

TIANMA Microelectronics (U.S.A.) Inc.

SPECIFICATION FOR LCD MODULE

Model No. TM402CFF6

To:

☐ Customer's Approval

Date: _____

By: _____

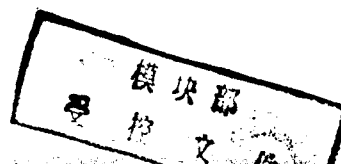
Presented

By: _____

Tianma Microelectronics (U.S.A.) Inc.

REVISION RECORD

Date	Ref. Page	Revision No.	Revision Items	Check & Approval



1 Display Specifications

1.1 Display type: STN

1.2 Display color*:

Display color: white

Background color: Blue

1.3 Polarizer mode: Transmissive

1.4 Viewing Angle: 6:00

1.5 Driving Duty: 1/16

1.6 Backlight: LED

* Color tone is slightly changed by temperature and driving voltage.

2 Mechanical Specifications

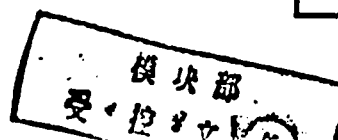
2.1 Outline Dimensions: Refer to outline drawing on page: 2

2.2 Dot Matrix: Refer to outline drawing on page: 2

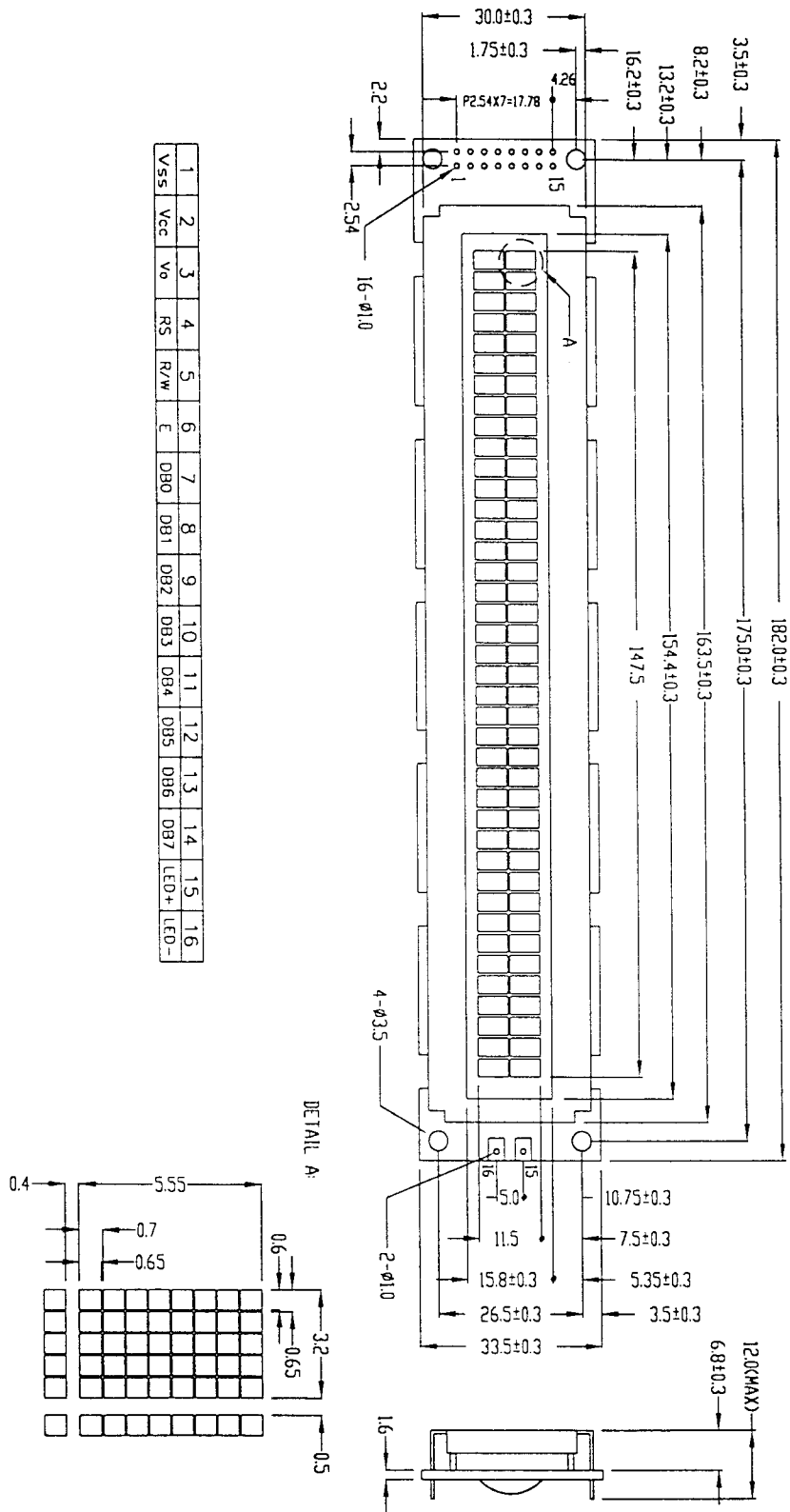
2.3 Dot size: 0.65×0.60 (mm)

