Messrs.					
Product Specification	Model:	MTB-F000235RPHS-A	Rev. No.	Issued Date.	Page.
			A	*Mar. 19, 03*	*1*

LIQUID CRYSTAL DISPLAY MODULE
MODEL: MTB-F000235RPHS-A
Customer's No.:

Acceptance

Microtips Technology Inc.
12F. No.31 Lane 169, Kang Ning St., His-Chih,
Taipei Hsien, Taiwan, R.O.C.
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Approved and Checked by

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Microtips Technology

Microtips Technology Inc.

Revise Records

Rev.	Date	Contents	Written	Approved
A	03/19/2003	Initial Release	Joy Shen	Garry Chen

Special notes

Note1.	
Note2.	
Note3.	
Note4.	
Note5.	

CONTENTS

1. General Specifications

Operating Temperature	:	Min. -20°C Max. 70°C
Storage Temperature	:	Min. -30°C Max. 80°C
Dot Pixels	:	160 (W) x 160 (H) dots
Dot Size	:	0.335 (W) x 0.335 (H) mm
Dot Pitch	:	0.350 (W) x 0.350 (H) mm
Viewing Area	:	63.4 (W) x 63.3 (H) mm
Outline Dimensions	:	69.5* (W) x 69.5 (H) x 5.90 max. (D) mm * Without FFC Connector Cable
Weight	:	N/A
LCD Type	:	FSTN/ Gray, Positive-mode / Reflective (With Paper White Polarizer)
Viewing Direction	:	6:00
Data Transfer	:	4-bit parallel data input from a LCD controller
Drawings	:	As attached drawings

2. Electrical Specifications

2.1 Absolute Maximum Ratings

V_{SS} = 0V

Parameter	Symbol	Conditions	Min.	Max.	Units
Supply Voltage (Logic)	V_{DD} - V_{SS}	--	-0.3	7.0	V
Supply Voltage (LCD Drive)	V_{LCD} - V_{SS}	--	-0.3	45.0	V
Input Voltage	V_I	--	- 0.3	V_{DD} + 0.3	V

2.2 DC Characteristics

Ta = 25°C, V_{SS} = 0V

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units	Note
Supply Voltage (Logic)	V_{DD} - V_{SS}	--	2.5	3.3	5.5	V	
Supply Voltage (LCD Drive)	V_{DD} - V_{EE}	--	15.0	--	40.0	V	
	V_{DD} - V_{ADJ}	Shown in 3.1				V	
High Level Input Voltage	V_{IH}	V_{DD} = 3.0V±10%	0.8 x V_{DD}	--	V_{DD}	V	
Low Level Input Voltage	V_{IL}	V_{DD} = 3.0V±10%	--	--	0.2 x V_{DD}	V	
High Level Output Voltage	V_{OH}	I_{OH} = -0.4mA	V_{DD}-0.4	--	--	V	
Standby Current	I_{STB}	--	--	--	50	μA	1
Supply Current (1) Non-selection	I_{DD1}	--	--	2.0	12.0	mA	2
Supply Current (2) Selection	I_{DD2}	--	--	7.0	--	mA	3
Supply Current (3)	I_0				0.9	mA	4
Frame	f_F	Duty = 50%	65	70	75	Hz	

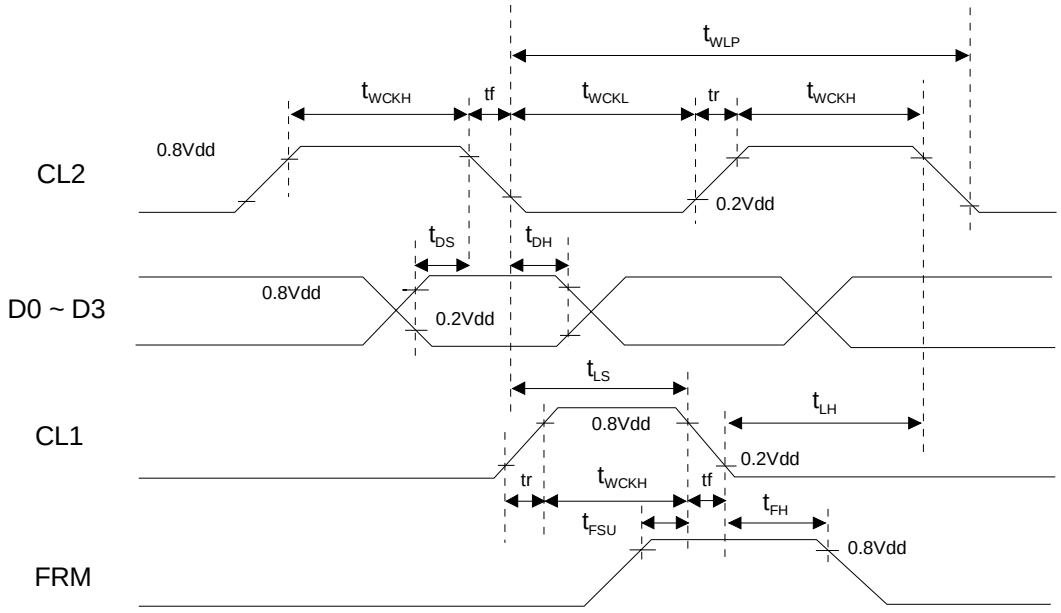
NOTES:

