TIANMA

SPECIFICATION

FOR LCD MODULE

MODEL NO:	**TM240160B1CFWGWA**
CUSTOMER:	奥维通信
CUSTOMER P/N.	
VERSION	**V0.1**
CUSTOMER APPROVED	

□ Preliminary specification

■ Final specification

PREPARED BY	CHECKED BY	VERIFIED BY QA DEPT.	APPROVED BY
董坤 2012-3-12	彭仕平 2012-3-12	郑芳 2012-3-12	赵晓宇 2012-3-12

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REVISION RECORD

Version	Page	Revision Items	Name	Date
0.1		First release	Keven Dong	2012.3.9

TABLE OF CONTENTS

Page

1. LCD Module Part Numbering System

TM	240160	B1	C	F	W	G	W	A
①	②	③	④	⑤	⑥	⑦	⑧	⑨

NO.	Explanation	
①	**TIANMA module indicating**	
②	**Module type:** 240 columns×160 rows， 6 DIGITS	
③	**TIANMA module series**	
④	**LCD type**	
	C	Positive, FSTN
⑤	**Backlight type**	
	F	Transmissive, LED
⑥	Temperature range	
	W	Wide temperature
⑦	**Technology**	
	G	COG
⑧	**The color of backlight**	
	W	White
⑨	**Function choice**	
	A	Without any function

2 Basic specification

Item	Contents			
LCD type	□TN	□STN	■FSTN	□
	■positive	□negative		
LCD Duty	□64	□128	□240	■160
LCD Bias	■1/9	□1/12	□1/17	□1/5
Polarizer	□reflective	□transflective	■transmissive	
LCD background color	■grey	□yellow/green	□blue	□white
Backlighting	■LED	□EL	□CFL	□
LED type	■edge	□area	□	□
Backlighting color	■white	□yellow/green	□blue	□
View direction	■6:00	□12:00	□9:00	□Wide View
Operating temperature	□0℃~50℃	■-10℃~60℃	□	
Storage temperature	■-20℃~70℃	□-30℃~80℃	□	
Controller	■ST7669A	□	□	
Frame	□SPCC(black)	□Zinc plated	□stainless steel	■Without
Technology	□SMT	□COB	■COG	□Other
Power supply	■single +3.3V	□single +5.0V	□dual	□triplex
Data Transfer	■8 Bit Parallel	□4 Bit Parallel	□Serial	□

Features

- ◆ Requirements on environmental protection: RoHS.

Notes:

- Color tone can slightly change with temperature and driving voltage.
- Color tone will be changed by backlight.

3 Mechanical data

Parameter	Standard Value	Unit
Display type	Dot-matrix module	--
Number of dots (W×H)	240×160	--
View area (W×H)	74.30 × 40.40	mm
Active Area (W×H)	67.18 × 35.98	mm
Dot Size (W×H)	0.260 × 0.205	mm
Dot Pitch (W×H)	0.280 × 0.225	mm
Module size(W×H×D)	87.40 × 74.35 × 5.9	mm
Module total weight (approx)	41.40	g
Module outline dimensions	Refer to page 6-"Outline drawing"	--

4 Absolute maximum ratings

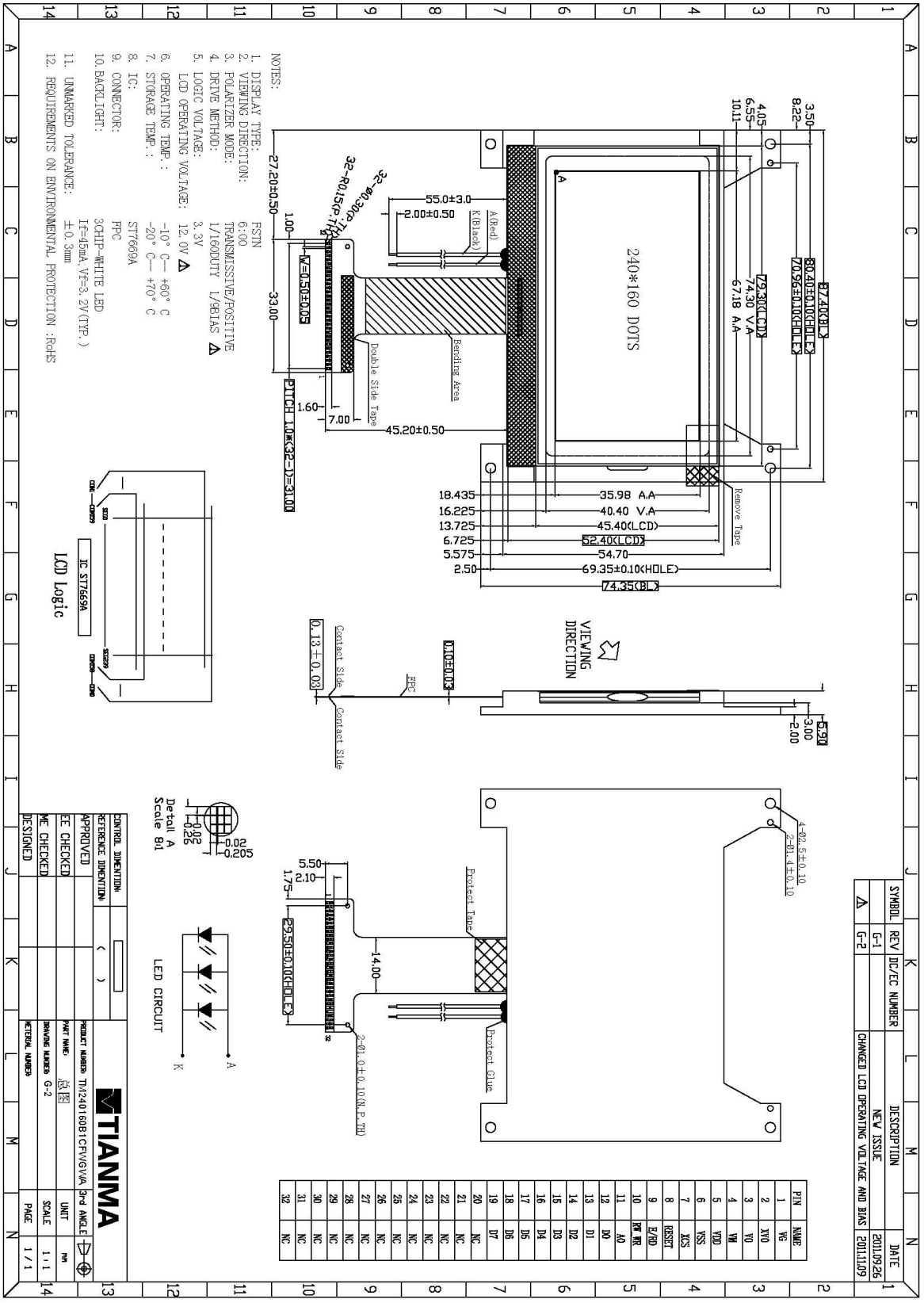
(Without LED backlighting ,Ta=25℃)

Parameter	Symbol	Min	Max	Unit	Remark
Logic circuit supply voltage	V_{DD}	3.0	3.4	V	
LCD driving voltage	V_{LCD} (V0-XV0)	11.8	12.20	V	
Operating temperature range	Top	-10	+60	℃	No Condensation
Storage temperature range	Tst	-20	+70	℃	

