



8SPEC TITLE
DOCUMENT CONTROL SPECIFICATION

**SPECIFICATION
OF
LCD MODULE
MODULE NO.: TL015FQV09-B1017A**

Customer Approval:

Accept

Reject

SAEF TECHNOLOGY LIMITED	SIGNATURE	DATE
PREPARED BY		
CHECKED BY		
APPROVED BY		



上海冠显光电科技有限公司
TOP DISPLAY OPTOELECTRONICS CO.,LTD

MODULE No.:

REV : A PAGE : 2/23

DATE : 2018-01-23

8SPEC TITLE

DOCUMENT CONTROL SPECIFICATION

DOCUMENT REVISION HISTORY

Sample Version	Doc. Version	DATE	DESCRIPTION	CHECKED BY
01	A	2018-01-23	First Release.	



8SPEC TITLE
DOCUMENT CONTROL SPECIFICATION

CONTENTS

List	Description	Page No.
1	GENERAL DESCRIPTION	4
2	MECHANICAL SPECIFICATIONS	4
3	BLOCK DIAGRAM	5
4	DIMENSIONAL OUTLINE	6
5	PIN DESCRIPTION	7
6	TIMING CHARACTERISTICS	8
7	ELECTRICAL CHARACTERISTICS	8
8	AC CHARACTERISTICS	10
9	OPTICAL CHARACTERISTICS	11
10	PACKAGE	13
11	RELIABILITY	14
12	SPECIFICATION OF QUALITY ASSURANCE	15
13	GENERAL PRECAUTIONS	24



8SPEC TITLE
DOCUMENT CONTROL SPECIFICATION

1. GENERAL DESCRIPTION:

Display & LCD Type: 240* (RGB) *240TFT-Panel

Viewing Direction: ALL

Backlight Type: White LED

2. MECHANICAL SPECIFICATIONS:

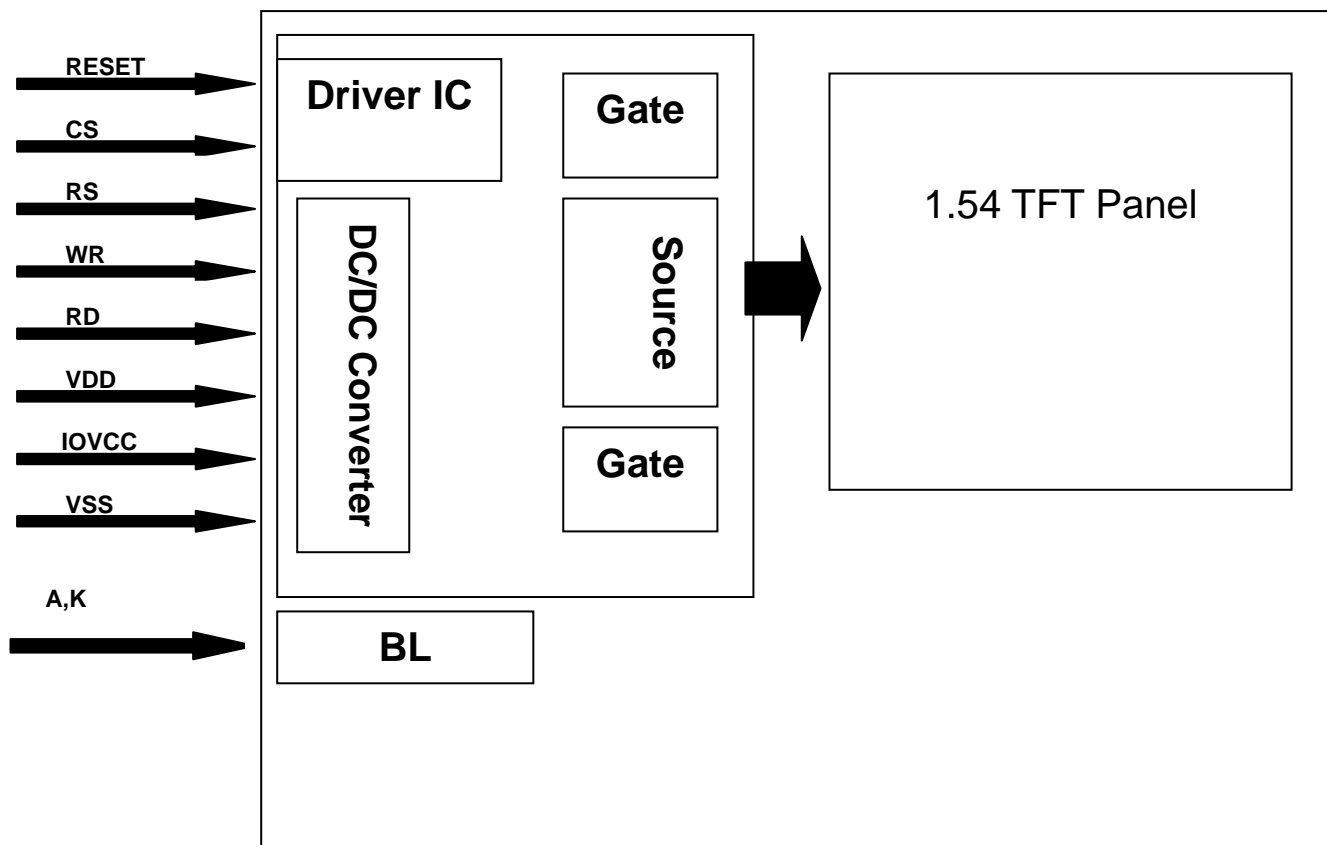
ITEM	SPECIFICATION	UNIT
DISPLAY SIZE	1.54	inch
OUTLINE DIMENSIONS	31.52*33.72*1.5	mm
DRIVER IC	ST7789V	-
INTERFACE TYPE	SPI	-

