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SPECIFICATION FOR LCD MODULE

Model No. [TM128160ANFWG](#)

Prepared by:	Date:
Checked by :	Date:
Verified by :	Date:
Approved by:	Date:

TIANMA MICROELECTRONICS CO., LTD

REVISION RECORD

Date	Ver.	Ref. Page	Revision No.	Revision Items

1. General Specifications:

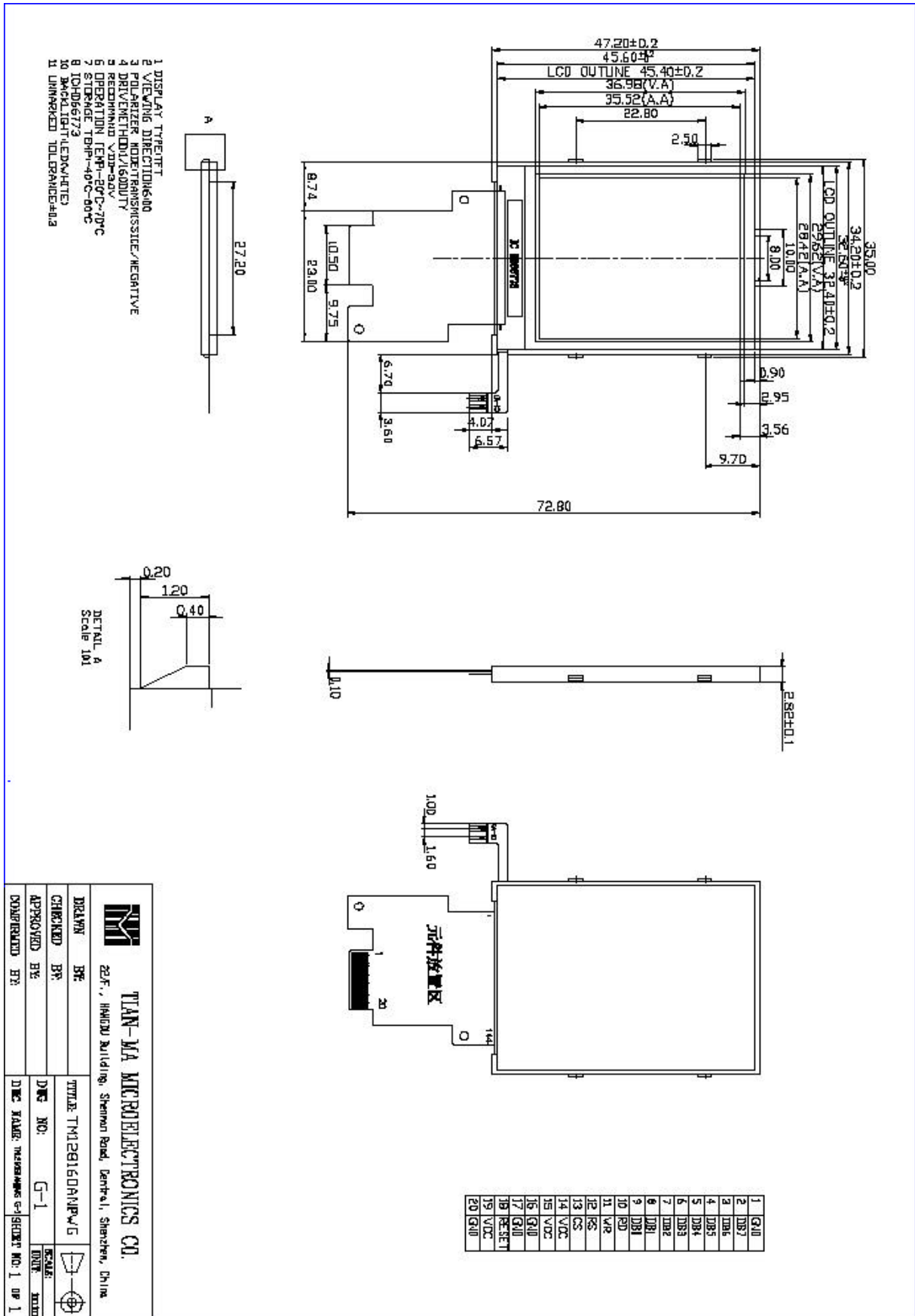
- 1.1 Display type: TFT
- 1.2 Display color*¹:
 - Display color: 262K(max) COLOR
 - Background*²: Black (Red, Green, Blue dots are off state)
- 1.3 Polarizer mode: Transmissive/Negative
- 1.4 Viewing Angle: 6:00
- 1.5 Driving Method: 1/160 Duty
- 1.6 Backlight Type: LED (3 LAMPS)
 - Backlight Color: WHITE
- 1.7 Controller: HCD667B73RBP
- 1.8 Data Transfer: 8 Bit Parallel
- 1.9 Operating Temperature: -20----+70
 - Storage Temperature: -40----+80
- 1.10 Power Supply Voltage: VDD=3.0V
- 1.11 LCD Operating Voltage: VLCD=15.6V
- 1.12 Outline Dimensions: Refer to outline drawing on next page
- 1.13 Dot Matrix: 128 X 3 (RGB) X 160 Dots
- 1.14 Pixel Pitch: 0.074mmX0.222mm
- 1.15 Weight: TBD*³

