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MDT0240A12SH-SPI	240 x 320	SPI Interface	TFT Module

Specification

Version: 1	Date: 10/11/2021

Revision

1	08/11/2021	First issue

Display Features	
Display Size	2.40”
Resolution	240 x 320
Orientation	Portrait
Appearance	RGB
Logic Voltage	3.3V
Interface	SPI
Brightness	500 cd/m^2
Touchscreen	---
Module Size	42.72 x 60.26 x 2.25mm
Operating Temperature	-20°C ~ +70°C
Pinout	20 way FFC
Pitch	0.5mm

RoHS compliant

Box Quantity	Weight / Display
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* - For full design functionality, please use this specification in conjunction with the ST7789V specification.(Provided Separately)

Display Accessories

Part Number	Description

Optional Variants

Appearances	Voltage

Summary

TFT 2.4”is a TN transmissive type color active matrix TFT liquid crystal display that use amorphous silicon TFT as switching devices. This module is a composed of a TFT_LCD module, It is usually designed for industrial application and this module follows RoHs,

General Specifications

- Size: 2.4” inch
- Dot Matrix: 240 x RGB x 320(TFT) dots
- Module dimension: 42.72(W) x 60.26(H) x 2.25(D) mm
- Active area: 36.72 x 48.96 mm
- Pixel Pitch: 0.153 x 0.153 mm
- LCD type: TFT, Normally White, Transmissive
- TFT Interface: SPI
- TFT Driver IC: ST7789V or Equivalent
- View Direction: 6 o’clock
- Gray Scale Inversion Direction: 12 o’clock
- Aspect Ratio: Portrait
- Backlight Type: LED,Normally White
- With /Without TP: Without TP
- Surface: Glare

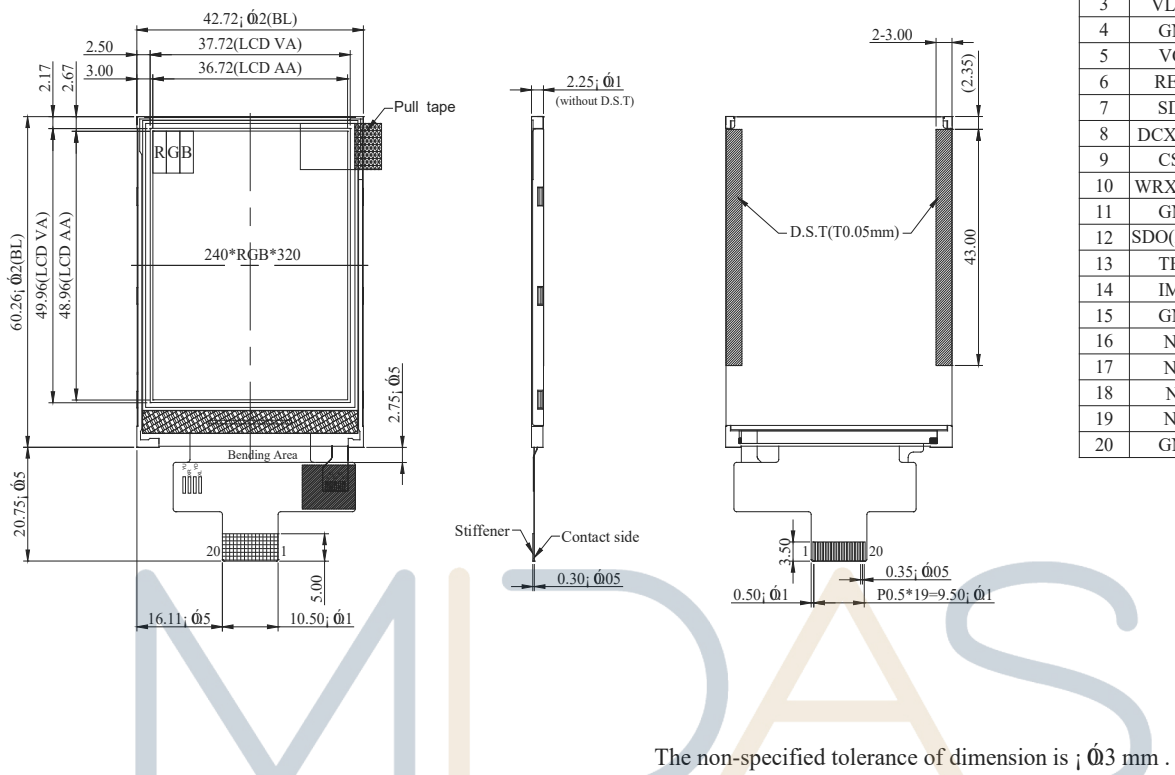
*Color tone slight changed by temperature and driving voltage.