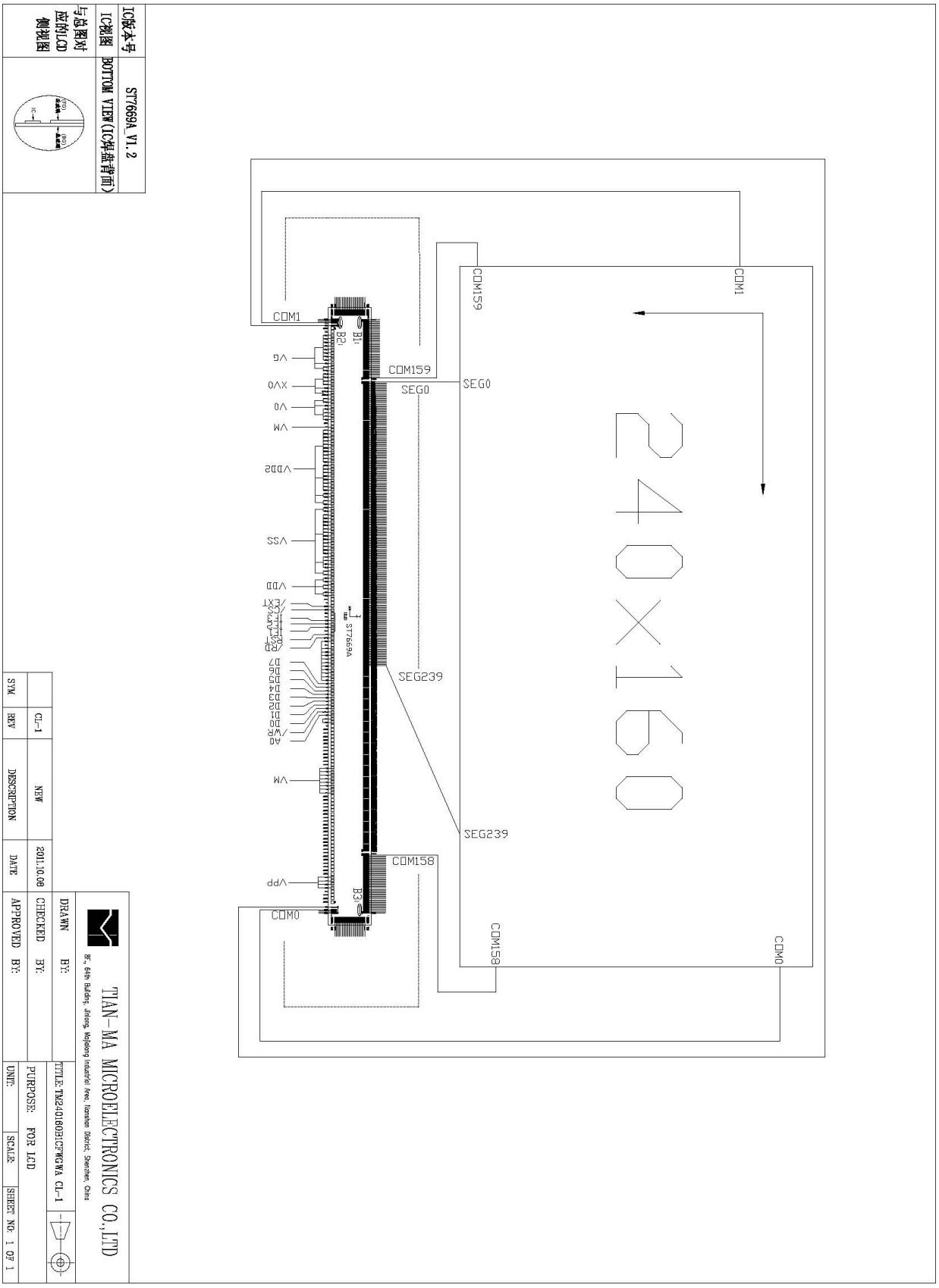
Notes:

- LCD operating voltage V_{LCD}=V0-XV0.
- If the module is above these absolute maximum ratings. It may become permanently damaged. Using the module within the following electrical characteristic conditions are also exceeded, the module will malfunction and cause poor reliability, and its service life will reduce.
- V_{LCD} >V_{SS} must be maintained.

5. Outline Drawing



6. Circuit



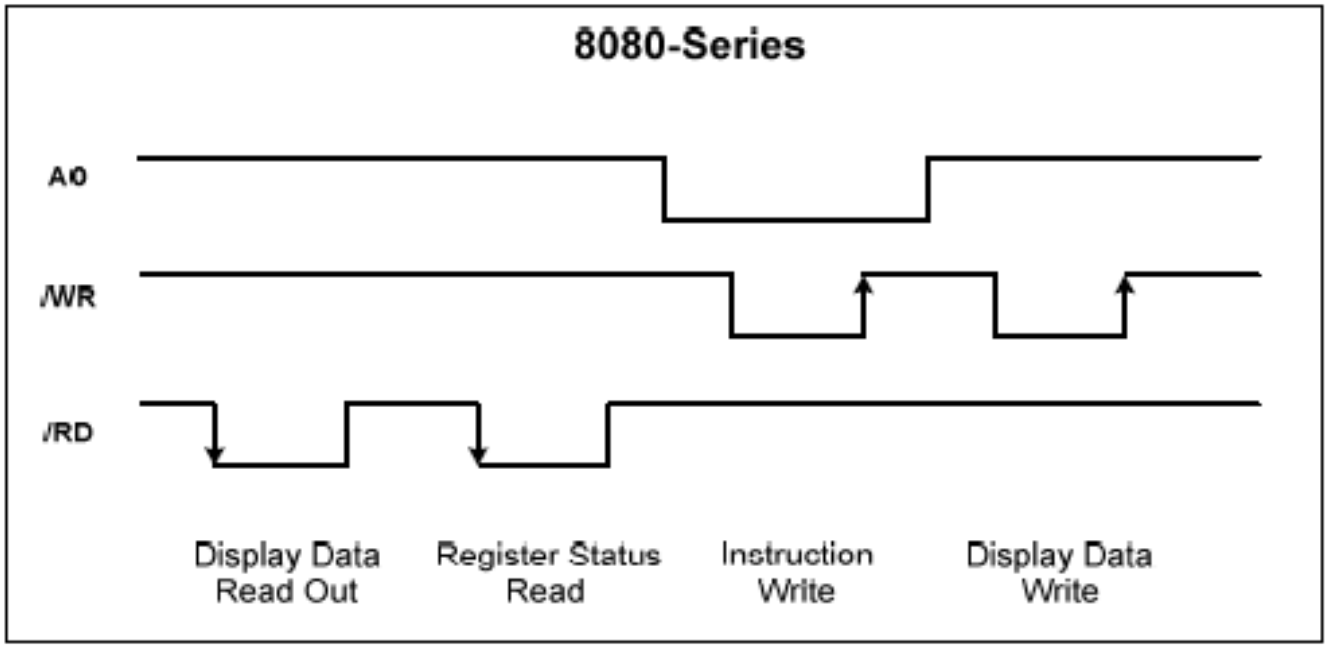
7 Pin connections

Pin No.	Symbol	Level	Description
1	VG		Bias LCD driver supply voltages
2	XV0		Negative LCD driver supply voltages
3	V0		Positive LCD driver supply voltages
4	VM		the I/O pin of LCD bias supply voltage.
5	VDD	3.3V	Power supply voltage for analog circuit
6	VSS	0V	Ground pin
7	XCS	I	Chip select signal
8	RESET	I	Reset pin
9	E/RD	I	Read execution control pin
10	RW_WR	I	Write execution control pin
11	A0	I	Register select signal
12	D0	I/O	Data bus
13	D1	I/O	Data bus
14	D2	I/O	Data bus
15	D3	I/O	Data bus
16	D4	I/O	Data bus
17	D5	I/O	Data bus
18	D6	I/O	Data bus
19	D7	I/O	Data bus
20~32	NC		

8 Interface Timing Chart

Note: please refer to sitronix's ST7669A datasheet for more details
sitronix's ST7669A INTERFACE POTOCOL
Inter 80 system cpu interface

Common	6800-series		8080-series		Description
A0	R/W	E	/RD	/WR	
H	H	↑	↓	H	Display data read out
H	H	↑	↓	H	Register status read
L	L	↓	H	↑	Instruction write
H	L	↓	H	↑	Display data write



Instruction description(sitronix's ST7669A)

