L255(White) checker 	14. Maximum Power Pattern Horizontally Sub-pixel, Vertically Double-pixel Checker. L0(Black) and L255 (Red, Green and Blue).  First On/Off inversion is between 2'nd line and 3'rd line as shown the above picture.	

2.8. Screen Quality Criteria

2.8.1. Conditions

Refer to F85-ALL Engineering Memo-005.

2.8.2. Criteria

Table 8. Screen Quality Criteria

	Item	Display Pattern		M201Z2 (Count both Lit & Slight Lit)
1	Lit count	White raster	L0, L63	2
2	Lit (Green)	White raster	L0	N/A
3	Unlit count	WRGB raster	L255	4
4	Pixel defect count	WRGB raster	L0, L255	5
5	Leak Pixel Defect (*3)	WRGB & Black two tone pattern	Half L0, Half L255	N/A
6	2 adjacent lit defect(*4)	White raster	L0	0
7	3 adjacent lit defect	White raster	L0	0
8	2 adjacent unlit	WRGB raster	L255	Horizontal: 1 Vertical: 0
9	3 adjacent unlit	WRGB raster	L255	0
10	Distance lit to lit	White raster	L0	15mm
11	Distance Unlit to Unlit (*7)	WRGB raster	L255	15mm
12	CF defect (*10)	WRGB raster	L255	Limitation sample may be used
13	Lit by Grain	White raster	L0,L63	Visible by naked eye (*11)
14	Unlit by Grain	WRGB raster	L255	Visible by naked eye (*11)
15	JND (*12)	White raster	L0,L255	JND1.5 maximum
			L1～L254	JND2.0 maximum
		Gap Mura	L0,L255	(*13)
		Mask Boundary Mura	L1～L254	(*13)
		Stripe like Mura	L1～L254	(*13)
16	Limitation sample			If Limitation sample is provided, refer to it prior to this document. That sample may change according to the market requirement.

(*1) Subpixel defect should by count as one. The same subpixel shows defect at different patterns should not be double counted.
(*2)The same subpixel shows both lit and unlit defect, count as lit only for the sum of the pixel defects.
(*3)Leak defects mean “White/Black” two-tone pattern only.
(*4) Adjacent lit defect means vertically, horizontally and slantingly series lit defects.
(*5) Adjacent unlit defect means vertically, horizontally and slantingly series unlit defects.
(*6) Distance lit to lit means “Lit to Lit”, “Lit to 2 adjacent lit” and “2 adjacent lit to 2 adjacent lit”
(*7) Distance unlit to unlit means “Unlit to Unlit”, “Unlit to 2 adjacent unlit” and “2 adjacent unlit to 2 adjacent unlit”
(*8) Criteria of lit defects and its application should be defined by all related functions and members.
(*9) Limitation sample will be defined for Grains
(*10) A lack of Color Filter should be counted as a lit defect.
(*11) “By naked eye” means the criteria is defined by limit samples.
(*12) Criteria of Mura should be OK from just after Power ON.
(*13) Limitation sample will be provided with specified display pattern.

2.8.3. Pixel Defect Definition

Following Limit sample should be used to judge Lit/Slight lit Defect.

The lit defect is a visible pixel through the neutral density filter (transmittance: 5%).

2.8.4. JND Definition

1. JND definition (Just Noticeable Difference)
   Mura at gray level is defined as follow

Table 9. JND definition

JND level	Contrast (y)
1.5 maximum	$y <= 0.4+0.25*(1/(S/S0)^{1/3})$
2.0 maximum	$y <= 0.53+0.33*(1/(S/S0)^{1/3})$

Contrast(y) is

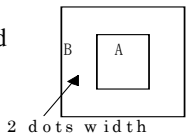
$y = |(\text{Averaged Mura Brightness}) - (\text{Averaged Background Brightness})|$
$/ (\text{Averaged Background Brightness}) \times 100\ \%$

s = area of Mura (cm^2)

so = half of the active are (cm^2)

Where "s", (Averaged Mura brightness) and (Averaged Background Brightness) is defined below.

2. s, (Averaged Mura Brightness), (Averaged Background Brightness)



- Covered by more than 0.4% differed contrast dot, the area A is defined as Mura area. And the area is defined as s(cm^2).
- Averaged A area brightness is (Averaged Mura Brightness)
- Background B is defined as 2dots width outer border of A.
- Averaged B area brightness is (Averaged Background Brightness)
- The figure shows the typical definition.

2.8.5. Other Visual screen quality

Table 10. Visual screen quality at power-on

Defect Type	Accept	Reject
Bright spot (No visible with 5% ND filter) (Foreign circular matter)	0.1 [mm] < D <= 0.4 [mm] N <= 4	D > 0.4 [mm] N > 4
Dark spot (Foreign circular matter)	0.1 [mm] < D <= 0.4 [mm] N <= 4	D > 0.4 [mm] N > 4
Bright line (light lint)	0.01 [mm] <= W <= 0.08 [mm] 0.3 [mm] <= L <= 2.0 [mm] N <= 4	W > 0.08 [mm] L > 2.0 [mm] N > 4
Dark line (dark lint/hair)	0.01 [mm] <= W < 0.08 [mm] 0.3 [mm] <= L <= 2.0 [mm] N <= 4	W > 0.08 [mm] L > 2.0 [mm] N > 4
Maximum allowable number of visual defects	N <= 5	N > 5

2.9. Appearance Specifications

1. Test Condition

Distance: 30cm (eye to LCD module)
Remove the protective film of the polarizer when inspecting the screen area
Inspect under Power On condition when doubtful phenomenon is observed.

2. Criteria

Table 11. Appearance Criteria

Inspection points	Inspection items	Criteria
(1) Screen area: 2mm over the active area Bubble (15mm max in length) over 1mm outside from active area is void (OK).	1-a) Scratch, garbage, bubble 1-b) Broken glass, stain, lines 1-c) bubble in active area	- Granular defects Averaged Diameter: D(mm) Number: n1(pcs) D<0.15 void 0.15<=D<0.30 n1<=5 0.3<=D n1=0 -Linear defects Width: W(mm) Length: L(mm) Number: n2(pcs) W<0.05 0.05<=W<0.07 L<=2 n2<=5 0.07<=W n2=0 - Total defects n1+n2 <= 5 Hard to see with the naked eye. Hard to see with the naked eye.
(2) BEZEL Opening	2-a) BEZEL Gap Garbage caught 2-b) Tape	- 0.1 - 0.8mm at four corners. Able to insert 0.1mm thickness gauge and Unable to insert 0.9mm thickness gauge. - 0 - 0.8mm at upper side and lower side. Unable to insert 0.9mm thickness gauge. - White mura must not be observed. No appearance
(3) BEZEL Top	3-a) Scratch, Knock trace	No actual harm
(4) BEZEL Side	4-a) Screws (8 Points) 4-b) User holes(4 Points) 4-c) Latch(14 points) 4-d) Tape	No lack, No loose Appear M3 holes Perfectly locked No lack, No coming off
(5) FPC	5-a) Lack 5-b) Position 5-c) Scratch	No lack No slippage No noticeable scratches (over 10mm)
(6) Tape for FPC	6-a) Lack 6-b) coming off	No lack, No coming off
(7) Connector (IF, FPC)	7-a) PIN bending, broken housing 7-b) Connection	None Surely inserted and locked
(8) Labels	8-a) Lack 8-b) Position 8-c) Wrong Label 8-d) Stain, blurred, warp fonts	No lack On the proper position, proper direction None Readable character by character
(9) IF-PCB	9-a) Screws (4 points)	No lack, No loose
(10) Lamp Cable	10-a) Cable length	CN1: 125+/-10mm, CN2: 125+/-10mm CN3: 145+/-10mm, CN4: 145+/-10mm

	10-b) Cable damage 10-c) Connector damage	No damage No damage
(11) Cushion	11-a) Lack 11-b) Coming off	N/A N/A
(12) Screen Center	12-a) BM Width	| A-B | : 0.8mm Max., | C-D | : 0.8mm Max.

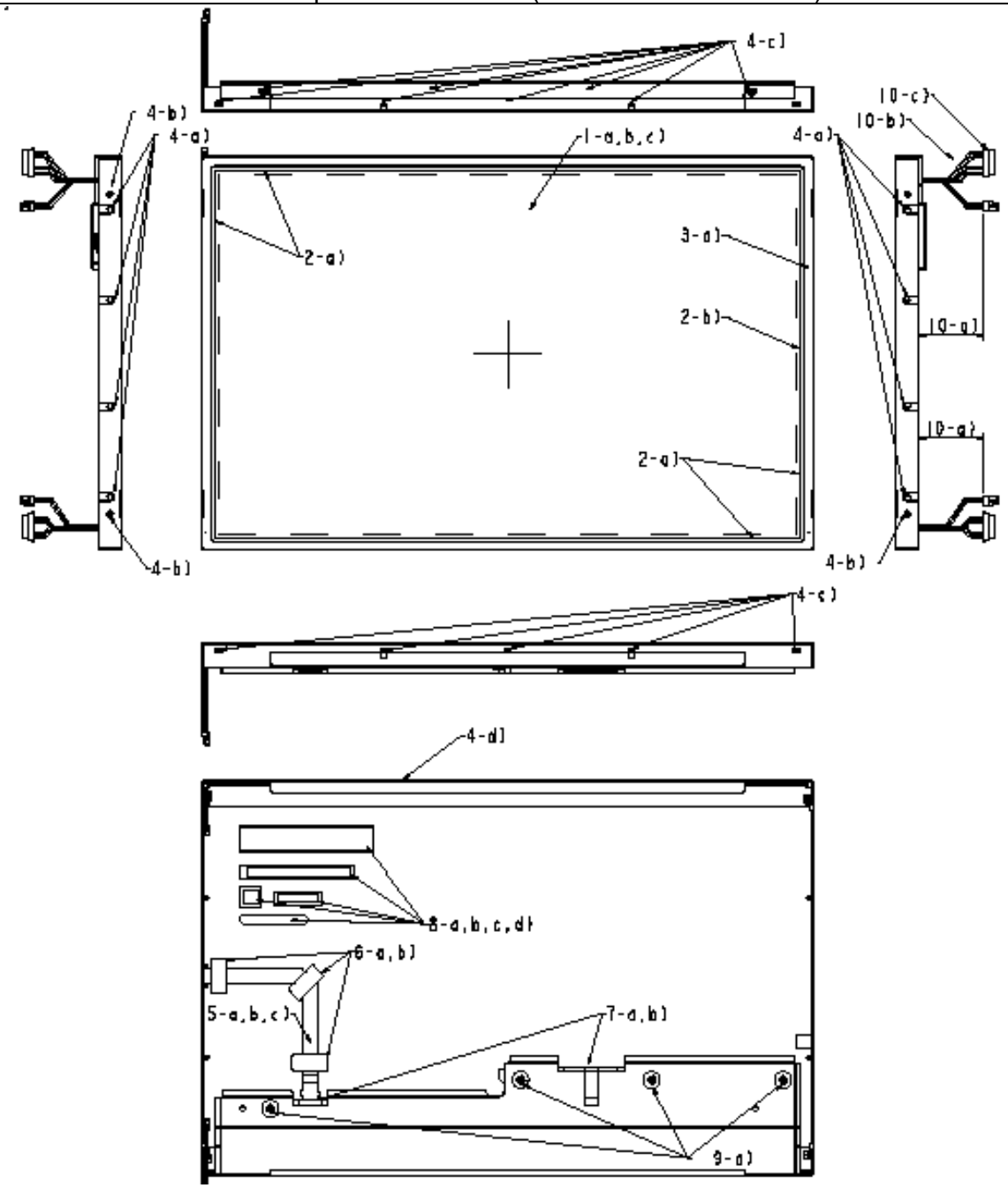


Figure 1. Inspection Points Definitions

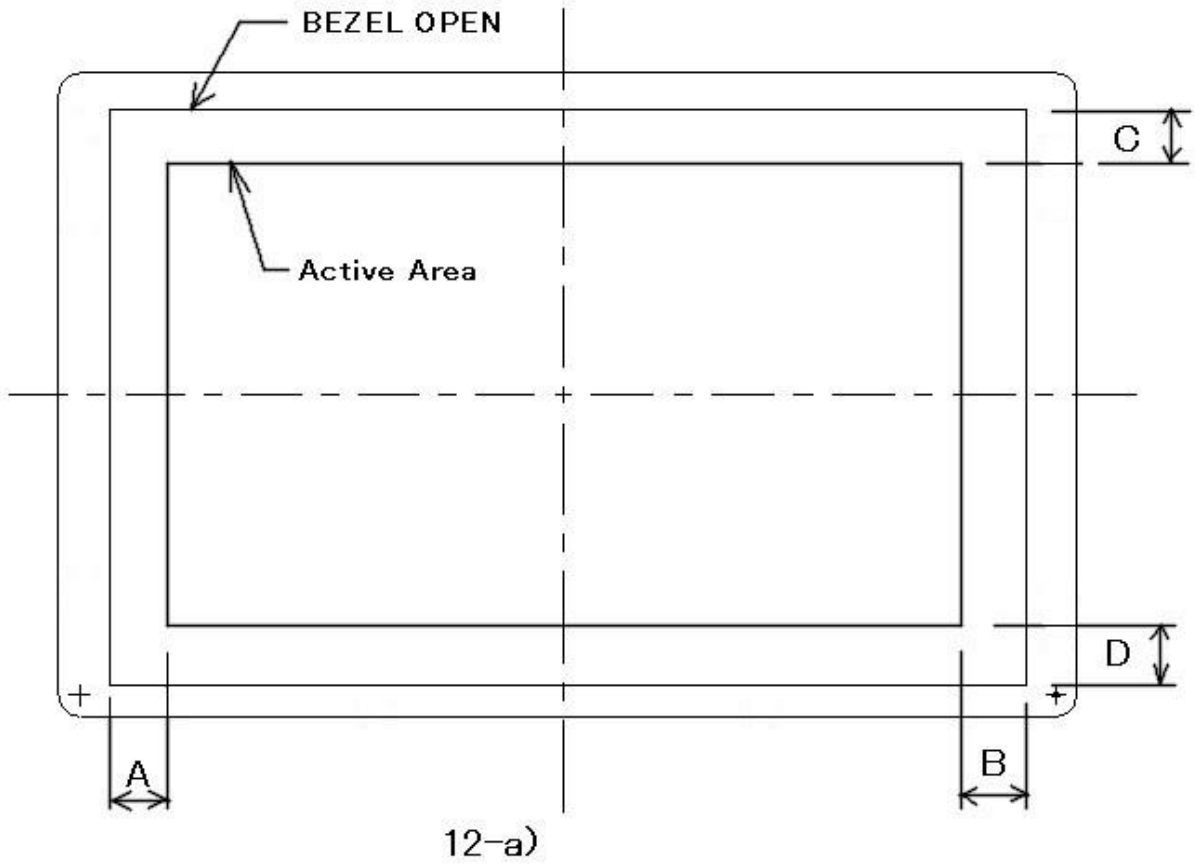


Figure 2. Inspection Points Definitions (Screen Center)