Interface

1. LCM PIN Definition

<table>
<tr><th>NO</th><th>Symbol</th><th>Function</th></tr>
<tr><td>1</td><td>GND</td><td>Ground</td></tr>
<tr><td>2</td><td>VLED+</td><td>Anode of LED backlight.</td></tr>
<tr><td>3</td><td>VLED-</td><td>Cathode of LED backlight.</td></tr>
<tr><td>4</td><td>GND</td><td>Ground</td></tr>
<tr><td>5</td><td>VCC</td><td>Power supply</td></tr>
<tr><td>6</td><td>RESET</td><td>System reset pin. (RESX) signal is active low</td></tr>
<tr><td>7</td><td>SDA</td><td>When IM3: Low, SPI interface input/output pin.
When IM3: High, SPI interface input pin.
The data is latched on the rising edge of the SCL signal.
If not used, please fix this pin at VDDI or DGND level.</td></tr>
<tr><td>8</td><td>DCX(SCL)</td><td>This pin is used to be serial interface clock.
DCX=’1’: display data or parameter.
DCX=’0’: command data.
If not used, please fix this pin at VDDI or DGND.</td></tr>
<tr><td>9</td><td>CSX</td><td>Chip selection pin
Low enable.
High disable.</td></tr>
<tr><td>10</td><td>WRX(D/CX)</td><td>Display data/command selection pin in 4-line serial interface.
Second Data lane in 2 data lane serial interface.
If not used, please fix this pin at VDDI or DGND.</td></tr>
<tr><td>11</td><td>GND</td><td>Ground</td></tr>
<tr><td>12</td><td>SDO(DOUT)</td><td>SPI interface output pin.
The data is output on the falling edge of the SCL signal.
If not used, let this pin open.</td></tr>
<tr><td>13</td><td>TE</td><td>Tearing effect signal is used to synchronize MCU to frame memory writing. If not used, please let this pin open</td></tr>
<tr><td>14</td><td>IM3</td><td>The MCU interface mode select.
<table>
<tr><th>IM3</th><th>IM2</th><th>IM1</th><th>IM0</th><th>MPU Interface Mode</th><th>Data pin</th></tr>
<tr><td>0</td><td>1</td><td>1</td><td>0</td><td>4-line 8bit serial I/F</td><td>SDA: in/out</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>0</td><td>4-line 8bit serial I/F Ⅱ</td><td>SDA:in/
SDO: out</td></tr>
</table></td></tr>
<tr><td>15</td><td>GND</td><td>Ground</td></tr>
<tr><td>16-19</td><td>NC</td><td>No connection</td></tr>
<tr><td>20</td><td>GND</td><td>Ground</td></tr>
</table>