1. V_{DD} = +5.0 V, V0 = +30.0 V, V_I = V_{SS}.
2. V_{DD} = +5.0 V, V0 = +30.0 V, f_{XCK} = 8 MHz, no-load, El = V_{DD}. The input data is turned over by data taking clock (4-bit parallel input mode).
3. V_{DD} = +5.0 V, V0 = +30.0 V, f_{XCK} = 8 MHz, no-load, El = V_{SS}. The input data is turned over by data taking clock (4-bit parallel input mode).
4. V_{DD} = +5.0 V, V0 = +30.0 V, f_{XCK} = 8MHz, f_{LP} = 19.2 kHz, f_{FR} = 80 Hz, no-load. The input data is turned over by data taking clock (4-bit parallel input mode).

2.3 Signal Timing Diagram

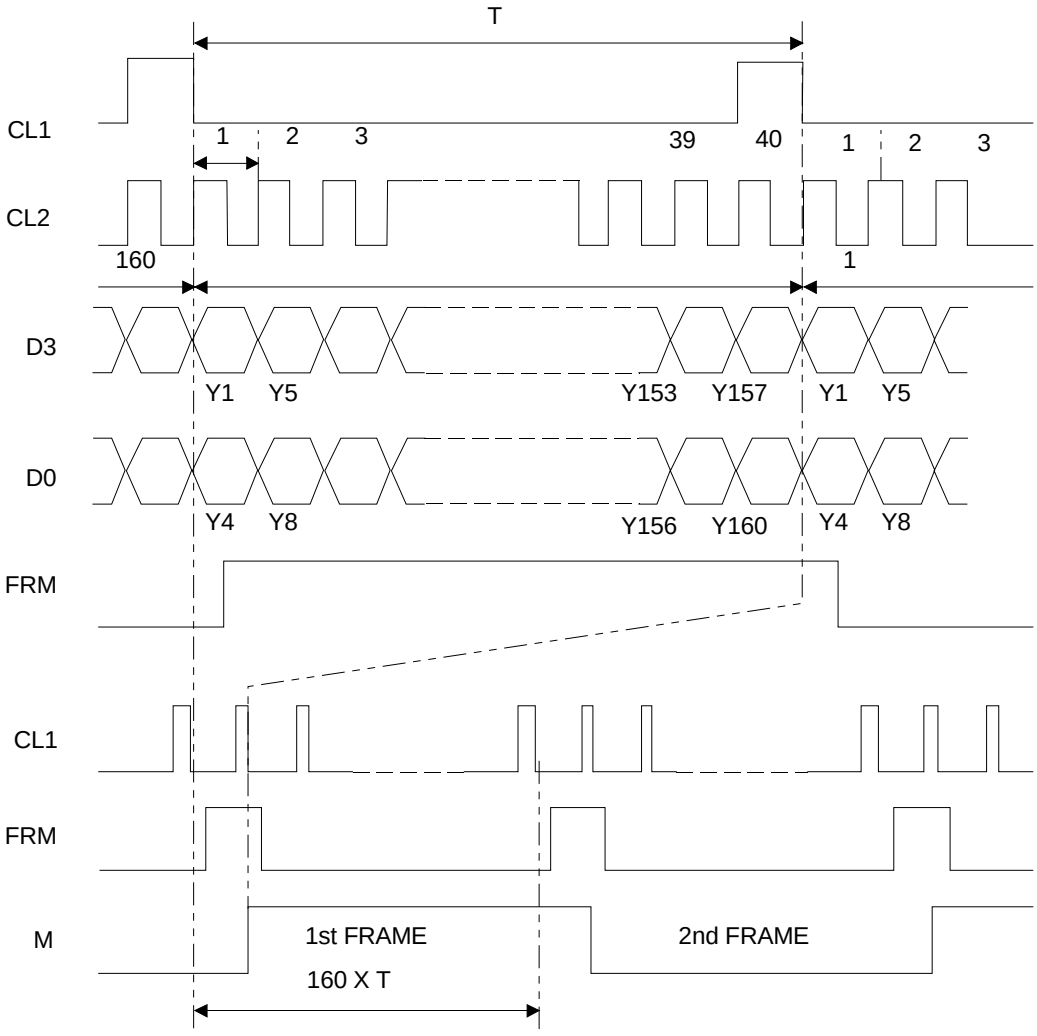
V_{SS}=0V, V_{DD}= 2.5~5.5V, V0=15 to 30 V, and TA=-20 to +85°C