2.10. Dimension Specifications

Table 12. Dimension Specifications

No	Item		Criteria			Note
	Name	Unit	Min	Typ	Max	
1	Height	[mm]	295.9	296.4	296.9	
2	Width	[mm]	458.9	459.4	459.9	
3	Thickness 1	[mm]	17.3	17.8	18.3	
4	Thickness 2	[mm]	22.6	23.1	23.6	

Note: Refer to the REF DWG 000R002 for the measurement points
Bending and Warping should be ignored for thickness.

2.11. Backlight Power Measurement

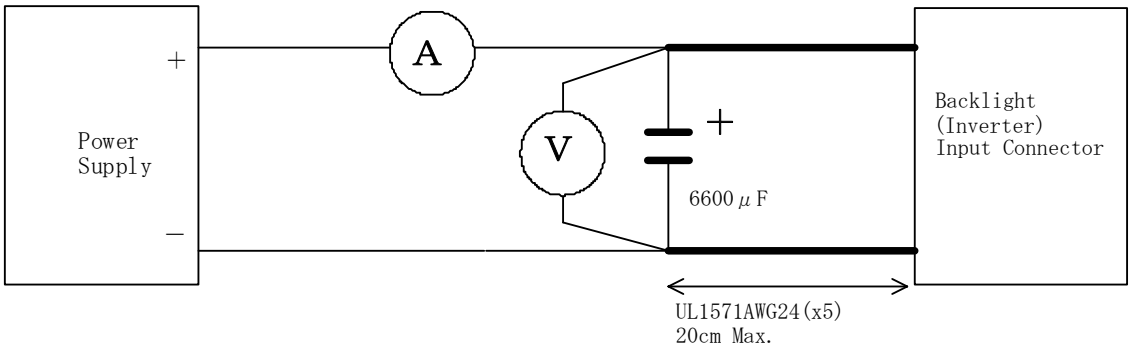


Figure 3. Backlight Power Measurement Method

2.12. Uniformity Measurement Specifications

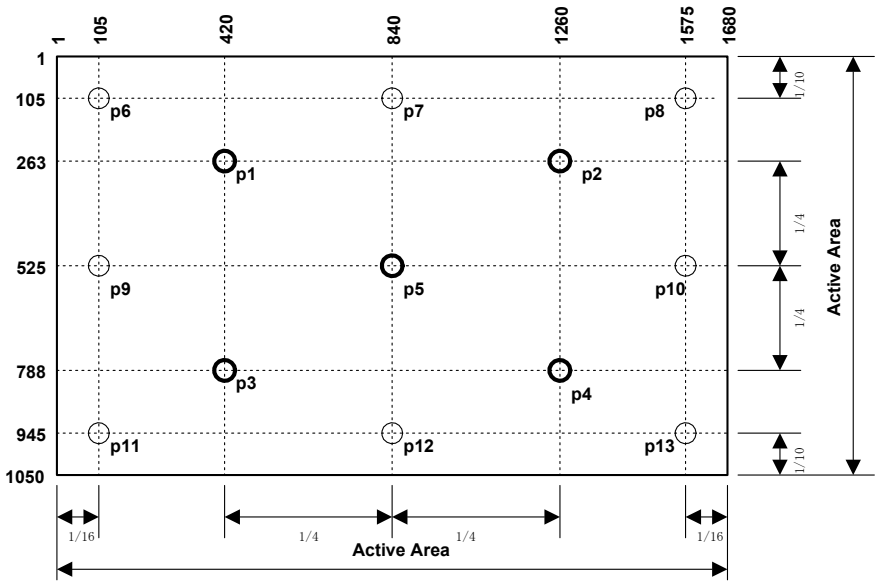


Figure 4. Uniformity Measurement Points

3. Functional Specifications

3.1. Handling Precautions

- If any signal or power line deviates from the power on/off sequence, it may cause shortening the life of the LCD module and/or damage the electrical components. Also, hot plug-in operation may cause the similar damages as above.
- The LCD panel and the CCFL (Cold Cathode Fluorescent Lamp)s are made of glass and may break or crack if dropped on a hard surface. Handling with care is necessary.
- The fluorescent lamp in the liquid crystal display (LCD) contains mercury. Do not put it in trash that is disposed of in landfills. Dispose of it as required by local ordinances or regulations.
- Small amount of materials having no flammability grade is used in the LCD module. The LCD module should be applied to exemption conditions of the flammability requirements (4.4.3.3, EN60950 or UL1950) in an end product.
- Please handle with care when mounted in the system cover. Mechanical damage for the lamp cable / lamp connector may cause safety problems.
- After installation of the TFT Module into an enclosure (Monitor frame, for example), do not twist nor bent the TFT Module even momentary. At designing the enclosure, it should be taken into consideration that no bending/ twisting forces are applied to the TFT Module from out side. Otherwise the TFT Module may be damaged.
- Since CMOS LSI is used in this module, take care of static electricity and insure human earth when handling.
- Also, when removing a protection sheet from the module surface, please take some actions against static electricity, like earth band, ionic shower, etc.
- Since front polarizer is easily damaged, pay attention not to scratch it.
- Wipe off water drop immediately. Long contact with water may cause discoloration or spots.
- When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.
- Do not open nor modify the Module Assembly.
- Prevent continuous 10 hours or over same pattern displaying, to avoid image sticking.

3.2. Conditions of Acceptability

When installed in the end-product, consideration shall be given to the following:

- This component has been judged on the basis of the required spacing in the Standard for Safety of Information Technology Equipment, Including Electrical Business Equipment, CAN/CSA-C22.2 No. 60950-00 UL60950, Third Edition, which would cover the component itself if submitted for Listing.
- The units are supplied by Limited Power Sources.
- The terminals and connectors are suitable for factory wiring only.
- The terminals and connectors have not been evaluated for field wiring.
- A suitable Electrical and Fire enclosure shall be provided.

3.3. Characteristics

Table 13. Summary

CHARACTERISTICS ITEMS	SPECIFICATIONS
Screen Diagonal [cm]	51.11 (20.12 inch) (16:10)
Pixels	1680(H) x 1050(V)
Active Area [mm]	433.44(H) x 270.90(V)
Pixel Pitch [mm]	0.258 x 0.258
Pixel Arrangement	RGB-subpixels per one Pixel, Vertical Stripe
Weight [K grams]	2.85 Typ. 3.0 Max.
Physical Size [mm]	459.4(W) x 296.4(H) x 17.8 (Bottom), 23.1(Conn). (D)
Surface Treatment	Low Reflection (<80 G.U.), Anti-glare, Hard-Coating (3H)
Display Mode	Dual Domain IPS, Normally Black
Supported Color	Native 24bit colors (RGB 8-bits per each subpixel)
White Luminance [cd/m^2] (5points Average)	250 Typ., 215 Min. (ICFL=6.0 [mA])
Contrast Ratio	350:1 Typ. 250:1 Min. (In the Dark room)
Optical Rise Time or Fall Time [msec]	25 Typ. / 40 Max.
White Point (x, y)	0.313, 0.329 (Typ.) (D65)
White Point Tracking [K]	600 Max Grayscale (L64 -L255)
Luminance Uniformity [%]	30 Max. (13 points)
Viewing Angle [degree]	+/- 85 Typ. (Horizontal, Vertical) (15:1 CR)
Input Voltage [V]	+12.0 +/-5% (Logic)
Power Consumption [W]	Logic 5.1 Typ., Backlight 32 Typ.
Electrical Interface	Single Link TMDS (Clock Freq.: 117.13[MHz] & 119[MHz])
Temperature Range [degree C] Operating Storage (Shipping)	 0 to +50 (*1) -20 to +65
Humidity [%RH]	5 to 80 (Operating/Non-operating) Max wet bulb temp. 39deg.C, No condensation
Lamp Quantity	6 Lamps (Upper: 3Lamps, Lower: 3Lamps)
Lamp Life [hour]	50,000 (by Lamp Maker @ Ta=25deg.C)
Module Backlight Life [hour]	30,000

Note:(*1) Max. Operating Temperature 50deg.C in the spec means the temperature measured at the point of the front surface of the LCD glass cell.

3.4. Functional Block Diagram

The following diagram shows the functional block diagram for the M201Z2-M01 TFT/LCD Module.

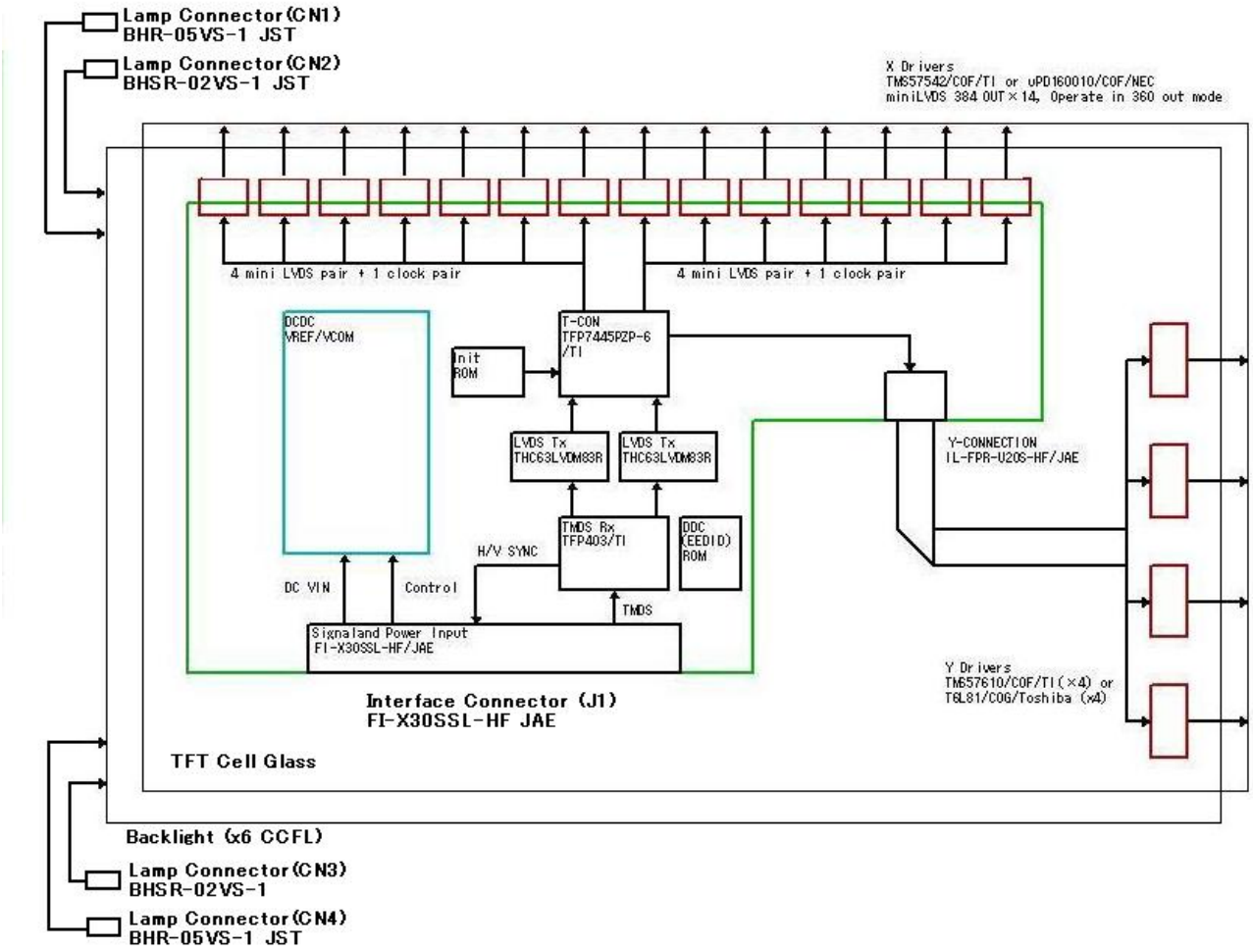


Figure 5. M201Z2-M01 Color TFT/LCD Module Functional Block Diagram

3.5. GENERAL REQUIREMENTS

3.5.1. Conformance to Specification

This module shall conform to all contents of this specification. In case of conflict between this specification and any other documents that are referenced, this specification shall take precedence.