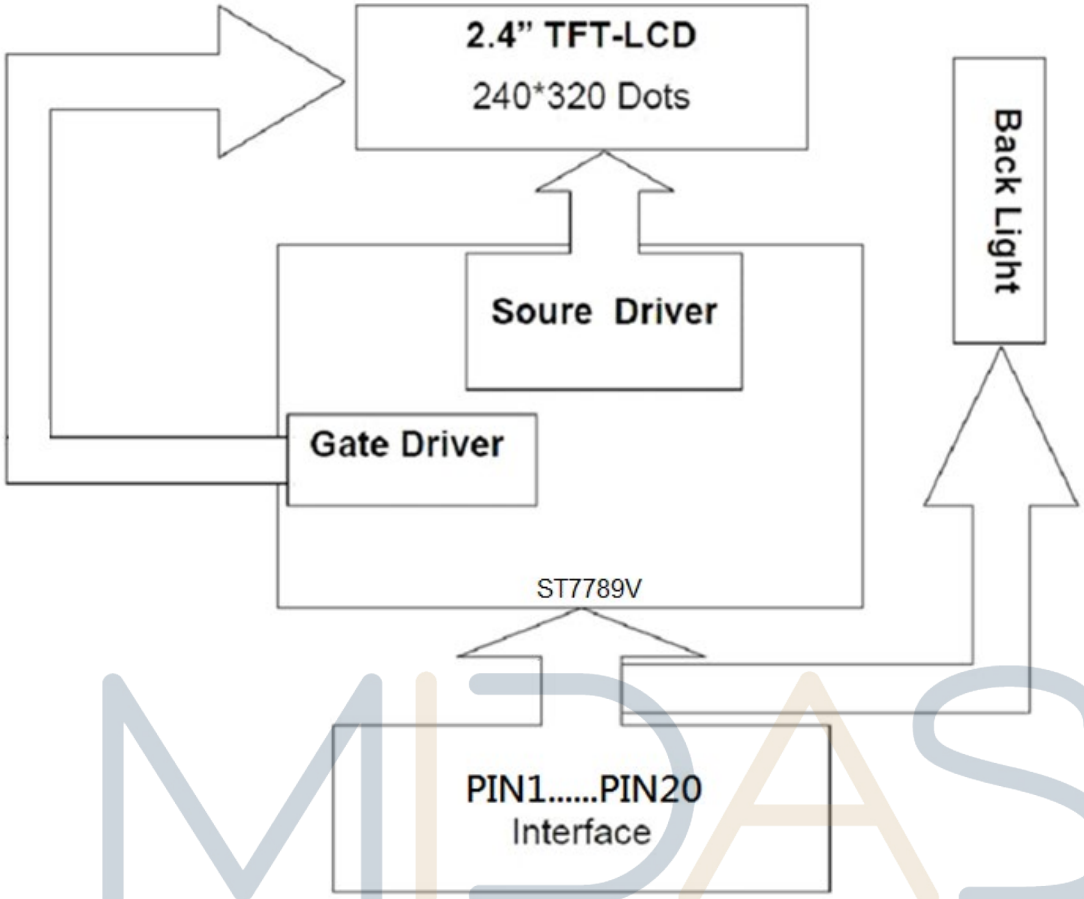
Contour Drawing



PIN NO.	SYMBOL
1	GND
2	VLED+
3	VLED-
4	GND
5	VCC
6	RESET
7	SDA
8	DCX(SCL)
9	CSX
10	WRX(D/CX)
11	GND
12	SDO(DOUT)
13	TE
14	IM3
15	GND
16	NC
17	NC
18	NC
19	NC
20	GND

The non-specified tolerance of dimension is ¡ Ó3 mm .

Block Diagram



Absolute Maximum Ratings

Item	Symbol	Min	Typ	Max	Unit
Operating Temperature	TOP	-20	—	+70	℃
Storage Temperature	TST	-30	—	+80	℃

Note: Device is subject to be damaged permanently if stresses beyond those absolute maximum ratings listed above

1. Temp. ≦60℃, 90% RH MAX. Temp.＞60℃, Absolute humidity shall be less than 90% RH at 60℃

Electrical Characteristics

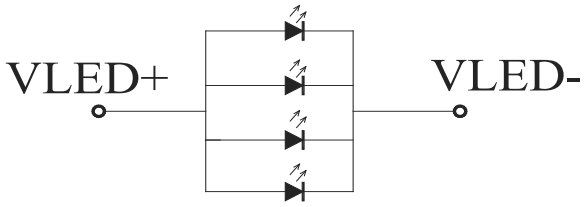
1. Operating conditions

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage For Analog	V_{CC}	—	2.4	3.3	3.6	V
Supply Current For LCM	I_{CC}	—	—	6.4	9.6	mA

2. LED driving conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
LED current	—	—	80	—	mA	—
Power Consumption	—	—	256	—	mW	—
LED voltage	VLED+	2.8	3.1	3.3	V	Note 1
LED Life Time	—	—	50,000	—	Hr	Note 2,3,4