2.4 Dot pitch: 0.70×0.65 (mm)

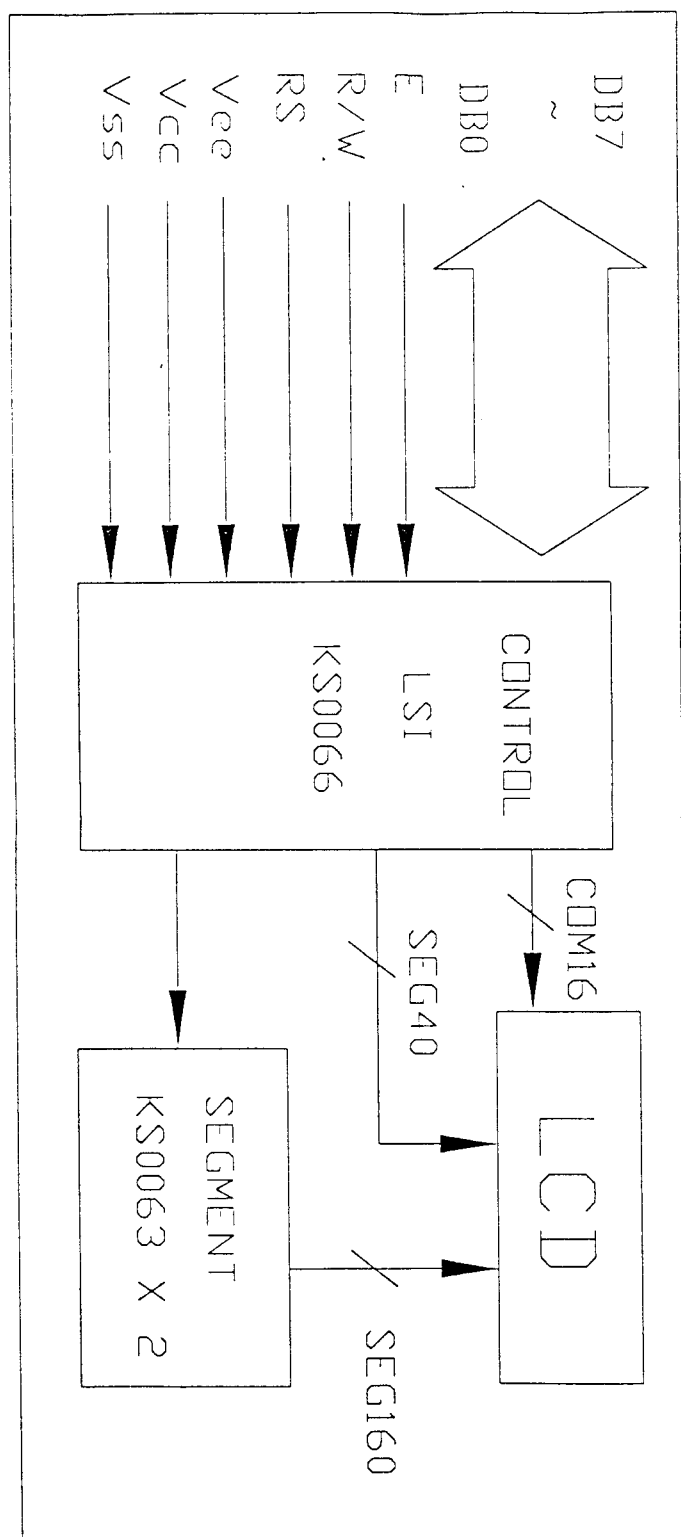
2.5 Weight: 210 g



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
VSS	VCC	Vo	RS	R/W	E	DB0	DB1	DB2	DB3	DB4	DB5	DB6	DB7	LED+	LED-