Command Table-1 , /EXT= H or L

Hex	Command	A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	Function	Ref
(00h)	NOP	0	1	0	0	0	0	0	0	0	0	0	No Operation	9.1.1
(01h)	SWRESET	0	1	0	0	0	0	0	0	0	0	1	Software reset	9.1.2
(04h)	RDDID	0	1	0	0	0	0	0	0	1	0	0	Read Display ID	9.1.3
-		1	0	1	-	-	-	-	-	-	-	-	Dummy read	
-		1	0	1	ID17	ID16	ID15	ID14	ID13	ID12	ID11	ID10	ID1 read (D23-D16)	
-		1	0	1	1	ID26	ID25	ID24	ID23	ID22	ID21	ID20	ID2 read (D15-D8)	
-		1	0	1	ID37	ID36	ID35	ID34	ID33	ID32	ID31	ID30	ID3 read (D7-D0)	
(09h)	RDDST	0	1	0	0	0	0	0	1	0	0	1	Read Display Status	9.1.4
-		1	0	1	-	-	-	-	-	-	-	-	Dummy read	
-		1	0	1	ST31	ST30	ST29	ST28	ST27	ST26	ST25	ST24	(D31-D24)	
-		1	0	1	ST23	ST22	ST21	ST20	ST19	ST18	ST17	ST16	(D23-D16)	
-		1	0	1	ST15	ST14	ST13	ST12	ST11	ST10	ST9	ST8	(D15-D8)	
-		1	0	1	ST7	ST6	ST5	ST4	ST3	ST2	ST1	ST0	(D7-D0)	
(0Ah)	RDDPM	0	1	0	0	0	0	0	1	0	1	0	Read Display Power Mode	9.1.5
-		1	0	1	-	-	-	-	-	-	-	-	Dummy read	
-		1	0	1	D7	D6	D5	D4	D3	D2	0	0	-	
(0Bh)	RDDMADCTR	0	1	0	0	0	0	0	1	0	1	1	Read Display MADCTR	9.1.6
-		1	0	1	-	-	-	-	-	-	-	-	Dummy read	
-		1	0	1	D7	D6	D5	D4	D3	0	0	0	-	
(0Ch)	RDDCOLMOD	0	1	0	0	0	0	0	1	1	0	0	Read Display Pixel Format	9.1.7
-		1	0	1	-	-	-	-	-	-	-	-	Dummy read	
-		1	0	1	0	0	0	0	0	D2	D1	D0	-	
(0Dh)	RDDIM	0	1	0	0	0	0	0	1	1	0	1	Read Display Image Mode	9.1.8
-		1	0	1	-	-	-	-	-	-	-	-	Dummy read	
-		1	0	1	D7	0	D5	D4	D3	0	0	0	-	
(0Eh)	RDDSM	0	1	0	0	0	0	0	1	1	1	0	Read Display signal Mode	9.1.9
-		1	0	1	-	-	-	-	-	-	-	-	Dummy read	
-		1	0	1	D7	D6	0	0	0	0	0	0	-	
(0Fh)	RDDSDR	0	1	0	0	0	0	0	1	1	1	1	Read Display Self-diagnostic result	9.1.10
-		1	0	1	-	-	-	-	-	-	-	-	Dummy read	
		1	0	1	D7	D6	0	0	0	0	0	0	-	

Hex	Command	A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	Function	Ref
(10h)	SLPIN	0	1	0	0	0	0	1	0	0	0	0	Sleep in & booster off	9.1.11
(11h)	SLPOUT	0	1	0	0	0	0	1	0	0	0	1	Sleep out & booster on	9.1.12
(12h)	PTLON	0	1	0	0	0	0	1	0	0	1	0	Partial mode on	9.1.13
(13h)	NORON	0	1	0	0	0	0	1	0	0	1	1	Partial off (Normal)	9.1.14
(20h)	INVOFF	0	1	0	0	0	1	0	0	0	0	0	Display inversion off (normal)	9.1.15
(21h)	INVON	0	1	0	0	0	1	0	0	0	0	1	Display inversion on	9.1.16
(22h)	APOFF	0	1	0	0	0	1	0	0	0	1	0	All pixel off (Only for test purpose)	9.1.17
(23h)	APON	0	1	0	0	0	1	0	0	0	1	1	All pixel on (Only for test purpose)	9.1.18
(25h)	WRCNTR	0	1	0	0	0	1	0	0	1	0	1	Write contrast	9.1.19
-		1	1	0	0	EV6	EV5	EV4	EV3	EV2	EV1	EV0	EV = 0 to 127	
(28h)	DISPOFF	0	1	0	0	0	1	0	1	0	0	0	Display off	9.1.20
(29h)	DISPON	0	1	0	0	0	1	0	1	0	0	1	Display on	9.1.21
(2Ah)	CASET	0	1	0	0	0	1	0	1	0	1	0	Column address set	9.1.22
		1	1	0	XS15	XS14	XS13	XS12	XS11	XS10	XS9	XS8	X_ADR start: 0≦XS≦83h	
		1	1	0	XS7	XS6	XS5	XS4	XS3	XS2	XS1	XS0		
		1	1	0	XE15	XE14	XE13	XE12	XE11	XE10	XE9	XE8	X_ADR end: XS≦XE ≦83h	
		1	1	0	XE7	XE6	XE5	XE4	XE3	XE2	XE1	XE0		
(2Bh)	RASET	0	1	0	0	0	1	0	1	0	1	1	Row address set	9.1.23
		1	1	0	YS15	YS14	YS13	YS12	YS11	YS10	YS9	YS8	Y_ADR start: 0≦YS≦A1h	
		1	1	0	YS7	YS6	YS5	YS4	YS3	YS2	YS1	YS0		
		1	1	0	YE15	YE14	YE13	YE12	YE11	YE10	YE9	YE8	Y_ADR end: YS≦YE≦A1h	
		1	1	0	YE7	YE6	YE5	YE4	YE3	YE2	YE1	YE0		
(2Ch)	RAMWR	0	1	0	0	0	1	0	1	1	0	0	Memory write	9.1.24
		1	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data	
(2Eh)	RAMRD	0	1	0	0	0	1	0	1	1	1	0	Memory Read	9.1.25
		1	1	0	-	-	-	-	-	-	-	-		
		1	1	0	D7	D6	D5	D4	D3	D2	D1	D0		
(30h)	PTLAR	0	1	0	0	0	1	1	0	0	0	0	Partial start/end address set	9.1.26
-		1	1	0	PS15	PS14	PS13	PS12	PS11	PS10	PS9	PS8	Start address (0~161)	
		1	1	0	PS7	PS6	PS5	PS4	PS3	PS2	PS1	PS0		
		1	1	0	PE15	PE14	PE13	PE12	PE11	PE10	PE9	PE8	End address (0~161)	
-		1	1	0	PE7	PE6	PE5	PE4	PE3	PE2	PE1	PE0		

Hex	Command	A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	Function	Ref
(33h)	SCRLAR	0	1	0	0	0	1	1	0	0	1	1	Scroll Area	9.1.27
-		1	1	0	TFA7	TFA6	TFA5	TFA4	TFA3	TFA2	TFA1	TFA0	TFA=0~162	
-		1	1	0	VSA7	VSA6	VSA5	VSA4	VSA3	VSA2	VSA1	VSA0	VSA=0~162	
-		1	1	0	BFA7	BFA6	BFA5	BFA4	BFA3	BFA2	BFA1	BFA0	BFA=0~162	
(34h)	TEOFF	0	1	0	0	0	1	1	0	1	0	0	Tearing effect line off	9.1.28
(35h)	TEON	0	1	0	0	0	1	1	0	1	0	1	Tearing effect mode set & on	9.1.29
-		1	1	0	-	-	-	-	-	-	-	M	"0": mode1, "1": mode2	
(36h)	MADCTR	0	1	0	0	0	1	1	0	1	1	0	Memory data access control	9.1.30
-		1	1	0	MY	MX	MV	ML	RGB	-	-	-	-	
(37h)	VSCSAD	0	1	0	0	0	1	1	0	1	1	1	Scroll start address of RAM	9.1.31
		1	1	0	SSA7	SSA6	SSA5	SSA4	SSA3	SSA2	SSA1	SSA0	SSA = 0~161	
(38h)	IDMOFF	0	1	0	0	0	1	1	1	0	0	0	Idle mode off	9.1.32
(39h)	IDMON	0	1	0	0	0	1	1	1	0	0	1	Idle mode on	9.1.33
(3Ah)	COLMOD	0	1	0	0	0	1	1	1	0	1	0	Interface pixel format	9.1.34
-		1	1	0	-	-	-	-	-	P2	P1	P0	Interface format	
(DAh)	RDID1	0	1	0	1	1	0	1	1	0	1	0	Read ID1	9.1.35
-		1	0	1	-	-	-	-	-	-	-	-	Dummy read	
-		1	0	1	ID17	ID16	ID15	ID14	ID13	ID12	ID11	ID10	(D7-D0)	
(DBh)	RDID2	0	1	0	1	1	0	1	1	0	1	0	Read ID2	9.1.36
-		1	0	1	-	-	-	-	-	-	-	-	Dummy read	
-		1	0	1	ID27	ID26	ID25	ID24	ID23	ID22	ID21	ID20	(D7-D0)	
(DCh)	RDID3	0	1	0	1	1	0	1	1	0	1	0	Read ID3	9.1.37
-		1	0	1	-	-	-	-	-	-	-	-	Dummy read	
-		1	0	1	ID37	ID36	ID35	ID34	ID33	ID32	ID31	ID30	(D7-D0)	

Note 1: When /EXT connects to H or floating, commands which are not defined in "Command Table-1" are treated as NOP (00H) command.

