

# Specification for Approval

PRODUCT NUMBER:

IE-RT20825664Y9-1

<b>CUSTOMER</b>
<b>APPROVED BY</b>
<b>DATE:</b>
<b>RITDISPLAY CORP. APPROVED</b>

## REVISION RECORD

REV.	REVISION DESCRIPTION	REV. DATE	REMARK
X01	■ INITIAL RELEASE	2019. 12. 02	
A01	■ Transfer from X version ■ Add the packing specification	2020. 04. 10	Page 18
A02	■ MODIFY OPERATING/STORAGR TEMP ■ MODIFY LIFETIME SPECIFICATION NOTE ■ MODIFY RELIABILITY TEST TIME (120 hrs modify to 240hrs) ■ MODIFY MEASUREMENT APPARATUS	2024. 04. 11	Page 4、 6, 8, 16, 28

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## **1. SCOPE**

The purpose of this specification is to define the general provisions and quality requirements that apply to the supply of display cells manufactured by RiTdisplay. This document, together with the Module Assembly Drawing, is the highest-level specification for this product. It describes the product, identifies supporting documents and contains specifications.

## **2. FEATURES**

- Small molecular organic light emitting diode.
- Color : Yellow - 16 gray scale.
- Panel resolution : 256x64
- Driver IC : SH1122G
- Excellent quick response time.
- Extremely thin thickness for best mechanism design : 1.61 mm
- High contrast : 10,000:1
- Wide viewing angle : 160°
- Strong environmental resistance. - 4 wire serial peripheral interface.
- Wide range of operating temperature : -40 to 85°C - Anti-glare polarizer.

## **3. MECHANICAL DATA**

NO	ITEM	SPECIFICATION	UNIT
1	Dot Matrix	256 x 64	dot
2	Dot Size	0.18 (W) x 0.18 (H)	mm <sup>2</sup>
3	Dot Pitch	0.2 (W) x 0.2 (H)	mm <sup>2</sup>
4	Aperture Rate	81	%
5	Active Area	51.18 (W) x 12.78 (H)	mm <sup>2</sup>
6	Panel Size	62.5 (W) x 20.6 (H)	mm <sup>2</sup>
7*	Panel Thickness	1.42 ± 0.15	mm
8	Module Size	127.5 (W) x 20.6 (H) x 1.61 (T)	mm <sup>3</sup>
9	Diagonal A/A size	2.08	inch
10	Module Weight	4.45 ± 10%	gram

\* Panel thickness includes substrate glass, cover glass and UV glue thickness.

## 4. MAXIMUM RATINGS

ITEM	MIN	MAX	UNIT	Condition	Remark
Supply Voltage ( $V_{DD1}$ )	-0.3	3.6	V	$T_a = 25^\circ\text{C}$	IC maximum rating
Supply Voltage ( $V_{PP}$ )	8	14.5	V	$T_a = 25^\circ\text{C}$	IC maximum rating
Operating Temp.	-40	85	$^\circ\text{C}$	-	Note (2)
Storage Temp	-40	90	$^\circ\text{C}$	-	Note (2)

Note:

- (1) Maximum ratings are those values beyond which damages to the OLED module may occur. The OLED functional operation should be restricted to the limits in the section 6. Electrical Characteristics tables.
- (2) The defined temperature ranges do not include the polarizer. The maximum withstood temperature of the polarizer should be  $80^\circ\text{C}$ .

## 5. ELECTRICAL CHARACTERISTICS

### 5.1 D.C ELECTRICAL CHARACTERISTICS

SYMBOL	PARAMETERS	TEST CONDITION	MIN	TYP	MAX	UNIT
$V_{PP}$	Analog power supply (for OLED panel)	$T_a 25^\circ\text{C}$	11.5	12	12.5	V
$V_{DD1}$	Digital power supply	$T_a 25^\circ\text{C}$	1.65	-	3.5	V
$V_{IH}$	High logic input level		$0.8 * V_{DD1}$	-	$V_{DD1}$	V
$V_{IL}$	Low logic input level		$V_{SS}$	-	$0.2 * V_{DD1}$	V
$V_{OH}$	High logic output level	$I_{OH} = -0.5\text{mA}$	$0.8 * V_{DD1}$	-	$V_{DD1}$	V
$V_{OL}$	Low logic output level	$I_{OL} = 0.5\text{mA}$	$V_{SS}$	-	$0.2 * V_{DD1}$	V

Note: The  $V_{PP}$  input must keep in a stable value; ripple and noise are not allowed.

## 5.2 ELECTRO-OPTICAL CHARACTERISTICS

### PANEL ELECTRICAL SPECIFICATIONS

PARAMETER	MIN	TYP.	MAX	UNITS	COMMENTS
Normal mode current (IPP)	-	30	33	mA	All pixels on (1)
	-	10.5	11.5	mA	30% pixels on (1)
Standby mode current (IPP)	-	2	3	mA	Standby mode 10% pixels on (2)
Normal mode power consumption	-	360	396	mW	All pixels on (1)
	-	126	138	mW	30% pixels on (1)
Standby mode power consumption	-	24	36	mW	Standby mode 10% pixels on (2)
IDD1 sleep mode current	-	-	5	uA	Sleep mode Current (3)
IPP sleep mode current	-	-	5	uA	Sleep mode Current (3)
Normal mode Luminance	130	180	-	cd/m <sup>2</sup>	Display Average
Standby Luminance		50	-	cd/m <sup>2</sup>	
CIE <sub>x</sub> (Yellow)	0.43	0.47	0.51		CIE1931
CIE <sub>y</sub> (Yellow)	0.47	0.51	0.55		CIE1931
Dark Room Contrast	10,000:1				
Viewing Angle	160			degree	
Response Time		10		μs	

(1) Normal mode condition : -

Driving Voltage : 12V

- Contrast setting : 0x32
- Frame rate : 105Hz
- Duty setting : 1/64 (2) Standby mode condition :
- Driving Voltage : 12V
- Contrast setting : 0x00
- Frame rate : 105Hz
- Duty setting : 1/64 (3) Sleep mode condition :

When send 0xae command OLED display off and memory data will be maintained.