*¹ Color tone is slightly changed by temperature and driving voltage.

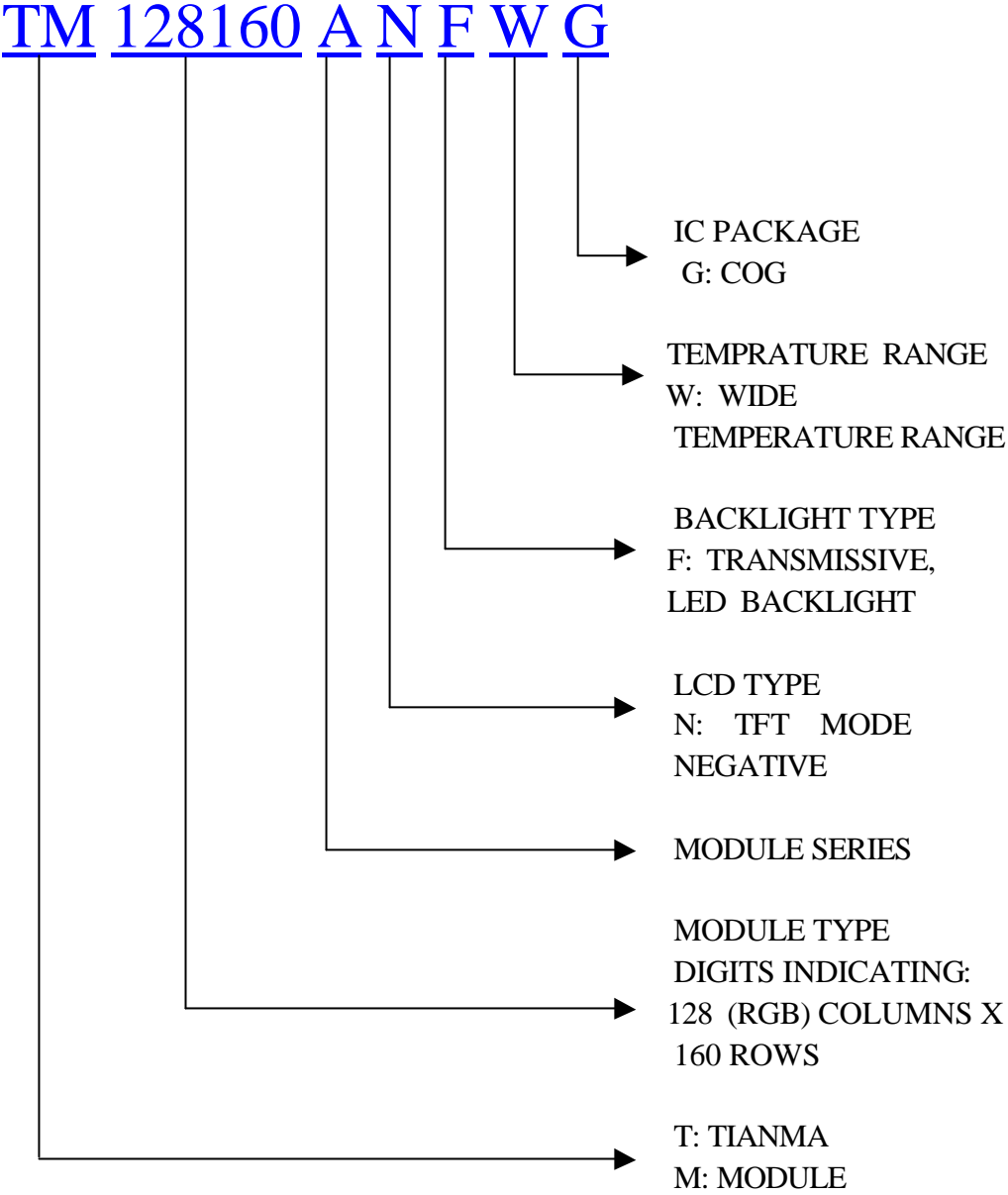
*² Color tone will be changed by backlight.

