DOT MATRIX
LIQUID CRYSTAL DISPLAY
MODULE

G12232-28 Serial

USER' MANUAL

PROPOSED BY		APPROVED
Design	Approved	

0755-25324802

CONTENTS

1. Mechanical Specification

ITEM	STANDARD VALUE			UNIT
DOT MATRIX FORMAT	122 X 32 DOTS			--
MODULE DIMENSION	73. 85 (W) X 28.0 (H) X 17.0((T)			mm
VIEWING DISPLAY AREA	55.0 (W) X 18.2 (H)			mm
ACTIVE DISPLAY AREA	48.73 (W) X 14. 36 (H)			mm
DOT SIZE	0.36 (W) X 0.41 (H)			mm
DOT PITCH	0.40 (W) X 0.45 (H)			mm
	STN/黄绿膜黑字/LED底部黄绿光			
		V		mA
		V		Hz
BACKLIGHT Half-Lift TIME				HR.
LED Backlight Color	WHITE			
Backlight Input	DC +5. 0V	V	150	Ma
BACKLIGHT Half-Lift TIME	100,000			HR.

2. Mechanical Diagram
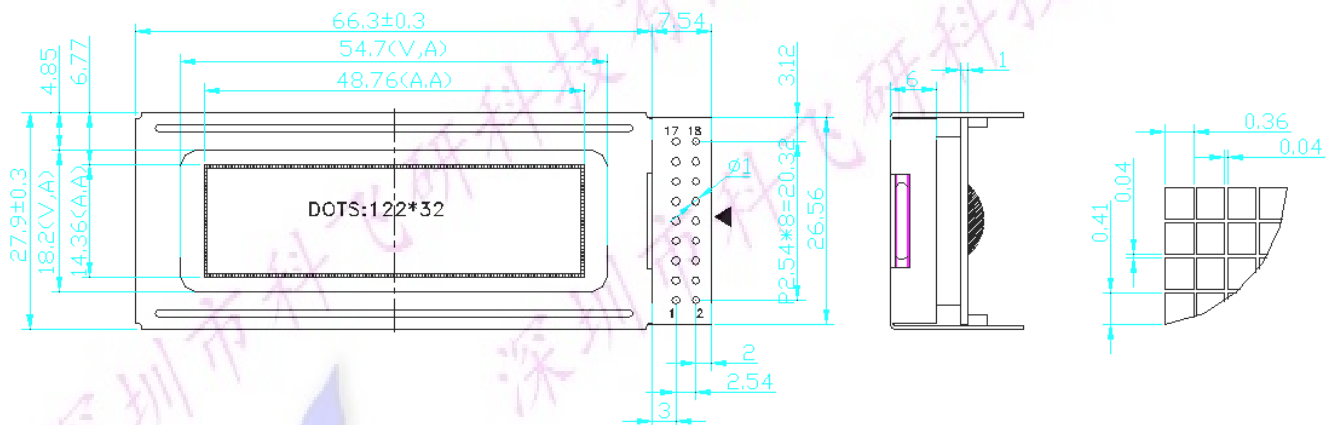
3. Interface Pin Connections

No.	Symbol	Level	Function
1	A(+)	+5.0V	LED+ (Backlight 1)
2	K(-)	0V	LED- (Backlight 2)
3	DB6	H/L	Data Bit 6
4	DB7	H/L	Data Bit 7
5	DB4	H/L	Data Bit 4
6	DB5	H/L	Data Bit 5
7	DB2	H/L	Data Bit 2
8	DB3	H/L	Data Bit 3
9	DB0	H/L	Data Bit 0
10	DB1	H/L	Data Bit 1
11	R/W	H/L	H:READ(LCM　　MPU) L:WRITE(MPU　　LCM)
12	A0（RS）	H/L	Data / Instruction code
13	E1	H,H→L	Chip select for IC1
14	E2	H,H→L	Chip select for IC2
15	VO	H/L	Contrast Adjust
16	RST(/RST)	H/L	RST:68 serial,/RST:80serial
17	VDD	--	DC +5V
18	VSS	--	GND (0V)

