

**SPECIFICATION
FOR
LCM MODULE**

MODULE NO.: RF1602A BW

REVISION NO.: V0

Customer Approval:

	SIGNATURE
PREPARED BY	
VERIFIED BY	
APPROVED BY	

RECORDS OF REVISION

Date	Rev.	Description	Page	Design by
2017/5/11	V0	New Sample.	-	-
			-	-

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1. SPECIFICATIONS

1.1 Features

Item	Standard Value
Display Type	16characters × 2 lines
LCD Type	STN, NEGATIVE (BLUE) ,TRANSMISSIVE
Driver Condition	LCD Module : 1/16Duty , 1/5Bias
Viewing Direction	6 O'clock
Backlight Type	WHITE
Interface	8-bit MPU interface
Driver IC	AIP31066

1.2 Mechanical Specifications

Item	Standard Value	Unit
Outline Dimension	80(L) * 36(W) * 13.0(T)	mm
Viewing Area	64.5(L) * 14.5(W)	mm
Dot size	0.54(W) × 0.60(H)	mm
Dot pitch	0.59(W) × 0.65(H)	mm
Character size	2.9(W) × 5.15(H)	mm

1.3 Absolute Maximum Ratings

Item	Symbol	Condition	Min.	Max.	Unit
System Power Supply Voltage	VDD	-	-0.3	5.5	V
LCD Driver Supply Voltage	VLCD	-	VDD-12	VDD-0.3	V
Input Voltage	V _{IN}	-	-0.3	VDD + 0.3	V
Operating Temperature	T _{OP}	-	0	50	°C
Storage Temperature	T _{ST}	-	-10	60	°C
Storage Humidity	H _D	Ta < 40 °C	20	70	%RH

1.4 DC Electrical Characteristics

VDD = 5.0V ± 0.2V, GND = 0V, Ta = 25°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Logic Supply Voltage	VDD	-	3.0	5.0	5.5	V
Input High Voltage	V _{IH}	-	0.8VDD	-	VDD	V
Input Low Voltage	V _{IL}	-	GND	-	0.3VDD	V
Output High Voltage	V _{OH}	-	0.7VDD	-	VDD	V
Output Low Voltage	V _{OL}	-	GND	-	0.2VDD	V