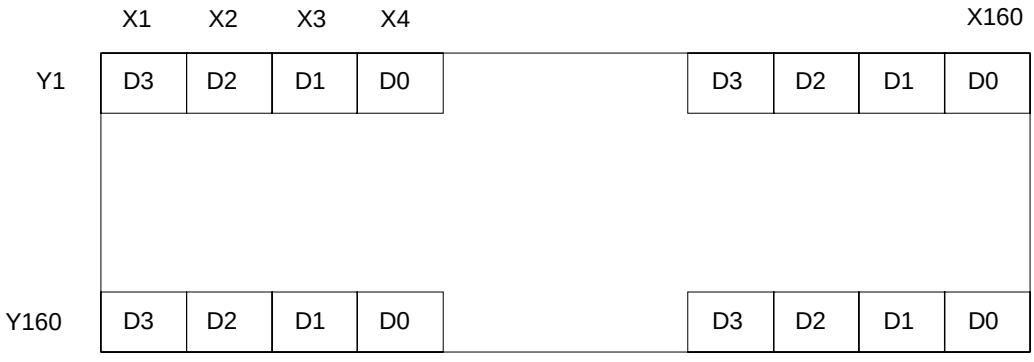
Parameter	Symbol	Min.	Max.	Units	Condition
Shift clock period	t_{WLP}	250	--	ns	tr, tf <=20ns
Shift clock "H" pulse width	t_{WCKH}	30	--	ns	V_{DD}=+2.5~+4.5V
Shift clock “L” pulse width	t_{WCKL}	51		ns	
Input signal rise time	tr	--	50	ns	
Input signal fall time	tf	--	50	ns	
Data setup time	t_{DS}	30	--	ns	
Data hole time	t_{DH}	50	--	ns	
Shift clock rise to latch pulse rise time	t_{LD}	0	--	ns	
Latch pulse rise to shift clock rise time	t_{LS}	51	--	ns	
Latch pulse fall to shift clock fall time	t_{LH}	51	--	ns	
FLM set-up time	t_{FSU}				
FLM hold time	t_{FH}				



Signal Timing(1)

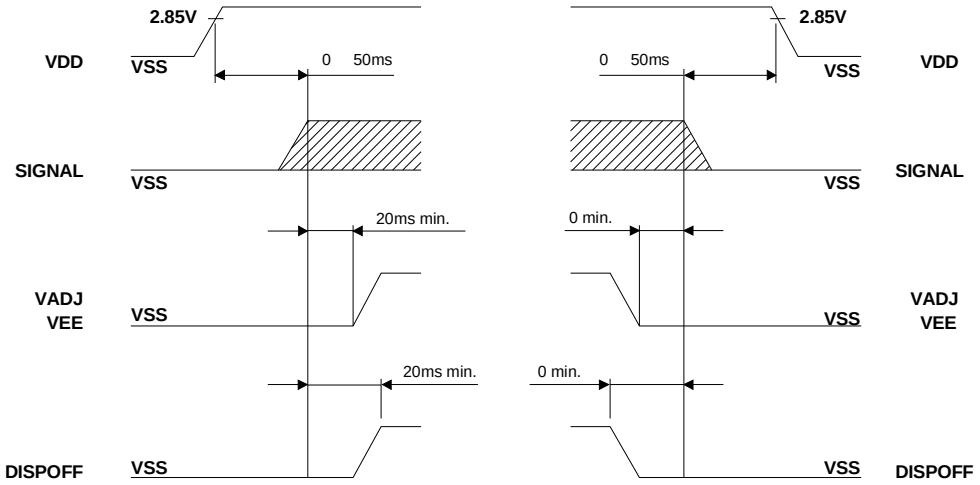
2.4 Timing Chart & Comparison of Display and Data





Signal Timing (2)

2.5 Power Supply ON/OFF Sequence



The missing pixels may occur when the LCM is driver beyond above power interface timing sequence.

2.6 Spec. for touch panel

Item	Unit	Standard value			Note
		Min.	Typ.	Max.	
Linearity	%	-1.5	--	1.5	
Terminal resistance	Ω	200	--	900	X (Glass side) Resistance between terminal is greater than 100Ω
	Ω	200	--	900	Y (Film side)
Insulation resistance	MΩ	20	--	--	DC25V
Chattering	ms	--	--	10	DC5V, 100Ωk. Hold an R0.8 polyacetal stylus and tune it on/off with the same load and speed as usual finger input.
Transparency	%	80	--	--	(JIS-K7105, ASTM D1003)
Operating force	g	--	--	80	
Surface hardness	H	--	3	--	(JIS-K5400, ASTM D3363)
Newton ring	No unusual interference finger must show when seen through the surface sheet.				Detail criterion for inspection refer attached inspection sheet.

3. Optical Specifications

3.1 LCD Driving Voltage Recommended

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
LCD Driving Voltage Note 1	V_{DD}-V_{EE}	Ta = 0 °C	19.9	20.5	21.1	V
		Ta = 25 °C	18.3	18.8	19.4	V
		Ta = 50 °C	17.0	17.5	18.0	V

Note 1 : Voltage (Applied actual waveform to LCD Module) for the best contrast. The range of minimum and maximum shows tolerance of the operating voltage. The specified contrast ratio and response time are not guaranteed over the entire range.