3.5.2. General Test Conditions

All measurements shall be made under the following conditions unless otherwise specified.

1. The backlight on, (Lamp current: 6.0 [mArms] each)
2. Inverter for backlight: P/N: 050001000400 , Type No.: IV105130/T (SUMIDA) [TBD]
3. In a dark room
4. At 25 +/- 3 degree C
5. At a nominal input voltage
6. A photometer shall measure an area at the center of the screen that is larger than 1mm in diameter. Viewing direction is perpendicular to the surface of the screen.
7. Input signals shall comply with the timing listed in the "typical" of "Video Interface Timing".
8. Standard Equipment:
   Brightness: MCPD7000
   White Point: MCPD7000

3.5.3. Image Stabilizing Time

The image will begin to be visible within 3 seconds of application of power and the input signals. The image will be stabilized within 10 seconds of application of power and the input signals. "stabilized" means that using the unaided eyes, no significant change will occur in terms of the image quality specifications, such as luminance, uniformity, white point, and so on. The light output will meet the brightness specifications after 60 minutes of the application of power and the input signals.

3.6. MECHANICAL CHARACTERISTICS

Reference Drawing of M201Z2-M01 is below.

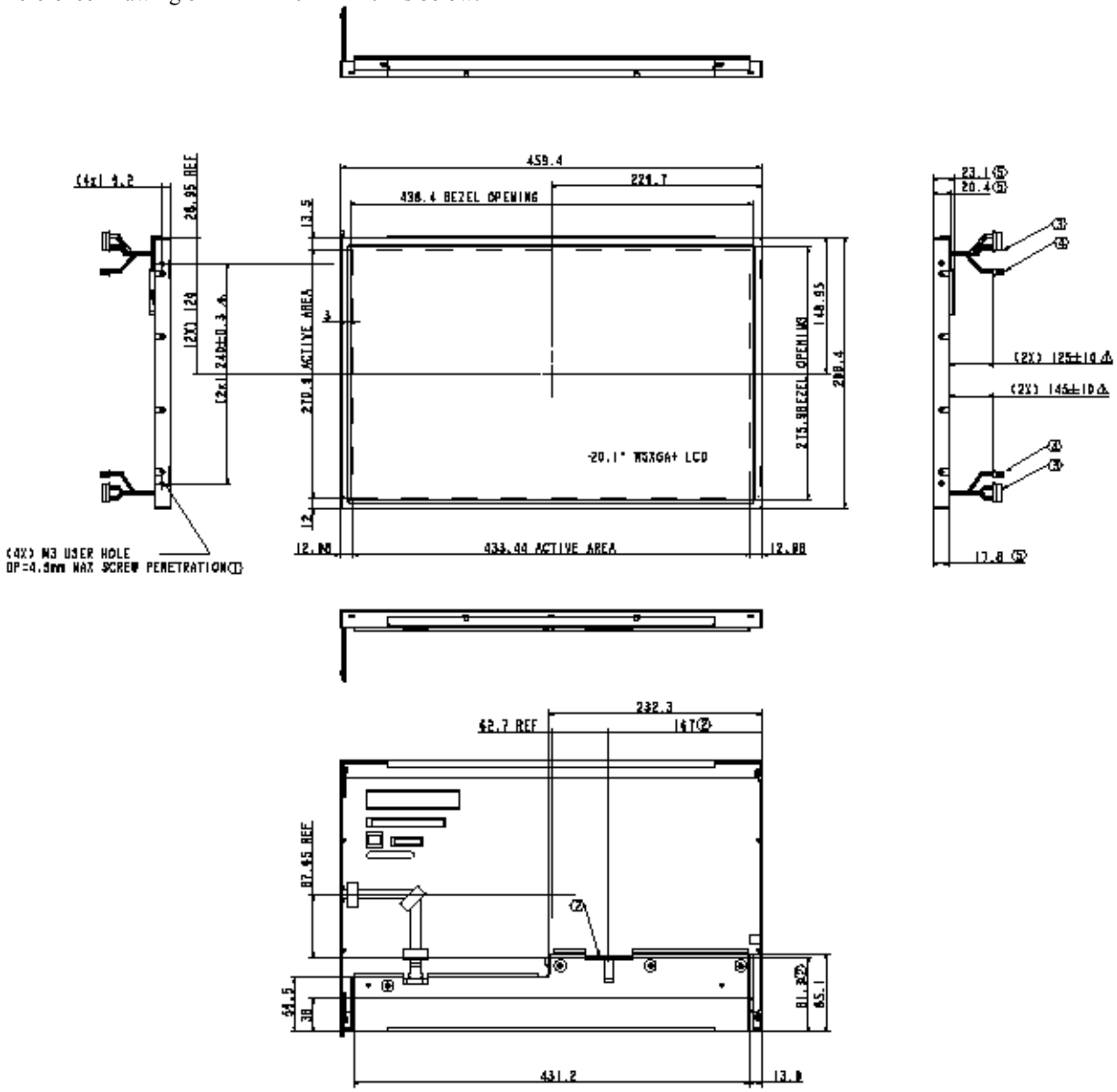


Figure 6. View of the display module of M201Z2-M01 for reference.(1)

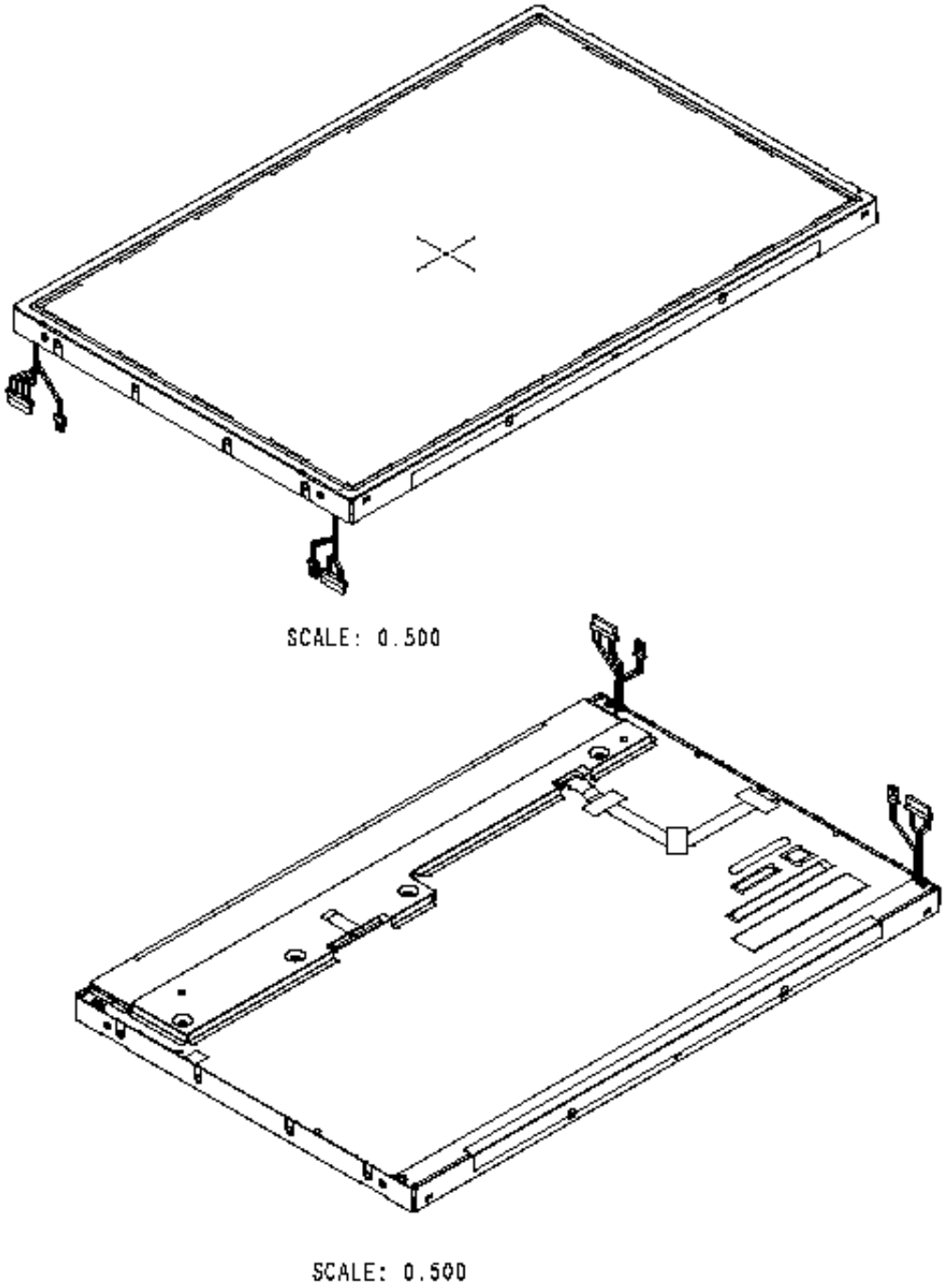


Figure 7. View of the display module of M201Z2-M01 for reference.(2)

3.6.1. Reference Drawing

Table 14. IDT drawing P/N and the weight

Model	OEM Name	IDT P/N	Ref. DWG P/N
M201Z2-M01	M201Z2-M01	000R000	000R002

3.6.2. Dimension

Table 15. Dimension

M201Z2-M01	Min.	Typ.	Max.	Unit
Width	458.9	459.4	459.9	[mm]
Height	295.9	296.4	296.9	[mm]
Depth (High)	22.6	23.1	23.6	[mm]
Depth (Low)	17.3	17.8	18.3	[mm]
Lamp Cable (CN1)	115	125	135	[mm]
Lamp Cable (CN2)	115	125	135	[mm]
Lamp Cable (CN3)	135	145	155	[mm]
Lamp Cable (CN4)	135	145	155	[mm]

3.6.3. Weight

Table 16. Weight

Model	Min.	Typ.	Max.	Unit
M201Z2-M01	2.7	2.85	3.0	[k grams]

3.6.4. Protective Front Filter

The front filter described in this section is a part of this module. A film is adhered to the LCD surface to minimize optical interference.
The objective of the filter is:

- To protect the display from impact and prevent glass from breaking into pieces and scattering.
- To provide a good surface to control glare.

3.6.4.1. Rigidity

The film may not be rigid enough to protect the LCD module from breakage but it will prevent pieces of the glass from scattering when it is broken. The rigidity may be 3H or harder.

Note: Refer to JIS Standard K5400 (Method of Rockwell Hardness Test for Plastic).

3.6.4.2. Panel Breakage Test

The module shall pass the following breakage test:
A single impact of 6.8 joules (5 foot-pounds) at the center of the viewing area. The impact shall be from a solid steel sphere with a 50 mm diameter and weighing 535 grams.
The LCD module is deemed acceptable if:

- There is no exposure of sharp edges of glass.
- All the glass particles are retained on the anti-glare protective panel and do not scatter. Small glass particles (i.e. powder) in the area where the steel ball impacts are excluded from this requirement.

3.6.4.3. Non-Glare

To minimize glare, the black matrix is made of anti glare material. In addition, the film has anti glare treatment.

Table 17. Gloss

M201Z2-M01	Min.	Typ.	Max.	Unit
Gloss	-	-	80	[gloss]

Note: 60[deg.] angle of incidence with a VG-2PD Gloss meter (Nippon Denshoku), or equivalent.

3.6.5. Display Area

3.6.5.1. Active Area

Table 18. Active Area

	Active Area	Unit
Height	270.90	[mm]
Width	433.44	[mm]

3.6.5.2. Pixel Dimension

Table 19. Pixel Dimension

	Height	Width	Unit
Pixel	0.258	0.258	[mm]
Sub pixel	0.258	0.086	[mm]

3.6.5.3. Screen Format

Following figure shows the relationship between the input signals and the LCD pixel format image.
F8964 has a TMDS interface. Following figure shows the relationship of the input signals and LCD pixel format image.

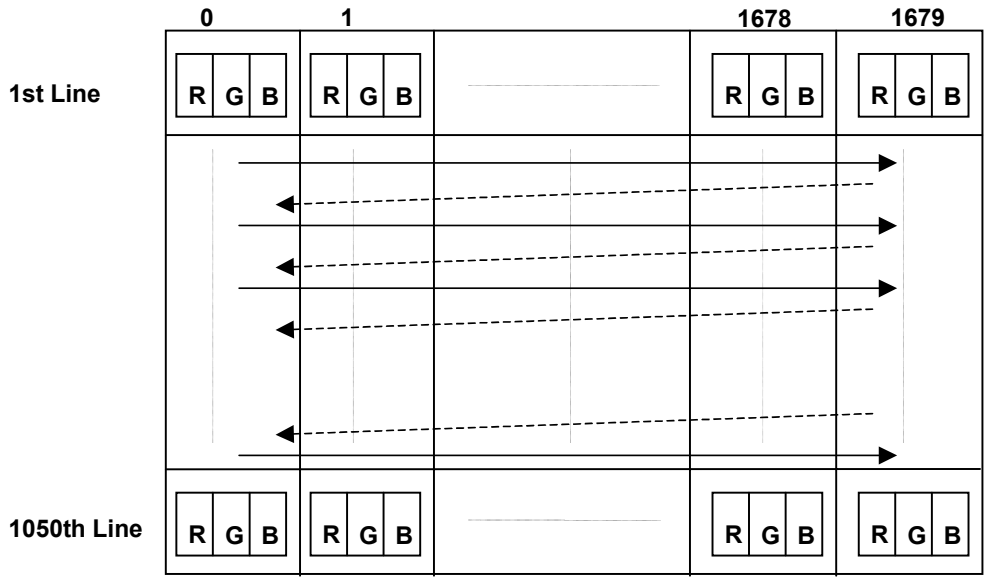


Figure 8. Screen Format

3.7. SYSTEM INTERFACE

3.7.1. Physical Interface

Physical interface is described in accordance with the connectors on the LCD module.
These connectors are capable of accommodating the following signals and will be the following components or IDT approved types.