(4) Wake up condition :

When send 0xaf command OLED will be turned on.

## 6. LIFETIME SPECIFICATION

ITEM	MIN	UNIT	Condition	Remark
Life Time	30,000	Hrs	230 cd/m <sup>2</sup> , alternating checkerboard	Note (1)
Life Time	50,000	Hrs	180 cd/m <sup>2</sup> , alternating checkerboard	Note (2)
Life Time	90,000	Hrs	130 cd/m <sup>2</sup> , alternating checkerboard	Note (3)

Note:

Lifetime Expectancy is not guaranteed one but expected lifetime in normal condition.

(A) Under VPP = 12V, Ta = 25°C, 50% RH.

(B) Life time is defined the amount of time when the luminance has decayed to less than 50% of the initial measured luminance.

(1) Setting of 230 cd/m<sup>2</sup> :

- Contrast setting : 0x47

- Frame rate : 105Hz

- Duty setting : 1/64 (2) Setting of 180 cd/m<sup>2</sup> :

- Contrast setting : 0x32

- Frame rate : 105Hz

- Duty setting : 1/64 (3) Setting of 130 cd/m<sup>2</sup> :

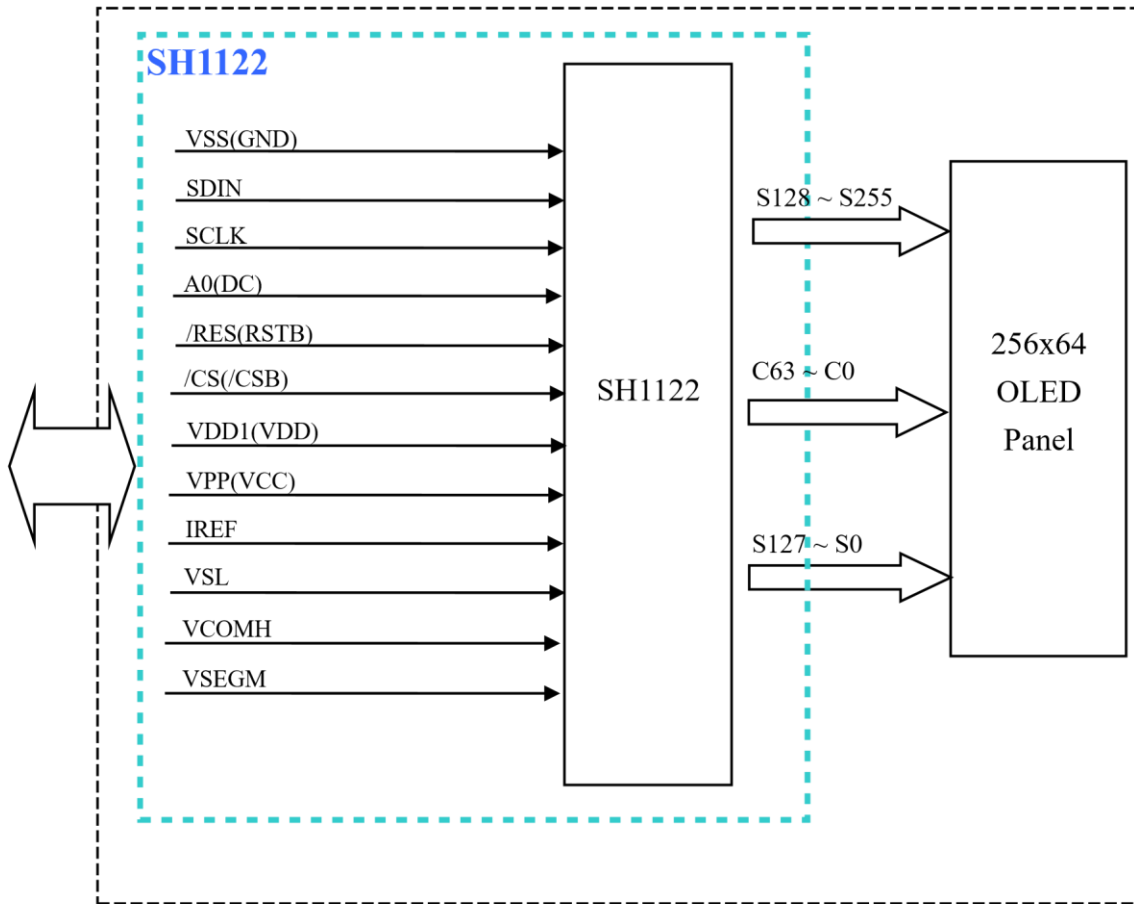
- Contrast setting : 0x1e

- Frame rate : 105Hz

- Duty setting : 1/64

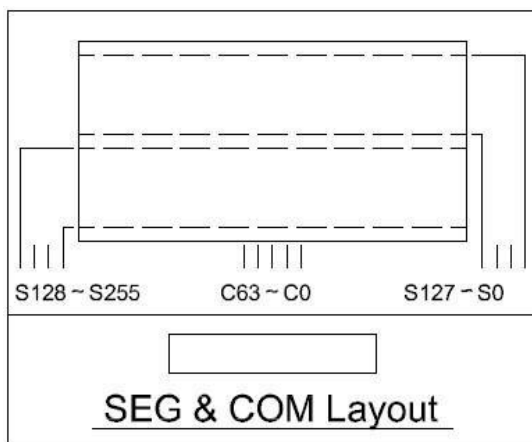
## 7. INTERFACE

### 7.1 FUNCTION BLOCK DIAGRAM



RiTdisplay 256X64 OLED Module

### 7.2 PANEL LAYOUT DIAGRAM



### 7.3 PIN ASSIGNMENTS

PIN NO.	PIN NAME	DESCRIPTION	Setting at each interface		
			8080 parallel	SPI	IIC
1	VSS (GND)	Ground pin.			
2	SDIN	When the serial interface is selected, then D0 serves as the serial clock input pin (SCL) and D1 serves as the serial data input pin (SI).	NA	SI	NA
3	SCLK		NA	SCL	NA
4	A0 (DC)	This is the Data/Command control pin that determines whether the data bits are data or a command.	NA	A0	NA
5	/RES (RSTB)	This is a reset signal input pin. When RES is set to "L", the settings are initialized.	NA	/RES	NA
6	/CS (/CSB)	This pin is the chip select input. When CS = "L", then the chip select becomes active, and data/command I/O is enabled.	NA	/CS	NA
7	VDD1 (VDD)	Power supply for logic and input/output.			
8	VSS (GND)	Ground pin.			
9	NC	No connection.			
10	VPP (VCC)	Power supply for panel driving voltage.			
11	IREF	This is a segment current reference pin. A resistor should be connected between this pin and VSS.			