3.2 Optical Characteristics

Ta=25 °C, 1/32 Duty, 1/5 Bias, V_{DD} = V (Note 4), θ = 0°, ϕ = 270°

Parameter		Symbol	Conditions	Min.	Typ.	Max.	Units
Contrast Ratio Note 1		C	θ = 0°, ϕ = 0°	6.8	8.5	--	--
Viewing Angle (Shown in 3.3)		Front-Back	θ_f - θ_b, ϕ = 270°	+50	to	-30	deg.
		Left-Right	θ_l - θ_r, ϕ = 270°	+36	to	-30	deg.
Response Time	Rise Note 2	T_{ON}	--	--	132	--	msec
	Decay Note 3	T_{OFF}	--	--	278	--	msec

Note 1 : Contrast ratio is defined as follows.
CR = L_{OFF} / L_{ON}
L_{ON} : Luminance of the ON segments, L_{OFF} : Luminance of the OFF segments

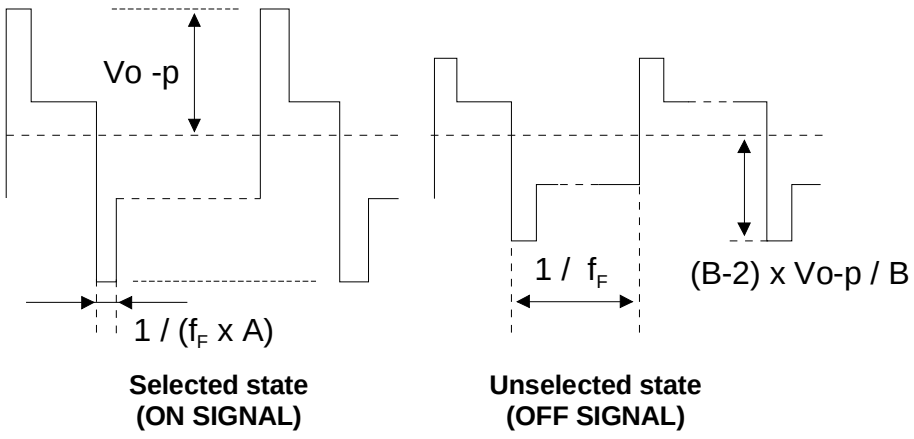
Note 2 : The time that the luminance level reaches 90% of the saturation level from 0% when ON signal is applied.

Note 3 : The time that the luminance level reaches 10% of the saturation level from 100% when OFF signal is applied.

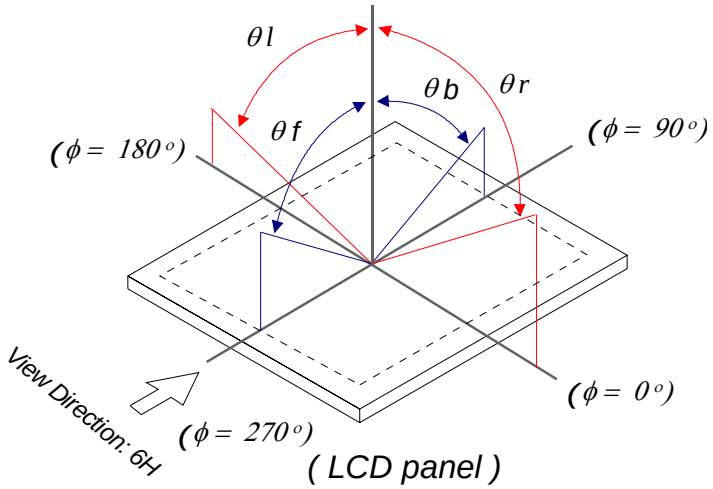
Note 4 : Definition of Driving Voltage V_D. Assuming that the typical driving waveforms shown below are applied to the LCD Panel at /A Duty - 1/B Bias (A : Duty Number, B : Bias Number). Driving voltage V_D is defined s follows: V_D = (Vth1+Vth2) / 2

Vth1 : The voltage VO-P that should provide 50% of the saturation level in the luminance at the segment which the ON signal is applied to.

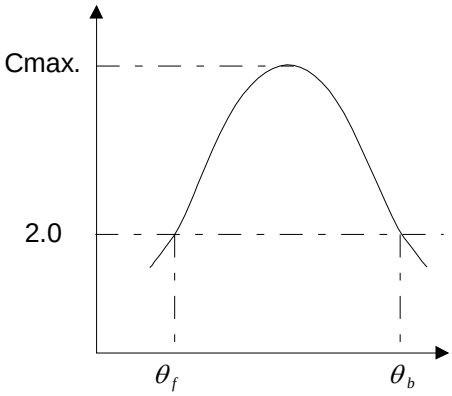
Vth2 : The voltage VO-P that should provide 50% of the saturation level in the luminance at the segment which the OFF signal is applied to.



3.3 Definition of Viewing Angle and Optimum Viewing Area



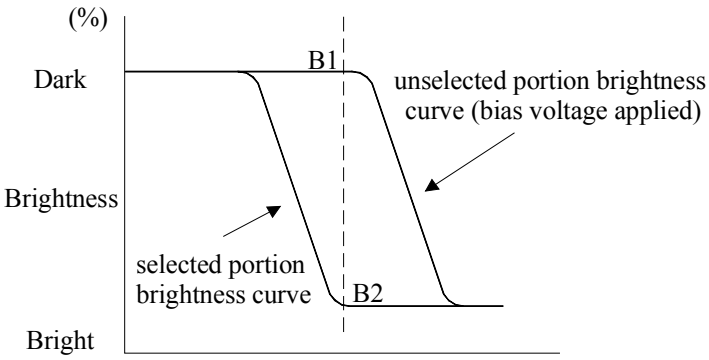
3.4 Definition of Viewing Angle θ_f and θ_b



Viewing angles θ (ϕ fixed)

Optimum viewing angle with the naked eye and viewing angle θ at Cmax. Above are not always the same.