Note 2: Commands 10H, 12H, 13H, 20H, 21H, 25H, 28H, 29H, 30H, 36H (Bit ML only), 38H and 39H are updated during V-sync when Module is in Sleep Out Mode to avoid abnormal visual effects.

During Sleep In mode, these commands are updated immediately.

Read status (09H), Read Display Power Mode (0AH), Read Display MADCTR (0BH), Read Display Pixel Format (0CH), Read Display Image Mode (0DH), Read Display Signal Mode (0EH) and Read Display Self Diagnostic Result (0FH) of these commands is updated immediately both in Sleep In mode and Sleep Out mode.

Command Table-2 , /EXT= L														
Hex	**Command**	**A0**	**/RD**	**/WR**	**D7**	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**	**Function**	**Ref**
(B0h)	DutySet	0	1	0	1	0	1	1	0	0	0	0	Display Duty setting	9.1.38
		1	1	0	Du7	Du6	Du5	Du4	Du3	Du2	Du1	Du0		
(B1h)	FirstCom	0	1	0	1	0	1	1	0	0	0	1	First Com. Page address	9.1.39
		1	1	0	F7	F6	F5	F4	F3	F2	F1	F0		
(B3h)	OscDiv	0	1	0	1	0	1	1	0	0	1	1	FOSC divider	9.1.40
		1	1	0	-	-	-	-	-	-	CLD1	CLD0		
(B4h)	PTLMOD	0	1	0	1	0	1	1	0	1	0	0	Saving Power Mode Selection	9.1.41
		1	1	0	PTLM	0	0	1	1	0	0	0		
(B5h)	NLInvSet	0	1	0	1	0	1	1	0	1	0	1	N-line control	9.1.42
		1	1	0	M	N6	N5	N4	N3	N2	N1	N0		
(B7h)	ComScanDir	0	1	0	1	0	1	1	0	1	1	1	Com/Seg Scan Direction for Glass layout	9.1.43
		1	1	0	0	SMX	0	0	SBGR	0	0	1		
(B8h)	RmwIn	0	1	0	1	0	1	1	1	0	0	0	read modify write control IN	9.1.44
(B9h)	RmwOut	0	1	0	1	0	1	1	1	0	0	1	read modify write control Out	9.1.45
(BCh)	IdleImageSaving	0	1	0	1	0	1	1	1	1	0	0	Idle Image Saving Mode	9.1.46
		1	1	0	0	0	0	0	Idleim	Sunit	0	0		
(BDh)	DispCompStep	0	1	0	1	0	1	1	1	1	0	1	Display Compensation Step	9.1.47
		1	1	0	0	0	0	0	0	Step2	Step1	Step0		
(C0h)	VopSet	0	1	0	1	1	0	0	0	0	0	0	Vop setting	9.1.48
		1	1	0	Vop7	Vop6	Vop5	Vop4	Vop3	Vop2	Vop1	Vop0		
		1	1	0	-	-	-	-	-	-	-	Vop8		
(C1h)	VopOfsetInc	0	1	0	1	1	0	0	0	0	0	1	+40mv/setp	9.1.49
(C2h)	VopOfsetDec	0	1	0	1	1	0	0	0	0	1	0	-40mv/setp	9.1.50
(C3h)	BiasSel	0	1	0	1	1	0	0	0	0	1	1	Bias selection	9.1.51
		1	1	0	-	-	-	-	-	Bias2	Bias1	Bias0		
(C4h)	BstBmpXSel	0	1	0	1	1	0	0	0	1	0	0	Booster setting	9.1.52
		1	1	0	-	-	-	-	-	BST2	BST 1	BST0		

Hex	Command	A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	Function	Ref
(C5h)	BstEffSel	0	1	0	1	1	0	0	0	1	0	1	Booster efficiency selection	9.1.53
		1	1	0	-	-	1	0	-	-	BTF1	BTF0		
(C7h)	VopOffset	0	1	0	1	1	0	0	0	1	1	1	Vop offset fuse bit adjust	9.1.54
		1	1	0	0	VOS6	VOS5	VOS4	VOS3	VOS2	VOS1	VOS0		
(CBh)	VgSorcSel	0	1	0	1	1	0	0	1	0	1	1	Vg with Booster x2 control	9.1.55
		1	1	0	-	-	-	-	-	-	-	2BT0		
(CCh)	ID1Set	0	1	0	1	1	0	0	1	1	0	0	ID1 setting	9.1.56
		1	1	0	ID1_7	ID1_6	ID1_5	ID1_4	ID1_3	ID1_2	ID1_1	ID1_0		
(CDh)	ID2Set	0	1	0	1	1	0	0	1	1	0	1	ID2 setting	9.1.57
		1	1	0	1	ID2_6	ID2_5	ID2_4	ID2_3	ID2_2	ID2_1	ID2_0		
(CEh)	ID3Set	0	1	0	1	1	0	0	1	1	1	0	ID3 setting	9.1.58
		1	1	0	ID3_7	ID3_6	ID3_5	ID3_4	ID3_3	ID3_2	ID3_1	ID3_0		
(D0h)	ANASET	0	1	0	1	1	0	0	0	0	0	0	Analog circuit setting	9.1.59
		1	1	0	0	0	0	1	1	1	0	1		
(D7h)	AutoLoadSet	0	1	0	1	1	0	1	0	1	1	1	mask rom data auto re-load control	9.1.60
		1	1	0	EXTE	OTBE	-	ARD	1	1	1	1		
(DEh)	RDTstStatus	0	1	0	1	1	0	1	1	1	1	0	read IC status	9.1.61
		1	0	1	-	-	-	-	-	-	-	-	Dummy Read	
(E0h)	EPCTIN	0	1	0	1	1	1	0	0	0	0	0	Control OTP WR/RD	9.1.62
		1	1	0	0	0	WR /XRD	0	0	0	0	0		
(E1h)	EPCTOUT	0	1	0	1	1	1	0	0	0	0	1	OTP control cancel	9.1.63
(E2h)	EPMWR	0	1	0	1	1	1	0	0	0	1	0	Write to OTP	9.1.64
(E3h)	EPMRD	0	1	0	1	1	1	0	0	0	1	1	Read from OTP	9.1.65
(E4h)	OTPSEL	0	1	0	1	1	1	0	0	1	0	0	Select OTP	9.1.66
		1	1	0	MS1	MS0	0	1	1	0	0	0		
(E5h)	ROMSET	0	1	0	0	1	1	1	0	1	0	1	Programmable rom setting	9.1.67
		1	1	0	0	0	0	0	1	1	1	0		
(E6h)	StusRDSEL	0	1	0	1	1	1	0	0	1	1	0	Fuse data readout control	9.1.68
		1	1	0	-	-	-	-	STU3	STU2	STU1	STU0		