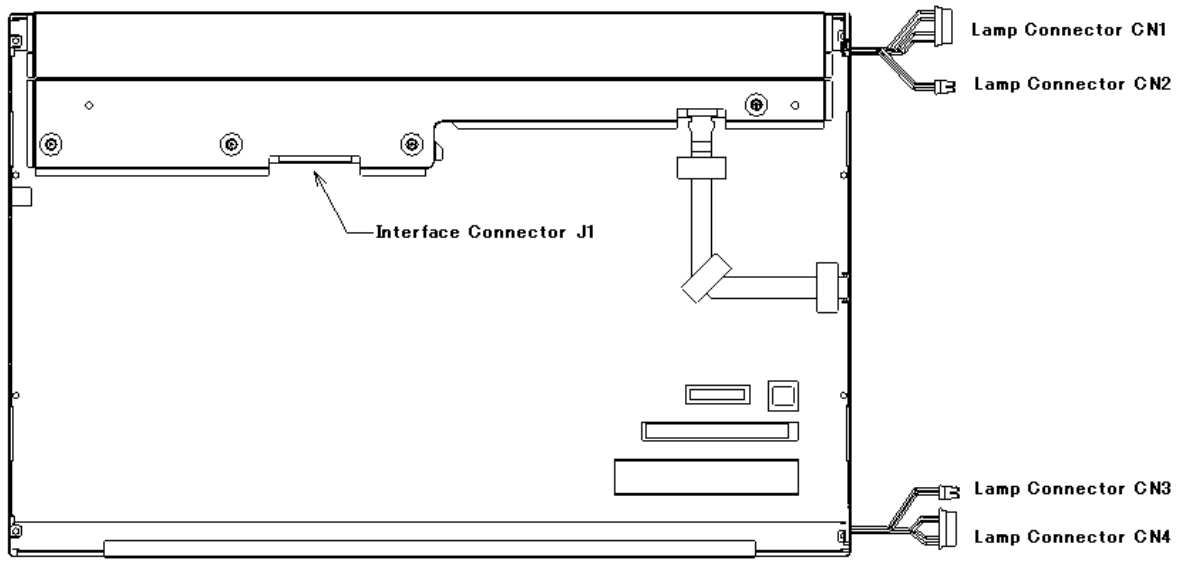


Figure 9. Connectors Positions on Interface Card and Lamp Connectors (Rear View)

3.7.2. Signal Connector

All video signals are provided through the TMDS cable from Monitor Card. These connectors are the input connector of video signals. The TMDS signals, which are provided from monitor card, are described on the following table.

Table 20. Signal Connectors

Connector	Function	Type	Manufacturer	Mating Connector
J1	Interface Connector	FI-X30SSL-HF	JAE	

Table 21. Interface Connector Signals Pin Assignment (J1)

Pin #	Signal Name
1	GND
2	SHLD2
3	RX2+
4	RX2-
5	SHLD1
6	RX1+
7	RX1-
8	SHLD0
9	RX0+
10	RX0-
11	SHLD C
12	RXC+
13	RXC-
14	GND
15	V-EDID
16	AGING
17	Clk-Edid
18	Data-Edid
19	GND
20	GND
21	GND
22	Vcc
23	Vcc
24	Vcc
25	PWR-ctrl
26	Hsync
27	Vsync
28	GND
29	Reserved
30	Reserved

3.7.3. Lamp Connectors

Table 22. Lamp Connectors

Connector	Function	Connector Type	Manufacturer	Mating Connector
CN1	Lamp Connector (Upper1)	BHR-05VS-1	JST	SM04(9-E2)B-BHS-1
CN2	Lamp Connector (Upper2)	BHSR-02VS-1	JST	SM02B-BHSS-1
CN3	Lamp Connector (Lower1)	BHSR-02VS-1	JST	SM02B-BHSS-1
CN4	Lamp Connector (Lower2)	BHR-05VS-1	JST	SM04(9-E2)B-BHS-1

Table 23. Lamp Connectors Pin Assignment (CN1)

Pin #	Signal Name	CFL Position *1	Voltage	Wire Color
1	Lamp High	HIGH	HV	PINK
2	Lamp High	MID	HV	BLUE
3				
4	Lamp Low	HIGH	LV	YELLOW
5	Lamp Low	MID	LV	ORANGE

Table 24. Lamp Connectors Pin Assignment (CN2)

Pin #	Signal Name	CFL Position *1	Voltage	Wire Color
1	Lamp High	LOW	HV	GRAY
2	Lamp Low	LOW	LV	WHITE

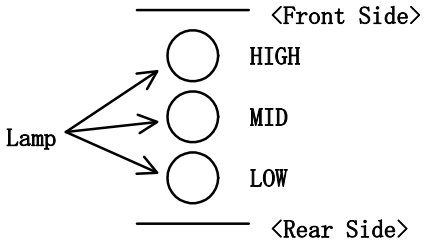
Table 25. Lamp Connectors Pin Assignment (CN3)

Pin #	Signal Name	CFL Position *1	Voltage	Wire Color
1	Lamp High	LOW	HV	GRAY
2	Lamp Low	LOW	LV	WHITE

Table 26. Lamp Connectors Pin Assignment (CN4)

Pin #	Signal Name	CFL Position *1	Voltage	Wire Color
1	Lamp High	HIGH	HV	PINK
2	Lamp High	MID	HV	BLUE
3				
4	Lamp Low	HIGH	LV	YELLOW
5	Lamp Low	MID	LV	ORANGE

Note *1: CFL Position is defined as follows.



3.8. ELECTRICAL INTERFACE REQUIREMENTS

3.8.1. Interface Signals

3.8.1.1. TMDS Connector Signal Description (J1)

Table 27. Signal Description for J1

SIGNAL NAME	Description
RX0+	TMDS passive differential input(Pair 0)
RX0-	TMDS negative differential Input (Pair 0)
RX1+	TMDS passive differential input(Pair 1)
RX1-	TMDS negative differential Input (Pair 1)
RX2+	TMDS passive differential input(Pair 2)
RX2-	TMDS negative differential Input (Pair 2)
RXC+	TMDS passive differential input(clock)
RXC-	TMDS negative differential Input (clock)
SHLD0	Shield for TMDS pair 0
SHLD1	Shield for TMDS pair 1
SHLD2	Shield for TMDS pair 2
SHLDC	Shield for TMDS clock
V-EDID	DDC power (3.3V or 5.0V)
AGING	Manufacturing Test Pin. Must be open on user application
Clk-Edid	DDC clock
Data-Edid	DDC data
Vcc	LCM power supply
PWR-ctrl	Power control pin, Active high. Pulled up internally on the panel
Hsync	H sync output from the TMDS receiver
Vsync	V sync output from the TMDS receiver
GND	Ground

3.8.1.2. Lamp Connector Signal Description (CN1, CN2, CN3, CN4)

Table 28. Lamp Connector Signal Description for CN1, CN2, CN3 and CN4

SIGNAL NAME	Description
Lamp High	Lamp Electrode at High Voltage Side
Lamp Low	Lamp Electrode at Low Voltage Side

3.8.1.3. Signal Electrical Characteristics for TMDS Receiver

Please refer to TI TFP403 datasheet (SLDS 125 December 2000)

3.8.1.4. Recommended Guidelines for Motherboard PCB Design and Cable Selection

Following the suggestions below will help to achieve optimal results.

- Use controlled impedance media for TMDS signals.
- Match electrical lengths between traces to minimize signal skew.
- Isolate TTL signals from TMDS signals.
- For cables, twisted pair, twinax or flexible circuit with closed coupling differential traces are recommended.

3.8.1.5. TMDS Receiver Output Signal Definition

TMDS Receiver Signal Name	Definition
QE [0:7]	Even Blue Pixel Out (LSB: QE0, MSB: QE7)
QE [8:15]	Even Green Pixel Out (LSB: QE8, MSB: QE15)
QE [16:23]	Even Red Pixel Out (LSB: QE16, MSB: QE23)
QO [0:7]	Odd Blue Pixel Out (LSB: QE0, MSB: QE7)
QO [8:15]	Odd Green Pixel Out (LSB: QE8, MSB: QE15)
QO [16:23]	Odd Red Pixel Out (LSB: QE16, MSB: QE23)

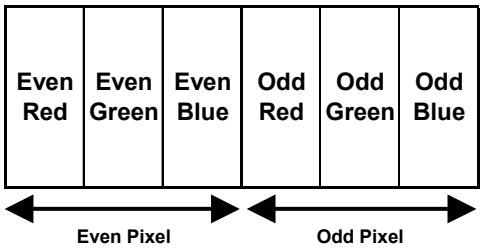


Figure 10. Sub Pixel Construction

3.8.1.6. LCD Drive Signal Description (TMDS Output)

Table 29. Signal Description

SIGNAL NAME	Description
+Red7 (QE23, QO23) +Red6 (QE22, QO22) +Red5 (QE21, QO21) +Red4 (QE20, QO20) +Red3 (QE19, QO19) +Red2 (QE18, QO18) +Red1 (QE17, QO17) +Red0 (QE16, QO16)	Red Sub Pixel Data 7 (MSB) Red Sub Pixel Data 6 Red Sub Pixel Data 5 Red Sub Pixel Data 4 Red Sub Pixel Data 3 Red Sub Pixel Data 2 Red Sub Pixel Data 1 Red Sub Pixel Data 0 (LSB) Red Sub Pixel Data: Each Red Sub pixel's brightness data consists of these 8 bits pixel data.
+Green7 (QE15, QO15) +Green6 (QE14, QO14) +Green5 (QE13, QO13) +Green4 (QE12, QO12) +Green3 (QE11, QO11) +Green2 (QE10, QO10) +Green1 (QE9, QO9) +Green0 (QE8, QO8)	Green Sub Pixel Data 7 (MSB) Green Sub Pixel Data 6 Green Sub Pixel Data 5 Green Sub Pixel Data 4 Green Sub Pixel Data 3 Green Sub Pixel Data 2 Green Sub Pixel Data 1 Green Sub Pixel Data 0 (LSB) Green Sub Pixel Data: Each Green Sub pixel's brightness data consists of these 8 bits pixel data.
+Blue7 (QE7, QO7) +Blue6 (QE6, QO6) +Blue5 (QE5, QO5) +Blue4 (QE4, QO4) +Blue3 (QE3, QO3) +Blue2 (QE2, QO2) +Blue1 (QE1, QO1) +Blue0 (QE0, QO0)	Blue Sub Pixel Data 7 (MSB) Blue Sub Pixel Data 6 Blue Sub Pixel Data 5 Blue Sub Pixel Data 4 Blue Sub Pixel Data 3 Blue Sub Pixel Data 2 Blue Sub Pixel Data 1 Blue Sub Pixel Data 0 (LSB) Blue Sub Pixel Data: Each Blue Sub pixel's brightness data consists of these 8 bits pixel data.
DTCLK	Data Clock: The typical frequency is 117.13MHz. The signal is used to strobe the pixel +data and the +DSPTMG
+DSPTMG (DSP)	When the signal is high, the pixel data shall be valid to be displayed.
VSYNC (V-S)	Vertical Sync: This signal is synchronized with DTCLK. Both active high/low signals are acceptable.
HSYNC (H-S)	Horizontal Sync: This signal is synchronized with DTCLK. Both active high/low signals are acceptable.

3.8.1.7. Pixel Data

The relations between pixel data and gray level are follows.

Table 30. Signal Description

+Red7 +Green7 +Blue7	+Red6 +Green6 +Blue6	+Red5 +Green5 +Blue5	+Red4 +Green4 +Blue4	+Red3 +Green3 +Blue3	+Red2 +Green2 +Blue2	+Red1 +Green1 +Blue1	+Red0 +Green0 +Blue0	Gray Level
H	H	H	H	H	H	H	H	255
H	H	H	H	H	H	H	L	254
H	H	H	H	H	H	L	H	253
H	H	H	H	H	H	L	L	252
H	H	H	H	H	L	H	H	251
H	H	H	H	H	L	H	L	250
H	H	H	H	H	L	L	H	249
H	H	H	H	H	L	L	L	248
H	H	H	H	L	H	H	H	247
H	H	H	H	L	H	H	L	246
H	H	H	H	L	H	L	H	245
H	H	H	H	L	H	L	L	244
H	H	H	H	L	L	H	H	243
H	H	H	H	L	L	H	L	242
H	H	H	H	L	L	L	H	241
H	H	H	H	L	L	L	L	240
H	H	H	L	H	H	H	H	239
:	:	:	:	:	:	:	:	:
H	L	L	L	L	L	L	H	129
H	L	L	L	L	L	L	L	128
L	H	H	H	H	H	H	H	127
		:	:	:	:	:	:	:
L	L	L	L	L	L	H	L	2
L	L	L	L	L	L	L	H	1
L	L	L	L	L	L	L	L	0

3.8.2. Video Interface Timing

3.8.2.1. Video Interface Timing Consideration

Following is the Video timing per channel to be converted to/from TMDS interface.