***See attached drawing for details.**



8SPEC TITLE
DOCUMENT CONTROL SPECIFICATION

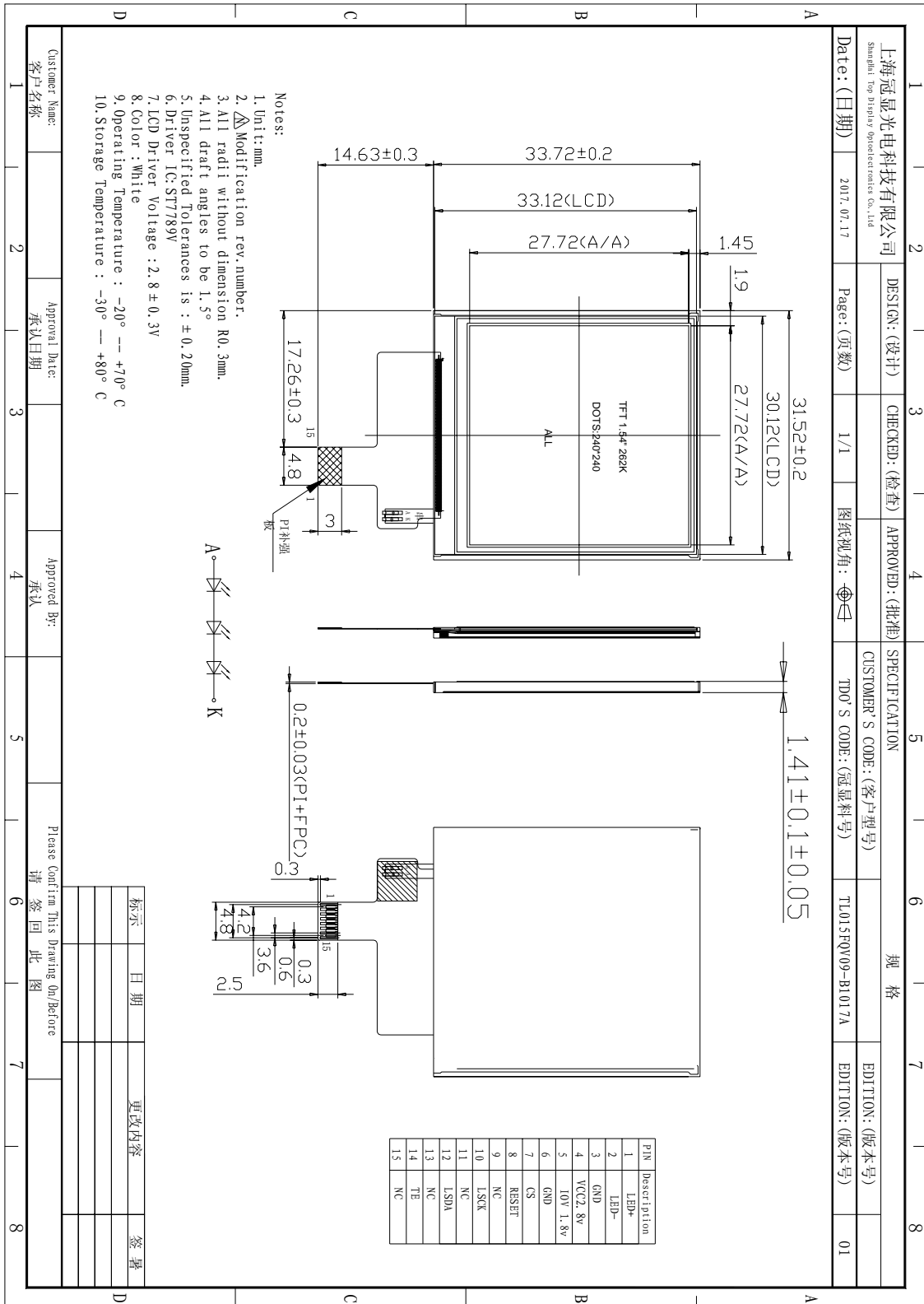
3.BLOCK DIAGRAM:





8SPEC TITLE
DOCUMENT CONTROL SPECIFICATION

4.DIMENSIONAL OUTLINE:





8SPEC TITLE
DOCUMENT CONTROL SPECIFICATION

5. PIN DESCRIPTION:

NO.	PIN NAME	I/O	Description
1	A	I	LED Anode
2	K	I	LED Cathode
3	GND	I	Ground
4	VCC	P	Power Supply 2.8V Voltage
5	IOVCC	I	Power Supply 2.8V/1.8V Voltage
6	GND	I	Ground
7	CS	I	Input pin for chip selection signal
8	RESET	I	LCM Reset input signal
9	NC	NC	NC
10	SCLK	I	SPI Clock Signal
11	NC	NC	NC
12	SDI	I	SPI Interface Input Pin
13	NC	NC	NC
14	TE	O	Tearing effect signal is used to synchronize MCU to frame memory
15	NC	NC	NC

Note:



8SPEC TITLE
DOCUMENT CONTROL SPECIFICATION

6. MAXIMUM ABSOLUTE LIMIT:

Item	Symbol	Value	Unit
Power supply voltage for logic	V_{DD}	1.6~3.3	V
Input voltage	V_{in}	$V_{DD}+0.3$	V
Operating temperature	T_{opr}	-20 to 70	°C
Storage temperature	T_{stg}	-30 to 80	°C

Note: Note1: Absolute maximum rating is the limit value beyond which the IC maybe broken.

They do not assure operations.

Note2: Background color changes slightly depending on ambient temperature. This Phenomenon is reversible.

