□ CUSTOMER'S APPROVAL

CORPORATION:_____

DATE:_____

BY:_____

DEVICE SPECIFICATION for

TFT Color LCD Module

(240 X RGB X 320 dots)

Model No：**SBT280-009**

VERSION: V0.1

Skyworth 创维液晶器件（深圳）有限公司
创维 SKYWORTH LCD(SHENZHEN) CO.,LTD.

Write	Verify	Approve	Project	Quality

SKYWORTH LCD MODULES(SHENZHEN) CO., LTD
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History of Revision

Version	Date	Description
V0.1	2016.03.25	First Version

Contents

1. General

1.1.Application

This specification applies to the LCD module designated SBT280-009 LCD to be delivered to customer for mobile phone.

1.2.Name of product, model number

Name of product : LCD module
Model number of **SKYWORTH**: SBT280-009

1.3.Mechanical Dimensions and Circuit diagram

Refer to drawing as Page5.
Note:
(): Reference value
TBD: To Be Determined after evaluation of sample

2. Product specifications

This product is LCD module with 240 (x3:RGB) x 320dots LCD module with LCD driver.

2.1.Features

NO.	Item	Specification	Unit	Remark
1	LCD Size:	2.8	inch	-
2	Module Size:	50x69.2x2.05mm(max) (except FPC length)	mm	-
3	Active Area:	57.6x43.2mm	mm	-
4	Resolution:	240x(3:RGB)x320dots	-	-
5	Dot Pitch:	0.18x0.18mm	mm	-
6	Viewing Direction:	6:00	-	-
7	Display color:	262K colors	-	-
8	Display Mode:	TFT LCD, Transmissive Mode Normally Black	-	-
9	LCD Driver:	ST7789V	-	-
10	Interface Mode：	3-line serial	-	-
11	Drive Method:	Dot inversion	-	-
12	Driver IC RAM Size：	240x18x320	-	-
13	Weight:	TBDg typ.	-	-
14	Operating Temperature:	From -20 to +70 °C (dry)	-	-
15	Storage Temperature :	From -30 to +80 °C (dry)	-	-

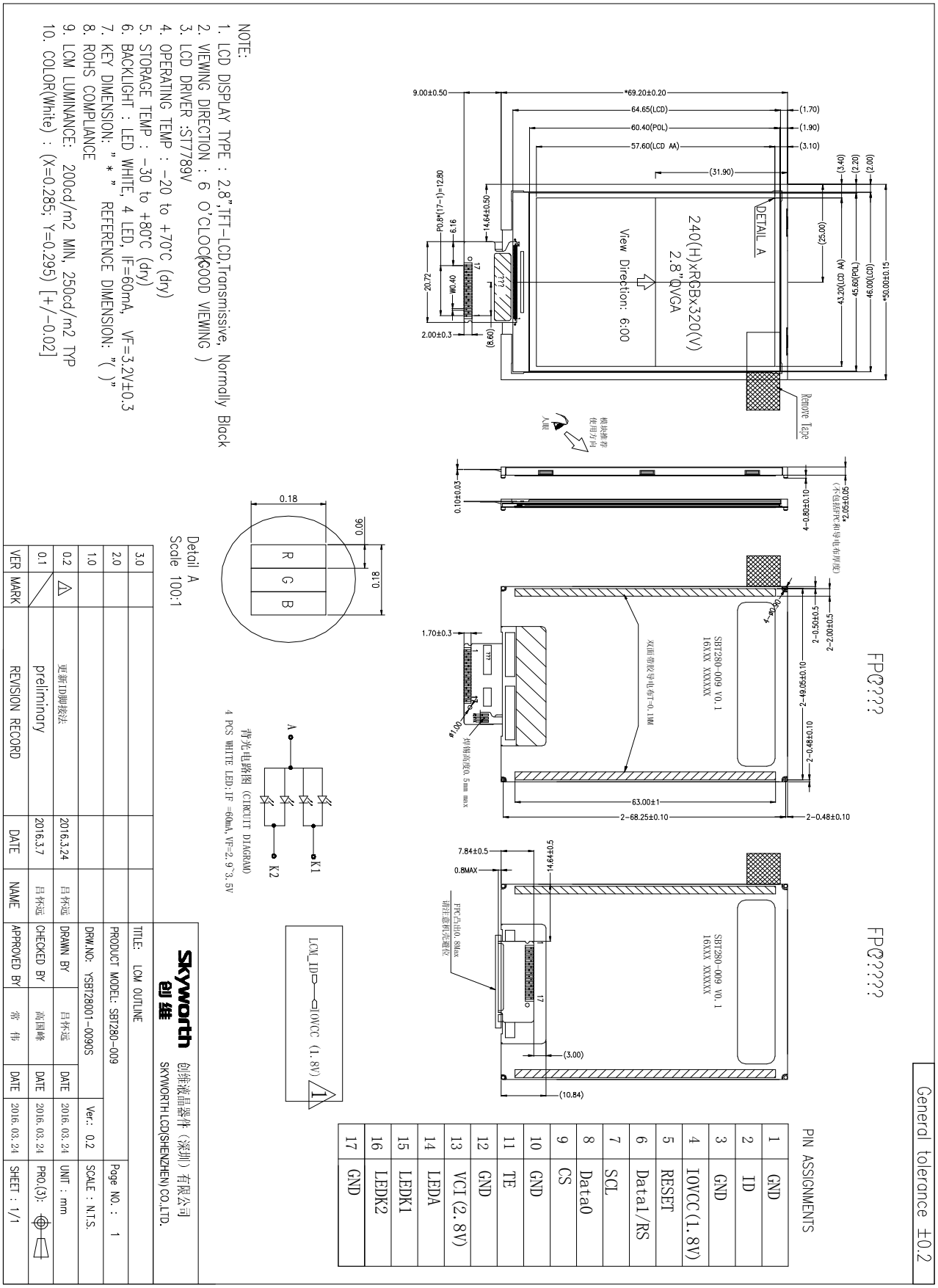
Note 1: Color tune is slightly changed by temperature and driving voltage.