3.5 Definition of Contrast C, *C= Brightness of selected dot (B1)/ Brightness of unselected dot (B2)*



4. Terminal

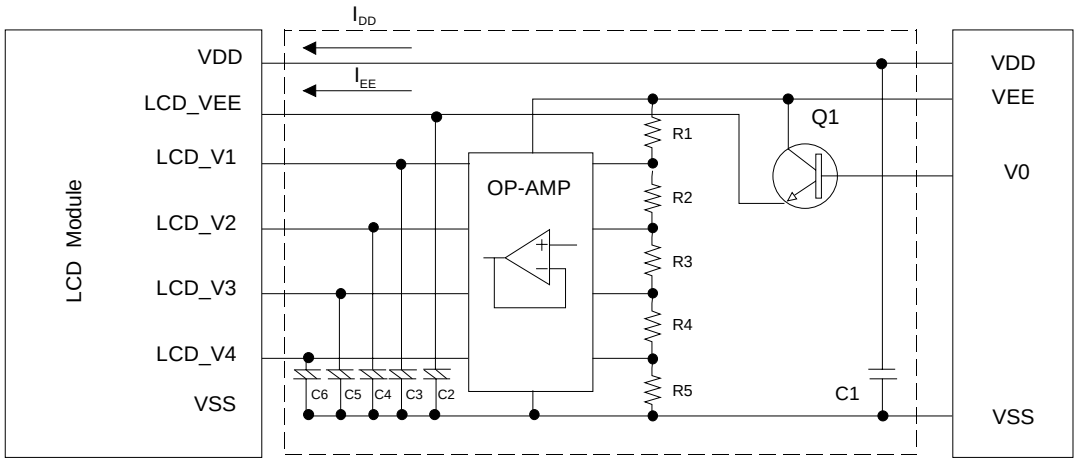
4.1 Pin Assignment

LCD

Pin No.	Symbol	I/O	Function
1	V_{SS}	--	Ground pin connects to 0V
2	FLM (FRM)	--	AC-converting signal input for LCD drive waveform
3	CL1 (LP)	Input	Latch pulse input/shift clock input for shift register
4	CL2 (SCP)	Input	Display data shift clock input for segment mode
5	M	--	AC-converting signal input for LCD drive waveform
6	V_{DD}	--	Power supply for logic system (+2.5 to + 5.5 V)
7	EL_ON	--	No Connection
8	V_{EE}	--	Power supply for LCD drive
9	D3	--	Display data
10	D2	--	Display data
11	D1	--	Display data
12	D0	--	Display data
13	TP_XL	--	Touch Panel Signal (X-position Left) Touch Panel Pin Output Left (X Axis)
14	TP_YU	--	Touch Panel Signal (Y-position Upper) Touch Panel Pin Output Upper (Y Axis)
15	TP_XR	--	Touch Panel Signal (X-position Right) Touch Panel Pin Output Right (X Axis)
16	TP_YD	--	Touch Panel Signal (Y-position Down) Touch Panel Pin Output Lower (Y Axis)
17	V_{SS}	--	Ground pin connects to 0V
18	V_{SS}	--	Ground pin connects to 0V

4.2 Example of Power Supply

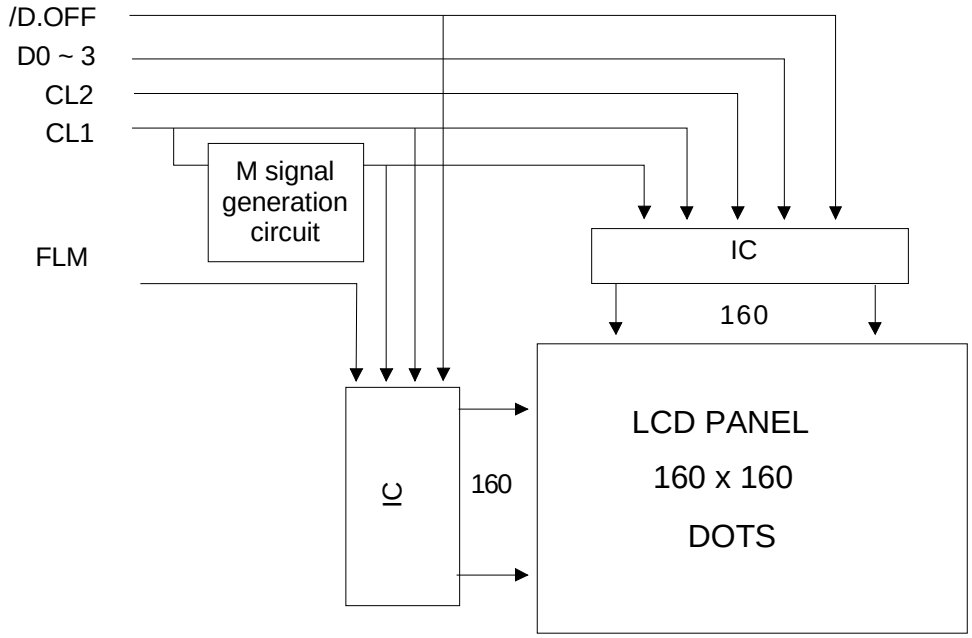
It is recommended to apply a potentiometer for the contrast adjust due to the tolerance of the driving voltage and its temperature dependence.