*³ TBD: To Be Determined.

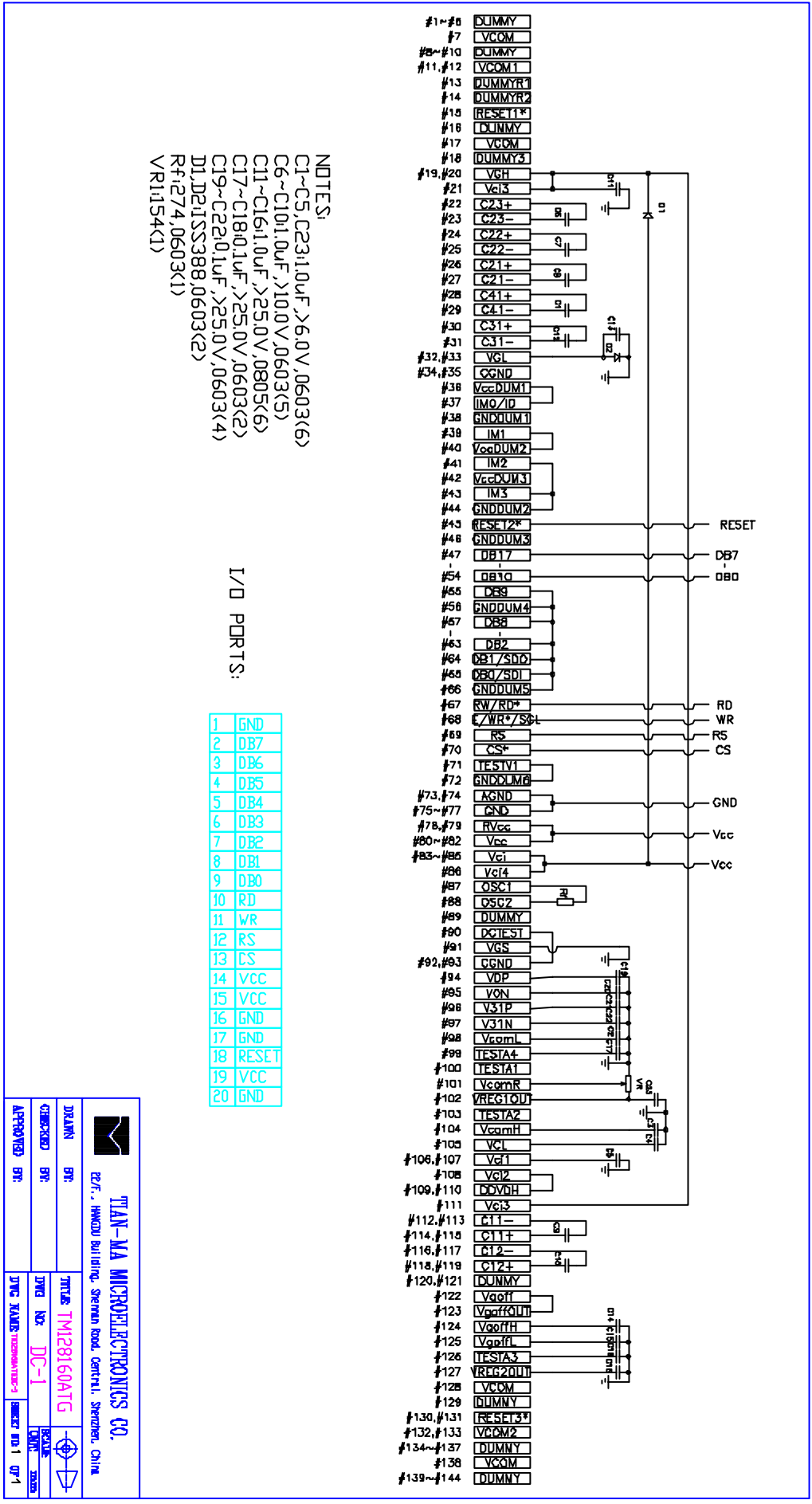
2. Outline Drawing



3. LCD Module Part Numbering System



4. Circuit Block Diagram



TIAN-MA MICROELECTRONICS CO.
 2/F., HANGOU BUILDING, SHENYAN ROAD, GONGTAN, SHENZHEN, CHINA

DESIGNED BY:	DATE:	SCALE:
CHECKED BY:	DATE:	SCALE:
APPROVED BY:	DATE:	SCALE:

TITLE: **TM128160ATG**
 DC-1
 SHEET NO. 1 OF 1

5. Absolute Maximum Ratings

Ta=25

Item	Symbol	Min.	Max.	Unit	Remark
Power Supply Voltage	V _{DD} - V _{SS}	-	+3.3	V	
LCD Driving Voltage	V _{LCD}	-16.0	+16.0		
Operating Temperature Range	T _{OP}	-20	+70		No Condensation