Note 2: Requirements on Environmental Protection:RoHS

Note 3: Customer should do assembly according to our FPC bending sketch in the outline drawing

Note 4: Please approve our spec before placing mass production order. Otherwise we will regard customer has approved the spec when we receive the first 2Kpcs or above order from customer.

2.2.Mechanical Drawing



3. Interface Introduction

3.1.Pin Assignment

No.	Symbol	Description	Remark
1	GND	GND	-
2	ID	LCD ID Number Connect to GND	-
3	GND	GND	-
4	IOVCC	I/O power supply	-
5	RESET	Reset signal: active Low	-
6	Data1/RS	Data/Command select signal 0:Command,1-Data	-
7	SCL	(SPI_IF)Serial Clock	-
8	Data0	Serial input/output signal	-
9	CS	Chip select signal: active Low	
10	GND	GND	-
11	TE	Fmark signal. If not used then open	-
12	GND	GND	-
13	VCI	Analog/Logic Power supply	-
14	LEDA	LED Anode	-
15	LEDK1	LED Cathode	-
16	LEDK2	LED Cathode	-
17	GND	GND	-

Pin assign :Reference Page 5 Assembly drawing

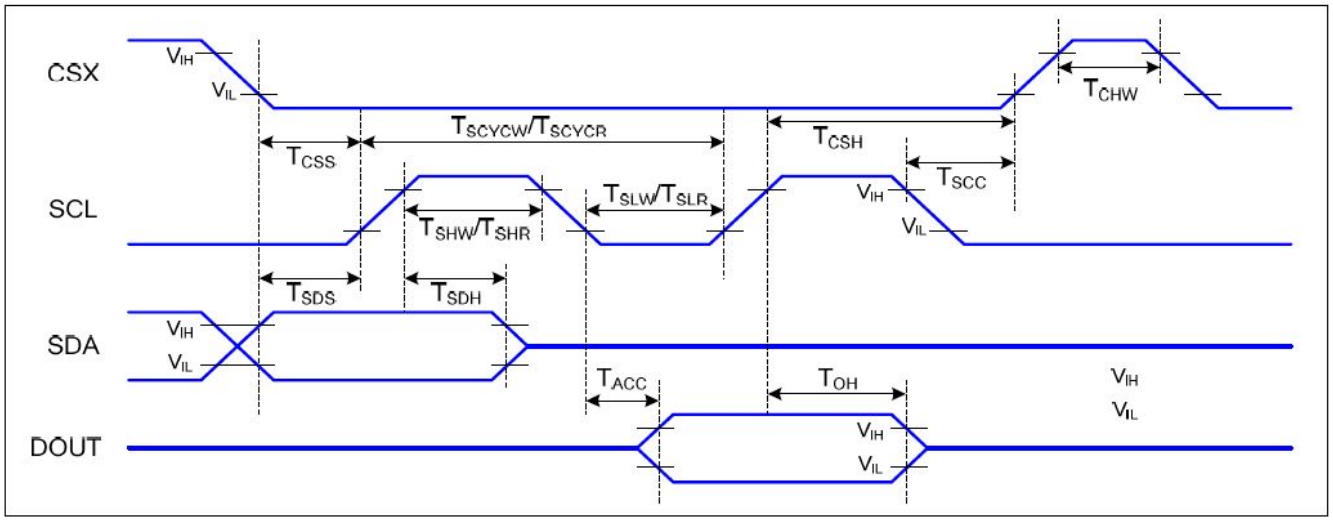
3.2.Interface Select

Register	Interface
RE7h=00h	3-line Serial Interface
RE7h=10h	2 data lane serial Interface

4. Command List

Please refer to the Driver IC Initial Code and contact our engineers.

5. Timing Sequence