Note 1 : There are 1 Groups LED



Back Light Circuit

Note 2 : Ta = 25 ℃

Note 3 : Brightness to be decreased to 50% of the initial value

Note 4 : The single LED lamp case

AC Characteristics

1. Serial Interface Characteristics (4-line serial)

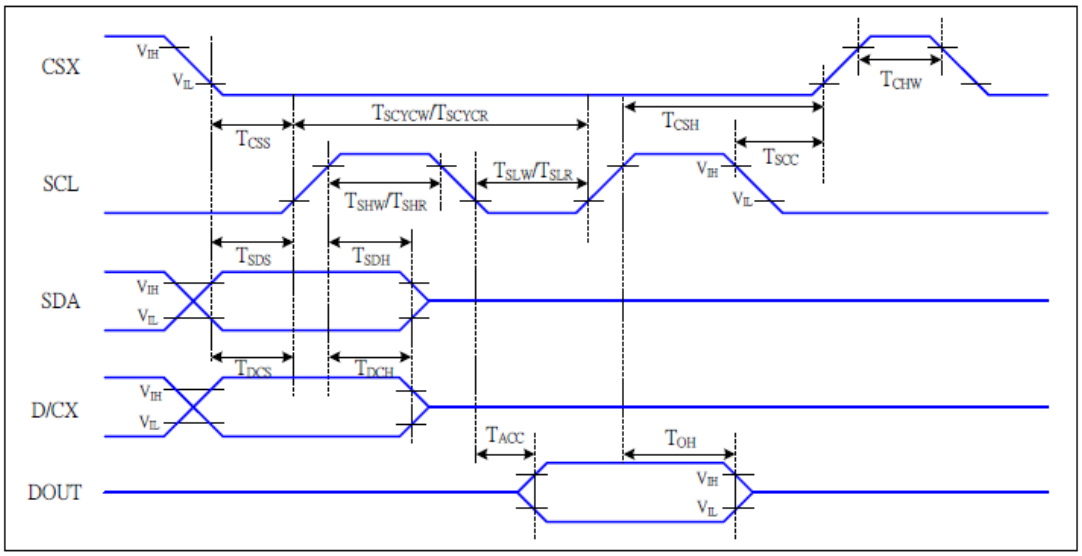


Figure 1 4-line serial Interface Timing Characteristics

VDDI=1.65 to 3.6V, VDD=2.4 to 3.6V, AGND=DGND=0V, Ta=25 ℃

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	T_{CSS}	Chip select setup time (write)	15		ns	
	T_{CSH}	Chip select hold time (write)	15		ns	
	T_{CSS}	Chip select setup time (read)	60		ns	
	T_{SCC}	Chip select hold time (read)	65		ns	
	T_{CHW}	Chip select "H" pulse width	40		ns	
SCL	T_{SCYCW}	Serial clock cycle (Write)	16		ns	-write command & data ram
	T_{SHW}	SCL "H" pulse width (Write)	7		ns	
	T_{SLW}	SCL "L" pulse width (Write)	7		ns	
	T_{SCYCR}	Serial clock cycle (Read)	150		ns	-read command & data ram
	T_{SHR}	SCL "H" pulse width (Read)	60		ns	
	T_{SLR}	SCL "L" pulse width (Read)	60		ns	
D/CX	T_{DCS}	D/CX setup time	10		ns	
	T_{DCH}	D/CX hold time	10		ns	
SDA (DIN)	T_{SDS}	Data setup time	7		ns	
	T_{SDH}	Data hold time	7		ns	
DOUT	T_{ACC}	Access time	10	50	ns	For maximum CL=30pF
	T_{OH}	Output disable time	15	50	ns	For minimum CL=8pF

Table 1 4-line serial Interface Characteristics

Note : The rising time and falling time (Tr, Tf) of input signal are specified at 15 ns or less.
Logic high and low levels arespecified as 30% and 70% of VDDI for Input signals.