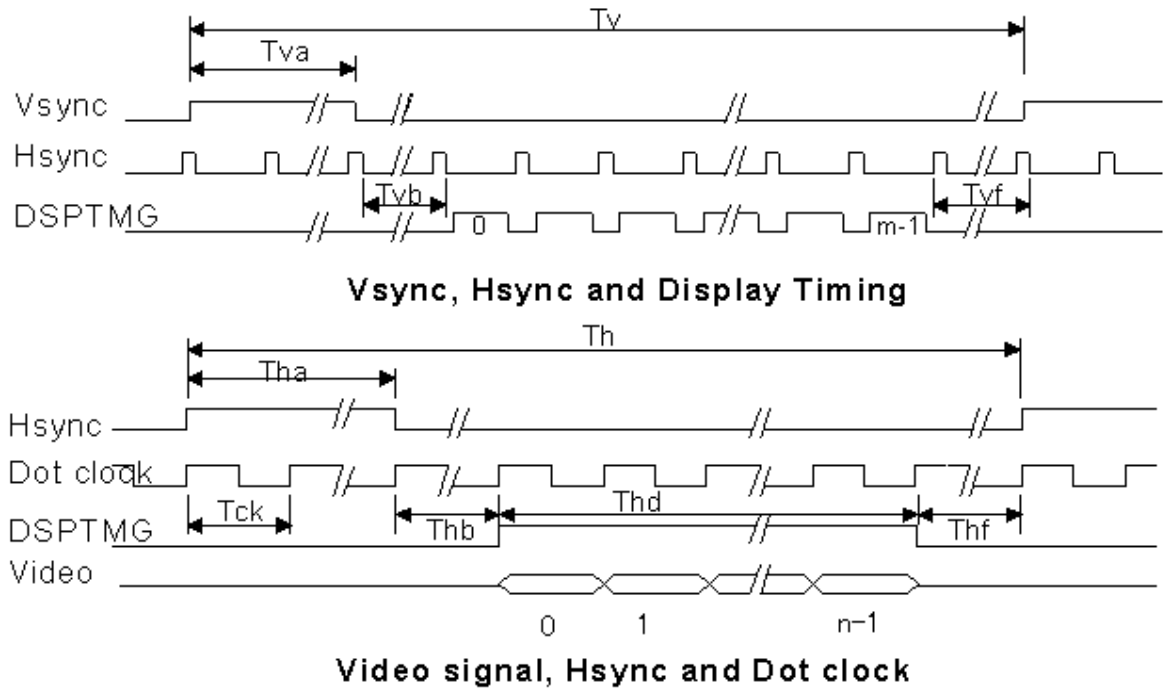


Figure 11. Interface Timing Definition

3.8.2.2. Detailed Timing Characteristics

Table 31. Timing Characteristics

Signal (*1) (*2)	Item	Symbol	Min.	Typ.1 (*3)	Typ.2 (*4)	Max.	Unit
DTCLK	Dot Clock Freq.	Fdck	111.0	119.00	117.13	124.0	[MHz] +/- 5%
DTCLK	Dot Clock period	Tck	8.06	8.40	8.54	9.01	[ns]
+V-Sync	Refresh Rate	1/Tv		59.88	59.94		[Hz]
+V-Sync	Frame period	Tv		16.70	16.68		[ms]
+V-Sync	Total line	Tv		1080	1062	1305	[lines]
+V-Sync	V-front porch	Tvf	1	3	3		[lines]
+V-Sync	V-active level	Tva	1	6	3		[lines]
+V-Sync	V-back porch	Tvb	6	21	6	127	[lines]
+V-Sync	V-Blank	Tvf+Tva+Tvb	8	30	12	255	[lines]
+DSPTMG	Display Lines / frame	m	-	1050	1050	-	[lines]
+H-Sync	H-Scan Rate	1/Th		64.67	63.7		[kHz]
+H-Sync	H-Scan Rate	Th		15.46	15.71		[us]
+H-Sync	Cycle	Th		1840	1840	2048	[tck]
+H-Sync	H-front porch	Thf	64	48	64		[tck]
+H-Sync	H-active level	Tha	8	32	32		[tck]
+H-Sync	H-back porch	Thb	8	80	64		[tck]
+H-Sync	H-Blank	Thf+Tha+Thb	80	160	160		[tck]
+DSPTMG	Display clocks	Thd	-	1680	1680	-	[tck]
+DSPTMG	Display Pixels	n	-	1680	1680	-	[pixels]

Note:
1. H/V sync Polarity will be acceptable both positive and negative. DSPTMG (Data Enable) should be Active High.
2. Vsync should not be changed at Hsync trailing edge (+/- 6 [tck]).
3. VESA CVT timing parameter.
4. Conventional 20”-Wide timing parameter.

3.8.3. Power Requirement

3.8.3.1. Power Consumption

Table 32. Power Characteristics

SYMBOL	PARAMETER	Min.	Typ.	Max.	UNITS	CONDITION
Vcc	Logic/LCD Drive Voltage	11.4	12.0	12.6	[V]	(*5)
Icc (1)	Vcc Current (1)			0.7	[A]	Vcc=11.4 to 12.6 [V] (*1)
Icc(p)	Vcc Peak Current			2.0	[A]	Vcc=11.4 to 12.6 [V] (*1)(*4)
Pin(1)	Vcc Power (1)		5.1		[W]	Vcc=12.0 [V] (*3)
Pin(2)	Vcc Power (2)			7.3	[W]	Vcc=11.4 to 12.6 [V] (*1)
Pin(3)	Vcc Stand By Power			0.5	[W]	Vcc=11.4 to 12.6 [V] PWR CTRL=Inactive. No TMDS input.
Icc(rush)	Vcc Inrush Current			2.0	[A]	Vcc=11.4 to 12.6 [V](*4)

NOTE:
(*1): Horizontally-Sub-Pixel/Vertically-Double-Pixel Checker
(*2): All White (L255) Screen
(*3): Horizontally Gray Bar
(*4): Each “Vcc” and “GND” is connected through triple 100[mm] length AWG30 wires to DC source.
(*5): Input voltage measured at M201Z2-M01 module interface connector shall be within this limit.

3.8.3.2. Input Low Voltage Detection

M201Z2 power supply circuit is equipped with low voltage detection mechanism to avoid the LCD module from operating in abnormal condition.
Threshold voltage of the low voltage detection mechanism is a function of time duration of voltage drop. The following table shows several conditions of allowable dip voltage and duration.

Table 33. Input voltage dip condition

Voltage dip (Bottom of dip)	Maximum Allowable Duration
11.4 [V]	Infinity
10.0 [V]	100 [usec]
9.0 [V]	0 [sec]

3.8.3.3. CFL Characteristics

The backlight of M201Z2 LCD module has 6 CCFL lamps. 3 lamps are upper side, and 3 lamps are lower side of the LCD module.

Table 34. CFL Specifications

Manufacturer Name		Harison Toshiba Lighting	
Part Number		MBTM24J(*)x450NCRBU/CD	(*): color code
Length		445 Typ.	[mm]
Diameter	Outer	2.4 Typ.	[mm]
	Inner	2.0 Typ.	[mm]
Mercury Contain		3.5 Max., 2.7 Typ.,1.9 Min.	[mg]

Table 35. CFL Characteristics

Symbol	Parameter	Min.	Max.	Units	Conditions
ICFL	CFL Current	2.0	6.0	[mArms]	Ta=25 [deg. C] *1
FCFL	CFL Frequency	35	80	[kHz]	Ta=25 [deg. C] *2
Vinv	CFL Ignition Voltage	-	1350	[Vrms]	Ta=25 [deg. C]
		-	1650	[Vrms]	Ta=0 [deg. C]

Note *1: CFL current exceeds Min./Max. values, then “CFL life”, ”ON/OFF Cycle” and “Safety” will not be guaranteed.
Note *2: CFL frequency should be carefully determined to avoid interference between inverter and TFT LCD.

3.8.3.4. Inverter Design Point

Following is a guideline for inverter design.

Table 36. Inverter Design Points

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
(L255)	White Luminance (5points) (Reference)	-	250	-	[cd/m^2]	Ta=25 [deg. C]
ICFL	CFL Current *5	2.0	6.0	6.5	[mArms]	Ta=25 [deg. C] *1
ICFLP	CFL Peak Inrush Current			20	[mA]	Ta=25 [deg. C] *1, *6
FCFL	CFL Frequency	35		60	[kHz]	Ta=25 [deg. C] *2
Vinv	Inverter Ignition Voltage *5	1500			[Vrms]	Ta=25 [deg. C]
		1700			[Vrms]	Ta=10 [deg. C]
		1850			[Vrms]	Ta=0 [deg. C]
VCFL	CFL Voltage (Reference)		860		[Vrms]	Ta=25 [deg. C]
PCFL	CFL Power Consumption		5.2	5.6	[W]	Ta=25 [deg. C] *3
	Total CFL Power Consumption (6 lamps)		32	34	[W]	Ta=25 [deg. C]

Note *1: If it exceeds Min./Max. values, then “CFL Life”, “ON/OFF Cycle” and “Safety” will not be guaranteed.
*2: CFL Frequency should be carefully determined to avoid interference between inverter and TFT LCD.
*3: Calculated value for reference (ICFL x VCFL = PCFL).
*4: It should be employed the inverter which has ‘Duty Dimming’, if ICFL is less than 4.0[mA].
*5: Please keep balancing of all CFL currents.
*6: Duration: 50[mS] Max.

3.8.3.5. Power On/Off Sequence

Vcc power and lamp on/off sequence is as follows. Interface signals are also shown in the chart. Signals from any system shall be Hi-Z state or low level when Vcc is off.

Table 37. Power On/Off Sequence

Parameter	Min.	Typ.	Max.	Unit
T1	-		10	[ms]
T2	0 *(1)		-	[ms]
T3	-		50 *(2)	[ms]
T4	100		-	[ms]
T5	-		50	[ms]
T6	-		80	[ms]
T7	400		-	[ms]
T8	0		-	[ms]
T9	-		10	[ms]

Note *1: TMDS transmitter output can be active before VCC goes active.
*2: If power control signal is unconnected, internal pull up resistor makes this signal active state.

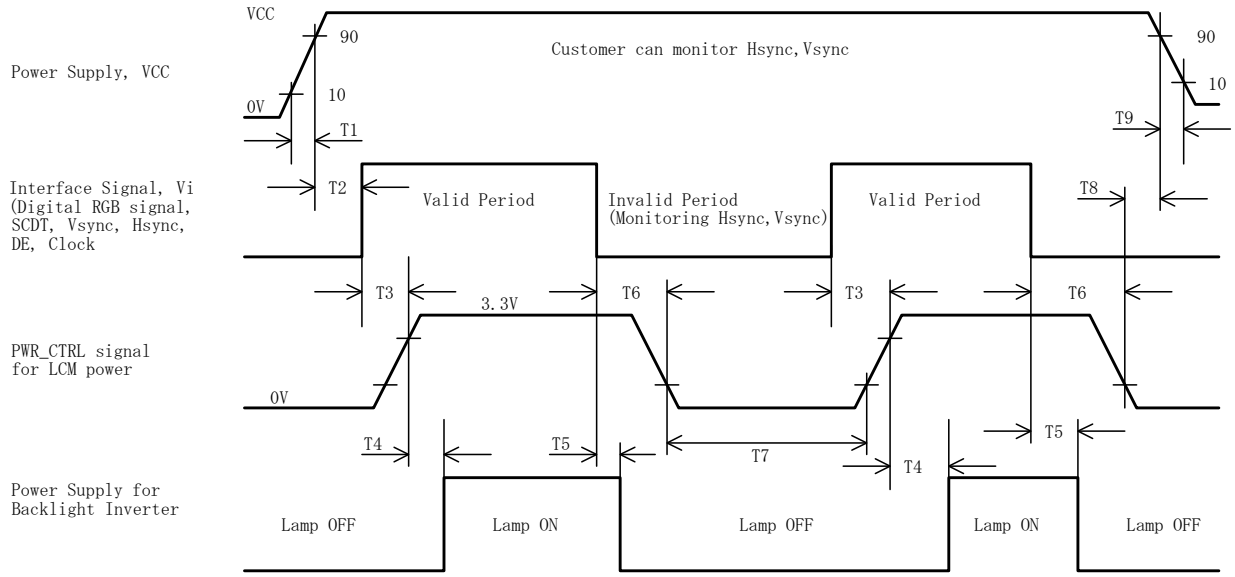


Figure 12. Vcc/TMDS Signals/Lamp Voltage On/Off Sequence Requirements

3.8.3.6. OFF Mode Power

When the monitor is in low power mode (when there is no video signal, and PWR_CTRL signal remains low), the Power Supply to the module (Vcc) will be turned on for 165 ms (Typ) every 500 ms (Typ). This will continue until the video signal is present again.