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)	66		ns	
	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	
	T_{SHR}	SCL “H” pulse width (Read)	60		ns	
	T_{SLR}	SCL “L” pulse width (Read)	60		ns	
SDA (DIN)	T_{SDS}	Data setup time	10		ns	
	T_{SDH}	Data hold time	10		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

6. Electrical Characteristics

6.1.Absolute Maximum Rating

Item	Symbol	Standard	Unit	Remark
Supply Voltage	IOVCC	-0.3 to 4.6V	V	-
	VCI	-0.3 to 4.6V	V	-
Input Voltage	V_{IN}	-0.3 to IOVCC+0.5	V	-
Output Voltage	V_O	-0.3 to IOVCC+0.5	V	-

Note: Use over the absolute maximum rating might affect reliability and might cause malfunction.

6.2.DC Characteristics

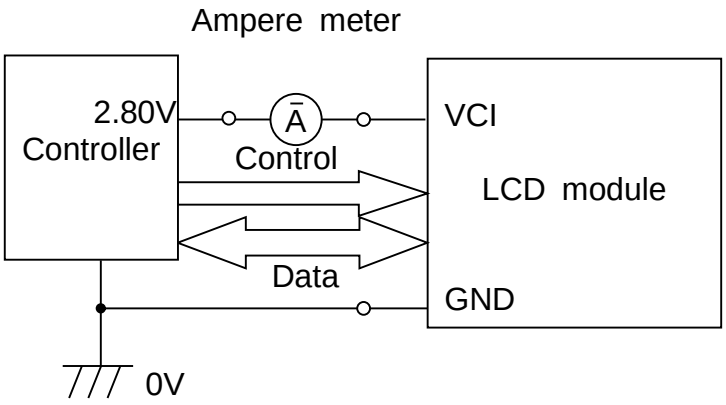
T=25℃

Item		Symbol	Min.	Typ.	Max.	Unit	Remark
Operating Voltage		IOVCC	1.65	1.80	3.30	V	*1
		VCI	2.40	2.75	3.30	V	
Input high-level voltage		V_{IH}	0.7*IOVCC	-	IOVCC	V	-
Input low-level voltage		V_{IL}	0	-	0.3*IOVCC	V	
Output high-level voltage		V_{OH}	0.8*IOVCC	-	IOVCC	V	
Output low-level voltage		V_{OL}	0	-	0.2*IOVCC	V	
Current Consumption	Operating (All on: Black)	IOVCC	-	TDB	TDB	mA	*2
	Sleep in	IOVCC	-	-	TDB	mA	

*1: VCI≧IOVCC
*2 :It applies, when there is no access from MPU.