3 Circuit Block Diagram



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4 Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit	Remark
Power Supply Voltage	$V_{CC}-V_{SS}$	-0.3	7.0	V	
LCD Driving Voltage	V_{LCD}	-0.3	13.0V		
Operating Temperature Range	T_{OP}	0	50	°C	No Condensation
Storage Temperature Range	T_{ST}	-20	60		

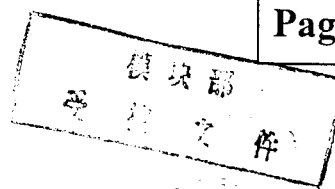
5 Electrical Specifications and Instruction Code

5.1 Electrical characteristics

Item		Symbol	Min.	Typ.	Max.	Unit	Remark
Supply Voltage (Logic)		V _{CC} –V _{SS}	4.5	5.0	5.5	V	
Supply Voltage (LCD Drive)		V _{CC} –V ₀	-	6.0	-	V	
Input Signal Voltage	'H'Level	V _{IH}	0.7V _{CC}	-	V _{CC} +0.3	V	
	'L'Level	V _{IL}	-0.3	-	0.2V _{CC}	V	
Supply current (Logic)		I _{DD}	-		5.5	mA	
Supply current (LCD Drive)		I _{EE}	-	2.0	5	mA	
Supply current (LED)		I _{LED}	-	410.3	-	mA	

5.2 Interface Signals

Pin No.	Symbol	Level	Description
1	Vss	0V	Ground
2	Vcc	5.0V	Power supply voltage for logic and LCD(+)
3	Vo	-1.0V	Power Operating voltage for LCD(-)
4	RS	H/L	Selection display data or instruction
5	R/W	H/L	Read/Write Singal
6	E	H/L	Chip enable singal
7	DB0	H/L	Data bit0
8	DB1	H/L	Data bit1
9	DB2	H/L	Data bit2
10	DB3	H/L	Data bit3
11	DB4	H/L	Data bit4
12	DB5	H/L	Data bit5
13	DB6	H/L	Data bit6
14	DB7	H/L	Data bit7
15	LED+	4.2V	Backlight Power Supply(+)
16	LED-	0V	Backlight Power Supply(-)