12	VSL	This is a segment voltage reference pin. A capacitor should be connected between this pin and VSS.			
13	VCOMH	This is voltage output high level for common signals. A capacitor should be connected between this pin and VSS.			
14	VSEGM	This is voltage output high level for segment pre-charge. A capacitor should be connected between this pin and VSS.			

**Note** Low is connected to VSS(GND): High is connected to VDD1(VDD)

## 7.4 GRAPHIC DISPLAY DATA RAM ADDRESS MAP

The Display Data RAM is a bit mapped static RAM holding the bit pattern to be displayed. The size of the RAM is 256 X 64 X 4 bits.

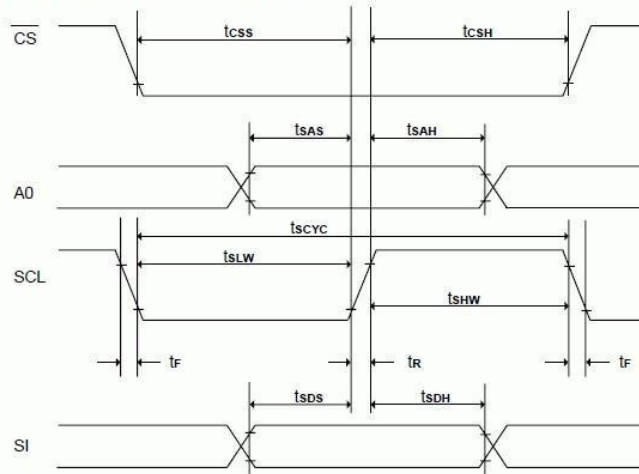
For mechanical flexibility, re-mapping on both segment and common outputs can be selected by software.

For vertical scrolling of the display, an internal register storing display start line can be set to control the portion of the RAM data to be mapped to the display.

Column Row	COL0								---	COL127								
0	D7	D6	D5	D4	D3	D2	D1	D0	---	D7	D6	D5	D4	D3	D2	D1	D0	
1	D7	D6	D5	D4	D3	D2	D1	D0	---	D7	D6	D5	D4	D3	D2	D1	D0	
2	D7	D6	D5	D4	D3	D2	D1	D0	---	D7	D6	D5	D4	D3	D2	D1	D0	
---	---								---	---								
62	D7	D6	D5	D4	D3	D2	D1	D0	---	D7	D6	D5	D4	D3	D2	D1	D0	
63	D7	D6	D5	D4	D3	D2	D1	D0	---	D7	D6	D5	D4	D3	D2	D1	D0	
ADC	= 0	SEG0				SEG1				---	SEG254				SEG255			
	= 1	SEG255				SEG254				---	SEG1				SEG0			

## 7.5 INTERFACE TIMING CHART

System buses Write characteristics (For 4 wire SPI)



( $V_{DD1} = V_{DD2} = 1.65 - 3.5V$ ,  $T_A = +25^\circ C$ )

Symbol	Parameter	Min.	Typ.	Max.	Unit	Condition
$t_{SCYC}$	Serial clock cycle	500	-	-	ns	
$t_{SAS}$	Address setup time	300	-	-	ns	
$t_{SAH}$	Address hold time	300	-	-	ns	
$t_{SDS}$	Data setup time	200	-	-	ns	
$t_{SDH}$	Data hold time	200	-	-	ns	
$t_{CSS}$	$\overline{CS}$ setup time	240	-	-	ns	
$t_{CSH}$	$\overline{CS}$ hold time	120	-	-	ns	
$t_{SHW}$	Serial clock H pulse width	200	-	-	ns	
$t_{SLW}$	Serial clock L pulse width	200	-	-	ns	
$t_R$	Rise time	-	-	30	ns	
$t_F$	Fall time	-	-	30	ns	