Refer to ST7789V data sheet for AC and other DC characteristics

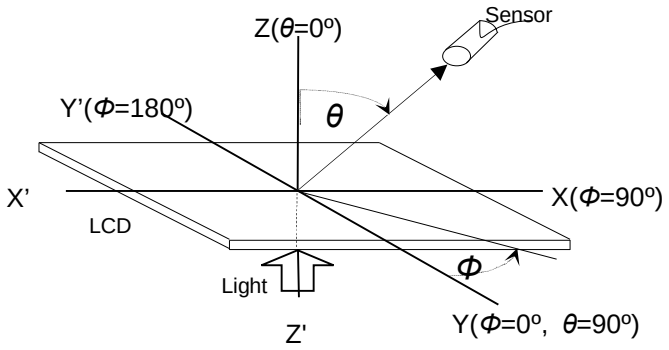
Test circuit



7. LCD Characteristics

GND=0V, IOVCC=1.8V,VCI=2.80V

Item		Symbol	Condition		Min.	Typ.	Max.	Unit
contrast ratio		C	θ=0°, φ=0°	25°C	-	500	-	-
Range of Viewing angle (θ:6h–12h)		θ(6h) - θ(12h)	C≥10	25°C	-	50 20	-	degree
Range of Viewing angle (θ:3h–9h)		θ(3h) - θ(9h)	C≥10	25°C	-	45 45	-	degree
Color	White	x	BM-7 (TOPCON) θ=0°, φ=0°	25°C	-	0.285	-	-
		y			-	0.295	-	-
	Red	x		25°C	-	0.621	-	-
		y			-	0.332	-	-
	Green	x		25°C	-	0.294	-	-
		y			-	0.577	-	-
	Blue	x		25°C	-	0.141	-	-
		y			-	0.157	-	-
NTSC ratio		-	↑	25°C	-	55	-	%
B/W Response time		Ton+T off	θ=0°, φ=0°	25°C	-	16	-	msec



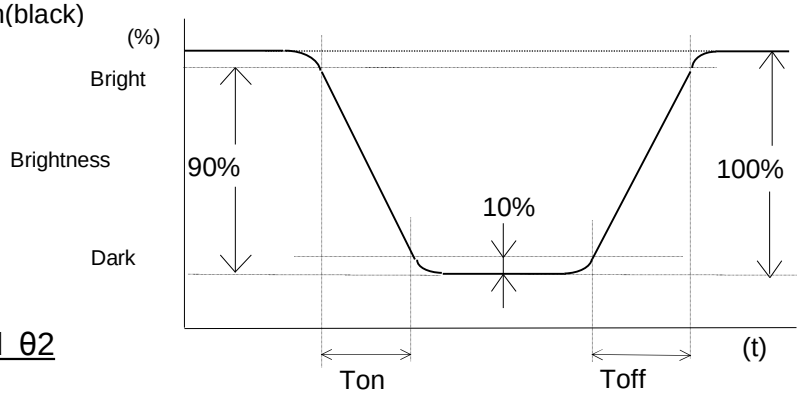
*Definition of contrast C

The contrast ratio is defined as follows:

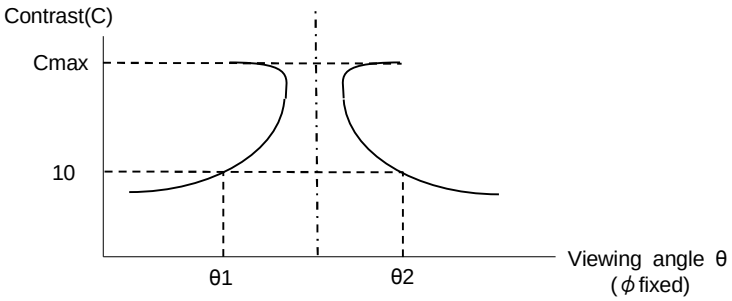
$$C = \frac{\text{Brightness of selected position(white)}}{\text{Brightness of unselected position(black)}}$$

*Definition of response time (Ton, Toff)

The response time is defined as the following figure.



*Definition of viewing angle θ1 and θ2



Note：Angle of optimized contrast with naked eye and viewing angle θ at Cmax above are not always the same.

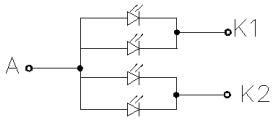
8. LED Backlight Characteristics

GND=0V, IOVCC=1.8V,VDD=2.80V

Item	Symbol	Condition	Min.	Typ.	Max.	unit	Remark
Current	I_{BL}	Ta=25ºC±3ºC	-	80	-	mA	*1
Power Consumption	P_{BL}	30-80%RH	-	256		mW	*2
LCM Brightness *3 *4 *5	Bp		310	330	-	cd/m^2	
Uniformity *3 *4 *6	Δ Bp		80	-	-	%	

Note 1:

*1 The data is measured using the constant current (If=20mA/1pcs.Total80mA) power supply.



背光电路图(CIRCUIT DIAGRAM)

4 PCS WHITE LED;IF =80mA,VF=2.9~3.5V

*2 Power Consumption PBL=IBL*3.2V*4=20mA * 3.2V*4 =256mW.

*3 The data is measured after LEDs are turned on for 5 minutes.