5.3 Interface Timing Chart:

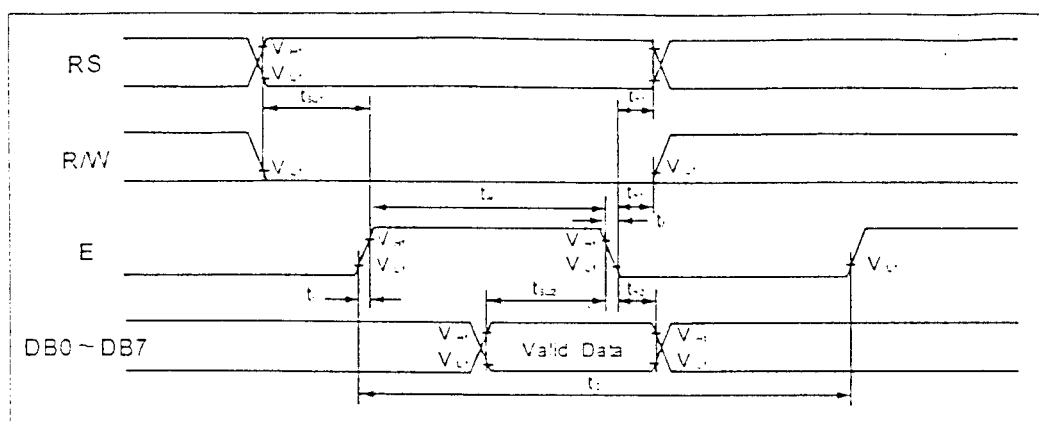


Figure 6 . Write Mode Timing Diagram

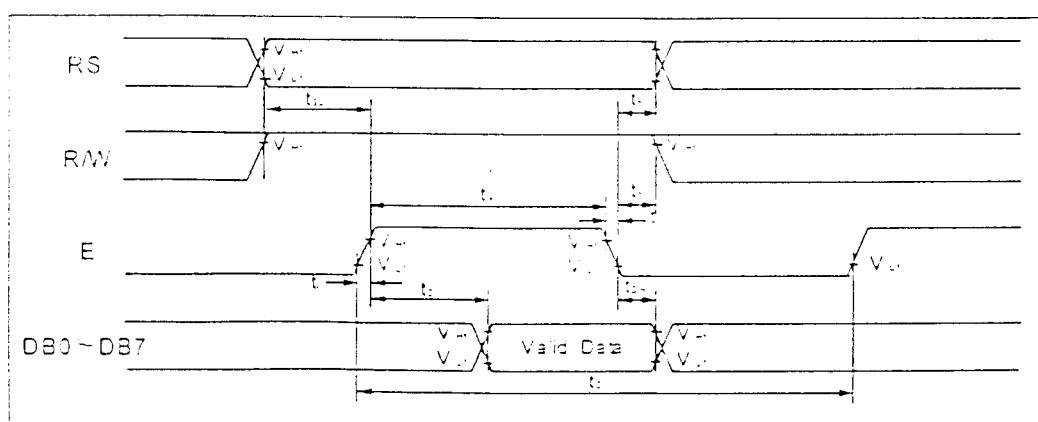
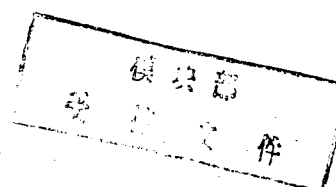


Figure 7 . Read Mode Timing Diagram

Table 12. AC Characteristics ($V_{DD} = 4.5V \sim 5.5V$, $T_a = -30 \sim +85^\circ C$)

Mode	Characteristic	Symbol	Min.	Typ.	Max.	Unit
Write Mode (Refer to Fig-6)	E Cycle Time	t_c	500	-	-	ns
	E Rise / Fall Time	$t_{R, F}$	-	-	20	
	E Pulse Width (High, Low)	t_w	230	-	-	
	R/W and RS Setup Time	t_{su1}	40	-	-	
	R/W and RS Hold Time	t_{H1}	10	-	-	
	Data Setup Time	t_{su2}	80	-	-	
	Data Hold Time	t_{H2}	10	-	-	
Read Mode (Refer to Fig-7)	E Cycle Time	t_c	500	-	-	ns
	E Rise / Fall Time	$t_{R, F}$	-	-	20	
	E Pulse Width (High, Low)	t_w	230	-	-	
	R/W and RS Setup Time	t_{su}	40	-	-	
	R/W and RS Hold Time	t_H	10	-	-	
	Data Output Delay Time	t_D	-	-	120	
	Data Hold Time	t_{DH}	5	-	-	

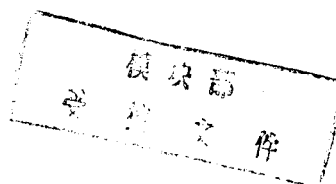


5.4 Instruction Code

Instruction	Instruction Code										Description	Execution time (fosc= 270 kHz)
	RS	RAW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM and set DDRAM address to "00H" from AC	1.53 ms
Return Home	0	0	0	0	0	0	0	0	1	-	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.53 ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	SH	Assign cursor moving direction and enable the shift of entire display.	39 μ s
Display ON/OFF Control	0	0	0	0	0	0	1	D	C	B	Set display(D), cursor(C), and blinking of cursor(B) on/off control bit.	39 μ s
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	-	-	Set cursor moving and display shift control bit, and the direction, without changing of DDRAM data.	39 μ s
Function Set	0	0	0	0	1	DL	N	F	-	-	Set interface data length (DL: 8-bit/4-bit), numbers of display line (N: 2-line/1-line) and, display font type (F 5x11dots/5x8 dots)	39 μ s
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter.	39 μ s
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter.	39 μ s
Read Busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	0 μ s
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	43 μ s
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM).	43 μ s

* "-": don't care

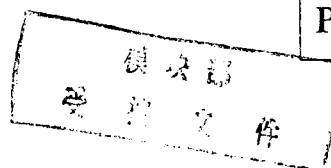
NOTE: When an MPU program with checking the Busy Flag(DB7) is made, it must be necessary 1/2Fosc is necessary for executing the next instruction by the falling edge of the 'E' signal after the Busy Flag (DB7) goes to "Low".