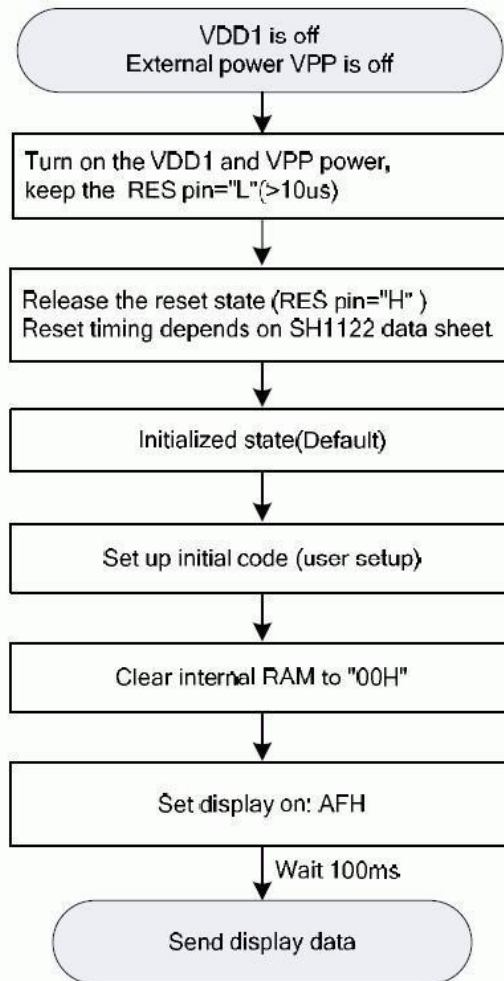
( $V_{DD1} = V_{DD2} = 2.4 - 3.5V$ ,  $T_A = +25^\circ C$ )

Symbol	Parameter	Min.	Typ.	Max.	Unit	Condition
$t_{SCYC}$	Serial clock cycle	250	-	-	ns	
$t_{SAS}$	Address setup time	150	-	-	ns	
$t_{SAH}$	Address hold time	150	-	-	ns	
$t_{SDS}$	Data setup time	100	-	-	ns	
$t_{SDH}$	Data hold time	100	-	-	ns	
$t_{CSS}$	$\overline{CS}$ setup time	120	-	-	ns	
$t_{CSH}$	$\overline{CS}$ hold time	60	-	-	ns	
$t_{SHW}$	Serial clock H pulse width	100	-	-	ns	
$t_{SLW}$	Serial clock L pulse width	100	-	-	ns	
$t_R$	Rise time	-	-	15	ns	
$t_F$	Fall time	-	-	15	ns	

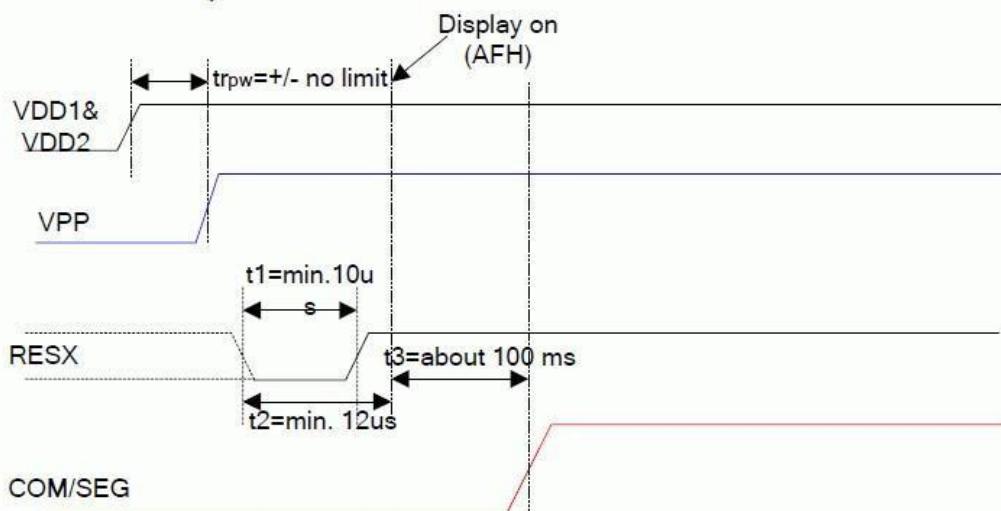
## 8. POWER ON / OFF SEQUENCE & APPLICATION CIRCUIT

### 8.1 POWER ON / OFF SEQUENCE

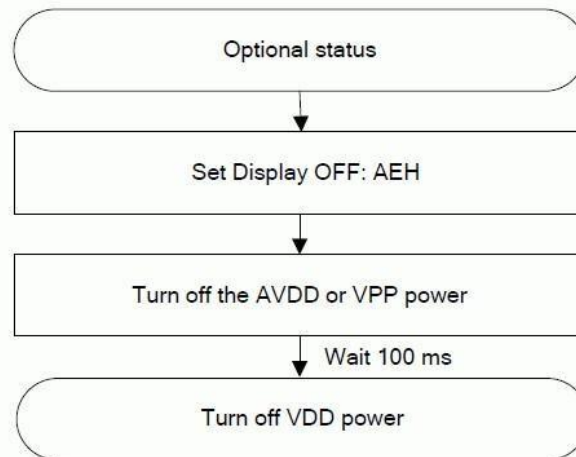
#### POWER ON



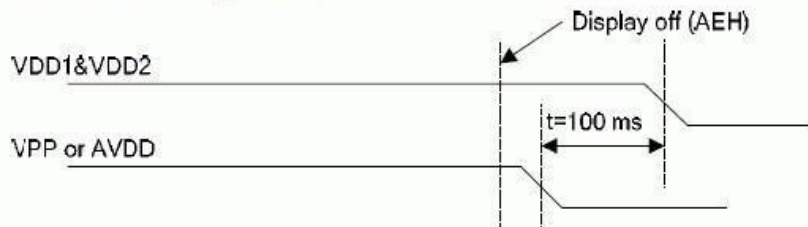
Power on sequence:



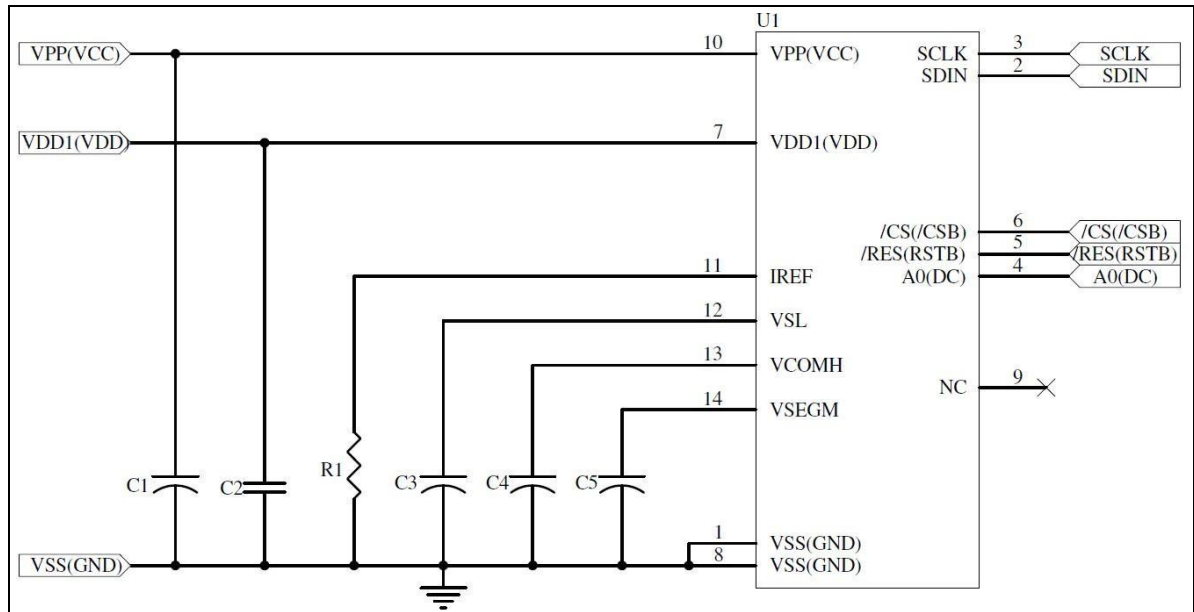
## POWER OFF



Power off sequence:



## 8.2 APPLICATION CIRCUIT



### Recommend components:

C1, C3, C4, C5: 4.7uF/25V(Tantalum type) or VISHAY (572D475X0025A2T) C2:

1uF/16V(0603)

R1: 620K ohm 1%(0603)

**This circuit is for SPI interface.**

### 8.3 COMMAND TABLE

Refer to IC Spec.: SH1122G

### 9. RELIABILITY TEST CONDITIONS

No.	Items	Specification	Quantity
1	High temp. (Non-operation)	85°C, 240hrs	5
2	High temp. (Operation)	70°C, 240hrs	5
3	Low temp. (Operation)	-40°C, 240hrs	5
4	High temp. / High humidity (Operation)	65°C, 90%RH, 240hrs	5
5	Thermal shock (Nonoperation)	-40°C ~85°C (-40°C /30min; transit /3min; 85°C /30min; transit /3min) 1cycle: 66min, 100 cycles	5
6	Vibration	Frequency : 5~50HZ, 0.5G Scan rate : 1 oct/min Time : 2 hrs/axis Test axis : X, Y, Z	1 Carton
7	Drop	Height: 120cm Sequence : 1 angle、 3 edges and 6 faces Cycles: 1	1 Carton
8	ESD (Non-operation)	Air discharge model, ±8kV, 10 times	5

#### Test and measurement conditions

1. All measurements shall not be started until the specimens attain to temperature stability.
2. The degradation of Polarizer are ignored for item 1, 4 & 5.

#### Evaluation criteria 1. The function

test is OK.

2. No observable defects.
3. Luminance: > 50% of initial value.
4. Current consumption: within ± 50% of initial value.



## 11. OUTGOING INSPECTION PROVISION

### 1. SAMPLING METHOD

MIL-STD-1916 / inspection level III / normal inspection / single sample inspection

Major Level III ; Minor Level II

MIL-STD-1916 樣本代字對照表							
批量	驗證水準 (VL)						
	VII	VI	V	IV	III	II	I
2 ~ 170	A	A	A	A	A	A	A
171 ~ 288	A	A	A	A	A	A	B
289 ~ 544	A	A	A	A	A	B	C
545 ~ 960	A	A	A	A	B	C	D
961 ~ 1632	A	A	A	B	C	D	E
1633 ~ 3072	A	A	B	C	D	E	E
3073 ~ 5440	A	B	C	D	E	E	E
5441 ~ 9216	B	C	D	E	E	E	E
9217 ~ 17408	C	D	E	E	E	E	E
17409 ~ 30720	D	E	E	E	E	E	E
≥ 30721	E	E	E	E	E	E	E

Code (CL)	Verification Level (VL)							
	T	VII	VI	V	IV	III	II	I
	Sample size							
<b>A</b>	<b>3072</b>	<b>1280</b>	<b>512</b>	<b>192</b>	<b>80</b>	<b>32</b>	<b>12</b>	<b>5</b>
<b>B</b>	<b>4096</b>	<b>1536</b>	<b>640</b>	<b>256</b>	<b>96</b>	<b>40</b>	<b>16</b>	<b>6</b>
<b>C</b>	<b>5120</b>	<b>2048</b>	<b>768</b>	<b>320</b>	<b>128</b>	<b>48</b>	<b>20</b>	<b>8</b>
<b>D</b>	<b>6144</b>	<b>2560</b>	<b>1024</b>	<b>384</b>	<b>160</b>	<b>64</b>	<b>24</b>	<b>10</b>
<b>E</b>	<b>8192</b>	<b>3072</b>	<b>1280</b>	<b>512</b>	<b>192</b>	<b>80</b>	<b>32</b>	<b>12</b>

## 2. INSPECTION CONDITION

The inspection and measurement are performed under the following conditions, unless otherwise specified.