$T_a \leq 70^\circ\text{C}$: 75%RH max

$T_a > 70^\circ\text{C}$: absolute humidity must be lower than the humidity of 75%RH at 70°C

Note3: T_a at -30°C will be <48hrs, at 80°C will be <120hrs

7.ELECTRICAL CHARACTERISTICS

7-1 DC Characteristics ($V_{DD}=2.8\text{V}, T_a=25^\circ\text{C}$)

Item	Symbol	Min	Type	Max	Unit	Test condition
Operating voltage	V_{DD}	2.6	2.8	3.3	V	-
Supply current	I_{DD}	-	-	15	mA	$V_{DD}=2.8\text{V}, T_a=25^\circ\text{C}$
Input voltage	V_{IH}	$0.8V_{DD}$	-	V_{DD}	V	-
	V_{IL}	0	-	$0.2V_{DD}$	V	
Input leakage current	I_{IL}	-1.0	-	1.0	μA	$V_{IN}=V_{DD}$ or V_{SS}

Note: Voltage greater than above may damage the module.

All voltages are specified relative to $V_{SS}=0\text{V}$.

7-2 Backlight Electrical-optical Characteristics

1. Stander Lamp Styles (Edge Lighting Type):

The LED chips are distributed over the edge light area of the illumination unit, which gives the less power consumption:

2. The Main Advantages of the LED Backlight are as following:

2.1 The brightness of the backlight can simply be adjusted by a resistor or a potentiometer.

3. Data About LED Backlight:



8SPEC TITLE
DOCUMENT CONTROL SPECIFICATION

Item	Symbol	MIN	TYP	MAX	UNIT	Test Condition	Note
Supply Voltage	Vf	8	9.6	10	V	If=60AMA	-
Supply Current	If	-	20	-	mA	-	-
Reverse Voltage	Vr	-	-	5	V	-	-
Power dissipation	Pd	-	192	-	mW	-	-
Luminous Intensity for LCM	-	-	-	-	Cd/m ²	If=60MA	-
Uniformity for LCM	-	80	-	-	%	If=60MA	-
Backlight Color	White						

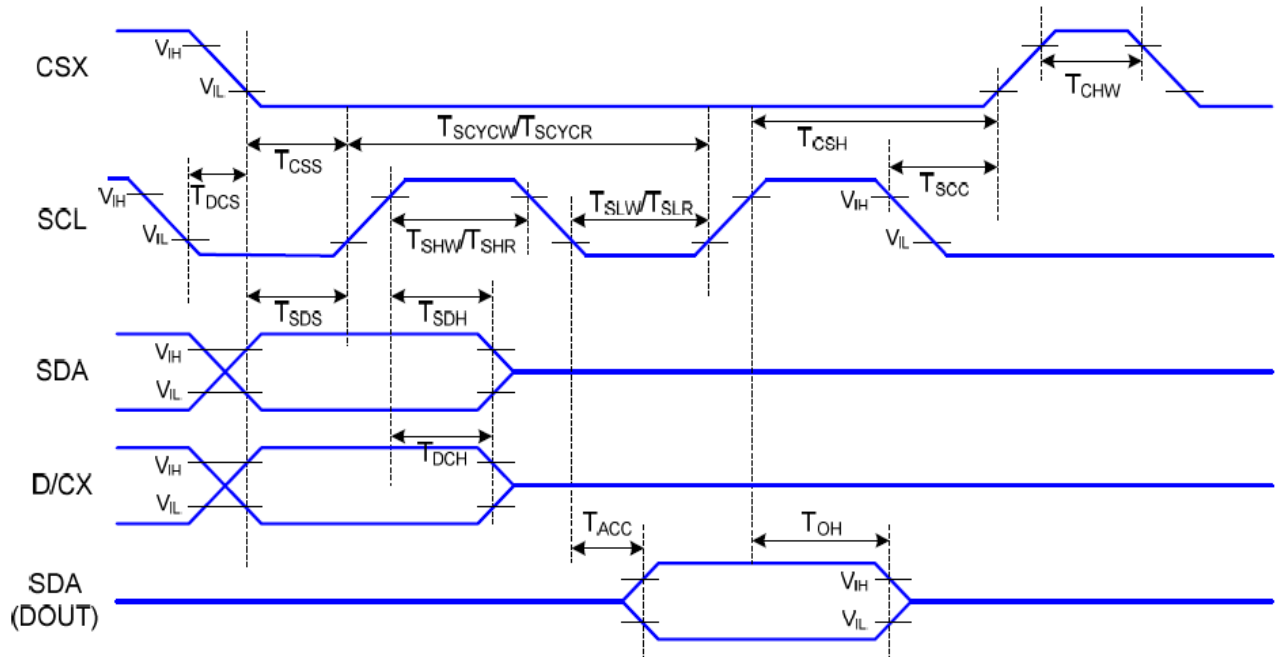
NOTE:



8SPEC TITLE
DOCUMENT CONTROL SPECIFICATION

8. AC CHARACTERISTICS ($V_{DD}=2.8V, T_A=25^{\circ}C$)

8.1. Interface : System Bus Read/Write Characteristics.



Ta=25 °C, VDDI=1.65~3.7V, VDD=2.3~4.8V

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	T_CSS	Chip select setup time (write)	45		ns	
	T_CSH	Chip select hold time (write)	45		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)	66		ns	-write command & data ram
	T_SHW	SCL "H" pulse width (Write)	15		ns	
	T_SLW	SCL "L" pulse width (Write)	15		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) (DOUT)	T_SDS	Data setup time	10		ns	For maximum CL=30pF For minimum CL=8pF
	T_SDH	Data hold time	10		ns	
	T_ACC	Access time	10	50	ns	
	T_OH	Output disable time	15	50	ns	