4. Black And Power Supply Diagram
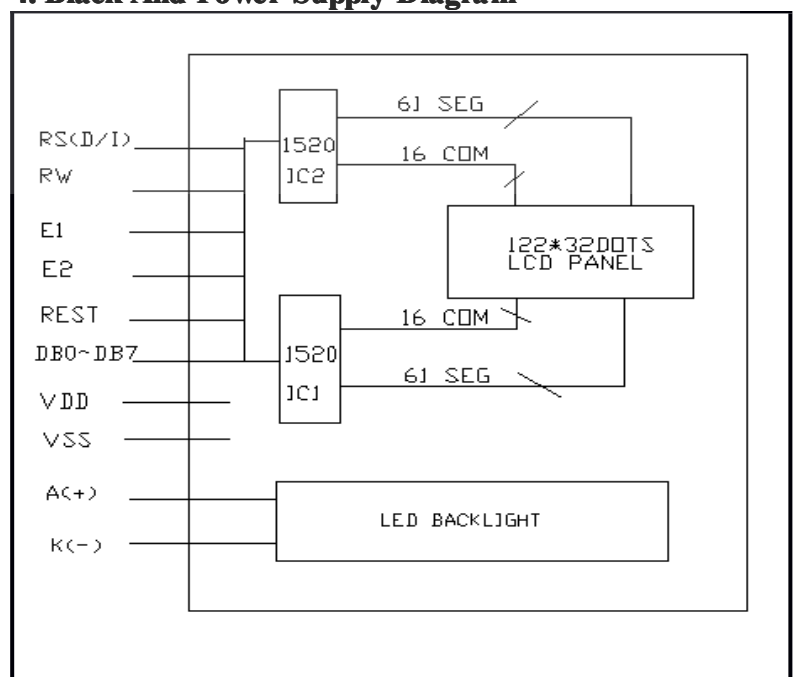
5. Environmental absolute maximum ratings

ITEM	OPERATING		STORAGE		REMARKS
	MIN.	MAX.	MIN.	MAX.	--
Ambient Temperature	0 /-20℃	+50/+70 ℃	-20/-30 ℃	+70/+80 ℃	NOTE 1
Humidity	NOTE 1		NOTE 2		Without Condensation
Vibration	--	4.9m/s^2	--	19.6m/s^2	XYZ Directions
Shock	--	29.4 m/s^2	--	490.0m/s^2	XYZ Directions

Remarks:
NOTE (1) :   Ta at 60 ℃ :   50 HR Max.
NOTE (2) :   Ta < 40 ℃ :   95% RH Max.
              Ta > 40 ℃ :   Absolute humidity must be lower than the humidity of 95% at 40 ℃.
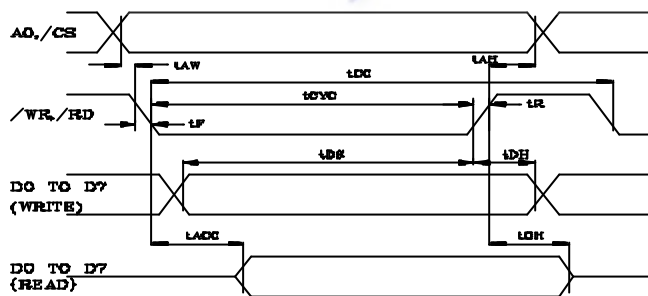
6. Electrical Characteristics

ITEM	SYN	CONDITION	MIN.	TYPE	MAX.	UNIT
SUPPLY VOLTAGE FOR LOGIC	VDD-VSS	--	4.5	5.0	5.5	V
SUPPLY VOLTAGE FOR LCD	VDD-VO	Ta= 25℃	0	--	1.50	V
INPUT HIGH VOLTAGE	VIH	--	0.7VDD	--	VDD	V
INPUT LOW VOLTAGE	VIL	--	0	--	0.3VDD	V
SUPPLY CURRENT (LOGIC)	IDD	VDD=+5V,VO=5V	--	--	2.0	mA