2. Reset Timing:

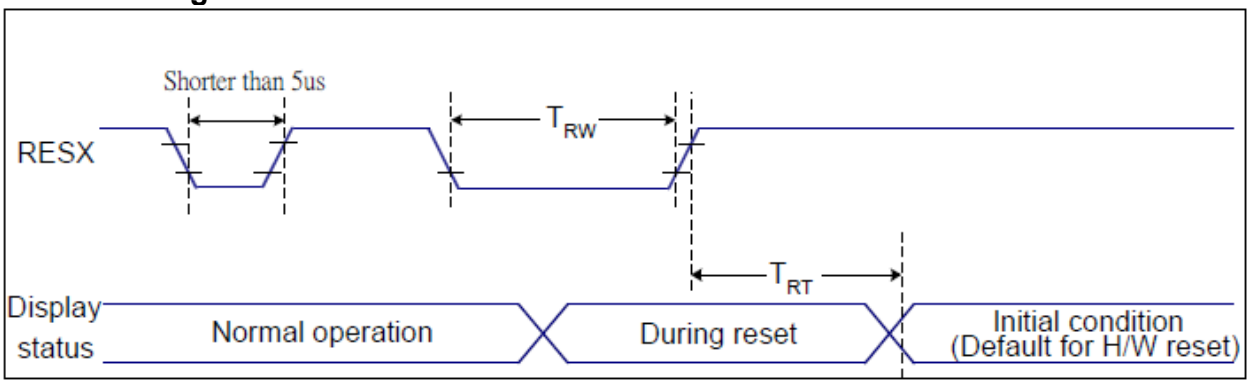


Figure 2 Reset Timing

VDDI=1.65 to 3.6V, VDD=2.4 to 3.6V, AGND=DGND=0V, Ta=25 ℃

Related Pins	Symbol	Parameter	MIN	MAX	Unit
RESX	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel	-	5 (Note 1, 5)	ms
				120 (Note 1, 6, 7)	ms

Notes:

1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.
2. Spike due to an electrostatic discharge on RESXline does not cause irregular system reset according to the table below:

RESX Pulse	Action
Shorter than 5us	Reset Rejected
Longer than 9us	Reset
Between 5us and 9us	Reset starts

3. During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In –mode.) and then return to Default condition for Hardware Reset.
4. Spike Rejection also applies during a valid reset pulse as shown below:

Optical Characteristics

Item		Symbol	Condition.	Min	Typ.	Max.	Unit	Remark
Response time		Tr	θ=0°、Φ=0°	-	4	8	ms	Note 3
		Tf		-	12	24	ms	
Contrast ratio		CR	At optimized viewing angle	400	500	-	-	Note 4
Color Chromaticity	White	Wx	θ=0°、Φ=0	0.253	0.303	0.353		Note 2,6,7
		Wy		0.275	0.325	0.375		
Viewing angle (Gray Scale Inversion Direction)	Hor.	ΘR	CR≧10	35	45	-	Deg.	Note 1
		ΘL		35	45	-		
	Ver.	ΦT		35	45	-		
		ΦB		10	20	-		
Brightness		-	-	400	500	-	cd/m²	Center of display
Uniformity		(U)	-	75	-	-	%	Note5

Ta=25±2℃

Note 1: Definition of viewing angle range

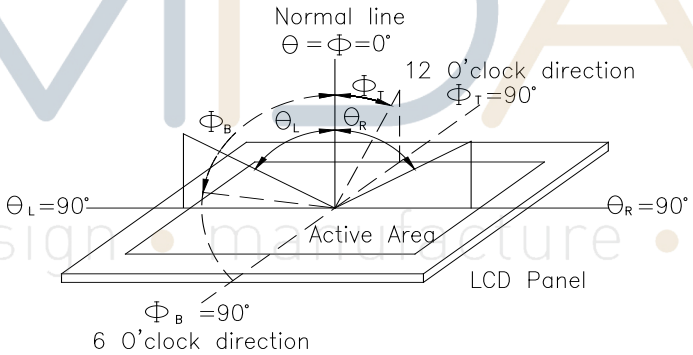


Fig. 10.1. Definition of viewing angle

Note 2: Test equipment setup:

After stabilizing and leaving the panel alone at a driven temperature for 10 minutes, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-7 or BM-5 luminance meter 1.0° field of view at a distance of 50cm and normal direction.