Temperature:  $25\pm 5^{\circ}\text{C}$  Humidity:

$50\pm 10\%\text{R.H.}$

Pressure: 860~1060hPa (mbar)

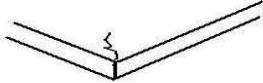
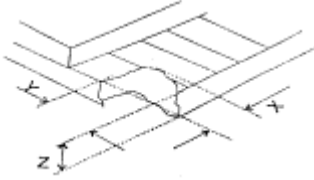
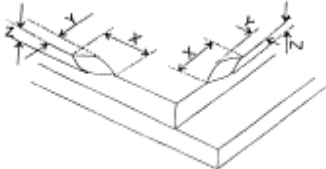
Distance between the panel and eyes of the inspector  $\geq 30\text{cm}$

### 3. SPECIFICATION FOR QUALITY CHECK

#### 3.1 DEFECT CLASSIFICATION

Severity	Inspection Item	Defect	Remark
Major Defect	Panel	(1) Non-displaying	
		(2) Line defects	
		(3) Malfunction	
		(4) Glass cracked	
	Film	(1) Film dimension out of specification	Can not be assembled
	Dimension	(1) Outline dimension out of specification	
Minor Defect	Panel	(1) Glass scratch	Appearance defect
		(2) Glass cutting NG	
		(3) Glass chip	
	Polarizer	(1) Polarizer scratch	
		(2) Stains on surface	
		(3) Polarizer bubbles	
	Displaying	(1) Dim spot, Bright spot, dust	
	Film	(1) Damage	
		(2) Foreign material	

### 3.2 OUTGOING SPECIFICATION

Item	Description	Criterion	AQL															
	1. Glass scratch	<table border="1"> <thead> <tr> <th data-bbox="703 445 935 607">Width (mm) W</th> <th data-bbox="938 445 1128 607">Length (mm) L</th> <th data-bbox="1131 445 1321 607">number of pieces permitted</th> </tr> </thead> <tbody> <tr> <td data-bbox="703 611 935 696"><math>W \leq 0.03</math></td> <td data-bbox="938 611 1128 696">Ignore</td> <td data-bbox="1131 611 1321 696">Ignore</td> </tr> <tr> <td data-bbox="703 701 935 786"><math>0.03 &lt; W \leq 0.05</math></td> <td data-bbox="938 701 1128 786"><math>L \leq 1</math></td> <td data-bbox="1131 701 1321 786">1</td> </tr> <tr> <td data-bbox="703 790 935 875"><math>0.05 &lt; W</math></td> <td data-bbox="938 790 1128 875">-----</td> <td data-bbox="1131 790 1321 875">None</td> </tr> <tr> <td data-bbox="703 880 935 965">beyond A.A.</td> <td data-bbox="938 880 1128 965">-----</td> <td data-bbox="1131 880 1321 965">Ignore</td> </tr> </tbody> </table>	Width (mm) W	Length (mm) L	number of pieces permitted	$W \leq 0.03$	Ignore	Ignore	$0.03 < W \leq 0.05$	$L \leq 1$	1	$0.05 < W$	-----	None	beyond A.A.	-----	Ignore	Minor
	Width (mm) W	Length (mm) L	number of pieces permitted															
	$W \leq 0.03$	Ignore	Ignore															
	$0.03 < W \leq 0.05$	$L \leq 1$	1															
	$0.05 < W$	-----	None															
beyond A.A.	-----	Ignore																
I. Panel	2. Glass crack	<p>(1) Propagation crack is not acceptable.</p> 	Major															
	3. Glass chip	<p>(1) Chip on corner</p>  <p>(2) Chip on edge</p> 	Minor															