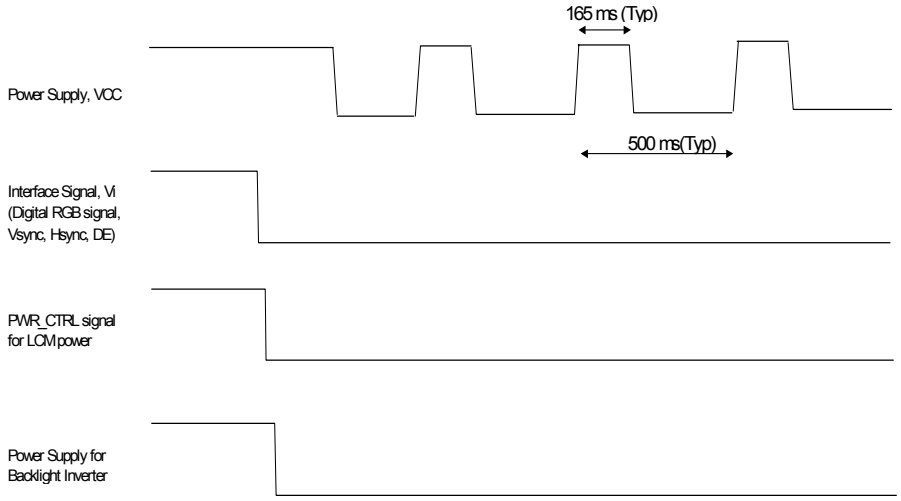


Figure 13. OFF Mode Power Sequence

3.8.3.7. Absolute Maximum Ratings

Absolute maximum ratings of the module are as follows;

Table 38. Absolute Maximum Ratings

SYMBOL	PARAMETER	VALUE	UNITS	CONDITION
Vcc	Logic/LCD Drive Voltage	-0.3 to +18.0	[V]	
	Input Voltage of Signal	-0.3 to +4.0	[V]	(TMDS pins)
	Input Voltage of Signal	-0.3 to +5.3	[V]	(PWR_CTRL)
	Input Signal Current	-75 to +75	[mA]	(TMDS pins)
Vinv	CFL Ignition Voltage	2,000	[Vrms]	Ta=0[deg. C] (*1)
ICFL	CFL Current	7.0	[mArms]	
ICFLP	CFL Peak Inrush Current	20	[mArms]	(*1)

Note: (*1) Duration: 50[mS] Max.

3.9. DISPLAY PERFORMANCE SPECIFICATIONS

The module shall meet the specifications in this section. The requirements shall be satisfied in any specified condition unless otherwise noted.

3.9.1. General

All the measurements shall be made under "General Test Conditions" otherwise specified.

3.9.2. Standard Compliance

This module is a part of a monitor Display, marketed as suitable for normal office tasks. It will meet all the requirements for VDTs used for office tasks. Minimum requirements are set by the following external standards:

- ISO13406 Part 2(Ergonomic requirements for work with visual displays based on flat panels)
- ANSI/HFS 100-1988 (American National Standard for Human Factors Functional of Visual Display Terminal Workstations)
- DIN 66234, Part 1-7, 9 (Federal Republic of German Standards on Display Work-stations)

These are summarized in IBM Corporate Standard, C-S 1-1100-003, Design of Visual Display Workstations-Ergonomic Requirements. Required measurement conditions and methods are as specified in the standard. The LCD module shall satisfy all requirements of this standard.

Also, comply with TCO'99 (- Mandatory and recommended requirements for Flat panel Visual Display Units (VDUs)).

3.9.3. Measurement Direction Definition

The following figure is defined the optical measurement directions.

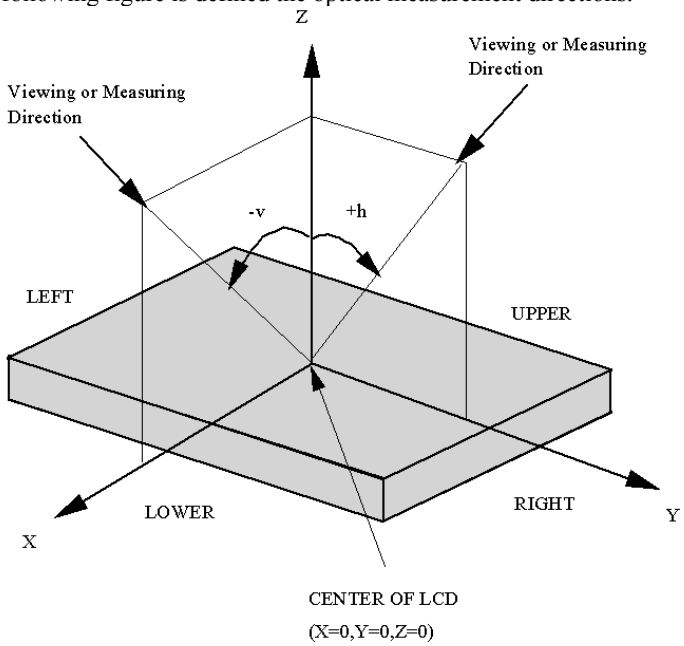


Figure 14. Optical measurement Direction

3.9.4. White Luminance

- All the measurements shall be made with the backlight ON and after 60 minutes of the application of power and input signals.
- All the pixels in the maximum gray level (L255).
- All the measurements shall be made in a dark room (at 25+/-3[deg. C]) with a photometer that is perpendicular to the screen.
- The measurement points are defined as following figure.

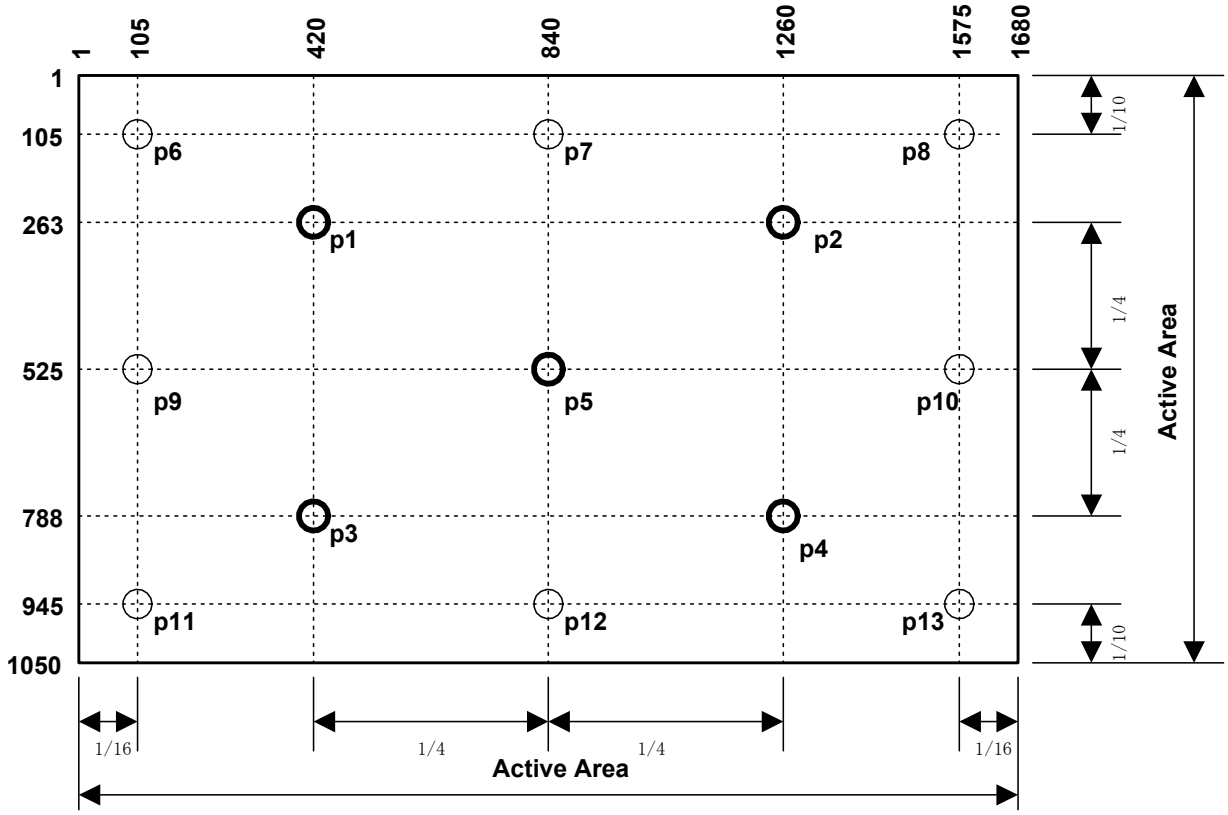


Figure 15. Optical Measurement Point for Luminance Uniformity (5points/13points)

The luminance data from $L_{(p1)}$ to $L_{(p5)}$ are used for the White luminance Measurement.
The luminance data from $L_{(p1)}$ to $L_{(p13)}$ are used for the Luminance Variation Measurement.

3.9.4.1. White Luminance Specifications

The white luminance of the display is as specified:

$$L_{average} = \frac{L_{(p1)} + L_{(p2)} + L_{(p3)} + L_{(p4)} + L_{(p5)}}{5}$$

Table 39. White Luminance

	Min.	Typ.	Max.	Unit	Backlight (each Lamp Current)
$L_{(p5)}$	215	250	285	[cd/m^2]	ICFL=6.0 [mArms]
$L_{average}$	200	250	300	[cd/m^2]	ICFL=6.0 [mArms]

Note:
Maximum luminance should NOT be disclosed to the customers.
Inverter: P/N: 050001000400, Type No.: IV105130/T (SUMIDA)

3.9.4.2. Luminance Uniformity

When the backlight is on with all the pels in the white (maximum gray) level, the luminance uniformity is defined as follows:

Where:
L_{bright}: The luminance of the brightest data from $L_{(p1)}$ to $L_{(p13)}$.
L_{dark}: The luminance of the darkest data from $L_{(p1)}$ to $L_{(p13)}$.
$L_{average}$: The average luminance of all data from $L_{(p1)}$ to $L_{(p13)}$.

$$L_{average} = \frac{L_{(p1)} + L_{(p2)} + L_{(p3)} + L_{(p4)} + L_{(p5)} + L_{(p6)} + L_{(p7)} + L_{(p8)} + L_{(p9)} + L_{(p10)} + L_{(p11)} + L_{(p12)} + L_{(p13)}}{13}$$

$$Luminance\ Uniformity = \frac{L_{bright} - L_{dark}}{L_{average}} \times 100 < 30[\%]$$

3.9.5. Color

The color point of each color element which is defined as the C.I.E. 1931 x,y coordinate readings on each primary color through the center of the screen, is given in the table shown below.

Table 40. White Point

		Min.	Typ.	Max.	Condition
Red	x	0.610	0.640	0.670	Vcc=12.0[V] ICFL= 6.0 [mArms] 2 hours after Power ON
	y	0.300	0.330	0.360	
Green	x	0.260	0.290	0.320	
	y	0.570	0.600	0.630	
Blue	x	0.120	0.150	0.180	
	y	0.030	0.060	0.090	

Note: Initial Value

3.9.6. White Point

The white point is defined as the C.I.E. 1931 x,y coordinate readings on maximum brightness through the center of the screen, is given in the table shown below.

Table 41. White Point

		Min.	Typ.	Max.	Condition
White	X	0.283	0.313	0.343	Vcc=12.0[V] ICFL= 6.0 [mArms] 2 hours after Power ON
	Y	0.299	0.329	0.359	

Note: Initial Value

3.9.7. Finger Pressure Distortion

The pressure distortion is allowed only if any affects disappear in 10 seconds after the removal of pressure at the center of the screen by IEC test finger with a 100g load for 5 seconds at L255 state. It will be evaluated in visual inspection performed at 500 mm viewing distance and the following viewing cone in 500 lux ambient illumination.

v = +/- 40 [deg.]
h = +/- 40 [deg.]

3.9.8. Screen Defects

This section defines the allowable limit for cosmetic defects visible in the active area of the display screen.

- No defect should impair the clarity or readability of any characters or significantly detract from the overall display quality.
- There should be no disturbing visual features such as pixel defect, line defect, non-uniform, unstable background, crack, or scratch, etc. These "disturbing visual features" will be evaluated in visual inspection performed at 300 mm viewing distance and the following viewing cone in 500 lux ambient illumination.

v = +/- 40 [deg.]
h = +/- 40 [deg.]

3.9.8.1. Pixel Defects

The following defects found in visual inspection are acceptable. (In the following, pixel means sub-pixel.)

Table 42. Pixel Defects

Defect	M201Z2
The total number of pixel defects	5 Max
Lit defects (No "2 adjacent lit defects")	2 Max
Lit defects (include "2 adjacent lit defects")	N/A
Lit defects (Green)	N/A
Lit defects (100mmx75mm of screen center)	N/A
Unlit defects	4 Max
2 adjacent lit defects	0
2 adjacent lit defects (vertical green)	0
2 adjacent lit defects (100mmx75mm of screen center)	N/A
2 adjacent unlit defects	0 (Vertical) 1 Max. (Horizontal)
3 adjacent defects	0
Lit Defects within 10mm diameter	N/A
Unlit Defects within 10mm diameter	N/A
Lit defects distance	15 [mm] Min
Unlit defects distance	15 [mm] Min

Inspection screen:

Black (for lit defects inspection)

White, Red, Green, Blue (for unlit defects inspection)

Note:

The lit defect is a visible pixel through the neutral density filter (transmittance: 5%).