(F0h)	FRMSEL	0	1	0	1	1	1	1	0	0	0	0	Frame Freq. in Temp range A,B,C and D	9.1.69
		1	1	0	-	-	-	FA4	FA3	FA2	FA1	FA0		
		1	1	0	-	-	-	FB4	FB3	FB2	FB1	FB0		
		1	1	0	-	-	-	FC4	FC3	FC2	FC1	FC0		
		1	1	0	-	-	-	FD4	FD3	FD2	FD1	FD0		
(F1h)	FRM8SEL	0	1	0	1	1	1	1	0	0	0	1	Frame Freq. in Temp range A,B,C and D (idle)	9.1.70
		1	1	0	-	-	-	F8A4	F8A3	F8A2	F8A1	F8A0		
		1	1	0	-	-	-	F8B4	F8B3	F8B2	F8B1	F8B0		
		1	1	0	-	-	-	F8C4	F8C3	F8C2	F8C1	F8C0		
		1	1	0	-	-	-	F8D4	F8D3	F8D2	F8D1	F8D0		
(F2h)	TMPRNG	0	1	0	1	1	1	1	0	0	1	0	Temp range A,B and C	9.1.71
		1	1	0	-	TA6	TA5	TA4	TA3	TA2	TA1	TA0		
		1	1	0	-	TB6	TB5	TB4	TB3	TB2	TB1	TB0		
		1	1	0	-	TC6	TC5	TC4	TC3	TC2	TC1	TC0		
(F3h)	TMPHYS	0	1	0	1	1	1	1	0	0	1	1	Hysteresis value set	9.1.72
		1	1	0	-	-	-	-	TH3	TH2	TH1	TH0		
(F4h)	TEMPSEL	0	1	0	1	1	1	1	0	1	0	0	TEMPSEL	9.1.73
		1	1	0	MT13	MT12	MT11	MT10	MT03	MT02	MT01	MT00		
		1	1	0	MT33	MT32	MT31	MT30	MT23	MT22	MT21	MT20		
		1	1	0	MT53	MT52	MT51	MT50	MT43	MT42	MT41	MT40		
		1	1	0	MT73	MT72	MT71	MT70	MT63	MT62	MT61	MT60		
		1	1	0	MT93	MT92	MT91	MT90	MT83	MT82	MT81	MT80		
		1	1	0	MTB3	MTB2	MTB1	MTB0	MTA3	MTA2	MTA1	MTA0		
		1	1	0	MTD3	MTD2	MTD1	MTD0	MTC3	MTC2	MTC1	MTC0		
		1	1	0	MTF3	MTF2	MTF1	MTF0	MTE3	MTE2	MTE1	MTE0		
(F7h)	THYS	0	1	0	1	1	1	1	0	1	1	1	Temperature detection threshold	9.1.74
		1	1	0	THYS7	THYS6	THYS5	THYS4	THYS3	THYS2	THYS1	THYS0		
(F9h)	Frame Set	0	1	0	1	1	1	1	1	0	0	1	Set Frame RGB PWM	9.1.75
		1	1	0	-	-	-	P14	P13	P12	P11	P10		
		1	1	0	-	-	-	P24	P23	P22	P21	P20		
		:	:	:	:	:	:	:	:	:	:	:		
		1	1	0	-	-	-	P154	P153	P152	P151	P150		
		1	1	0	-	-	-	P164	P163	P162	P161	P160		

9 Electrical characteristics

V_{SS}=0V, Ta=25℃

Item		Symbol	Condition	MIN	TYP	MAX	UNIT
Logic circuit supply voltage		V_{DD}	--	2.9	3.3	3.4	V
Operating voltage for LCD		Vop	--	11.8	12	12.2	
Input voltage for logic circuit	"H"level	V_{IH}	V_{DD}=3.3V	0.7V_{DD}	--	V_{DD}	
	"L"level	V_{IL}		VSS	--	0.3V_{DD}	
Output voltage for logic circuit	"H"level	V_{OH}		0.8V_{DD}	--	V_{DD}	
	"L"level	V_{OL}		VSS	--	0.2V_{DD}	
Logic power supply current (Without backlighting and Display character)		I_{CC}		--	--	--	uA

10 LED backlight characteristics

Ta=25℃

Item	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Forward voltage	V_f	I_f=45mA	3.1	3.3	3.5	V
Reverse voltage	V_r	--	--	--	--	V
Reverse Current	I_r	--	--	--	--	uA
Luminous intensity*	Bp	I_f=40mA	350	480	600	cd/m^2
Luminous Uniformity*	△Bp		75	--	--	%
Color coordinate*	X		0.26	0.28	0.30	--
	Y		0.26	0.28	0.30	--

Note:

- Measured at the bare LED backlight unit.
- If the backlight is above these maximum ratings for long time, the service life of the LED backlight will reduce or it will cause poor reliability.

11 Optical Characteristics

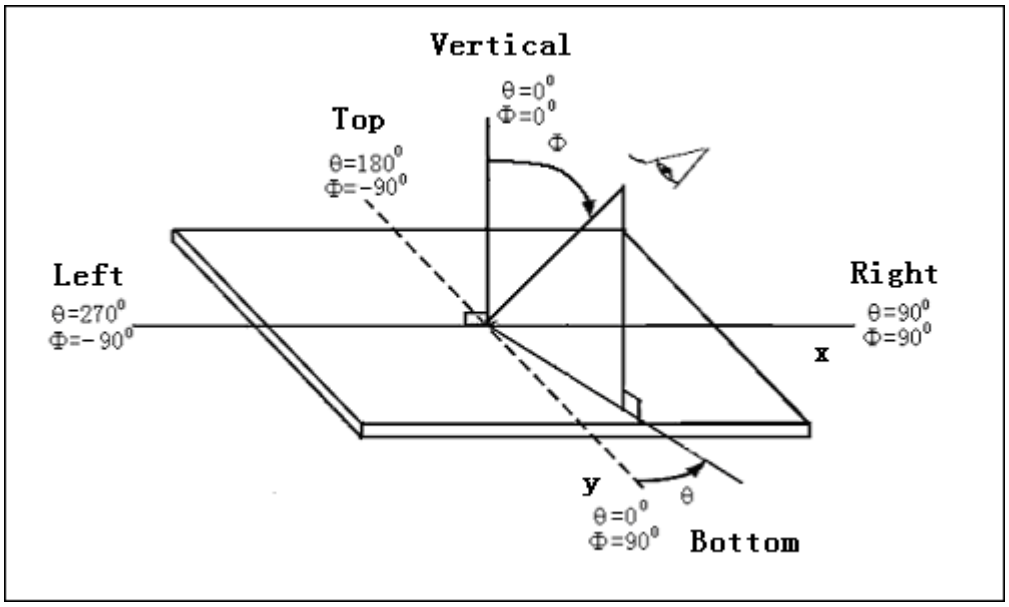
11.1 Optical Characteristics

Ta=25℃

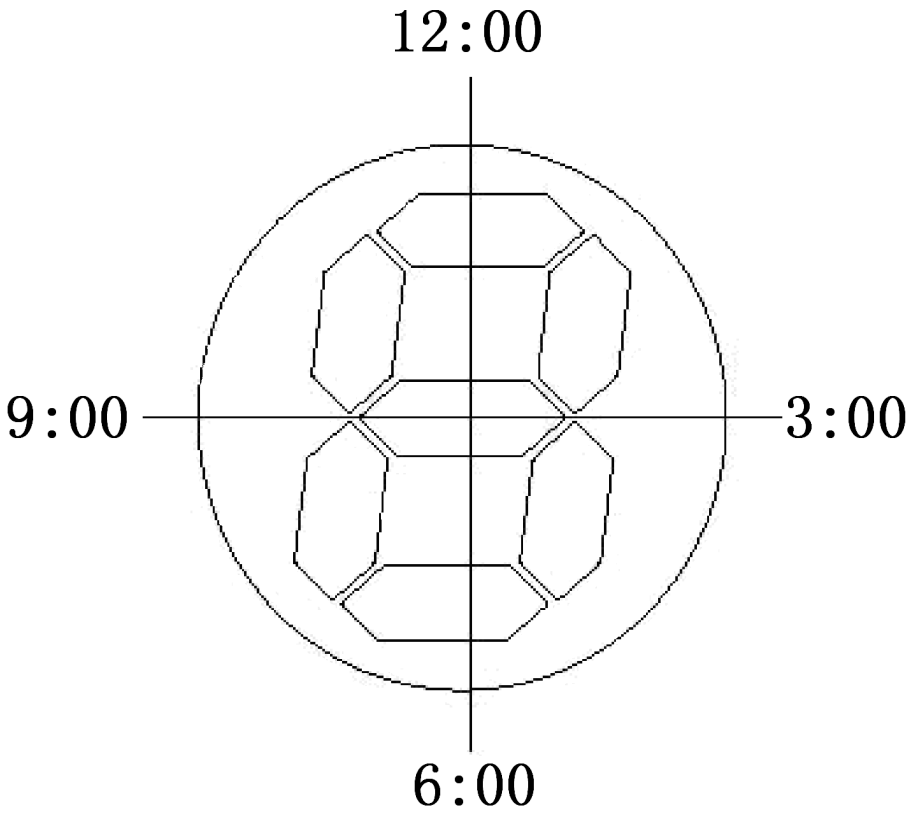
Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Viewing Angle		θ_x	Cr≥2	-34 -- 25			Deg
		θ_y		-25 -- 38			
Contrast Ratio		Cr	-	2	3.5	--	
Response Time	Tr		--	--	250	400	ms
	Tf			--	250	400	