Q1: 2SC1815
OP-AMP: LP324
R1=R2=R4=R4=22, R3=9R1=200 KΩ (1/13 Bias)
C1=0.1µF, C2~C6=3.3µF
V_{DD}=3.0V, V_{EE}=+24V, V_{EE}'>V0>Vss

Note 1: These are general values.In case to decrease LCD driving voltage with minimizing bias value, set these value with check display to avoid display's deterioration (response etc.)

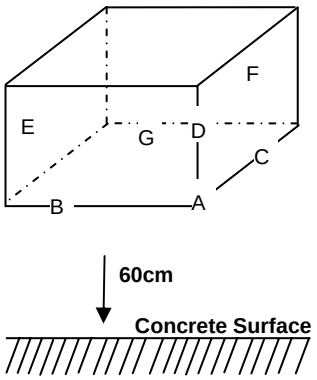
4.3 Block Diagram



5. Reliability Test

5.1 Test Item

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

No.	Test Item	Description	Condition	Note
1.	High Temperature (Operation)	Durability test under long time high temperature with electrical stress (voltage, current)	50°C ± 2°C 96hrs	
2.	High Temperature (Storage)	Durability test under long time high temperature storage	60°C ± 2°C 96hrs	4
3	Low Temperature (Operation)	Durability test under long time low temperature with electrical stress (voltage, current)	0°C ± 2°C, 96hrs	3
4	Low Temperature (Storage)	Durability test under long time low temperature storage	-20°C ± 2°C, 96hrs	3, 4
5	Damp Proof Test	Durability test under long time high temperature and high humidity	40°C± 2°C, 90 95% RH 96hrs	3 , 4
6.	Vibration Test	Total fixed amplitude: 1.5mm Vibration frequency: 10 55Hz One cycle 60 seconds to 3 directions of X, Y, Z for each 15 minutes	- -	5
7.	Drop Test	To be measured after dropping from 60cm high on the concrete surface in packing state.  **Dropping method corner dropping** **A corner: once** **Edge dropping** **B, C, D edge: once** **Face dropping** **E, F, G face: once**		

Note 1: Unless otherwise specified, tests will be conducted under the following condition,
Temperature : 25°C ± 2°C
Humidity : 65% ± 5%
Note 2: Unless otherwise specified, tests will be not conducted under functioning state.
Note 3: No dew condensation to be observed.
Note 4: The function test shall be conducted after 4 hours storage at the normal temperature and humidity after removed from the test chamber.
Note 5: Vibration test will be conducted to the product itself without putting it in a container.

5.2 Judgment Standard

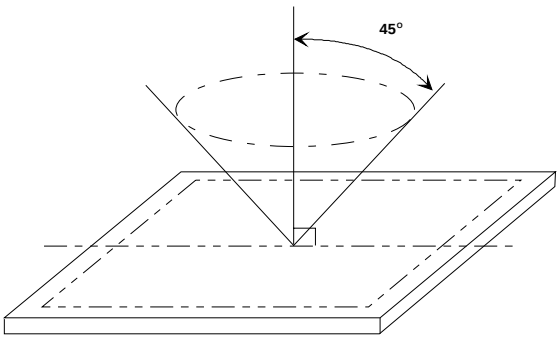
Failure Mode	Test Item							Judgment Standard
	1	2	3	4	5	6	7	
Orientation	*	*	*	*	*			No remarkable degradation of appearance under bias/ non-bias condition
Current Value (IAC)	*	*	*	*	*			No remarkable increase
Contrast	*		*	*	*			No remarkable poor contrast
Domain	*	*	*	*	*			Less than 20% of all dots have reverse tilt of more than on third of one dot area.
Bubble (Inside Cell)	*	*	*	*	*	*		As per "Appearance Standard" (Note. including one which disappear after 25°C 2H)
Polarizer	*				*	*		As per "Appearance Standard" no remarkable appearance change
Glass Damage							*	As per "Appearance Standard"

Note. 1. * is strong linkage between Failure Mode and Test Item.
2. Number of Test Item should be referred to former page.
3. Judgment and Standard value should be fixed by other inspection standard and criteria samples.

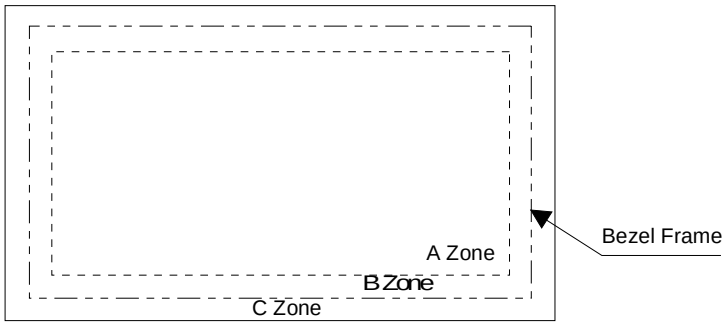
6. Appearance Standards

6.1 Inspection Conditions

The LCD shall be inspected under 40W white fluorescent light.
The distance between the eyes and the sample shall be more than 30cm.
All directions for inspecting the sample should be within 45° against perpendicular line.