5.5 Character Generator ROM (KS0066UP-00)

CHARACTER GENERATOR ROM (KS0066U-00)

Lower 4bit	Upper 4bit																
		LLLL	LLLH	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
LLLL	CG RAM (1)																
LLLH	(2)																
LLHL	(3)																
LLHH	(4)																
LHLL	(5)																
LHLH	(6)																
LHHL	(7)																
LHHH	(8)																
HLLL	(1)																
HLLH	(2)																
HLHL	(3)																
HLHH	(4)																
HHLL	(5)																
HHLH	(6)																
HHHL	(7)																
HHHH	(8)																

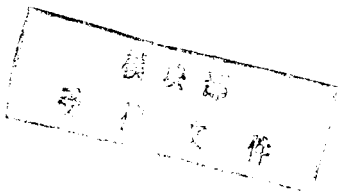


Optical Characteristics

1 Optical Characteristics

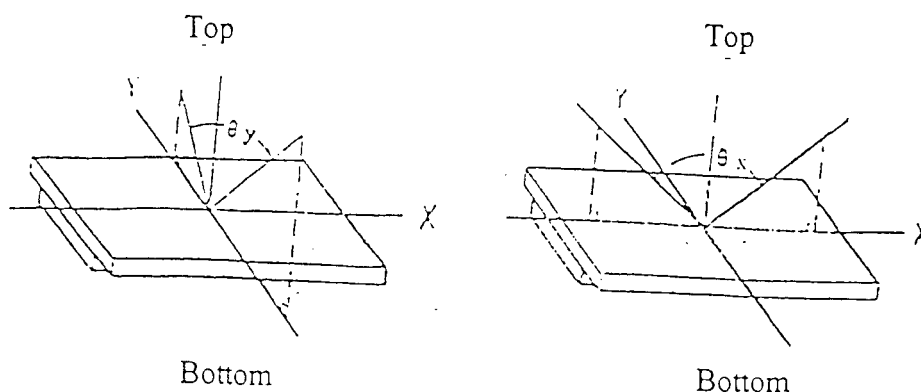
T_{OP}=25℃

Item		Symbol	Condition		Min.	Typ.	Max.	Unit	Remark
Viewing Angle		θ_x	$Cr \geq 2$	$\theta_y = 0^\circ$	-30	--	30	Deg	
		θ_y		$\theta_x = 90^\circ$	-35	--	20		
Contrast Ratio		Cr	$\theta_x = 0^\circ$ $\theta_y = 0^\circ$		4.0				
Response Time	Turn on	T _{on}	$\theta_x = 0^\circ$ $\theta_y = 0^\circ$				250	ms	
	Turn off	T _{off}					250		

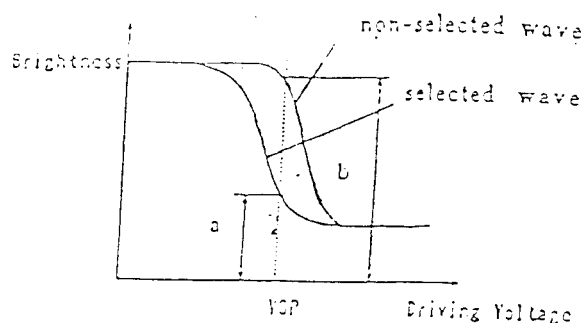


6.2 Definition of optical characteristics

6.2.1 Definition of viewing Angle(see fig. as follow)



6.2.2 Definition of Contrast Ratio(see fig. as follow)

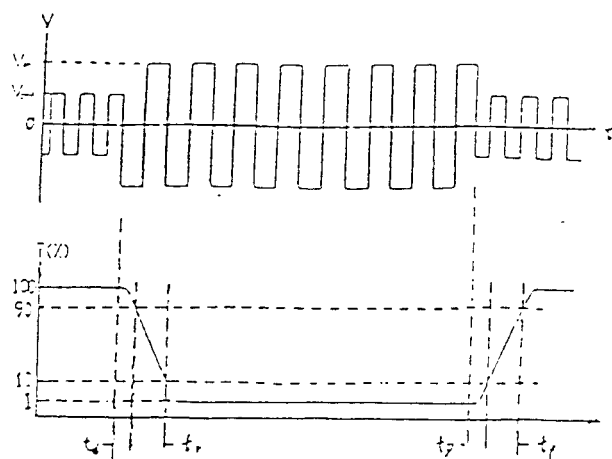


$$\text{Contrast Ratio} = b / a = \frac{\text{non-selected state brightness}}{\text{selected state brightness}}$$