8SPEC TITLE
DOCUMENT CONTROL SPECIFICATION

9. OPTICAL CHARACTERISTICS:

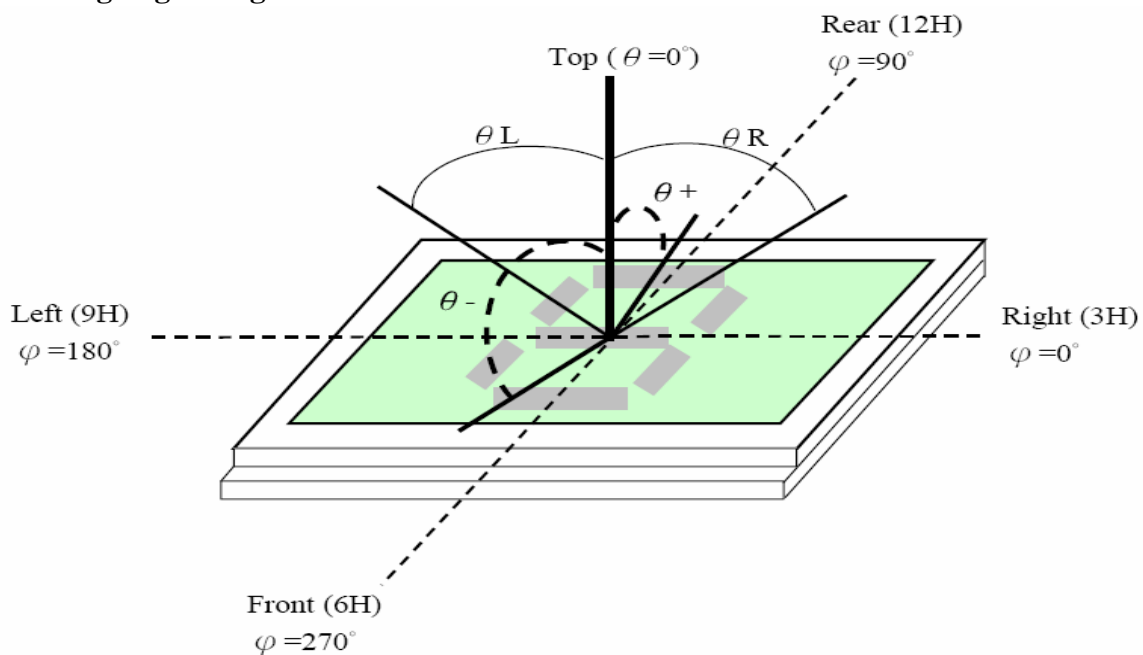
No.	ITEM		Symbol	Conditions	Specification			Unit	Note
					Min	Typ	Max		
1	Response Time		Tr+Tf	25°C	-	25	-	Ms	(1)(2)
2	Transmittance (With PL)		T(%)	-	-	7.1	-	-	-
3	Contrast Rate		Cr	$\theta=0$, Normal viewing angle	300	400	-	-	(1)(3)
4	Viewing Angle	Hor.	θR	CR>10		80	-	Deg	-
			θL			80	-		
		Ver.	$\theta+$		-	80	-		
			$\theta-$		-	80	-		

Measure Conditions:

1. Measure surrounding : dark room;
2. Ambient temperature: 25±2°C;
3. 30min.warm-up time.
4. POL:Sumitomo No: SRNS4IAPNSLD6

Note Definition:

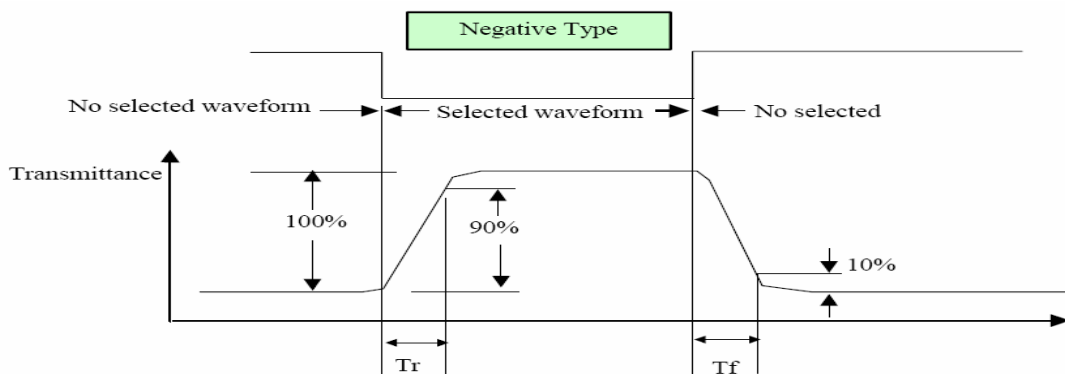
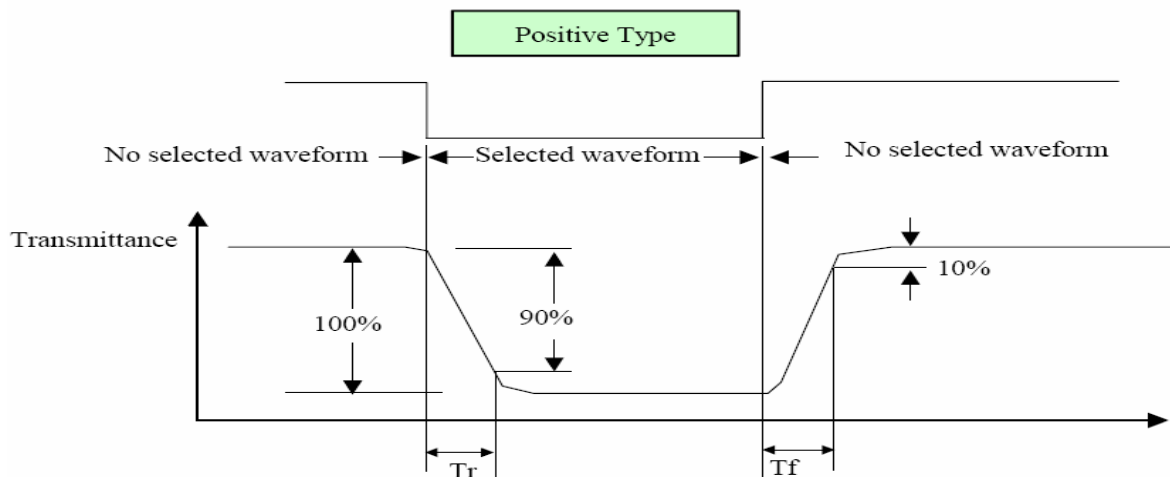
Note(1)Viewing angle range:



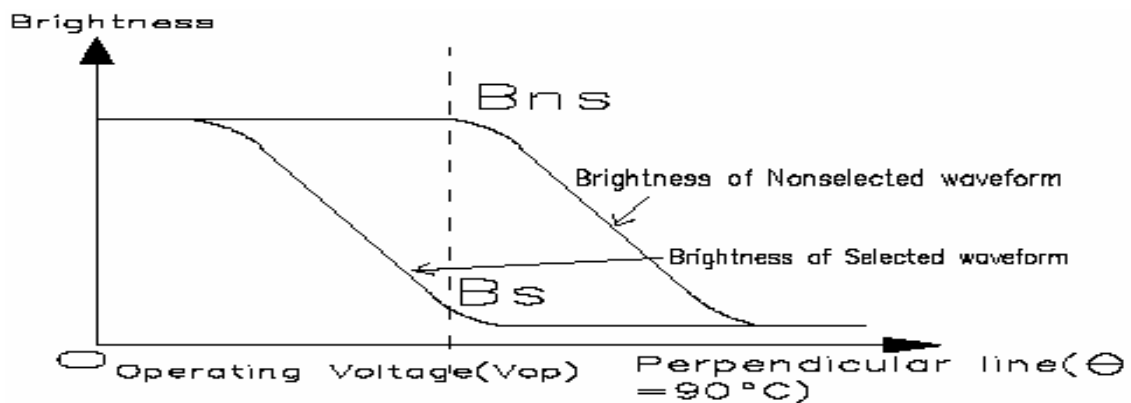


8SPEC TITLE
DOCUMENT CONTROL SPECIFICATION

Note(2) Response Time:



Note(3) Contrast Ratio Definition:



Luminance with all pixel white

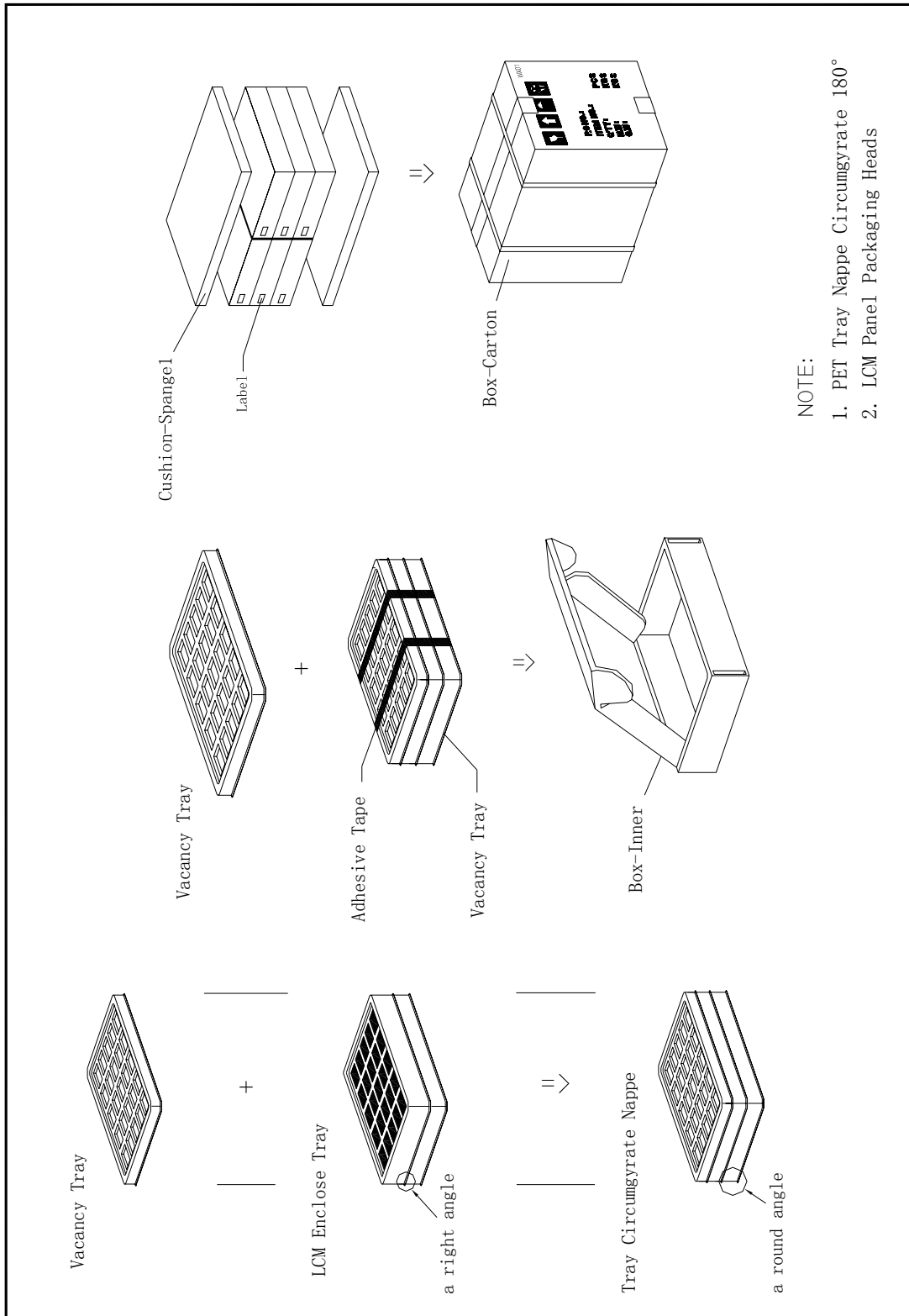
Contrast Ratio (Cr) = _____

Luminance with all pixel black



8SPEC TITLE
DOCUMENT CONTROL SPECIFICATION

10.PACKAGE.



- NOTE:
1. PET Tray Nappe Circumgyrate 180°
 2. LCM Panel Packaging Heads



8SPEC TITLE
DOCUMENT CONTROL SPECIFICATION

11. STANDARD SPECIFICATION FOR RELIABILITY:

Item	Condition	Time (hrs)	Assessment
High temp. Storage	80°C	120	No abnormalities in functions and appearance
High temp. Operating	70°C	120	
Low temp. Storage	-30°C	120	
Low temp. Operating	-20°C	120	
Humidity	40°C/ 90%RH	120	
Thermal Shock Temp. Cycle	-20°C ← 25°C → 70°C (0.5 hour ← 5 min → 0.5 hour)	10cycles	

Functions, performance, appearance, etc. shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions room temperature (25±10°C), normal humidity (45±20% RH), and in area not exposed to direct sun light. (Life time of backlight, please refer to Data about backlight.)

Testing Conditions and Inspection Criteria:

For the final test the testing sample must be stored at room temperature for 24 hours, after the tests listed in up Table, Standard specifications for Reliability have been executed in order to ensure stability.

Item	Test Model	In section Criteria
Current Consumption	Refer To Specification	The current consumption should conform to the product specification.
Contrast	Refer To Specification	After the tests have been executed, the contrast must be larger than half of its initial value prior to the tests.
Appearance	Visual inspection	Defect free.



8SPEC TITLE

DOCUMENT CONTROL SPECIFICATION

12.SPECIFICATION OF QUALITY ASSURANCE:

12.1 Purpose

This standard for Quality Assurance should affirm the quality of LCD Module products to supply to purchaser by Saef Technology Limited.

12.2 Standard for Quality Test

a. Inspection:

Before delivering, the supplier should take the following tests, and affirm the quality of product.

b. Electro-Optical Characteristics:

According to the individual specification to test the product.

c. Test of Appearance Characteristics:

According to the individual specification to test the product.

d. Test of Reliability Characteristics:

According to the definition of reliability on the specification for testing products.

e. Delivery Test:

Before delivering, the supplier should take the delivery test.

(i) Test method: According to MIL-STD105E.General Inspection Level II take a single time.

(ii) The defects classify of AQL as following:

Major defect: AQL = 0.65

Minor defect: AQL = 2.5

Total defects: AQL = 2.5

12-3. Nonconforming Analysis & Deal With Manners

a. Nonconforming Analysis:

(i) Purchaser should supply the detail data of non- conforming sample and the non- conforming.

(ii) After accepting the detail data from purchaser, the analysis of nonconforming should be finished in two weeks.

(iii) If supplier can not finish analysis on time, must announce purchaser before two weeks.

b. Disposition of nonconforming:

(i) If find any product defect of supplier during assembly time, supplier must change the good product for every defect after recognition.

(ii) Both supplier and customer should analyze the reason and discuss the disposition of nonconforming when the reason of nonconforming is not sure.

12-4. Agreement items

Both sides should discuss together when the following problems happen.

a. There is any problem of standard of quality assurance, and both sides think that it must be modified.

b. There is any argument item which does not record in the standard of quality assurance.

c. Any other special problem.



8SPEC TITLE
DOCUMENT CONTROL SPECIFICATION

12-5 Standard of The Product Appearance Test

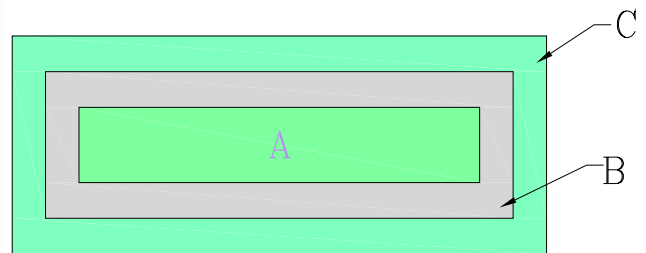
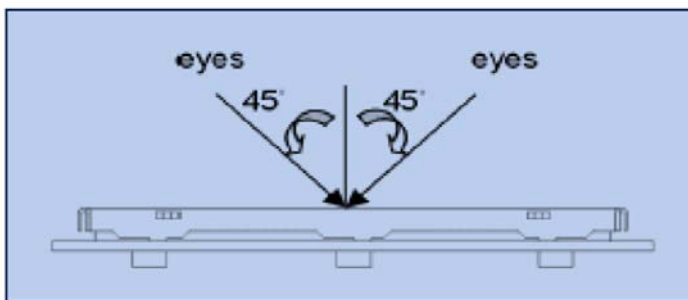
a. Manner of appearance test: This specification should be applied for both light on and off situation.

(i) The test must be under 20W × 2 or 40W fluorescent light, and the distance of view must be at 30±5cm.