*4 Tester: BM-7（TOPCON）; spot size=1°field ;Distance=500mm

Conditions

LED backlight power supply : 80mA

LCD: White color

*5 Brightness in the center of the LCD panel.

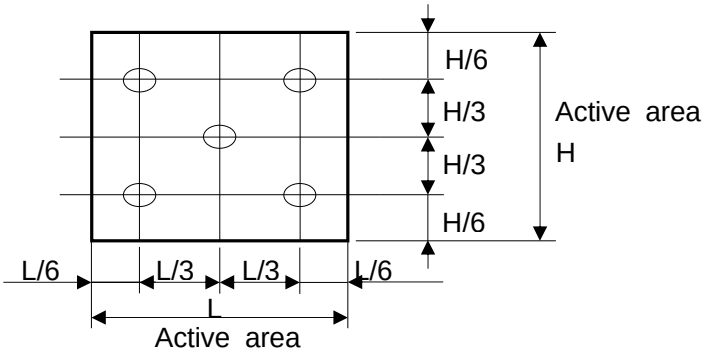
*6 Definition of Uniformity (ΔB_P)

$\Delta B_P = B_P$ (Min.) / B_P (Max.) x 100[%]

B_P (max.) = Maximum brightness in 5 measurement spots (refer to below chart).

B_P (Min.) = Minimum brightness in 5 measurement spots (refer to below chart).

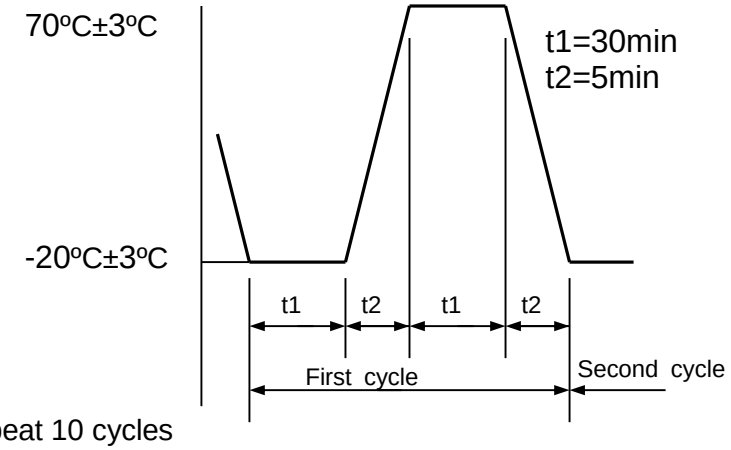
Measurement spots（5spots）



9. Reliability

SKYWORTH will develop engineering samples that meet the reliability level in mass production.

9.1.Reliability Test Items

Test Items	Condition
High temperature storage	+70ºC±3ºC, for 96 hours *Measure after 12hours left at normal temperature and humidity.
Low temperature storage	-20ºC±3ºC for 96 hours *Measure after 12hours left at normal temperature and humidity.
Operation at high temperature	+60ºC±3ºC, 30%RH max for 96 hours *Measure after 12hours left at normal temperature and humidity.
Operation at low temperature	-10ºC±3ºC, for 96 hours *Measure after 12hours left at normal temperature and humidity.
Operation at High temperature And high humidity	+40ºC±3ºC,90%+2%/-3%RH max. (no condensation) for 96 hours * Measure after 12 hours left at normal temperature and humidity
High temperature And high humidity storage	+60ºC±3ºC,90%+2%/-3%RH max.for 96 hours * Measure after 12 hours left at normal temperature and humidity
Temperature cycle storage	 Repeat 10 cycles *Measure after 12hours left at normal temperature and humidity
Vibration	Sweep at 10Hz to 50Hz, amplitude 1.5mm for2hours each in X, Y, and Z directions. Apply shipping package to this test.
Mechanical shock	Drop onto the tiled floor from 80 cm heights, 6 faces. Apply shipping package to this test.
ESD	・Air discharge 10time at panel center. Voltage:±8KV R=330Ω、C=150pF ・Contact discharge 10time at panel center Voltage:±4KV R=330Ω、C=150pF

9.2. Criteria

(1) Display characteristics: No Non-display, missing segments
(2) Electrical characteristics: Current Idd is twice higher than initial value.
(3) Appearance: No Air bubble in the LCD,Glass crack.