1.5 Backlight Characteristics

LCD Module without LED Backlight

Electrical / Optical Characteristics

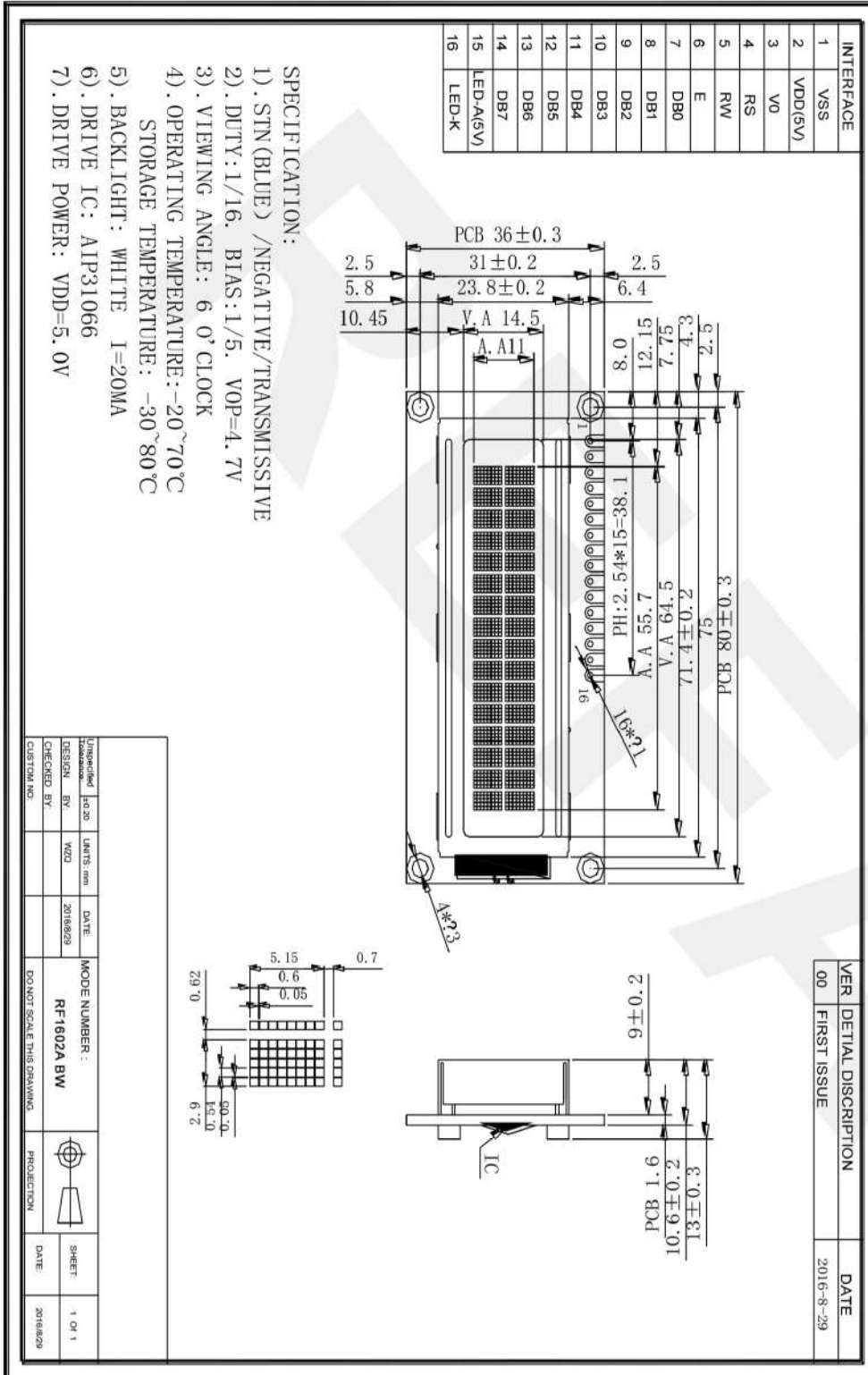
Ta = 25°C

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Forward Voltage	V _f	I _f =15mA	3.1	3.2	3.3	V
Reverse Current	I _r	I _f =5v			--	uA
Average Brightness	I _V	I _f =15mA				cd/m ²
Wavelength (Without LCD)	λ d	I _f =15mA	--	--	--	nm
Luminous Intensity (without LCD)	L _v Sub	I _f =15mA				cd/m ²
Uniformity	Δ%	I _v Min / I _v Max *100%	--	-	-	%
Color	Y-G					