11.2 Definition of Optical Characteristics

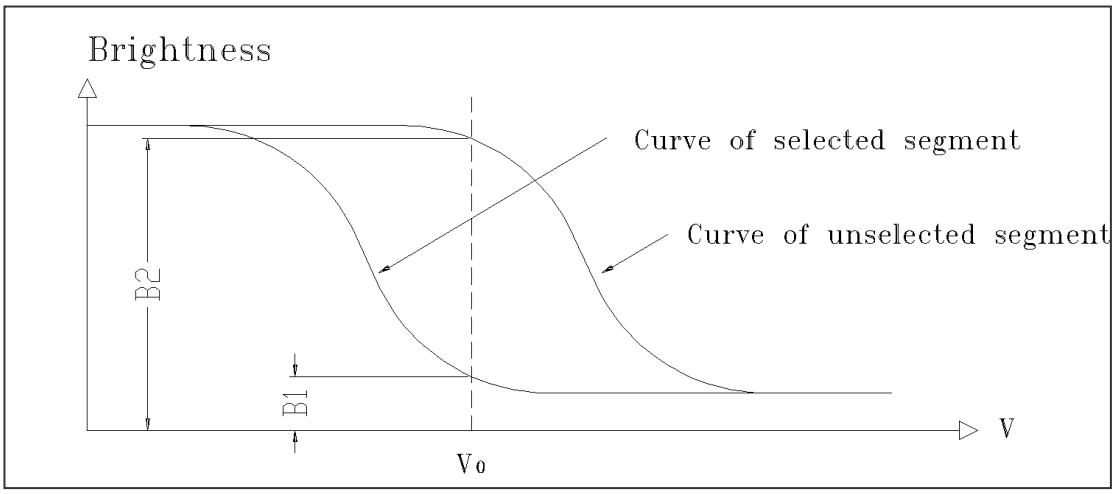
11.2.1 Definition of Viewing Angle



11.2.2 Indication of Viewing Angle



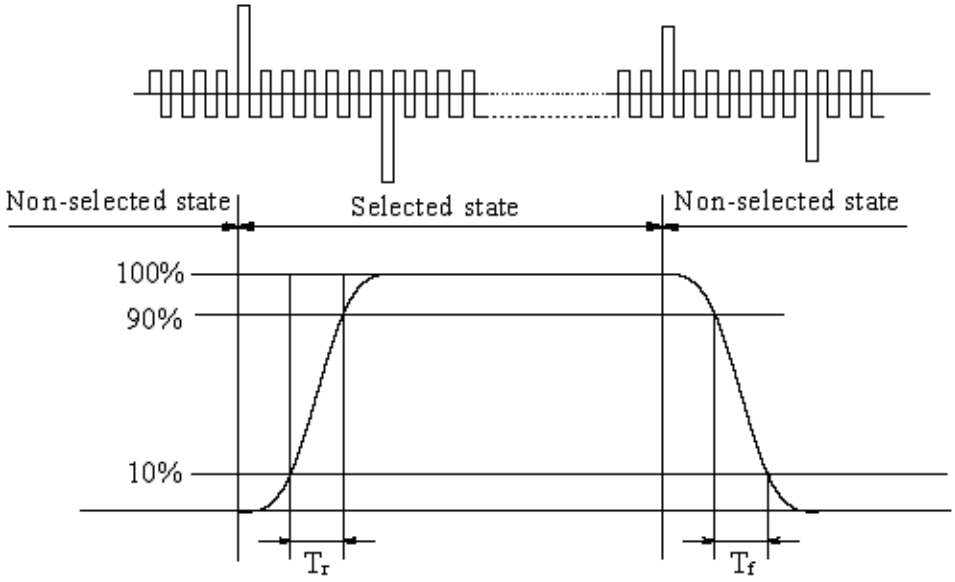
11.2.2 Definition of Contrast Ratio



$$\text{Contrast Ratio} = B2/B1 = \frac{\text{unselected state brightness}}{\text{selected state brightness}}$$

Measuring Conditions:
1) Ambient Temperature: 25℃
2) Frame frequency: 64Hz
3) Operating voltage: Vop＝12V
4) Appling waveform: 1/160 duty 1/9 bias
5) View angle (θ,φ): (0°, 0°)

11.2.3 Definition of Response time Test (LCD using DMS501)



Turn on time: $t_{on} = t_r$ Turn off time: $t_{off} = t_f$

Measuring Condition:
1) Operating Voltage: Vop=12V
2) Frame frequency: 64Hz
3) Appling waveform: 1/160duty 1/9bias
4) View angle (θ,φ): (0°, 0°)

12 Reliability

12.1 Content of Reliability Test

Ta=25℃

No	Test Item	Test condition	Criterion
1	High Temperature Storage	70℃±2℃ 72H Restore 2H at 25℃ Power off	After testing, cosmetic and electrical defects should not happen.
2	Low Temperature Storage	-20℃±2℃ 72H Restore 2H at 25℃ Power off	
3	High Temperature Operation	60℃±2℃ 72H Restore 2H at 25℃ Power on	
4	Low Temperature Operation	-10℃±2℃ 72H Restore 4H at 25℃ Power on	
5	High Temperature & Humidity Operation	40℃±2℃ 90%RH 72H Power on	
6	Temperature Cycle	-20℃←→25℃←→70℃ 30min 5min 30min after 10cycle, Restore 2H at 25℃ Power off	
7	Vibration Test	10Hz~150Hz, 100m/s^2, 120min	
8	Shock Test	Half-sine wave,300m/s^2,11ms	
9	Drop Test(package state)	800mm, concrete floor,1corner, 3edges, 6 sides each time	1.After testing, cosmetic and electrical defects should not happen. 2.the product should remain at initial place 3.Product uncovered or package broken is not permitted.

Notes:

1. Each test item applies for a test sample only once, The test sample can not be used again in any other test item.
2. The test sample is inspected after 2 hours or more storing at room temperature and room humidity after each test item is finished.
3. For Damp Proof Test, Pure water(Resistance＞10MΩ) should be used.
4. In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judge as a good part. Using ionizer (an antistatic blower) is recommended at

working area in order to reduce electro-static voltage. When removing protection film from LCM panel, peel off the tag slowly(recommended more than one second) while blowing with ionizer toward the peeling face to minimize ESD which may damage electrical circuit.

5. EL evaluation should be excepted from reliability test with humidity and temperature: Some defects such as black spot/blemish can happen by natural chemical reaction with humidity and Fluorescence that EL has.
6. Polarizer test criteria
   a. when testing avoid samples take out then return, It can cause water coagulation in Polarizer. Increase the distance of samples , And put samples before the wind.
   b. When the samples are put into the test, put them upright so that the glasses keep spaces between them each other. (Fig.7)

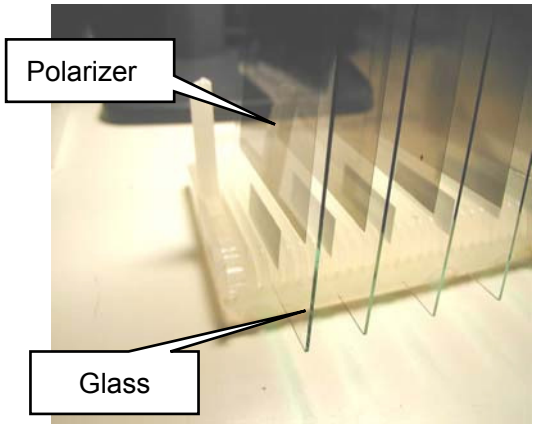


Fig.7

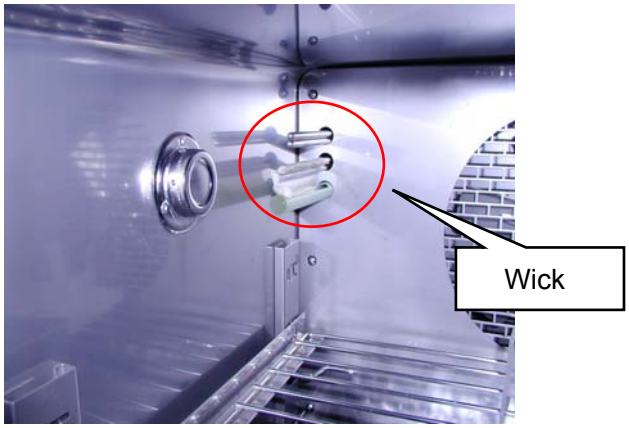


Fig.8

   c. Put samples into testing machine as small as possible so that it is drafty.
   d. Do not put samples under wick because water will fall.(Fig.8)
   e. Do not open testing machine except for taking them out in order to prevent moisture condensation.
7. The criteria refer to 12.2.