Measuring Conditions:

- 1) Ambient Temperature: 25°C ;
- 2) Frame frequency: 64Hz

6.2.3 Definition of Response time(see fig. as follow)

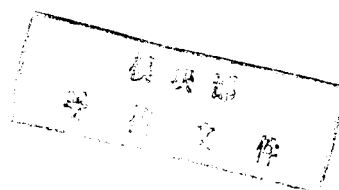


Turn-on time: $t_{on} = t_d + t_r$

Turn-off time: $t_{off} = t_d + t_f$

Measuring Condition:

- 1) Operating Voltage: 6.0V ;
- 2) Frame frequency: 64Hz

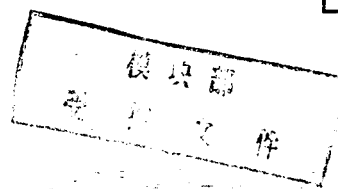


7. Reliability

7.1 Content of Reliability Test

($T_{OP}=25^{\circ}\text{C}$)

No.	Test Item	Content of Test	Test condition
1	High Temperature Storage	Endurance test applying the high storage temperature for a long time	80°C 240H
2	Low Temperature Storage	Endurance test applying the low storage temperature for a long time	-30°C 240H
3	High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the thermal stress to the element for a long time	70°C 240H
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time	-20°C 240H
5	High Temperature /Humidity Storage	Endurance test applying the high temperature and high humidity storage for a long time	60°C 95%RH 240H
6	Temperature Cycle	Endurance test applying the low and high temperature cycle $\begin{array}{ccccccc} -30^{\circ}\text{C} & \longleftrightarrow & 25^{\circ}\text{C} & \longleftrightarrow & 80^{\circ}\text{C} & \longleftrightarrow & 25^{\circ}\text{C} \\ 30\text{min} & & 5\text{min} & & 30\text{min} & & 5\text{min} \end{array}$ $\xleftarrow{\hspace{10em}}$ 1 cycle $\xrightarrow{\hspace{10em}}$	-30°C/80°C 10 cycles
7	Vibration Test (package state)	Endurance test applying the vibration during transportation	10Hz~500Hz, 100m/s ² , 120min
8	Shock Test (package state)	Endurance test applying the shock during transportation	Half-sinewave, 300m/s ² , 18ms
9	Atmospheric Pressure Test	Endurance test applying the atmospheric pressure during transportation by air	25kPa 16H



7.2 Failure Judgment Criterion

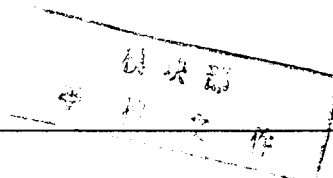
Criterion Item	Test Item No.									Failure Judgement Criterion
	1	2	3	4	5	6	7	8	9	
Basic Specification	0	0	0	0	0	0	0	0	0	Out of the basic Specification
Electrical specification	0	0	0	0	0					Out of the electrical specification
Mechanical Specification							0	0		Out of the mechanical specification
Optical Characteristic	0	0	0	0	0	0			0	Out of the optical specification
Remark	Basic specification = Optical specification + Mechanical specification									

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8 Precautions for use of LCD Modules

8.1 Handling Precautions

- 8.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
- 8.1.2 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.
- 8.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- 8.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.
- 1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:
 - Isopropyl alcohol
 - Ethyl alcoholSolvents other than those mentioned above may damage the polarizer. Especially, do not use the following:
 - Water
 - Ketone
 - Aromatic solvents
- 8.1.6 Do not attempt to disassemble the LCD Module.
- 8.1.7 If the logic circuit power is off, do not apply the input signals.
- 8.1.8 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
 - a. Be sure to ground the body when handling the LCD Modules.
 - b. Tools required for assembly, such as soldering irons, must be properly ground.
 - c. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.
 - d. The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.



8.2 Storage precautions

8.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

8.2.2 The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

temperature : $0^{\circ}\text{C} \sim 40^{\circ}\text{C}$

relatively humidity: $\leq 80\%$

8.2.3 The LCD modules should be stored in the room without acid, alkali and harmful gas.

8.3 The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.