2. MODULE STRUCTURE

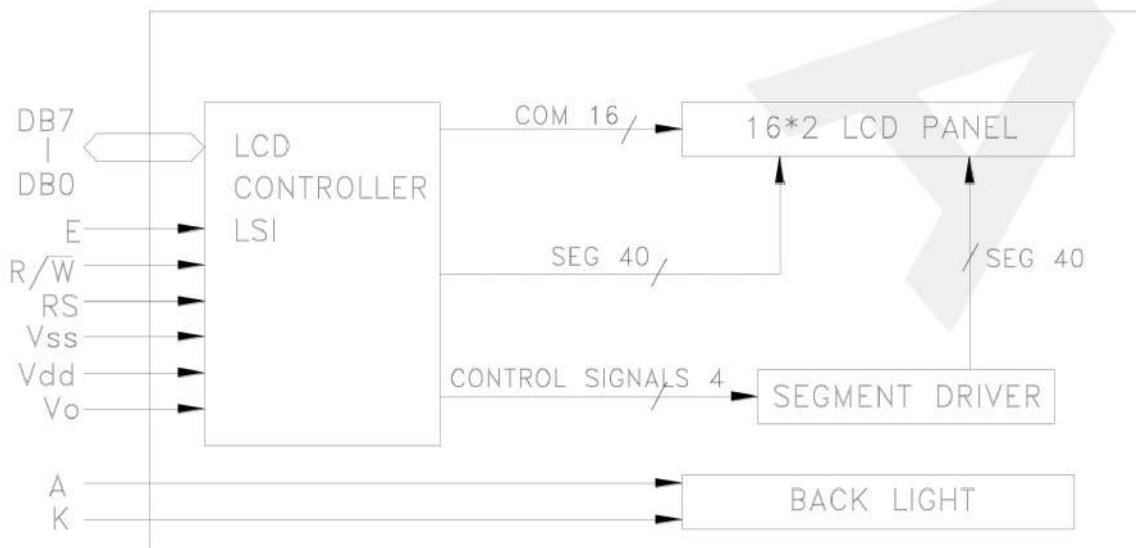
2.1 Counter Drawing

2.1.1 LCM Mechanical Diagram



2.2 Interface Pin Description

No.	Symbol	Function
1	VSS	Ground (0V)
2	VDD	Supply Voltage for Logic (+5.0V)
3	VO	Contrast Adjustment
4	RS	Data/Instruction Select
5	R/W	Read/Write Select
6	E	Enable Signal
7	DB0	Data Bus
8	DB1	Data Bus
9	DB2	Data Bus
10	DB3	Data Bus
11	DB4	Data Bus
12	DB5	Data Bus
13	DB6	Data Bus
14	DB7	Data Bus
15	LED_A	LED Power Supply + (5.0V)
16	LED_K	LED Power Supply - (0V)



2.3 Timing Characteristics

DC Characteristics

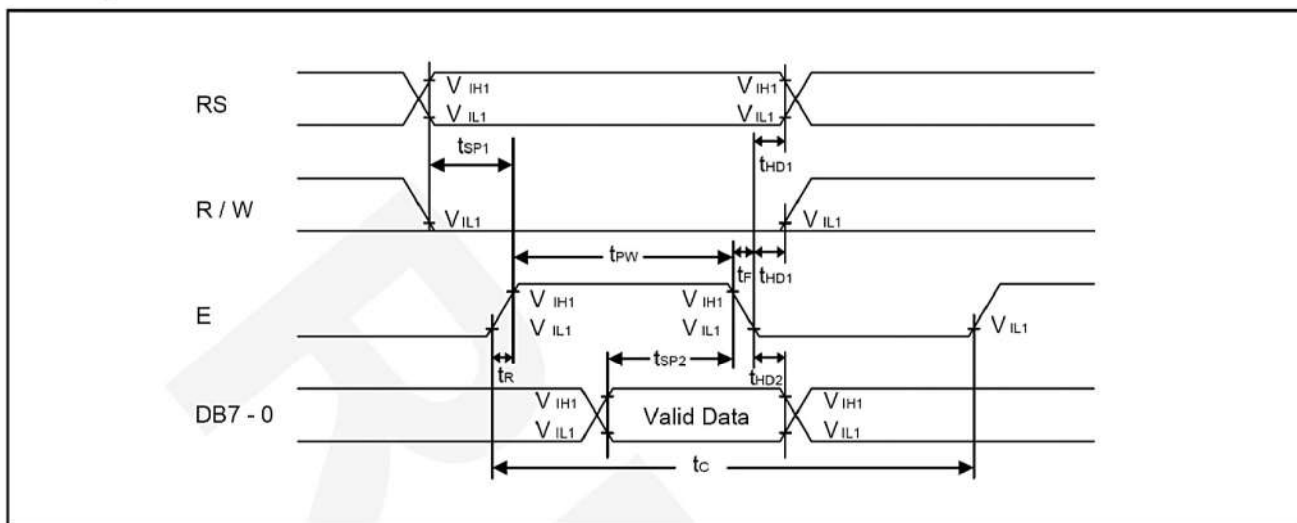
Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
Operating Current	IDD	-	0.55	0.8	mA	External clock (Note)
Input High Voltage	V _{IH1}	2.2	-	VDD	V	Pins:(E, RS, R/W, DB7 - 0)
Input Low Voltage	V _{IL1}	-0.3	-	0.6	V	
Input High Voltage	V _{IH2}	VDD-1	-	VDD	V	Pin OSC1
Input Low Voltage	V _{IL2}	-0.2	-	1.0	V	Pin OSC1
Input High Current	I _{IH}	-2.0	-	2.0	μA	Pins: (RS, R/W, DB7 - 0)
Input Low Current	I _{IL}	-20.0	-50.0	-100.0	μA	VDD = 5.0V
Output High Voltage (TTL)	V _{OH1}	2.4	-	VDD	V	I _{OH} = - 0.1mA Pins: DB7 - 0
Output Low Voltage (TTL)	V _{OL1}	-	-	0.4	V	I _{OL} = 0.1mA Pins: DB7 - 0
Output High Voltage (CMOS)	V _{OH2}	0.9VDD	-	VDD	V	I _{OH} = - 40.0μA, Pins: CL1, CL2, M, D
Output Low Voltage (CMOS)	V _{OL2}	-	-	0.1VDD	V	I _{OL} = 40.0μA, Pins: CL1, CL2, M, D
Driver ON Resistance (COM)	R _{COM}	-	-	20.0	KΩ	I _O = ±50.0μA, V _{LCD} = 4.0V Pins: COM16 - 1
Driver ON Resistance (SEG)	R _{SEG}	-	-	30.0	KΩ	I _O = ±50.0μA, V _{LCD} = 4.0V Pins: SEG40 - 1
LCD Voltage	V _{LCD}	3.0	-	11.0	V	VDD - V5, 1/4 bias or 1/5 bias

Note: F_{OSC} = 250.0KHz, VDD = 5.0V, pin E = "L", RS, R/W, DB7 - 0 are open, all outputs are no loads.