(ii) When test the model of transmissive product must add the reflective plate.

(iii)The test direction is base on about around 10° of vertical line (Left graph)

(iiii)Temperature: 25±5°C Humidity: 65±10%RH



(iv) Definition of area (Right graph)

A. Area: Viewing area. B. Area: Out of viewing area.(Outside viewing area)

b. Basic principle:

(i) It will accord to the AQL when the standard can not be described.

(ii) The sample of the lowest acceptable quality level must be discussed by both supplier and customer when any dispute happened.

(iii) Must add new item on time when it is necessary.

c. Standard of inspection: (Unit: mm)

Allowable limits defined in follow Dot defect Table should be met for each white, black , R, G, B raster. The limits apply to the entire area. Missing white in 60% or more of typical (one color, R or G or B) pixel aperture is defined as a bright defect, less than 60% is acceptable .Black spot in 60% or more of typical pixel aperture is defined as a dark defect, less than 60% is acceptable.

Dot defect table:

Item		White dot defect	Black dot defect	Total
1	Defect counts	3	3	3
2	Combined defect Counts	No combined dot defect allowed. Two Single dot defect that within 5mm during each dot defect should be counted as combined dot defect.		



8SPEC TITLE
DOCUMENT CONTROL SPECIFICATION

12-6 Inspection specification

AQL inspection standard

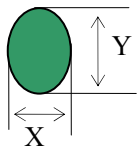
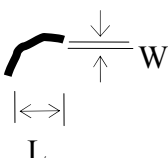
Sampling method: MIL-STD-105E, Level II, single sampling

Classify	Item		Note	AQL
Major	Display state	Short or open circuit	1	0.65
		Contrast defect (dim, ghost)		
		LC leakage		
		Flickering		
		No display		
		Wrong viewing direction	2	
		Wrong Back-light	7	
	Non-display	Flat cable or pin reverse	9	
		Wrong or missing component	10	
Minor	Display state	Background color deviation	2	2.5
		Black spot and dust	3	
		Line defect	4	
		Scratch		
		Rainbow	5	
		Pin hole	6	
	Polarizer	Bubble and foreign material	3	
		Scratch	4	
	PCB,FPC	Scratch	4	
	Soldering	Poor connection	8	
	Wire	Poor connection	9	
LCD	CHIP OUT	11		



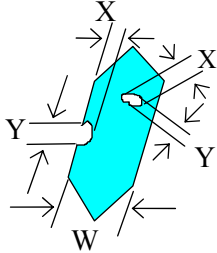
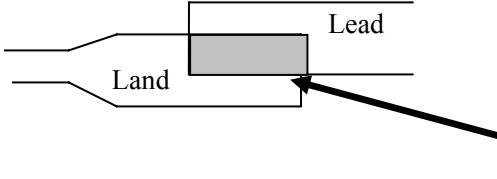
8SPEC TITLE
DOCUMENT CONTROL SPECIFICATION

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) ex.: dirt under polarizer, Pinhole of reflector ,glass scratch, dirt under glass,scratch on polarizer $\phi = (X+Y)/2$	 <table border="1" data-bbox="901 1086 1340 1377"> <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> <p style="text-align: right;">Unit: mm</p>	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																		
4	Line defect	 <table border="1" data-bbox="877 1601 1428 1848"> <thead> <tr> <th>L</th> <th>Line W</th> <th>Acceptable Qty.</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> <p style="text-align: right;">Unit: mm</p>	L	Line W	Acceptable Qty.	---	$0.015 \geq W$	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
L	Line W	Acceptable Qty.																	
---	$0.015 \geq W$	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																	
5	Rainbow	Not more than two color changes across the viewing area																	



8SPEC TITLE
DOCUMENT CONTROL SPECIFICATION

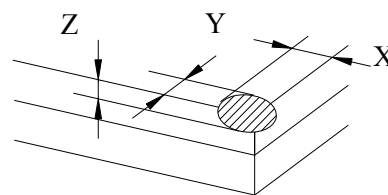
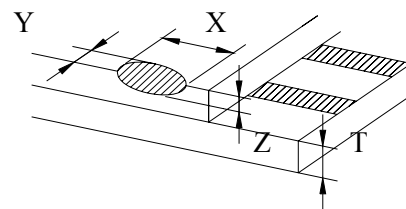
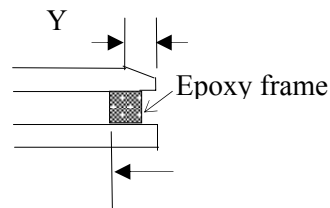
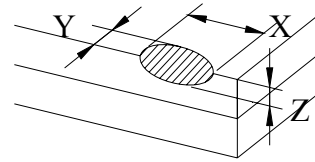
No.	Item	Criterion								
6	<p>Segment pattern W = Segment width $\phi = (X+Y)/2$</p>	<p>(1) Pin hole $\phi < 0.15\text{mm}$ is acceptable.</p>  <table border="1" data-bbox="970 600 1433 786"> <thead> <tr> <th>Point Size</th> <th>Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td>$\phi \leq 1/4W$</td> <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	<p>(1) The color of backlight should correspond its specification. (2) Not allow flickering</p>								
8	Soldering	<p>(1) Not allow heavy dirty and solder ball on PCB or FPC. (The size of dirty refer to point and dust defect) (2) Over 50% of lead should be soldered on Land.</p> 								
9	Wire	<p>(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.</p>								
10	PCB,FPC	<p>(1) Not allow screw rust or damage. (2) Not allow missing or wrong putting of component.</p>								



8SPEC TITLE

DOCUMENT CONTROL SPECIFICATION

2.1.1 chip on the surface



Note: A:LCD Length

X	Y	Z
$>1/8A$	$\leq 0.3\text{mm}$	$\leq 1/2T$
$\leq 1/8A$	Not enter into epoxy frame	$\leq T$
	Not enter into the inner edge of epoxy	$\leq 1/2T$