7. Electro-Optical Characteristics

ITEM		SYM	TEMP (℃)	MIN.	TYPE	MAX.	UNIT
RESPONSE TIME		tr	0/-20	--	400/24 50	--	ms
		tr	25	--	150	--	ms
		tf	0/-20	--	1000/2088	--	ms
		tf	25	--	300	--	ms
FRAME FREQUENCY		fF	--	--	--	--	Hz
OPERATING VOLTAGE			0	5.8	6.2	6.6	V
		Vop	25	5.4	5.8	6.2	V
			50	5.0	5.4	5.8	V
VIEWING ANGLE	F-B	Ai	--	55	--	--	deg
	R-L	Qi	--	60	--	--	deg
CONTRAST RATIO		K	25	--	22.8	--	--

8. Timing Control

MPU Bus Read/Write(80-family MPU)   MPU Bus Read/Write(68-family MPU)
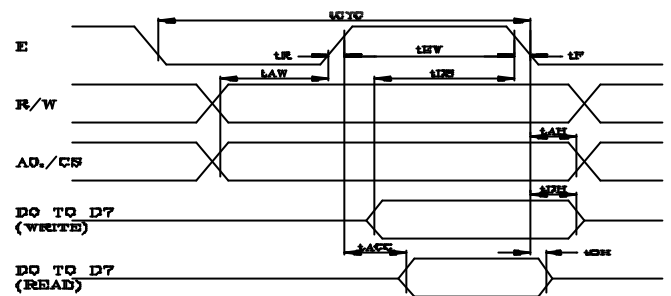
Item		Symbol	Limit (Min.)	Limit (Max.)	Unit
System cycle time		tCYC	1000	--	ns
Address setup time		tAW	20	--	ns
Address hold time		tAH	10	--	ns
Control pulse width		tCC	200	--	ns
Data setup time		tDS	80	--	ns
Data hold time		tDH	10	--	ns
Output disable time		tOH	10	60	ns
READ access time		tACC	--	90	ns
Enable	Read	tEW	100	--	ns
Pulse width	Write		80	--	ns
Rise and Fall time		tR,tF	--	15	ns

9. Instruction Set

Command	Code											Function
	A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	
Display On/Off	0	1	0	1	0	1	0	1	1	1	0/1	Turns display on or off. 1:ON, 0:OFF.
Display start line	0	1	0	1	1	0	Display start address (0 to 31)					Specifies RAM line corresponding to top line of display.
Set page address	0	1	0	1	0	1	1	1	0	Page (0 to 3)		Sets display RAM page in page address register.
Set column (segment address)	0	1	0	0	Column address (0 to 79)							Sets display RAM column address in column address register.
Read status	0	0	1	Busy	ADC	ON / OFF	RESET	0	0	0	0	Read the following status: BUSY 1:Busy 0:Ready ADC 1:CW output 0:CCW output ON/OFF 1:Display off 0:Display on RESET 1:Being reset 0:Normal
Write display data	1	1	0	Write data								Writes data from data bus into display RAM.
Read display data	1	0	1	Read data								Reads data from display RAM onto data bus.
Select ADC	0	1	0	1	0	1	0	0	0	0	0/1	0:CW output. 1:CCW output.
Static drive On/Off	0	1	0	1	0	1	0	0	1	0	0/1	Selects static driving operation. 1: Static drive. 0:Normal driving.
Select duty	0	1	0	1	0	1	0	1	0	0	0/1	Selects LCD duty cycle 1:1/32, 0:1/16.
Read-Modify-Write	0	1	0	1	1	1	0	0	0	0	0	Read-modify-write ON.
End	0	1	0	1	1	1	0	1	1	1	0	Read-modify-write OFF.
Reset	0	1	0	1	1	1	0	0	0	1	0	Software reset.