Item	Description	Criterion	AQL																
I. Panel	3Glass chip	<table border="1" data-bbox="676 533 1295 813"> <thead> <tr> <th data-bbox="676 533 831 656">Chip on corner</th> <th data-bbox="831 533 986 656">Size (mm)</th> <th data-bbox="986 533 1141 656">Chip on edge</th> <th data-bbox="1141 533 1295 656">Size (mm)</th> </tr> </thead> <tbody> <tr> <td data-bbox="676 656 831 707">X</td> <td data-bbox="831 656 986 707"><math>\leq 1.5</math></td> <td data-bbox="986 656 1141 707">X</td> <td data-bbox="1141 656 1295 707"><math>\leq 3.0</math></td> </tr> <tr> <td data-bbox="676 707 831 759">Y</td> <td data-bbox="831 707 986 759"><math>\leq 2.0</math></td> <td data-bbox="986 707 1141 759">Y</td> <td data-bbox="1141 707 1295 759"><math>\leq 1.0</math></td> </tr> <tr> <td data-bbox="676 759 831 813">Z</td> <td data-bbox="831 759 986 813"><math>\leq t</math></td> <td data-bbox="986 759 1141 813">Z</td> <td data-bbox="1141 759 1295 813"><math>\leq t</math></td> </tr> </tbody> </table> <p data-bbox="715 819 1305 931">t = glass thickness Chip on the corner extending into the ITO contact is not acceptable.</p>	Chip on corner	Size (mm)	Chip on edge	Size (mm)	X	$\leq 1.5$	X	$\leq 3.0$	Y	$\leq 2.0$	Y	$\leq 1.0$	Z	$\leq t$	Z	$\leq t$	Minor
	Chip on corner	Size (mm)	Chip on edge	Size (mm)															
X	$\leq 1.5$	X	$\leq 3.0$																
Y	$\leq 2.0$	Y	$\leq 1.0$																
Z	$\leq t$	Z	$\leq t$																
4. Dimension	Refer to the drawing of the spec	Major																	
II. Polarizer	1. Scratch	Spot type in accordance with the criteria of "Item II-3. Polarizer bubble". Line type in accordance with the criteria of "Item I-1. Glass scratch".	Minor																
	2. Stains on surface	Stains cannot be removed even when wiped lightly with a soft cloth or similar cleaning.	Minor																
	3. Polarizer bubble	<p data-bbox="1102 1480 1182 1514">(mm)</p> <table border="1" data-bbox="726 1514 1262 1975"> <thead> <tr> <th data-bbox="726 1514 992 1648">尺寸 Size</th> <th data-bbox="992 1514 1262 1648">number of pieces permitted</th> </tr> </thead> <tbody> <tr> <td data-bbox="726 1648 992 1749"><math>\Phi \leq 0.2</math></td> <td data-bbox="992 1648 1262 1749">Ignore</td> </tr> <tr> <td data-bbox="726 1749 992 1816"><math>0.2 &lt; \Phi \leq 0.5</math></td> <td data-bbox="992 1749 1262 1816">2</td> </tr> <tr> <td data-bbox="726 1816 992 1883"><math>0.5 &lt; \Phi</math></td> <td data-bbox="992 1816 1262 1883">0</td> </tr> <tr> <td data-bbox="726 1883 992 1975">beyond A.A.</td> <td data-bbox="992 1883 1262 1975">Ignore</td> </tr> </tbody> </table>	尺寸 Size	number of pieces permitted	$\Phi \leq 0.2$	Ignore	$0.2 < \Phi \leq 0.5$	2	$0.5 < \Phi$	0	beyond A.A.	Ignore	Minor						
尺寸 Size	number of pieces permitted																		
$\Phi \leq 0.2$	Ignore																		
$0.2 < \Phi \leq 0.5$	2																		
$0.5 < \Phi$	0																		
beyond A.A.	Ignore																		

Item	Description	Criterion	AQL											
III. Displaying	1. Power consumption	The module operating current consumption should not go beyond the standard indicated in Product Specification	Major											
	2. Pixel size	The tolerance of display pixel dimension should be within $\pm 25\%$ of specification.	Minor											
	3. Color	Refer to the product specification.	Major											
	4. Luminance	Refer to the product specification.	Major											
	5. Dimming spot 、 Lighting spot 、 Dust	<p style="text-align: center;">1.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th data-bbox="751 958 1034 1081">Average diameter D:(mm)</th> <th data-bbox="1034 958 1286 1081">number of pieces permitted</th> </tr> </thead> <tbody> <tr> <td data-bbox="751 1081 1034 1171" style="text-align: center;"><math>D \leq 0.1</math></td> <td data-bbox="1034 1081 1286 1171" style="text-align: center;">Ignore</td> </tr> <tr> <td data-bbox="751 1171 1034 1249" style="text-align: center;"><math>0.1 &lt; D \leq 0.15</math></td> <td data-bbox="1034 1171 1286 1249" style="text-align: center;">1</td> </tr> <tr> <td data-bbox="751 1249 1034 1328" style="text-align: center;"><math>0.15 &lt; D \leq 0.2</math></td> <td data-bbox="1034 1249 1286 1328" style="text-align: center;">1</td> </tr> <tr> <td data-bbox="751 1328 1034 1406" style="text-align: center;"><math>0.2 &lt; D</math></td> <td data-bbox="1034 1328 1286 1406" style="text-align: center;">0</td> </tr> <tr> <td data-bbox="751 1406 1034 1485" style="text-align: center;">beyond A.A.</td> <td data-bbox="1034 1406 1286 1485" style="text-align: center;">Ignore</td> </tr> </tbody> </table> <p style="text-align: center;"><math>D = (\text{long diameter} + \text{short diameter}) / 2</math> Pixel off is not allowed.</p>	Average diameter D:(mm)	number of pieces permitted	$D \leq 0.1$	Ignore	$0.1 < D \leq 0.15$	1	$0.15 < D \leq 0.2$	1	$0.2 < D$	0	beyond A.A.	Ignore
Average diameter D:(mm)	number of pieces permitted													
$D \leq 0.1$	Ignore													
$0.1 < D \leq 0.15$	1													
$0.15 < D \leq 0.2$	1													
$0.2 < D$	0													
beyond A.A.	Ignore													

Item	Description	Criterion	AQL		
III. Displaying	5. Dimming spot, Lighting spot, Dust	2.		Minor	
		width(mm) W	length(mm) L		number of pieces permitted
		$W \leq 0.03$	Ignore		Ignore
		$0.03 < W \leq 0.05$	$L \leq 1$		3
		$0.05 < W$	-----		None
		beyond A.A.	-----	Ignore	
IV. Film	1. Dimension	Film dimension out of Spec.			
	2. Damage	Crack; deep scratch; deep fold; deep pressure mark or other damage is not acceptable.		Minor	
	3. Foreign material	Conductive foreign material sticking to the leads, foreign material between film and glass are not acceptable.		Minor	

## **12. APPENDIXES**

### **APPENDIX 1: DEFINITIONS**

#### **A. DEFINITION OF CHROMATICITY COORDINATE**

The chromaticity coordinate is defined as the coordinate value on the CIE 1931 color chart for R, G, B, W.