11

LCD

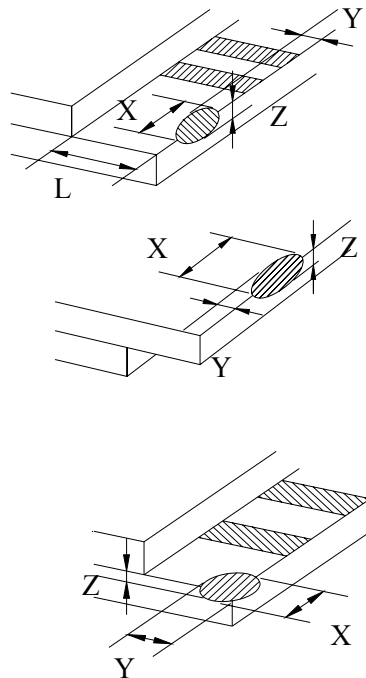


8SPEC TITLE
DOCUMENT CONTROL SPECIFICATION

11

LCD

2.1.2 chip on the terminal

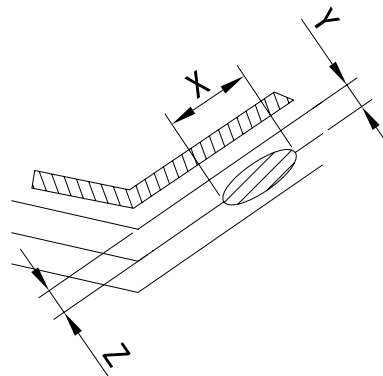


X	Y	Z
$>1/8A$	$\leq 0.3\text{mm}$	$\leq 1/2T$
$\leq 1/8A$	$\leq 1/2L$	$\leq T$
$\leq 1/8A \& \leq 1\text{mm}$	$\leq L$	$\leq T$
$\leq 1/8A \& \leq 2\text{mm}$	$\leq L$	$\leq 1/2T$

Note: A:LCD Length.

the distance between crack and contact pad must be greater than the width of 1st contact pad.

2.1.3 chip out on between side



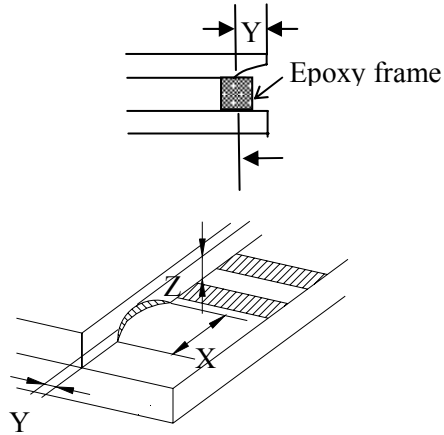


8SPEC TITLE

DOCUMENT CONTROL SPECIFICATION

11

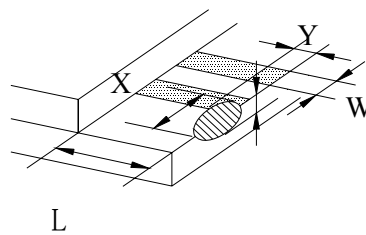
LCD



X	Y	Z
\leq	Not enter into epoxy frame	$Z \leq 2T$
$1/8A$	Not enter into 1/2 epoxy frame	$Z \leq 1/2T$

Note: A : LCD Length

2.1.4 including corner chip and side chip

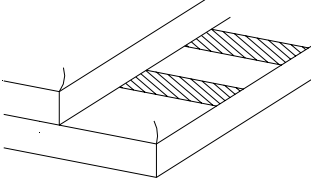
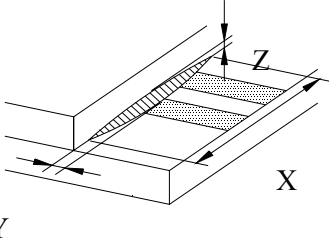


Note: A:LCD Length

X	Y	Z
$>1/8A$	$\leq 1/6L$	$\leq 1/2T$
$\leq 1/8A$	$\leq 1/3L$	
$\leq 1/4W$	$\leq 2/3L$	



8SPEC TITLE
DOCUMENT CONTROL SPECIFICATION

11	LCD	<p>2.2 Chip out</p>  <ol style="list-style-type: none"> 1) Chip out is that crackles extend to inner edge. 2) Crackles round epoxy frame will be rejected. 3) Chip out on the terminal will be rejected: $Z=T$ length $>1\text{mm}$ or $Z<T$ length $>2\text{mm}$ 4) The chip out at ITO will be rejected. <p>2.3 Poor cutting</p>  <table border="1" data-bbox="676 1099 1158 1346"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>$>1/8$ A</td> <td>≤ 0.3</td> <td>$\leq 1/2T$</td> </tr> <tr> <td>$\leq 1/8$ A</td> <td>According to drawing</td> <td>$1/2T \leq Z \leq T$</td> </tr> </tbody> </table> <p style="text-align: right;">Note : A:</p> <p>LCD Length.</p>	X	Y	Z	$>1/8$ A	≤ 0.3	$\leq 1/2T$	$\leq 1/8$ A	According to drawing	$1/2T \leq Z \leq T$
X	Y	Z									
$>1/8$ A	≤ 0.3	$\leq 1/2T$									
$\leq 1/8$ A	According to drawing	$1/2T \leq Z \leq T$									
12	SMT	<p>According to the <Acceptable of electronic assemblies> IPC-A-610C class 2 stander. Component missing or function defect are Major defect ,the others are Minor defect.</p>									

Any one out of the specification will be rejected.