10. Description of Instructions

10.1 Command list

(1) Display ON/OFF

	A0	/RD	/WR	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	1	0	1	0	1	0	1	1	1	D

This command turns the display on and off.
D = 1 : Display ON.   D = 0 : Display OFF.

(2) Display start line

	A0	/RD	/WR	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	1	0	1	1	0	A4	A3	A2	A1	A0

This command specifies the line address (10.2) and indicates the display line that corresponds to COM0. The display area begins at the specified line address and continues in the line address increment direction. The area having the number of lines of the specified display duty is displayed. If the line address is changed dynamically by this command, the vertical smooth scrolling and paging can be used.

A4	A3	A2	A1	A0	Line address
0	0	0	0	0	0
0	0	0	0	1	1
:	:	:	:	:	:
:	:	:	:	:	:
1	1	1	1	1	31

(3) Set page address

	A0	/RD	/WR	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	1	0	1	0	1	1	1	0	A1	A0

This command specifies the page address that corresponds to the low address of the display data RAM when it is accessed by the MPU. Any bit of the display data RAM can be accessed when it is page address and column address are specified. The display status is not changed even when the page address is changed.

A1	A0	Page
0	0	0
0	1	1
1	0	2
1	1	3

(4) Set column address

	A0	/RD	/WR	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	1	0	0	A6	A5	A4	A3	A2	A1	A0

This command specifies a column address of the display data RAM. When the display data RAM is accessed by the MPU continuously, the column address is incremented by 1 each time it is accessed from the set address. Therefore, the MPU can access to data continuously. The column address stops to be incremented at address 80, and the page address is not changed continuously.

A6	A5	A4	A3	A2	A1	A0	Column address
0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	1
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
1	0	0	1	1	1	1	79

(5) Status Read

	A0	/RD	/WR	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	1	BUSY	ADC	ON/OFF	RESET	0	0	0	0

Reading the command I/O register (A0=0) yields system status information.

- The BUSY bit is indicates whether the driver will accept a command or not.
  Busy = 1 : The driver is currently executing a command or is resetting. No new command will be accepted.
  Busy = 0 : The driver will accept a new command.

- The ADC bit indicates the way column address are assigned to segment drivers.
  ADC = 1 : Normal. Column address n -> segment driver n.
  ADC = 0 : Inverted. Column address 79-n -> segment driver n.

- The ON/OFF bit indicates the current status of the display.
  ON/OFF = 1 : Display OFF.   ON/OFF = 0 : Display ON.

- The RESET bit indicates whether the driver is executing a hardware or software reset or if it in normal operating mode.
  RESET = 1 : Currently executing reset command.   RESET = 0 : Normal operation.

(6) Write Display Data

	A0	/RD	/WR	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	1	1	0				Write data				

Writes 8-bits of data into the display data RAM, at location specified by the contents of the column address and page address registers and then increments the column address register by one.

(7) Read Display Data

	A0	/RD	/WR	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	1	0	1				Read data				

Read 8-bits of data from the data I/O latch, updates the contents of the I/O latch with display data from the display data RAM location specified by the contents of the column address and page address registers and then increments the column address register.
After loading a new address into the column address register one dummy read is required before valid data is obtained.

(8) Select ADC

	A0	/RD	/WR	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	1	0	1	0	1	0	0	0	0	D

This command selects the relationship between display data RAM column addresses and segment drivers.
D = 1 : SEG0 <- column address 4FH, ….. (inverted). D = 0 : SEG0 <- column address 00H, ….. (normal).
This command is provided to reduce restrictions on the placement of driver ICs and routing of traces during printed circuit board design.

(9) Select drive On/Off

	A0	/RD	/WR	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	1	0	1	0	1	0	0	1	0	D

Forces display on and all common outputs to be selected.
D = 1 : Static drive on.   D = 0 : Static drive off.

(10) Select duty

	A0	/RD	/WR	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	1	0	1	0	1	0	1	0	0	D

D = 1 : 1/32 duty cycle.   D = 0 : 1/16 duty cycle.