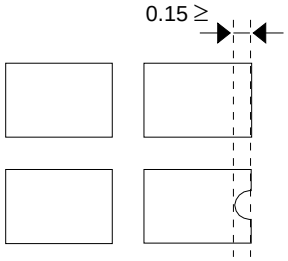
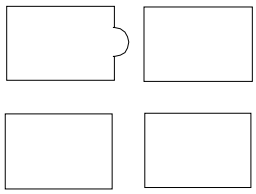
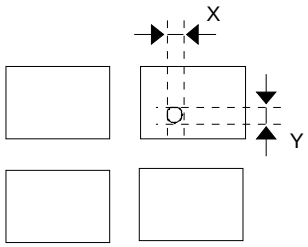
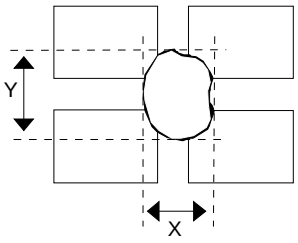
6.2 Definition of Applicable Zones



A Zone : Active display area
B Zone : Area from outside of "A Zone" to validity viewing area
C Zone : Rest parts
A Zone + B Zone = Validity viewing area

6.3 Standards

<table>
<tr><th>No.</th><th>Parameter</th><th>Criteria</th></tr>
<tr><td>1.</td><td>Black and White Spots, Foreign Substances</td><td>
(1) Round Shape
<table>
<tr><th rowspan="2">Dimension (mm) \ Zone</th><th colspan="3">Acceptable Number</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>D ≤ 0.1</td><td>*</td><td>*</td><td>*</td></tr>
<tr><td>0.1 < D ≤ 0.2</td><td>3</td><td>5</td><td>*</td></tr>
<tr><td>0.2 < D ≤ 0.25</td><td>2</td><td>3</td><td>*</td></tr>
<tr><td>0.25 < D ≤ 0.3</td><td>0</td><td>1</td><td>*</td></tr>
<tr><td>0.3 < D</td><td>0</td><td>0</td><td>*</td></tr>
</table>
D = (Long + Short)/2 *: Disregard
(2) Line Shape
<table>
<tr><th rowspan="2">X (mm) \ Y (mm) \ Zone</th><th colspan="3">Acceptable Number</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>- -</td><td>0.03 ≥ W</td><td>*</td><td>*</td><td>*</td></tr>
<tr><td>2.0 ≥ L</td><td>0.05 ≥ W</td><td>3</td><td>3</td><td>*</td></tr>
<tr><td>1.0 ≥ L</td><td>0.1 ≥ W</td><td>3</td><td>3</td><td>*</td></tr>
<tr><td>- -</td><td>0.1 < W</td><td colspan="3">In the same way (1)</td></tr>
<tr><td colspan="4">X : Length Y: Width *: Disregard
Total defects shall not exceed 5.</td></tr>
</table>
</td></tr>
<tr><td>2.</td><td>Air Bubbles (between glass & polarizer)</td><td>
<table>
<tr><th rowspan="2">Dimension (mm) \ Zone</th><th colspan="3">Acceptable Number</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>D ≤ 0.3</td><td>*</td><td>*</td><td>*</td></tr>
<tr><td>0.3 < D ≤ 0.4</td><td>3</td><td>*</td><td>*</td></tr>
<tr><td>0.4 < D ≤ 0.6</td><td>2</td><td>3</td><td>*</td></tr>
<tr><td>0.6 < D</td><td>0</td><td>0</td><td>*</td></tr>
</table>
*: Disregard
Total defects shall not exceed 3.
</td></tr>
</table>

No.	Parameter	Criteria
3.	The Shape of Dot	(1) Dot Shape (with Dent) As per the sketch of left hand.  (2) Dot Shape (with Projection) Should not be connected to next dot.  (3) Pin Hole (X+Y)/2≤0.2mm (Less than 0.1mm is no counted.)  (4) Deformation (X+Y)/2≤0.2mm  Total acceptable number: 1/dot, 5/cell (Defect number of (4): 1pc.)
4.	Polarizer Scratches	Not to be conspicuous defects.
5.	Polarizer Dirts	I f the stains are removed easily from LCDP surface, the module is not defective.
6.	Complex Foreign Substance Defects	Black spots, line shaped foreign substance or air bubbles between glass & polarizer should be 5pcs maximum in total.
7.	Distance between different Foreign Substance defects	D ≤ 0.2 : 20mm or more 0.2 < D : 40mm or more

7. Handling and Precautions

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

1 Liquid crystal display devices

1.1 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.
1.2 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.

2.1 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.
2.2 Avoid the use of work clothing made of synthetic fibers. We recommend cotton clothing or other conductivity-treated fibers.
2.3 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:

3.1 Protect the modules from high temperature and humidity.
3.2 Keep the modules out of direct sunlight or direct exposure to ultra-violet rays.
3.3 Protect the modules from excessive external forces.

4 Use the module with a power supply that is equipped with an over current 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.

8. 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.