## B. DEFINITION OF CONTRAST RATIO

The contrast ratio is defined as the following formula:

$$\text{Contrast Ratio} = \frac{\text{Luminance of all pixels on measurement}}{\text{Luminance of all pixels off measurement}}$$

## C. DEFINITION OF RESPONSE TIME

The definition of turn-on response time  $T_r$  is the time interval between a pixel reaching 10% of steady state luminance and 90% of steady state luminance. The definition of turn-off response time  $T_f$  is the time interval between a pixel reaching 90% of steady state luminance and 10% of steady state luminance. It is shown in Figure 2.

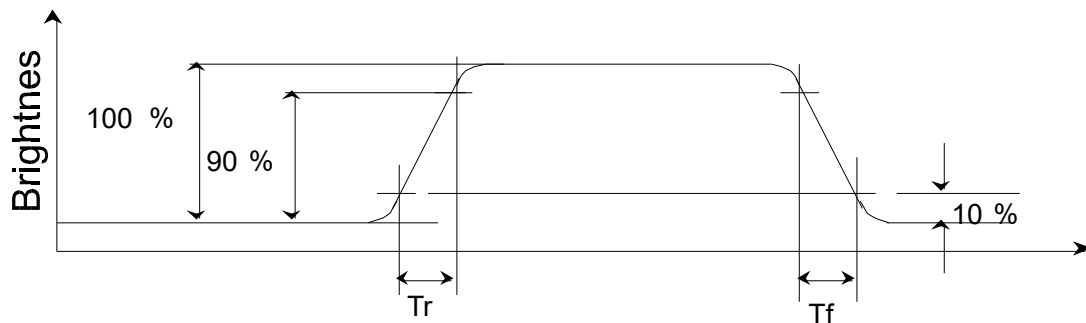


Figure 2 Response time

## D. DEFINITION OF VIEWING ANGLE

The viewing angle is defined as Figure 3. Horizontal and vertical (H & V) angles are determined for viewing directions where luminance varies by 50% of the perpendicular value.

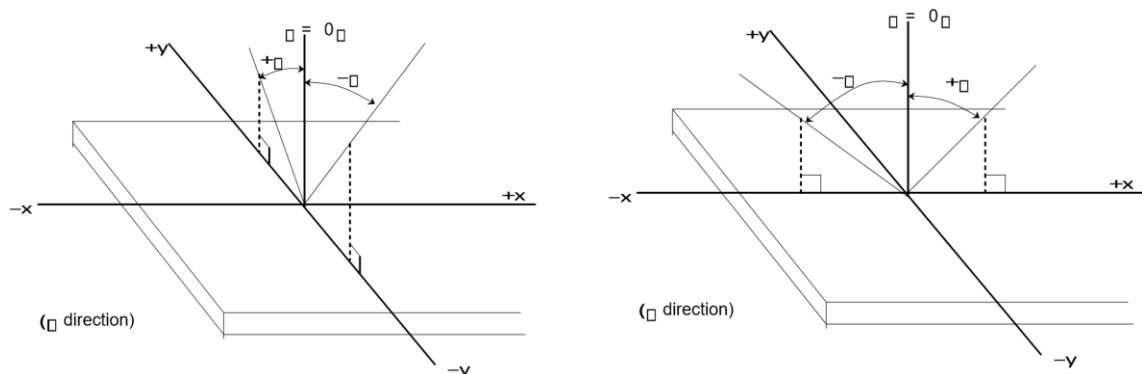
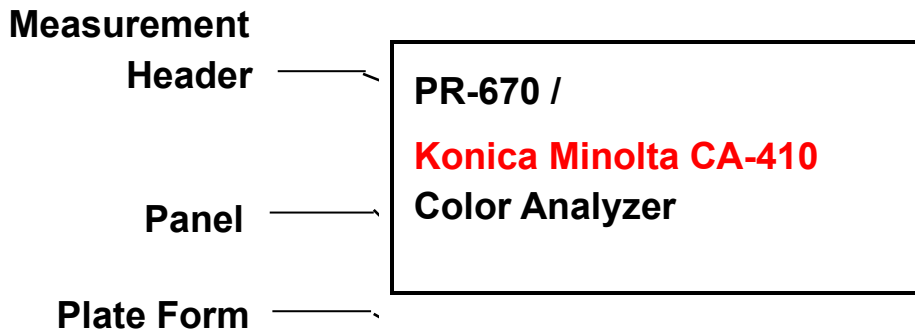


Figure 3 Viewing angle

**APPENDIX 2: MEASUREMENT APPARATUS**

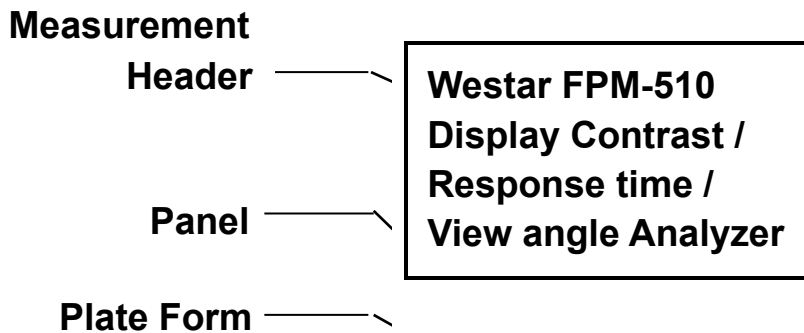
**A. LUMINANCE/COLOR COORDINATE**

PHOTO RESEARCH PR-670, **Konica Minolta CA-410**



**B. CONTRAST / RESPONSE TIME / VIEWING ANGLE**

WESTAR CORPORATION FPM-510



**C. ESD ON AIR DISCHARGE**