(11) Read-Modify-Write

	A0	/RD	/WR	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	1	0	1	1	1	0	0	0	0	0

This command defeats column address register auto-increment after data reads. The current contents of the column address register are saved. This mode remains active until an End command is received.
● **Operation sequence during cursor display**

When the End command is entered, the column address is returned to the one used during input of Read-Modify-Write command. This function can reduce the load MPU when data change is repeated at a specific display area (such as cursor blinking).
Any command other than Data Read or Write can be used in the Read-Modify-Write mode. However, the Column Address Set command cannot be used.
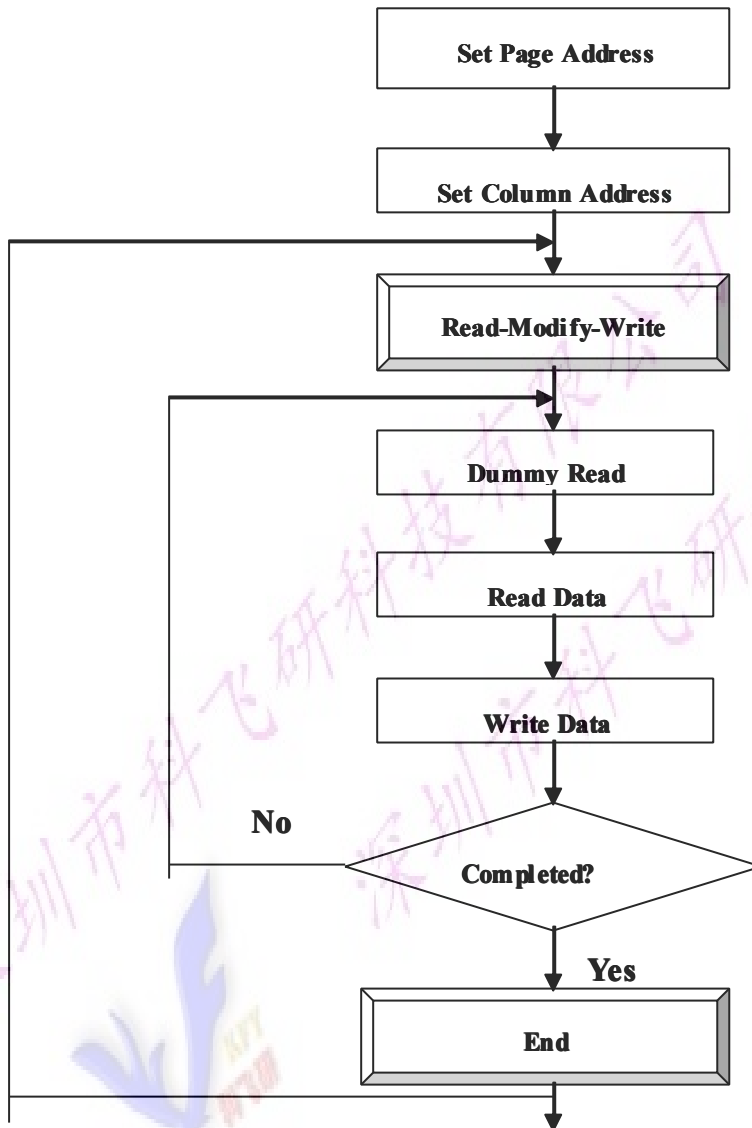
(12) End

	A0	/RD	/WR	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	1	0	1	1	1	0	1	1	1	0