12.2 Inspection of criteria

Remark NO.	Content
1	Functional test is OK. Missing Segment, shorts, unclear segment, nondisplay, display abnormally, liquid crystal leak are unallowable.
2	After testing, cosmetic defects should not happen, no low temperature bubbles, seal loose and fall, frame rainbow, ACF bubble growing are unallowable in the appearance test.
3	Total current consumption should not be over 10% of initial value.
4	After tests being executed, Contrast must be larger than 70% of its initial value prior to the tests.
5	No glass crack, chipped glass, end seal loose frame crack and so on.
6	No structure loose and fall.

12.3 LCD module service life

Functions, performance, appearance, etc. shall be free from remarkable deterioration within 100,000 hours under ordinary operating and storage conditions room temperature (25℃±10℃).

12.4 Definition of module service life

- Contrast becomes 30% of initial value.
- Current consumption becomes threes times higher than initial value.
- Remarkable alignment deterioration occurs in LCD cell layer.
- Unusual operation occurs in display functions

13 Quality level

13.1 Classification of Defects

Major defects (MA): A major defect refers to a defect that may substantially degrade usability for product applications, including all functional defects (such as no display, abnormal display, open or missing segment, short circuit, missing component), outline dimension beyond the drawing, progressive defects and those affecting reliability.

Minor defects (MI): A minor defect refers to a defect which is not considered to be able to substantially degrade the product application or a defect that deviates from existing standards almost unrelated to the effective use of the product or its operation, such as black spot, white spot, bright spot, pinhole, black line, white line, contrast variation, glass defect, polarizer defect, etc.

13.2 Definition of Inspection Range

For LCD defects, dividing two areas to make a judgment (according figure 1).

A zone : Inside Viewing area

B zone : Outside Viewing area

X1(A.A~V.A): 1.00mm X2(A.A~V.A): 1.01mm

Y1(A.A~V.A): 1.01mm Y2(A.A~V.A): 1.00mm

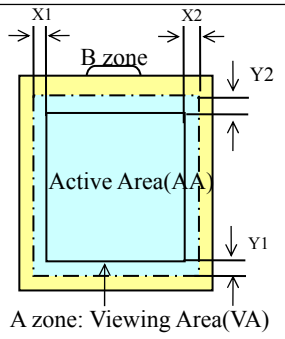


Figure 1

13.3 Inspection Items and General Notes

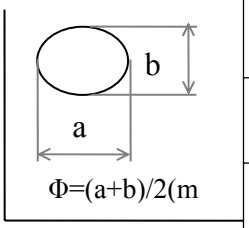
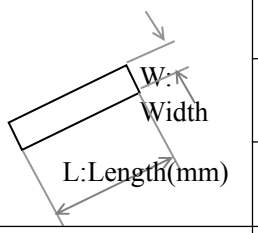
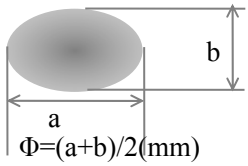
General notes	①Should any defects which are not specified in this standard happen, additional standard shall be determined by mutual agreement between customer and TIANMA. ②Viewing area should be the area which TIANMA guarantees. ③Limit sample should be prior to this Inspection standard. ④Viewing judgment should be under static pattern. ⑤Inspection conditions Inspection distance: 250 mm (from the sample) Temperature : 25±5 ºC Inspection angle : 45 degrees in 3 o′clock direction (all defects in viewing area should be inspected from this direction)	
Inspection items	Pinhole, Bright spot, Black spot, White spot, Black line, White Line, Foreign particle, Bubble	The color of a small area is different from the remainder. The phenomenon doesn't change with voltage

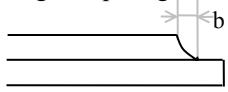
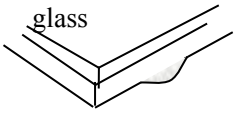
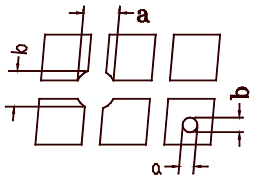
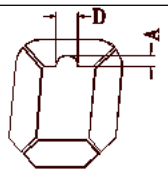
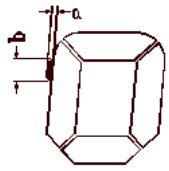
	Contrast variation	The color of a small area is different from the remainder. The phenomenon changes with voltage
	Polarizer defect	Scratch, Dirt, Particle, Bubble on polarizer or between polarizer and glass
	Functional defect	no display, display abnormally, open or missing segment, short circuit, False viewing direction
	Glass defect	Glass crack, Shaved corner of glass, Surplus glass
	Segment defect	Pin holes or cracks in segment, Transformation of segment
	PCB defect	Components assembly defect

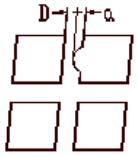
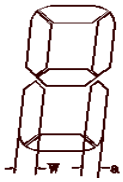
13.4 Outgoing Inspection Level

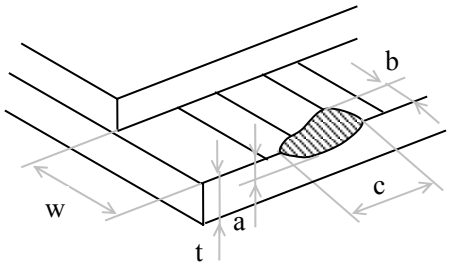
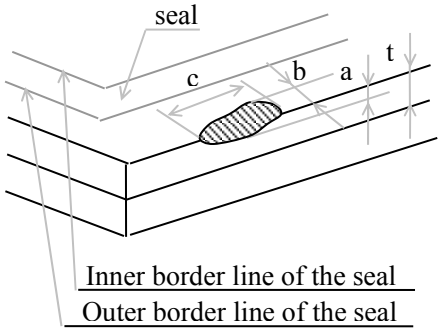
Outgoing Inspection standard	Inspection conditions	Inspection				
		Min.	Max.	Unit	IL	AQL
Major Defects	See 13.3 general notes	See 13.5			II	0.65
Minor Defects	See 13.3 general notes	See 13.5			**II**	1.5
Note：Sampling standard conforms to GB2828						

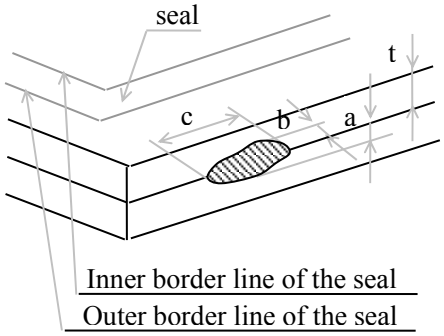
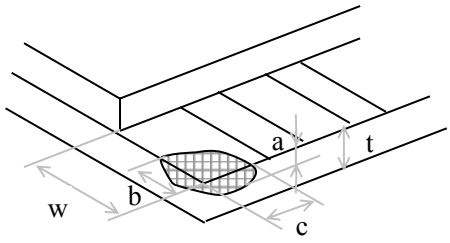
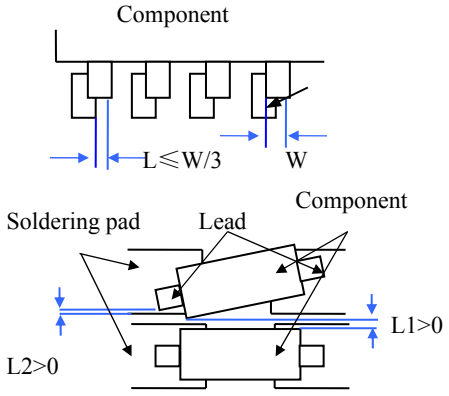
13.5 Inspection Items and Criteria