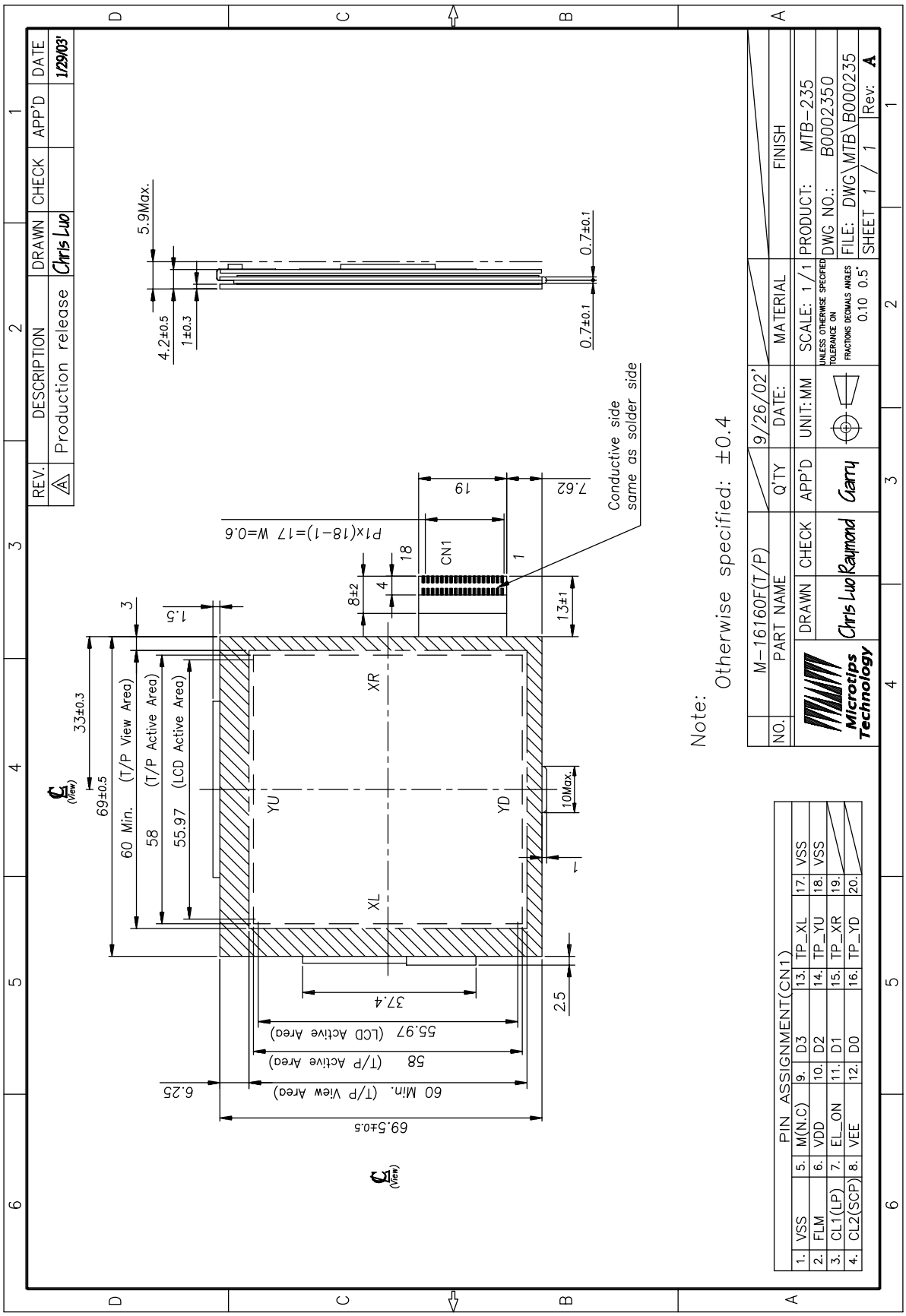
2 We cannot accept responsibility for any defect, which may arise after the application of strong external force to the product.

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 We cannot accept responsibility for industrial property, which may arise through the use of your product, with exception to those issues relating directly to the structure or method of manufacturing of our product. Microtips-origin longer than one year from Microtips production.

9. Dimensional Outlines

- See the next page……..


REV. DESCRIPTION DRAWN CHECK APP'D DATE
A Production release Chris Luo 1/29/03'
5.9Max.
4.2±0.5
1±0.3
0.7±0.1
0.7±0.1
Conductive side same as solder side
19
7.62
P1x(18-1)=17 W=0.6
CN1
18
4
8±2
1
13±1
1.5
3
33±0.3
69±0.5
60 Min. (T/P View Area)
58 (T/P Active Area)
55.97 (LCD Active Area)
XR
YU
YD
XL
10Max.
1
2.5
37.4
55.97 (LCD Active Area)
58 (T/P Active Area)
60 Min. (T/P View Area)
6.25
69.5±0.5
View
Note:
Otherwise specified: ±0.4
M-16160F(T/P) 9/26/02'
NO. PART NAME Q'TY DATE: MATERIAL FINISH
DRAWN Chris Luo CHECK Raymond APP'D Garry UNIT:MM SCALE: 1/1
UNLESS OTHERWISE SPECIFIED TOLERANCE ON FRACTIONS DECIMALS ANGLES 0.10 0.5'
Microtips Technology
PRODUCT: MTB-235
DWG NO.: B0002350
FILE: DWG\MTB\B000235
SHEET 1 / 1 Rev: A
PIN ASSIGNMENT(CN1)
1. VSS 5. M(N.C) 9. D3 13. TP_XL 17. VSS
2. FLM 6. VDD 10. D2 14. TP_YU 18. VSS
3. CL1(LP) 7. EL_ON 11. D1 15. TP_XR 19.
4. CL2(SCP) 8. VEE 12. D0 16. TP_YD 20.

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