This command cancels read-modify-write mode and restores the contents of the column address register to their value prior to the receipt of the Read-Modify-Write command.
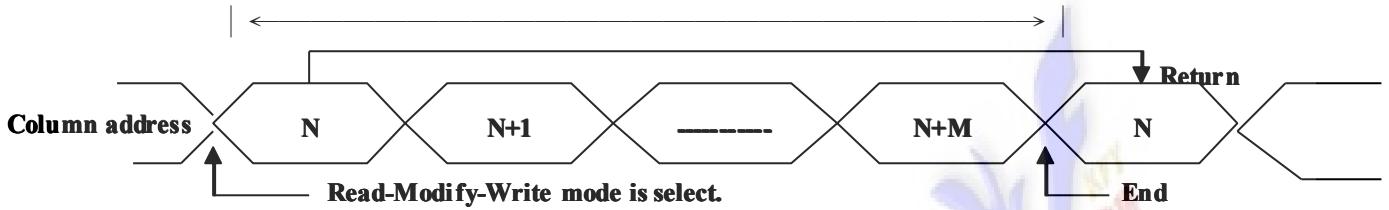
(13) Reset

	A0	/RD	/WR	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	1	0	1	1	1	0	0	0	1	0

This command clears
- The display start line register.
- And set page address register to 3 page.

It does not power supply is turned on, a Reset signal is entered in the /RES pin. The Reset command cannot be used instead of this Reset signal.

10.2 Display Data RAM addressing

Page address		DATA							Line address	Command output
D1	D0									
0	0	DB0							00H	COM 0
		DB1							01H	COM 1
		DB2							02H	COM 2
		DB3			PAGE 0				03H	COM 3
		DB4							04H	COM 4
		DB5							05H	COM 5
		DB6							06H	COM 6
		DB7							07H	COM 7
0	1	DB0			PAGE 1				08H	COM 8
		:							:	:
		DB7							0FH	COM15
1	0	DB0			PAGE 2				10H	COM16
		:							:	:
		DB7							17H	COM23
1	1	DB0							18H	COM24
		DB1							19H	COM25
		DB2							1AH	COM26
		DB3			PAGE 3				1BH	COM27
		DB4							1CH	COM28
		DB5							1DH	COM29
		DB6							1EH	COM30
		DB7							1FH	COM31
Column address	ADC	D=0	00H	01H	———————	4EH	4FH			
		D=1	4FH	4EH	———————	01H	00H			
		SEG pin	SEG 0	SEG1	———————	SEG78	SEG79			

11. Initialization

(a) Display off.
(b) Display start line register : first line.
(c) Static drive off.
(d) Column address counter : Address 0.
(e) Page address register : Page 0.
(f) Select duty : 1/32.
(g) Select ADC : Forward (ADC command d="0", ADC status flag = "1").
(h) Read modify write off.

12. Reliability Condition

		TN Type		STN Type	
		Normal Temp.	Wide Temp.	Normal Temp.	Wide Temp.
Viewing Angle	Horizontal Φ	±30°	±30°	±30°	±30°
	Vertical Θ (㎜)	10° to 30°	10° to 30°	-10° to 40°	-10° to 40°
Operating Temperature		-10 to 70℃	-25 to 80℃	0 to 50℃	*-20 to 70℃
Storage Temperature		-20 to 80℃	-35 to 90℃	-20 to 70℃	*-30 to 80℃
High Temperature (Power Off)		240 Hours @70℃	240 Hours @90℃	240 Hours @65℃	240 Hours @75℃
Low Temperature (Power Off)		240 Hours @-20℃	240 Hours @-35℃	240 Hours @-15℃	240 Hours @-25℃
High Temperature (Power On)		240 Hours @70℃	240 Hours @80℃	240 Hours @60℃	240 Hours @70℃
Low Temperature (Power On)		240 Hours @-10℃	240 Hours @-25℃	240 Hours @-10℃	240 Hours @-20℃
High Temperature & High Humidity		55℃/90%RH 240 Hours	75℃/90%RH 240 Hours	45℃/90%RH 240 Hours	65℃/90%RH 240 Hours
Thermal Shock 5 Cycle	A	60min@-20℃	60min@-35℃	60min@-20℃	60min@-30℃
	B	5min@25℃	5min@25℃	5min@25℃	5min@25℃
	C	60min@70℃	60min@90℃	60min@70℃	60min@80℃
Expected Lift		50,000 Hours	50,000 Hours	50,000 Hours	50,000 Hours

*Wide temp. version may not available for some products, Please consult our sales engineer or respresentative.