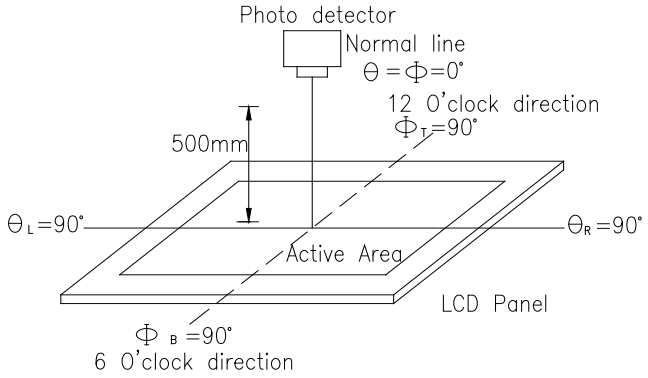
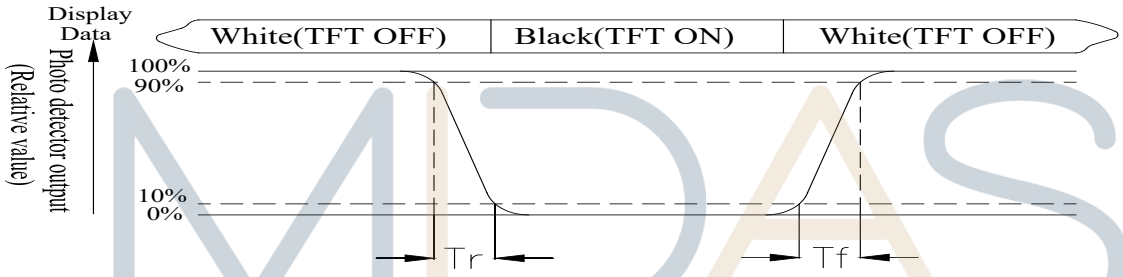


Fig. 10.2. Optical measurement system setup

Note 3: Definition of Response time:
The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time, Tr, is the time between photo detector output intensity changed from 90%to 10%. And fall time, Tf, is the time between photo detector output intensity changed from 10%to 90%



Note 4: Definition of contrast ratio:
The contrast ratio is defined as the following expression.

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the "White" state}}{\text{Luminance measured when LCD on the "Black" state}}$$

Note 5: Definition of Luminance Uniformity
Active area is divided into 9 measuring areas (reference the picture in below). Every measuring point is placed at the center of each measuring area.
Luminance Uniformity (U) = Lmin/Lmax x100%
L = Active area length
W = Active area width

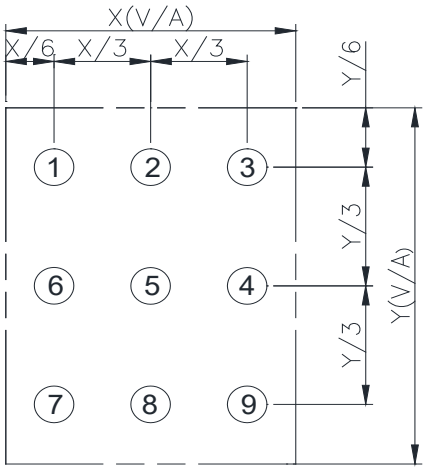


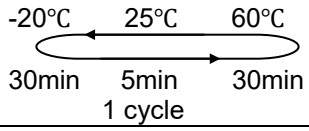
Fig 10.3. Definition of uniformity

Note 6: Definition of color chromaticity (CIE 1931)
Color coordinates measured at the center point of LCD

Note 7: Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

Reliability

Content of Reliability Test (Wide temperature, -20℃~70℃)

Environmental Test			
Test Item	**Content of Test**	**Test Condition**	**Note**
High Temperature storage	Endurance test applying the high storage temperature for a long time.	80℃ 96hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-30℃ 96hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	70℃ 96hrs	——
Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	-20℃ 96hrs	1
High Temperature/ Humidity Operation	The module should be allowed to stand at 60℃,85%RH max	60℃,85%RH 96hrs	1,2
Thermal shock resistance	The sample should be allowed stand the following 10 cycles of operation  	-20℃/60℃ 10 cycles	——
Vibration test	Endurance test applying the vibration during transportation and using.	Total fixed amplitude : 1.5mm Vibration Frequency : 10~55Hz One cycle 60 seconds to 3 directions of X,Y,Z for Each 15 minutes	3
Static electricity test	Endurance test applying the electric stress to the terminal.	VS=±600V(contact), ±800v(air), RS=330Ω CS=150pF 10 times	——

Note1: No dew condensation to be observed.

Note2: The function test shall be conducted after 4 hours storage at the normal Temperature and humidity after remove from the test chamber.

Note3: The packing have to including into the vibration testing.