AC Characteristics

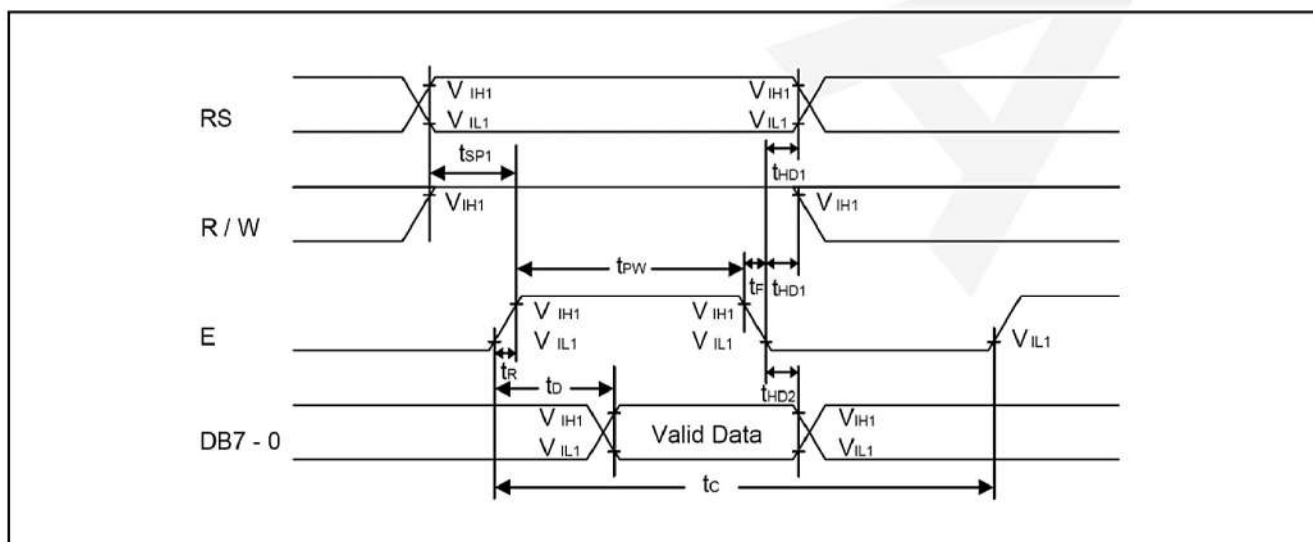
Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
OSC Frequency	F _{OSC1}	190.0	270.0	350.0	KHz	VDD = 5.0V Rf = 91.0KΩ±2%

Timing Diagram Writing mode



Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
E Cycle Time	t_c	400.0	-	-	ns	Pin E
E Pulse Width	t_{PW}	150.0	-	-	ns	Pin E
E Rise/Fall Time	t_{R1}, t_{F1}	-	-	25.0	ns	Pin E
Address Setup Time	t_{SP1}	30.0	-	-	ns	Pins: RS, R/W, E
Address Hold Time	t_{HD1}	10.0	-	-	ns	Pins: RS, R/W, E
Data Setup Time	t_{SP2}	40.0	-	-	ns	Pins: DB7 - 0
Data Hold Time	t_{HD2}	10.0	-	-	ns	Pins: DB7 - 0

Read mode



Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
E Cycle Time	t_c	400.0	-	-	ns	Pin E
E Pulse Width	t_w	150.0	-	-	ns	Pin E
E Rise/Fall Time	t_{r, t_f}	-	-	25.0	ns	Pin E
Address Setup Time	t_{SP1}	30.0	-	-	ns	Pins: RS, R/W,E
Address Hold Time	t_{HD1}	10.0	-	-	ns	Pins: RS, R/W,E
Data Output Delay Time	t_D	-	-	100.0	ns	Pins: DB7 - 0
Data hold time	t_{HD2}	20.0	-	-	ns	Pin DB7 - 0