13. Functional Test & Inspection Criteria

13.1 Sample plan

Sample plan according to MIL-STD-105D level 2, and acceptance/rejection criteria is.
Base on :   Major defect : AQL 0.65   Minor defect : AQL 2.5

13.2 Inspection condition

Viewing distance for cosmetic inspection is 30cm with bare eyes, and under an environment of 800 lus (20W) light intensity. All direction for inspecting the sample should be within 45° against perpendicular line.

13.3 Definition of Inspection Zone in LCD
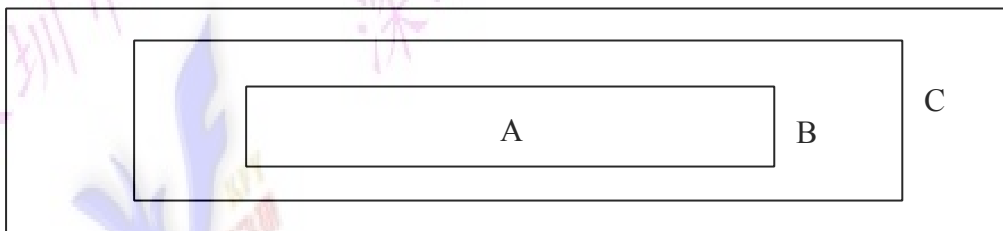
Zone A :   Character / Digit area
Zone B :   Viewing area except Zone A (Zone A + Zone B = minimum Viewing area)
Zone C :   Outside viewing area (invisible area after assembly in customer's product)
Note :   As a general rule, visual defects in Zone C are permissible, when it is no trouble for quality and assembly of customer's product.

13.4 Major Defect

All functional defects such as open (or missing segment), short, contrast differential, excess power consumption, smearing, leakage, etc. and overall outline dimension beyond the drawing. Are classified as major defects.

13.5 Minor Defect

Except the Major defects above, all cosmetic defects are classified as minor defects.

Item No.	Item to be Inspected	Inspection Standard				Classification of defects
1.	Spot defect (Defects in spot from)	Zone size (mm)	Acceptable Qty			Minor
			A	B	C	
		$\Phi \leqq 0.15$	Acceptable (clutering of spot not allowed)		Accepta-ble	
		$0.15 \leqq \Phi \leqq 0.20$	1	2		
		$0.20 \leqq \Phi \leqq 0.25$	0	1		
		$\Phi > 0.25$	0	0		
		Remarks : for dark/white spot, size Φ is defined as $\Phi = 1/2(X+Y)$				
2.	Line defect (Defects in line form)	Size (mm)		Acceptable Qty			Minor
		L Length	W Width	Zone			
				A	B	C	
		Accep-table	W$\leqq$0.02	Accep-table		Accep-table	
		L$\leqq$3.0	W$\leqq$0.03	2			
		L>2.5	W$\leqq$0.03	0			
		L$\leqq$3.0	0.03<W$\leqq$0.05	2			
		L>2.5	0.03<W$\leqq$0.05	0			
		W>0.05		Counted as spot defect (Follows item 17.5.1)			
		Remarks: The total of spot defect and line defect shall not exceed four.					
3.	Orientation defect (such as misalignment of L/C)	Not allowed inside viewing area (Zone A or Zone B)				Minor
4.	Polarizing	13.5.4.1 Polarizer Position 1. Shifting in Position Should not exceed the glass outline dimension. 2. Incomplete covering of the viewing area due to Shifting is not allowed.				Minor
		13.5.4.2 Seratches, bubble or dent on Glass/ Polarizer/Reflector, Bubble between Polarizer & Reflector/Glass:				
		Size (mm)	Acceptable Qty			
			Zone			
			A	B	C	
		$\Phi \leqq 0.20$	Acceptable		Accep-table	
		$0.20 < \Phi \leqq 0.50$	3			
		$0.50 < \Phi \leqq 1.00$	2			
		$\Phi > 1.00$	0			