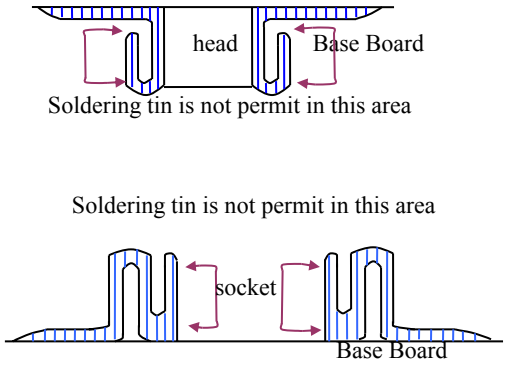
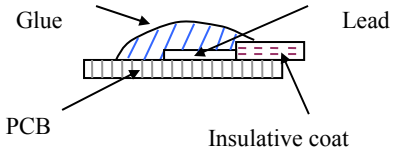
Inspection items			Judgment standard			
			Category		Acceptable number	
					A zone	B zone
1	Black spot,White spot, Bright Spot, Pinhole, Foreign Particle, Particle in or on glass, Scratch on glass		A	Φ≦0.10	Neglected	Neglected
			B	0.10<Φ≦0.20	3	
			C	0.20<Φ	0	
2	Black line, White line, Particle Between Polarizer and glass, Scratch on glass		A	W≦0.02	Neglected	Neglected
			B	0.02<W≦0.05 L≦3.0	3	
			C	W＞0.05 or L＞3.0	0	
3	Contrast variation		A	Φ≦0.2	Neglected	Neglected
			B	0.2<Φ≦0.3	2	
			C	0.3<Φ≦0.4	1	
			D	0.4<Φ	0	
			Total defective point(B,C)		3	
4	Bubble inside cell		any size		none	none

<table>
<tr><td rowspan="4">5</td><td rowspan="4">Polarizer defect (if Polarizer is used)</td><td>Scratch ,damage on polarizer, Particle on polarizer or between polarizer and glass.</td><td colspan="4">Refer to item 1 and item 2.</td></tr>
<tr><td rowspan="3">Bubble, dent and convex</td><td>A</td><td>Φ≦0.3</td><td>Neglected</td><td rowspan="3">Neglected</td></tr>
<tr><td>B</td><td>0.3<Φ≦0.7</td><td>2</td></tr>
<tr><td>C</td><td>0.7<Φ</td><td>0</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Surplus glass</td><td>Stage surplus glass  </td><td colspan="4">b≦0.3mm</td></tr>
<tr><td>Surrounding surplus glass  </td><td colspan="4">Should not influence outline dimension and assembling.</td></tr>
<tr><td>7</td><td colspan="2">Open segment or open common</td><td colspan="4">Not permitted</td></tr>
<tr><td>8</td><td colspan="2">Short circuit</td><td colspan="4">Not permitted</td></tr>
<tr><td>9</td><td colspan="2">False viewing direction</td><td colspan="4">Not permitted</td></tr>
<tr><td>10</td><td colspan="2">Contrast ratio uneven</td><td colspan="4">According to the limit specimen</td></tr>
<tr><td>11</td><td colspan="2">Crosstalk</td><td colspan="4">According to the limit specimen</td></tr>
<tr><td>12</td><td colspan="2">Black /White spot(display)</td><td colspan="4">Refer to item 1</td></tr>
<tr><td>13</td><td colspan="2">Black /White line(display)</td><td colspan="4">Refer to item 2</td></tr>
<tr><td rowspan="4">14</td><td rowspan="4">Pin holes and cracks in segment</td><td rowspan="2">  </td><td colspan="2">not counted</td><td colspan="2">Max.3 dots allowed</td><td rowspan="4">Max.3 dots allowed</td></tr>
<tr><td>x<0.1mm</td><td colspan="2">0.1mm x 0.2mm</td></tr>
<tr><td colspan="4">x=(a+b)/2</td></tr>
<tr><td>  </td><td colspan="2">not counted</td><td colspan="2">Max.2 dots allowed each segment</td></tr>
<tr><td colspan="2">A<0.1mm</td><td colspan="2">0.1mm A 0.2mm
D<0.25mm</td></tr>
<tr><td rowspan="3">15</td><td rowspan="3">Transformation of segment</td><td rowspan="3">  </td><td colspan="2">not counted</td><td colspan="2">Max.1 defect allowed each segment</td><td rowspan="3">Max.3 defects allowed</td></tr>
<tr><td>x<0.1mm</td><td colspan="2">0.1mm x 0.2mm</td></tr>
<tr><td colspan="4">x=(a+b)/2</td></tr>
</table>

			not counted	Max.1 defect allowed each segment	
			a<0.1mm	0.1mm a 0.2mm D>0	
			0.8W a 1.2W a=measured value of width W=nominal value of width		Max.2 defects allowed

Inspection items			Judgment standard		
			Category(application: B zone)		Acceptable number
16	Glass defect crack	①The front of lead terminals 	A	a≤ t, b≤1/5W, c≤3mm	Max.3 defects allowed
			B	Crack at two sides of lead terminals should not cover patterns and alignment mark	
		②Surrounding crack—non-contact side 	b < Inner borderline of the seal		

		③ Surrounding crack— contact side 	b < Outer borderline of the seal	
		④Corner 	A: a ≦ t, b ≦ 3.0, c ≦ 3.0 B: Glass crack should not cover patterns u and alignment mark and patterns.	
Inspection items			Judgment standard Category(application: B zone)	
17	PCB defect	Component soldering: No cold soldering、short、open circuit、burr、tin ball The flat encapsulation component position deviation must be less than 1/3 width of the pin (Pic.1)； the sheet component deviation: Pin deviates from the pad and contact with the near components is not permitted（Pic.2）		
		lead defect: The lead lack must be less than 1/3 of its width; The lead burr must be less than 1/3 of the seam; Impurities connect with the near leads is not permitted		

		Connector soldering: Soldering tin is at contact position of the plug and socket is not permitted No foundation is scald Serious cave distortion on plug and socket contact pin is not permitted	
		Glue on root of the speaker receiver and motor lead: The insulative coat of the lead must join into the PCB; the protected glue must envelop to the insulative coat.	

14 Precautions for Use of LCD Modules

14.1 Handling Precautions

14.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

14.1.2 Liquid in LCD is hazardous substance, if the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, thoroughly and promptly wash it off using soap and water.

14.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

14.1.4 Don't touch, push or rub the exposed polarizer covering the display surface of the LCD module with anything harder than an HB pencil lead, the polarizer is soft and easily scratched, handle it carefully.

14.1.5 Don't put or attach anything on the display area to avoid leaving any marks on.

14.1.6 If the display surface is contaminated or becomes dusty, breathe on the surface and gently wipe it with a soft dry cloth. do not scrub hard to avoid damage the surface. If still not completely clear, moisten cloth with one of the following solvents:

— Isopropyl alcohol
— Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

— Water
— Ketone
— Aromatic solvents

14.1.7 Do not attempt to disassemble the LCD Module.

14.1.8 If the logic circuit power is off, do not apply the input signals.

14.1.9 Avoid using the same display pattern long time (continous ON segment).Software must be prepared so that the pattern will be changed

14.1.10 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

a. Be sure to ground the body and electric appliances when handling the LCD Modules. It is preferable to use conductive mat on table and wear cotton clothes or conductive processed fibre. Synthetic fibre is not recommended.

b. Tools required for assembly, such as soldering irons, must be properly ground.

c. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

d. The LCD Module is coated with a film to protect the display surface. Be careful and slow when peeling off this protective film since static electricity may be generated. It is recommended to use ionic fan or machine when operating. It is recommended to remove the protection foil slowly (> 3 sec.).

e. It is preferable to wear gloves etc, to avoid damaging the LCD. Please do not touch electrodes with bare hands or avoid any other contamination.

14.2 Storage precautions

14.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

14.2.2 The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature : 5℃ ～ 40℃

Relatively humidity: ≤80%

14.2.3 The LCD modules should be stored in a clean environment or room, free from acid, alkali and harmful gas.

14.2.4 Store the module in anti-static electricity container and without any physical load.

14.3 Transportation precautions

The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.

14.4 Soldering

14.4.1 Use the high quality solders, only solder the I/O terminals.

14.4.2 No higher than 280℃ and time less than 3-4 second during soldering.

14.4.3 Rewiring: no more than 3 times.

14.4.4 when you remove connector or cable soldered to I/O terminals, please confirm that solder is fully melted. If you remove by force, electrodes at I/O terminals may be damaged (or stripped off). It is recommended to use solder suction machine.