2.4 Instruction Table

◆ Display Control Instruction

Instruction	Instruction Code										Description	Execution time ($F_{osc} = 270KHz$)
	RS	RW	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	1.52ms
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.	1.52ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Assign cursor moving direction and enable the shift of entire display	38 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.	38 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.	38 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: 5x10 dots/5x8 dots)	38 μ s
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter.	38 μ s
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in counter	38 μ s
Read Busy Flag and Address Counter	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.	
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	38 μ s
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM).	38 μ s

* "-": don't care

2.5 Character Generator ROM

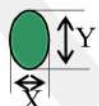
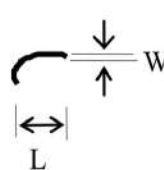
Upper 4 bit Lower 4 bit	LLLL	LLHH	LLHL	LLHH	LHLL	LHLLH	LHHL	LHHLH	HLLL	HLLH	HLLH	HLLH	HLLH	HLLH	HLLH	HLLH
LLLL				0	1	2	3	4				一	二	三	四	五
LLHH			!	1	2	3	4	5			。	ア	イ	ウ	エ	オ
LLHL			"	2	3	4	5	6			「	イ	ウ	エ	オ	カ
LLHH			#	3	4	5	6	7			」	ウ	エ	オ	カ	キ
LHLL			\$	4	5	6	7	8			ノ	エ	オ	カ	キ	ク
LHLLH			%	5	6	7	8	9			。	オ	カ	キ	ク	ケ
LHHL			&	6	7	8	9	0			ア	カ	キ	ク	ケ	コ
LHHH			'	7	8	9	0	1			ア	カ	キ	ク	ケ	コ
HLLL			(8	9	0	1	2			ア	カ	キ	ク	ケ	コ
HLLH)	9	0	1	2	3			ア	カ	キ	ク	ケ	コ
HHLH			*	0	1	2	3	4			ア	カ	キ	ク	ケ	コ
HLHH			+	1	2	3	4	5			ア	カ	キ	ク	ケ	コ
HLLL			,	2	3	4	5	6			ア	カ	キ	ク	ケ	コ
HLLH			-	3	4	5	6	7			ア	カ	キ	ク	ケ	コ
HHLH			.	4	5	6	7	8			ア	カ	キ	ク	ケ	コ
HHLL			/	5	6	7	8	9			ア	カ	キ	ク	ケ	コ
HHHL				6	7	8	9	0			ア	カ	キ	ク	ケ	コ
HHHH				7	8	9	0	1			ア	カ	キ	ク	ケ	コ

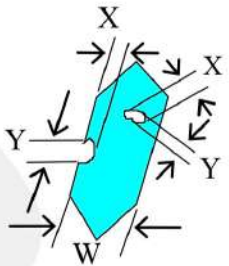
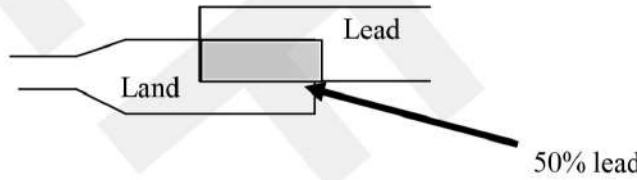
2.6 Inspection Specification

AQL inspection standard, Sampling method: Level II, single sampling, Defect classification

Classify	Item		Note	AQL
Major	Display state	Short or open circuit	1	0.65
		Contrast defect (dim, ghost)		
		LC leakage		
		Flickering		
		No display		
	Non-display	Wrong viewing direction	2	
		Wrong Back-light	7	
		Flat cable or pin reverse	9	
		Wrong or missing component	10	
Minor	Display state	Background color deviation	2	1.5
		Black spot and dust	3	
		Line defect	4	
		Scratch		
		Rainbow	5	
		Pin hole	6	
	Polarizer	Bubble and foreign material	3	
		Scratch	4	
	PCB	Scratch	4	
	Soldering	Poor connection	8	
	Wire	Poor connection	9	