Detail rejection criteria shall be updated timely with concurrence between International Display Technology (IDT) and users.

3.9.8.2. Line Defects

Line defect is defined as a horizontal or vertical line that differs from adjacent lines in brightness at any gray level. Line defects will not exist anywhere on the screen.

3.9.8.3. Visual Screen Quality

Table 43. Visual screen quality at power-on

Defect Type	Accept	Reject
Bright spot (invisible with 5% ND filter) (Foreign circular matter)	0.1 [mm] < D <= 0.4 [mm] N <= 4	D > 0.4 [mm] N > 4
Dark spot (Foreign circular matter)	0.1 [mm] < D <= 0.4 [mm] N <= 4	D > 0.4 [mm] N > 4
Bright line (light lint)	0.01 [mm] <= W <= 0.08 [mm] 0.3 [mm] <= L <= 2.0 [mm] N <= 4	W > 0.08 [mm] L > 2.0 [mm] N > 4
Dark line (dark lint/hair)	0.01 [mm] <= W < 0.008 [mm] 0.3[mm] <= L <= 2.0 [mm] N <= 4	W > 0.08 [mm] L > 2.0 [mm] N > 4
Maximum allowable number of visual defects	N <= 5	N > 5

Table 44. Allowable Maximum Counts of Polarizer Scratch/Bubble at power-off

Defect Type	Accept	Reject
Polarizer scratch	0.07 [mm] <= W < 0.1 [mm] L < 3.0 [mm] N <= 5	W > 0.1 [mm] L >= 3.0 [mm] N > 5
Polarizer dent/bubble	0.2 [mm] <= D < 0.4 [mm] N <= 5	D >= 0.4 [mm] N > 5
Maximum allowable number of visual defects	N <= 5	N > 5

d: diameter

$$d = \frac{long\ axis + short\ axis}{2}$$

w: line width
l: line length

This criteria is based on the Cosmetic Specification for 20.1" WSXGA+ TFT-LCD (DWG Number: 062-9932 Rev. 1.0) issued by Apple Computer Inc.
(TBD)

3.9.9. Gray Scale

The LCD module has a gray scale consisting of 256 addressable levels. The code points for these levels are numbered i=0,1,...,255. i=0 is the least luminous level, and i=255 is the most luminous level.

Gamma correction will be applied, i.e. the luminance is exponential to gray level(i). The value of power is 1.8 through 4.5, which approximately compensates human response for luminance. With this feature, the gray scale levels can be perceived linear to the human eyes.

3.9.9.1. Gamma Corrected Gray Scale

Following table shows the luminance for each gray level for reference.

Table 45. Luminance of the Gray Level

i (gray level)	L(i) [%]				
	Min.		Typ.	Max.	
	User	Internal		Internal	User
L0	-	-	0.28	0.4	0.4
L31	0.6	0.75	1.0	1.25	1.4
L63	2.5	3.0	4.7	6.00	7.0
L95	6.5	7.5	11.4	15.0	17.0
L127	14.0	16.5	21.7	28.0	30.0
L159	27.0	30.0	36.1	46.0	48.0
L191	42.0	46.0	53.0	65.0	67.0
L223	62.0	66.0	73.4	82.0	86.0
L255	100.0	100.0	100.0	100.0	100.0

3.9.10. Contrast and Viewing Cone

3.9.10.1. Definition

Brightness set to maximum.
Contrast (K) is defined by the following ratio:

$$K = \frac{Brightness\ of\ White\ level\ \ Area\ (grayscale\ level\ 255)}{Brightness\ of\ \ Black\ level\ \ Area\ (grayscale\ level\ 0)}$$

The brightness of the white (maximum gray) level area is measured by positioning the photometer at the required angle, and recording the brightness at the center of the screen at all in white (maximum gray) level.
The brightness of the black level area is measured by again recording the brightness at the center of the screen (same angle) at all in the black level.

3.9.10.2. Specification

The display module shall meet the following specifications.

1. The viewing angle of maximum contrast (K max) shall exist in the range of -20 deg to +20 deg vertical and horizontal.
2. The contrast (K) in various viewing angle shall meet the requirements in following Table.
3. The contrast in the range of -85 deg to 85 deg vertical, -85 deg to 85 deg horizontal is more than 10 typ.

Table 46. Viewing Cone Contrast Ratio

v [degree]	h [degree]	C/R (Min.)	C/R (Typ.)	Environment
+/- 85	0	15	20	25 [deg. C]
+/- 60	0	35	50	
+/- 40	0	85	110	
+/- 20	0	160	220	
0	0	250	350	
0	+/- 20	160	220	
0	+/- 40	85	110	
0	+/- 60	35	50	
0	+/- 85	15	20	
0	0	150	-	0 [deg. C]
0	0	200	-	55 [deg. C]

3.9.11. Brightness Ratio and Viewing Cone

3.9.11.1. Definition

Brightness set to maximum. (VDIM-IN=0[V])
Brightness Ratio (B) is defined by the following ratio:

$$B = \frac{Brightness\ of\ White\ level\ \ Area\ (h = H[\deg ree], v = V[\deg ree])}{Brightness\ of\ White\ level\ \ Area\ (h = 0[\deg ree], v = 0[\deg ree])} \times 100[\%]$$

The brightness of the white (maximum gray) level area is measured by positioning the photometer at the required angle, and recording the brightness at the center of the screen at all in white (maximum gray) level.

3.9.11.2. Specification

The brightness ratio(B) in various viewing angle shall meet the requirements in following Table.

Table 47. Brightness Ratio(B) and Viewing Cone

v [degree]	h [degree]	Min.	Typ.	Max.	Unit
50	0	35	45	-	[%]
-50	0	35	45	-	[%]
0	50	35	45	-	[%]
0	-50	35	45	-	[%]

3.9.12. White Point Shift and Viewing Cone

3.9.12.1. Definition

Brightness set to maximum. (ICFL= 6.0 [mArms])
White Point Shift(S) is defined by the following:

$$Sx = x(h = H, v = V) - x(h = 0, v = 0)$$
$$Sy = y(h = H, v = V) - y(h = 0, v = 0)$$

The brightness of the white (maximum gray) level area is measured by positioning the photometer at the required angle, and recording the brightness at the center of the screen at all in white (maximum gray) level.

3.9.12.2. Specification

The white point in various viewing angle shall meet the requirements in following Table.

Table 48. White Point Delta and Viewing Cone (L255)

V [degree]	h [degree]	Sx,Sy	Min.	Typ.	Max.	Unit
+85	0	Sx	-0.04	-	0.04	-
		Sy	-0.04	-	0.04	-
-85	0	Sx	-0.04	-	0.04	-
		Sy	-0.04	-	0.04	-
0	+85	Sx	-0.04	-	0.04	-
		Sy	-0.04	-	0.04	-
0	-85	Sx	-0.04	-	0.04	-
		Sy	-0.04	-	0.04	-

Table 49. White Point Delta and Viewing Cone (L0)

V [degree]	h [degree]	Sx,Sy	Min.	Typ.	Max.	Unit
+85	0	Sx	-0.05	-	0.08	-
		Sy	-0.05	-	0.08	-
-85	0	Sx	-0.05	-	0.08	-
		Sy	-0.05	-	0.08	-
0	+85	Sx	-0.05	-	0.05	-
		Sy	-0.05	-	0.05	-
0	-85	Sx	-0.05	-	0.05	-
		Sy	-0.05	-	0.05	-

3.9.13. White Point Tracking

In each grayscale between L63 and L255, the white point should be change of less than 600(TBD) [K].

3.9.13.1. Definition

3.9.13.2. Specification

3.9.14. Flicker Susceptibility

When the LCD is refreshed at a 60 Hz rate with the backlight ON, there shall not be noticeable flicker in any gray levels when the screen is viewed with the naked eyes.

3.9.15. Crosstalk

There shall be no noticeable crosstalk, which detracts from the overall screen quality

3.9.16. Optical Response Time

3.9.16.1. Definition

1. Optical response time "ON" (rise) is defined as the amount of the time from 10% to 90% luminance level for a group of pixels in changing the gray scale level from L0 to L255. And optical response time "OFF" (fall) is defined as the amount of the time from 90% luminance level to 10% luminance level for a group of pixels in changing the gray scale level from L255 to L0.
2. Optical response time shall be measured over an area on the screen that is larger than a single pixel.
3. Both the "ON" and "OFF" response times shall be measured between all in the white (maximum gray) level and all in the black level.
4. Both the ON and OFF response times shall be measured from the falling edge of the +DSPTMG signal for line 525. Line 525 is the center scan line included the sensor lines of the test patterns.
5. All the measurements shall be made with the photometer positioned perpendicular to the screen.

3.9.16.2. Characteristics

Optical response time characteristics are as follows:

Table 50. Optical Response Time

	Environment	Typ.	Max.	Unit
Rise (ON) response time	25 [deg. C]	13	20	[msec]
Fall (OFF) response time	25 [deg. C]	13	20	[msec]
Rise (ON) + Fall (OFF) response time	25 [deg. C]	25	40	[msec]
	0 [deg. C]	-	200	[msec]
	55 [deg. C]	-	60	[msec]

3.9.17. Image Sticking (Window)

The panel specification of image sticking / retention is as follows.

3.9.17.1. Conditions:

L0/L255 window pattern
10 hours on / 14 hours off 5cycles

3.9.17.2. Criteria:

The window images Invisible on L128 raster.

3.9.18. Image Sticking (User Requirements)

3.9.18.1. Quick Check

After displaying a checker pattern for 10 seconds at room temperature (about 25°C), the residual image or the pattern shall disappear within 3 seconds on a uniform background at the mid-gray level.

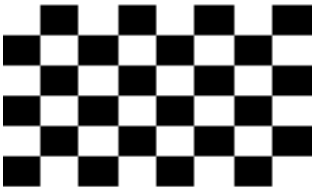


Figure 16. Checker pattern for image sticking test

3.9.18.2. Short-term

After displaying a checker pattern for 30 minutes at room temperature (about 25°C), the residual image or the pattern shall disappear within 3 minutes on a uniform background at mid-gray (50%) level.

3.9.18.3. Long-term

After displaying a checker pattern for 72 hours at room temperature (about 25°C), the residual image of the pattern shall disappear when viewed with a uniform background of mid-gray (50%) level after displaying the full white (100%) image for 24 hours.

3.10. PERFORMANCE CHARACTERISTICS

All the electromagnetic compatibility performance shall be applied when a display system equipped with the LCD module is attached to the host system.

3.10.1. EMI Performance

The construction of the display system is designed to suppress EMI. When used with a specified host system, the system will meet the following EMI requirements:

- United States Federal Communications Commission (FCC) Rules and Regulation, Part 15 Subpart J for computing device "Class B Limits".
- VCCI Limit Class-B.
- CISPR22 Class B.

3.10.2. ESD Performance (Table-top)

The monitor display shall meet IBM Standard C-S 2-0001-005.

3.10.3. Very/Extra Low Frequency Magnetic Field

A specified monitor display, which is used with this display system, shall meet MPR 1990:8 1990 12-01 IBM Standard C-S 2-0001-040.

Table 51. Very/Extra Low Frequency Magnetic Field

Frequency	Maximum Value	Unit (RMS)
5Hz - 2kHz	200	[nT]
2kHz - 400kHz	25	[nT]

3.10.4. Very/Extra Low Frequency Electric Field

This display system shall meet MPR 1990:8 1990 12-01 and IBM Standard C-S2-0001-040.

Table 52. Very/Extra Low Frequency Electric Field

Frequency	Maximum Value	Unit (RMS)
5Hz - 2kHz	10	[V/m]
2kHz - 400kHz	1	[V/m]

3.10.5. Acoustical Noise Requirements

The acoustics output of the display system, especially when it is a monitor display, shall not exceed 20db(A) at the operator's position.

3.11. ENVIRONMENT

The display module shall meet the provision of this specification under the operating condition or after the storage or the shipment condition specified below. Operation at 10% within the specified range will not cause physical damage to the unit.

3.11.1. Temperature and Humidity

3.11.1.1. Operating and Shipping Conditions

The display module shall operate error free, when operated under the operating conditions.
The display module shall operate error free, after the shipping conditions.

Table 53. Operating and Shipping Conditions

Operating Conditions	Temperature [deg. C]	0 to 50 (*1)
	Relative Humidity [%]	5 to 80
	Wet Bulb Temperature [deg. C]	39
Shipping Conditions	Temperature [deg. C]	-20 to 65
	Relative Humidity [%]	5 to 95
	Wet Bulb Temperature [deg. C]	39

Note (*1): Max. Operating Temperature 50 deg. C in the spec means the temperature measured for the point of the front surface of the LCD glass cell.

3.11.1.2. Component Temperature

The table below shows the maximum component temperature specifications.

Table 54. Maximum Component Temperature

Component	Maximum Temperature Specifications [deg. C]
X-Driver	100
Gate Array	85
TMDS Receiver	94

3.11.1.3. Atmospheric Pressure

The display system assembly is capable of being operated without affecting its operations over the pressure range as specified below:

Table 55. Atmospheric Pressure

	Pressure	**Note**
Maximum Pressure	104.0 [kPa]	-200 [m]
Minimum Pressure (Operational)	69.1 [kPa]	3,048 [m]
Minimum Pressure (Storage)	19.3 [kPa]	12,000 [m]

3.11.2. Thermal Shock

The display module shall not sustain damage after being subjected to 100 cycles of rapid temperature change. A cycle of rapid temperature change consists of varying the temperature from -20 to 60[deg. C], and back again.