10.Quality Assurance Standard

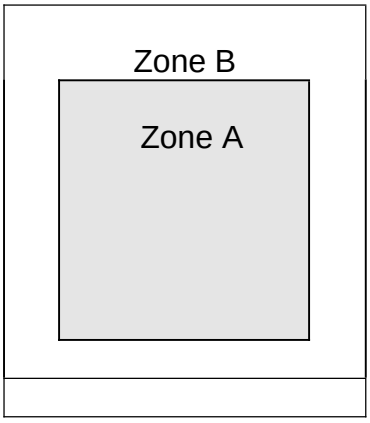
10.1. Outgoing Inspection Standards

・Sampling inspection is ANSI/ASQC Z1.4, single sampling inspection level 2, and normal inspection. The quality assurance level is shown below.

Rank	Inspection Item	AQL
Major Defect	Unable to turn on (disconnection) Short(Abnormal Display) Bubbles in the cell	0.65%
Minor Defect	Spot defect (Black·White·bright spots) Streak defect Glass defect Polarizer flaw (Scratch、Bubble、stain、Unevenness) Pattern defect(chip、boss、thick、slim)	1%

10.2. Zone Definitions

1) LCD



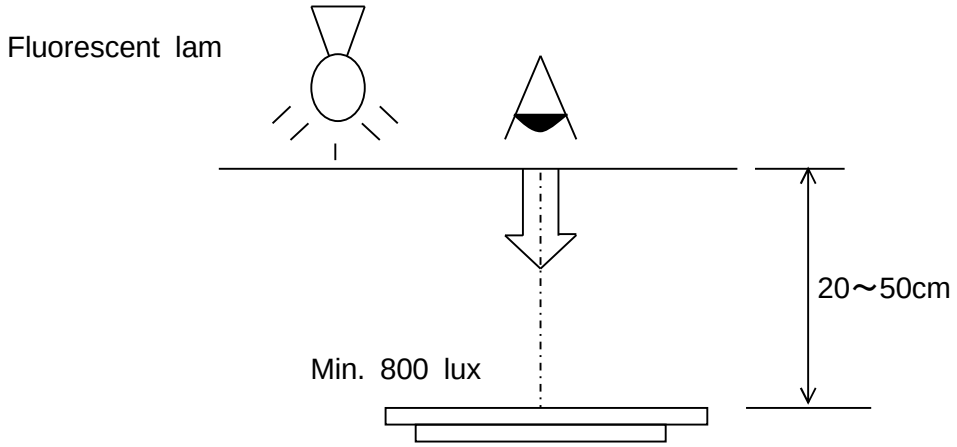
Zone A: Inside of the viewing area

Zone B: Outside of the viewing area

2) Inspection Condition

a) The visual inspection distance: The visual inspection distance of panel between LCD module and inspector's sight should be at 20~50cm distance.

b) Ambient Illumination:
External appearance inspection: 800 ~ 1200 Lux
Light on inspection: less than 80 Lux



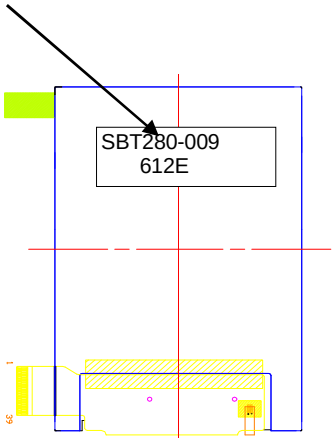
11.Packing Specifications

11.1. Indication of manufacturing code

Indicate following information by TBD digits marking on the Shield Tape by undefeatable ink.
: Model and revision code, Production plant, the last digit of the year, week, day of the week.