Note on defect classification

No.	Item	Criterion																				
1	Short or open circuit	Not allow																				
	LC leakage																					
	Flickering																					
	No display																					
	Wrong viewing direction																					
	Wrong Back-light																					
2	Contrast defect	Refer to approval sample																				
	Background color deviation																					
3	Point defect, Black spot, dust (incl. Polarizer) $\phi = (X+Y)/2$	 <table border="1" data-bbox="893 913 1339 1218"> <thead> <tr> <th>Point Size</th> <th>Acceptable Qty.</th> </tr> </thead> <tbody> <tr> <td>$\phi \leq 0.10$</td> <td>Disregard</td> </tr> <tr> <td>$0.10 < \phi \leq 0.20$</td> <td>3</td> </tr> <tr> <td>$0.20 < \phi \leq 0.25$</td> <td>2</td> </tr> <tr> <td>$0.25 < \phi \leq 0.30$</td> <td>1</td> </tr> <tr> <td>$\phi > 0.30$</td> <td>0</td> </tr> </tbody> </table>	Point Size	Acceptable Qty.	$\phi \leq 0.10$	Disregard	$0.10 < \phi \leq 0.20$	3	$0.20 < \phi \leq 0.25$	2	$0.25 < \phi \leq 0.30$	1	$\phi > 0.30$	0								
		Point Size	Acceptable Qty.																			
$\phi \leq 0.10$	Disregard																					
$0.10 < \phi \leq 0.20$	3																					
$0.20 < \phi \leq 0.25$	2																					
$0.25 < \phi \leq 0.30$	1																					
$\phi > 0.30$	0																					
Unit: mm																						
4	Line defect	 <table border="1" data-bbox="820 1417 1380 1690"> <thead> <tr> <th colspan="2">Line</th> <th>Acceptable Qty.</th> </tr> <tr> <th>L</th> <th>W</th> <th></th> </tr> </thead> <tbody> <tr> <td>---</td> <td>$0.015 \geq W$</td> <td>Disregard</td> </tr> <tr> <td>$3.0 \geq L$</td> <td>$0.03 \geq W$</td> <td rowspan="2">2</td> </tr> <tr> <td>$2.0 \geq L$</td> <td>$0.05 \geq W$</td> </tr> <tr> <td>$1.0 \geq L$</td> <td>$0.1 > W$</td> <td>1</td> </tr> <tr> <td>---</td> <td>$0.05 < W$</td> <td>Applied as point defect</td> </tr> </tbody> </table>	Line		Acceptable Qty.	L	W		---	$0.015 \geq W$	Disregard	$3.0 \geq L$	$0.03 \geq W$	2	$2.0 \geq L$	$0.05 \geq W$	$1.0 \geq L$	$0.1 > W$	1	---	$0.05 < W$	Applied as point defect
		Line		Acceptable Qty.																		
L	W																					
---	$0.015 \geq W$	Disregard																				
$3.0 \geq L$	$0.03 \geq W$	2																				
$2.0 \geq L$	$0.05 \geq W$																					
$1.0 \geq L$	$0.1 > W$	1																				
---	$0.05 < W$	Applied as point defect																				
Unit: mm																						
5	Rainbow	Not more than two color changes across the viewing area.																				

No.	Item	Criterion								
6	Segment pattern $W = \text{Segment width}$ $\phi = (X+Y)/2$	(1) Pin hole $\phi < 0.10\text{mm}$ is acceptable.  <table border="1" data-bbox="885 535 1356 709"> <thead> <tr> <th>Point Size</th> <th>Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td>$\phi \leq 1/4W$</td> <td>Disregard</td> </tr> <tr> <td>$1/4W < \phi \leq 1/2W$</td> <td>1</td> </tr> <tr> <td>$\phi > 1/2W$</td> <td>0</td> </tr> </tbody> </table> <p style="text-align: right;">Unit: mm</p>	Point Size	Acceptable Qty	$\phi \leq 1/4W$	Disregard	$1/4W < \phi \leq 1/2W$	1	$\phi > 1/2W$	0
Point Size	Acceptable Qty									
$\phi \leq 1/4W$	Disregard									
$1/4W < \phi \leq 1/2W$	1									
$\phi > 1/2W$	0									
7	Back-light	(1) The color of backlight should correspond its specification. (2) Not allow flickering								
8	Soldering	(1) Not allow heavy dirty and solder ball on PCB. (The size of dirty refer to point and dust defect) (2) Over 50% of lead should be soldered on Land. 								
9	Wire	(1) Copper wire should not be rusted (2) Not allow crack on copper wire connection. (3) Not allow reversing the position of the flat cable. (4) Not allow exposed copper wire inside the flat cable.								
10	PCB	(1) Not allow screw rust or damage. (2) Not allow missing or wrong putting of component.								