Thermal shock cycle
-20[deg. C] for 30[min]
60[deg. C] for 30[min]

Power is not applied during the test. After temperature cycling, the unit is placed in normal room ambient for at least 4 hours before powering on.

3.11.3. Vibration and Shock

The LCD module and its packaging shall comply with the following standards.

- C-S 1-9711-002, "Vibration levels for IBM Hardware product"
- C-H 1-9711-005, "Packaged IBM products, Testing for Shipment"
- C-B 1-9711-007, "Operational Shock Levels for IBM Hardware products"

The LCD module shall operate error free after it is subjected to shock impulse of 50[G] maximum half sine wave for duration of 11[ms] on each of its six sides. Likewise, the display module shall not sustain any damage from the shock impulse.

3.12. RELIABILITY

This LCD module and its packaging shall comply with the following standards.

3.12.1. Failure Criteria

The module assembly shall be considered as a failing unit when it no longer meets any of the requirements stated in this specification. Only as for Maximum White Luminance, the following criteria are applicable.

Maximum Center White Luminance shall be 100 cd/m^2 or more.

3.12.2. Failure Rate

The average failure rate of the LCD module from the first power-on cycle through 1,000 hours is 1.20% per 1,000 hours. The average failure rate of the LCD module from 1,000 hours until 13,000 hours is 1.00% per 1,000 hours.

3.12.2.1. Usage

The assumed usage for the above criteria is:

- 220 power-on hours per month
- 500 power on/off cycles per month
- Maximum brightness setting.
- Operation to be within office environment (25 [deg. C] typical)

3.12.2.2. Component Derating

As for all the components used in this device, the load condition shall be checked to meet the failure rate criteria.

3.12.3. CCFL Life

The assumed CCFL Life shall be longer than 50,000 hours at the general test condition. It is different between the CCFL Life and the LCD module Life.

3.12.4. ON/OFF Cycle

The LCD module will be capable of being operated over the following ON/OFF Cycles.

Table 56. Power ON/OFF Cycles

ON/OFF	Value	Unit
Vcc	24,000	[cycles]

3.13. SAFETY

3.13.1. IBM Corporate Standard

The LCD module shall satisfy all the requirements, which comply with the IBM Corporate Safety standard, CS 3-0501-070: Product Safety, IBM Requirements.

3.13.2. Sharp Edge Requirements

There shall be no sharp edges or corners on the LCD module assembly that could cause injury.

3.13.3. Materials

3.13.3.1. Toxicity

There shall be no carcinogenic materials used anywhere in the LCD module. If toxic materials are used, they shall be reviewed and approved by the responsible IBM Toxicologist.

3.13.3.2. Flammability

All the components including electrical components that do not meet the flammability grade UL94-V1 in the module shall complete the flammability rating exception approval process.

The printed circuit board shall be made from material rated 94-V1 or better. The actual UL flammability rating shall be printed on the printed circuit board.

3.13.4. Capacitors

If any polarized capacitors are used in the LCD module assembly, provisions shall be made to prevent them from being inserted backwards. No Tantalum cap should be used.

3.13.5. Hazardous Voltages

Any voltages exceeding 42.4Vpeak or 60Vd.c. except limited current circuit shall be completely insulated when the unit is assembled into a monitor, to eliminate the possibility of accidental contact by an operator. The development engineer of the system shall review the method of insulation in compliance with all the National Test Lab requirements. Nevertheless the circuit meets the limited current circuit requirements, a shock hazard is considered to exist at any exposed part of the unit if the available open-circuit voltage is more than 42.4Vpeak, or 60Vd.c., and the available current through a 2000[ohm] non-inductive resistance is more than 0.7x f (kHz) [mA] peak (not exceed 70mA peak) or 2mA d.c.

3.14. PRODUCTION SPECIFICATIONS

3.14.1. Packaging Requirement

The packaging of the LCD module shall meet 90cm drop test.

3.15. OTHER REQUIREMENTS

3.15.1. Smoke Free Design

By any single failure, any smoke nor strange smell shall not be observed by the operator. IDT will demonstrate it to the IBM representative by open/short test at design verification tests for approval if any dubious symptoms are found.

3.15.2. National Test Lab Requirement

The LCD module shall satisfy all the requirements, which comply with the following.

IDT Standard Compliance	See **F000-SCL-01**
UL 60950, 3rd Edition	U.S.A. Information Technology Equipment
CAN/CSA-C22.2 No.60950-00	Canada, Information Technology Equipment
IEC 60950 (3rd Ed.)	International, Information Technology Equipment
EN 60950 (3rd Ed.)	International, Information Technology Equipment (European Norm for IEC 60950)
ISO 13406 Part2	
ANSI/HFS 100-1988	
DIN 66234, Part 1-7, 9	
FCC Class B, VCCI Class B, CISPR 22 B	
TCO 95or 99 (0X)	
Japan Green Purchasing Law	

4. Product Implementations

4.1. Basic Design Strategy

4.1.1. Design Summary

M201Z2-M01 is the 51.1cm(20.1") Color TFT/LCD Module. M201Z2-M01 module is designed for Apple monitor The screen format and electrical interface are intended to support the WSXGA+ (1680(H) x 1050(V)) screen. Supported color scales are native 8bit level (8-bit per subpixels data driver). All input signals are TMDS (Transition Minimized Differential Signaling) interface compatible. The LCD module consists of the following components;

- A TFT displaying portion made of glass with an outer protective film.
- A backlight unit using six cold cathode fluorescent lamps (CCFLs)
- An inverter is not included.
- Associated electronics components (drivers, control circuits, and a DC-DC converter).
- A metal bezel and a shield cover.

The Assumed usage of this product is:

- 220 power-on hours per month
- 500 power on/off cycles per month
- Maximum brightness setting.
- Operation to be within office environment (25 [deg. C] typical)

4.1.2. Major Components Description

Table 57. Major Components Description

Component		Description
A/C		Cell: Normally Black IPS w/PCF WOA (Y-side) 0.7/0.7mm glass, narrow cell gap (3.4um), AG160 polarizer surface, CF 70% gamut, High response LC (NI=70deg) Array: Phase 3line / Cell: Phase 3.7line Loading
X-Driver		TI TMS57542, COF, 384/360OUT, 16.5V, mini LVDS, upper side, x14, 2H Driving
Y-Driver		TOSHIBA T6L81 (same as F8901M), COG/WOA, 264OUT, 3level driving, left side,
Backlight		Light guide (t=10mm), Long CFL (L=445mm D=2.4mm), 6 CFL (3 upper,3 lower), 3 diffuser sheets
Mechanical		Material SUS430 (Bezel, Shield Cover)
PCB		Long X-PCB TMDS Interface
	ASIC	TI T-CON TFP7445 (8bitx3,LVDS-miniLVDS)
	TMDS	TI TFP403 (8bitx3,TMDS-CMOS)
	LVDS Transmitter	THINE THC63LVDM83R x2 (8bit CMOS-LVDS)
	SS	PULSECORE P2040A (OPTIONAL)
	ESD Protector	TOSHIBA HN1D03FU x4 (Requirement)
Inverter		(Developing by user)

4.2. Bill of Materials

TFT LCD COLOR M201Z2-M01

As of 08/OCT/03

DESCRIPTION	QTY	DWG	ODR	M201Z2 PART No	EC No.	CMO OPTION	REMARK
LCD MODULE	1	-	-	000R000	000R03		
Barcode Header							
		CMO		00RC3			
├ PSS	0	X	X	000R001	000R03		
├ REFERENCE DWG	0	0	X	000R002	000R03		
├ ASM DWG	0	0	X	000R003	000R03		
├ S/N LABEL	1	0	X	000R005	000R01		
│ └ S/N LABEL BLANK	1	0	0	07K4110	F68069A		
├ DATE LABEL	1	0	0	07K4155	H30871		
│ └ DATE LABEL REFERENCE	0	0	X	47L7608	H30871		
├ UL LABEL : FUNAI	1	0	0	47L7492	H30871		
: P-IMES		0	0	47L7493	H30871		
: CMO		0	0	47L7495	H30871		
├ APPLE LABEL	1	0	x	000R006	000R03		Use: CMO P/N:7741419171
├ CELL - X/Y ASM	1	-	X	000R200	000R03		
├ X CARD	1	0	0	000R100	000R03		
├ ACF for X CARD	48cm	0	0	07N0012	*6	55P4412	IDT:2.0mm width, CMO:2.5mm width
└ CELL OLB ASM	1	-	X	000R201	000R01		
├ ARRAY CELL ASM	1	X	0	55P4461	*7		COMMON W/F8964C
├ COLOR FILTER	1	X	X	55P4462	*7		COMMON W/F8964C
├ ARRAY	1	X	X	55P4425	*7		COMMON W/F8964
├ POLARIZER(CF	1	X	X	55P4426	*7		COMMON W/F8964
├ POLARIZER(AF	1	X	X	55P4463	*7		COMMON W/F8964C
└ CELL PSS	0	X	X	55P4464	*7		COMMON W/F8964C
├ X COF	14	0	0	000R400	000R01		
├ Y DRIVER	4	0	0	55P4562	H90760		COMMON W/F8902
├ Y FPC	1	0	0	000R401	000R01	55P4422	Alternative COMMON W/F8964(P/N:55P4422)
├ ACF X COF	45cm	X	0	07N0013	*6	55P4413	IDT:1.0mm width, CMO:1.2mm width
├ ACF Y COG	10cm	X	0	07K8735	*6		COMMON W/F8910
├ ACF Y FPC	1.5cm	X	0	07K6984	*2	55P4414	CMO: AC7206-U 1.2mm
└ SILICON SEAL	2g	X	0	53G9860		00K3163	COLOR OF 00K3163: WHITE
├ BACKLIGHT ASM	1	0	0	000R300	000R02		
├ FRAME	1	0	X	000R301	000R01		
├ LAMP ASM U	1	0	X	000R302	000R01		
├ LAMP ASM L	1	0	X	000R303	000R01		
├ LIGHT GUIDE	1	0	X	000R304	000R01		
├ WHITE SHEET	1	0	X	000R305	000R01		
├ DIFFUSER UP	1	0	X	000R306	000R01		
├ DIFFUSER MID	1	0	X	000R307	000R01		
├ DIFFUSER LOW	1	0	X	000R308	000R01		
├ HEATSINK	1	0	X	000R309	000R01		
├ SCREW P2.0xL3.5	8	0	X	55P4449	H90760		COMMON W/F8964
├ RUBBER	1	0	X	000R310	000R01		
├ BL S/N LABEL	1	0	X	000R311	000R01		
├ CFL WIRE PROTECTION PL	2	0	X	000R312	000R02		
├ SIDE TAPE	2	0	X	000R313	000R02		
├ W-TAPE A	1	0	X	000R314	000R02		
├ W-TAPE B	1	0	X	000R315	000R02		
├ W-TAPE C	1	0	X	000R316	000R02		
├ W-TAPE D	1	0	X	000R317	000R02		
└ SCREW P1.7xL3.0	2	0	X	000R318	000R02		
├ METAL BEZEL ASM	1	0	0	000R500	000R03		
├ SHIELD COVER	1	0	0	000R501	000R01		
├ SCREW M2.5xL3.5	4	0	0	07K8682	F21763B	55P4416	COMMON W/F8596
├ SCREW P2.0xL3.7	8	0	0	30H0036			COMMON W/F8550
├ TAPE X FOR CELL	1	0	0	55P4406	H90761	55P4455	COMMON W/F8964
├ TAPE Y FOR CELL	1	0	0	55P4407	H90760	55P4456	COMMON W/F8964
├ METAL TAPE	2	0	0	55P4408	H90760	55P4457	COMMON W/F8964
├ TAPE Y FOR CELL2	1			55P4409	001S01	55P4458	COMMON W/F8964
└ TAPE FOR FPC2	2	0	0	47L8118	*5	55P4459	COMMON W/F8593

NOTES: *1:LATEST EC OF F8550, *2:LATEST EC OF F8597, *3:LATEST EC OF F8901,*4:LATEST EC OF F8902,*5:LATEST EC OF F8593,*6:LATEST EC OF F8910
*7:LATEST EC OF F8964SERIES

4.3. Design Target of Key Components

Table 58. Item of Specifications / Designs

	Target	Will achieved by / Consists of	Note
Brightness	250 cd/m2 (5pts ave.)	5.7% 4550 cd/m2 (x0.9 @ Monitor)	ICFL=6.0mA
	200 cd/m2 (5pts ave.)		
White Point	(0.313,0.329)	Backlight White Point (0.301, 0.289) A/C (+0.012, +0.040)	Lamp +/-0.010
Uniformity	30% max (Lmax-Lmin)/(13pts ave)		
Gray Scale Curve	Gamma 2.2		
White Point Shift	Less than 600K	Same as F8964C LC	
Response Time	Less than 25ms	Same as F8964C LC	
Interface	TMDS	TMDS Receiver + LVDS Transmitter + T-CON	
Lamp Replaceable	Not necessary		
WOA			
Transparency	6.1% (+/-10%)		
VSIG (Black)	0.057V		
VSIG (White)	6.9V		
VSIG (Center)	7.44V		
VCOM	6.35V		
VGH	24.0V		
VGL	-8.6V		
A/C driving timing		2HV inversion	