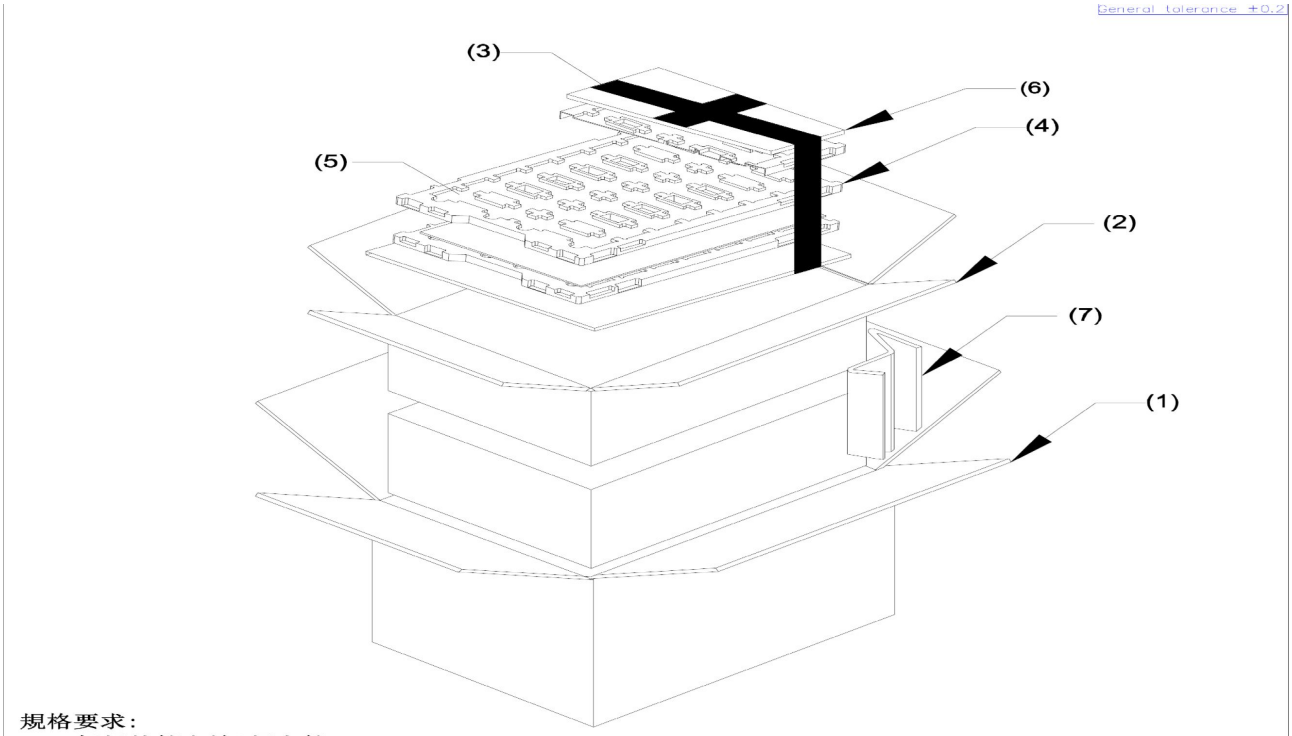
Ex：SBT280-009612E
↑ ↑↑↑
① ②③④

2016, Week12, Friday



①	Model and revision code:	SBT280-009
②	Production year:	last digit of the year
③	Production week:	week of the year
④	Production day of the week:	Mon-Sun; A-G

11.2.Packing process

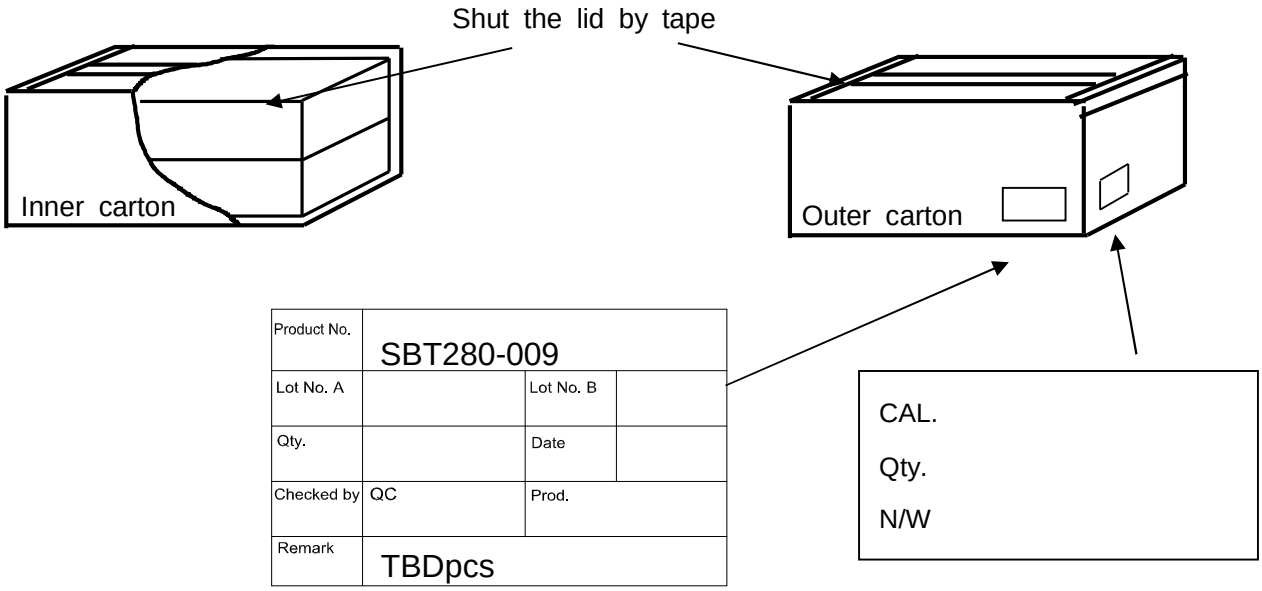


規格要求：
每個外箱內放2個內箱.
一個內箱裝X層產品，共需X+1個吸塑盤，
每層吸塑之間交錯180度放置，頂部放置1層空吸塑
一個吸塑盤裝X*X=XX個模組，
每層產品底部與頂部各放一層珍珠棉
每個內箱里放X*X*(XX-1)=XXX個模組.
一個外箱裝模組的數量:X*X*(XX-1)*2=XXX
最后，內箱和外箱封口

	NAME	UNIT	QTY PER	SPEC	MATERIAL	REMARK
1	外箱	PCS	1	465*345*315	PAPER	"A"TPY
2	内箱	PCS	2	435*315*142	PAPER	"B"TPY
3	防静电PE袋	m	6	1	PE	++ SHAPE
4	吸塑盒	PCS	XX	XXX*XXX*XX	PET	ESD 1Ω—10Ω
5	显示模组	PCS	XXX	XX*XX*XX		BE CAREFUL IN PUT
6	珍珠棉	PCS	4	425*305*6	PAPER	"B"TPY
7	纸板	PCS	4	288*285*6	PAPER	"B"TPY

Skyworth 创维 创维液晶器件（深圳）有限公司 SKYWORTH LCD(SHENZHEN) CO.,LTD.

TITLE: LCM OUTLINE				
PRODUCT MODEL: MIKI 4.02				Page NO. : 1
DRW.NO:			Ver. : 0.1	SCALE : N.T.S.
DRAWN BY		DATE		UNIT : mm
CHECKED BY		DATE		PRO.(3):
APPROVED BY		DATE		SHEET : 1/1



Product No.	SBT280-009		
Lot No. A		Lot No. B	
Qty.		Date	
Checked by	QC	Prod.	
Remark	TBDpcs		

12.Handling Precautions

12.1. Operation

Burn-in sometimes happens when the same character was displayed at along time. Therefore, to prevent Burn-in, SKYWORTH recommended to set up aScreen-saver function.

12.2. Safety

DO NOT put it in your mouth in case LCD panel has broken. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and water.

12.3. Handling

(1) The LCD panel is plate glass. **DO NOT** subject the panel to mechanical shock or to excessive force on its surface.
(2) The polarizer attached to the display is very easy to damage, handle it with care to avoid scratching.
(3) To avoid contamination on the display surface, **DO NOT** touch the display surface with bare hands.
(4) Provide a space so that the LCD panel does not come into contact with other components.
(5) To protect the LCD panel from external pressure, put covering glass (acrylic board or similar board) to keep appropriate space between them.
(6) Transparent electrodes may be disconnected if you use the LCD panel under environmental conditions where dew condensation occurs.
(7) Property of semiconductor devices may be affected when they are exposed to light possibly resulting in malfunctioning of the ICs.
To prevent such malfunctioning of the ICs, your design and mounting layout done are so that the IC is not exposed to light in actual use.

12.4. Static Electricity

(1) Ground soldering iron tips, tools and testers when they operate.
(2) Ground your body when handling the products.
(3) **DO NOT** apply voltage to the input terminal without applying power supply.
(4) **DO NOT** apply voltage that exceeds the absolute maximum rating.
(5) Store the products in an anti-electrostatic container.

12.5. Storage

Store the products in a dark place at +5~+25 degree C, low humidity (50%RH or less).
DO NOT store the products in an atmosphere containing organic solvents or corrosive gases.

12.6. Cleaning

(1) **DO NOT** wipe the polarizer with dry cloth, as it might cause scratch.
(2) Wipe the polarizer with a soft cloth soaked with petroleum IPA, other chemical might damage.

12.7. Waste

When dispose of LCD module, manage it as the production waste.