Storage Temperature Range	T _{ST}	-40	+80		

6. Electrical Specifications and Instruction Code

6.1 Electrical characteristics

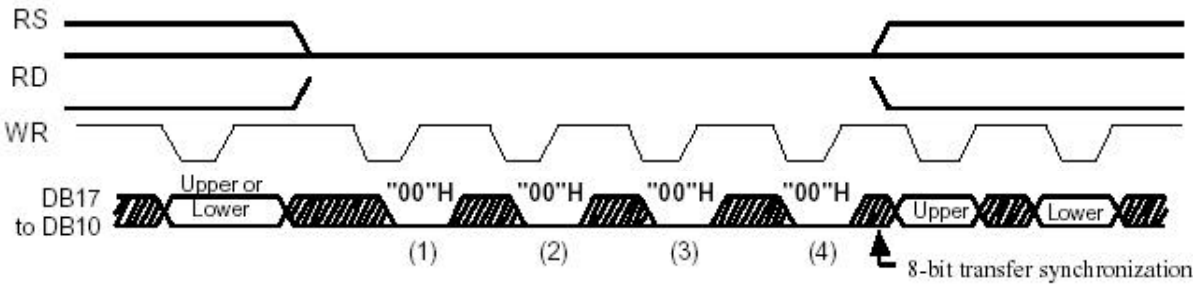
$V_{SS}=0V$, $T_a=25$

Item	Symbol	Min.	Typ.	Max.	Unit	
Supply Voltage (Logic)	$V_{DD}-V_{SS}$	+2.91	+3.0	+3.09	V	
Supply Voltage (LCD Drive)	V_{LCD}	-16.0	-	16.0	V	
Input Signal Voltage	High	V_{IH} ($V_{DD}=3.0$)	$0.8V_{DD}$	-	V_{DD}	V
	Low	V_{IL} ($V_{DD}=3.0$)	0	-	$0.2 V_{DD}$	V
Supply current (Logic)	I_{DD} ($V_{DD}-V_{SS}=3.0V$)	-	-	2.15	mA	
Oscillator frequency range	f_{osc}	135	-	470	KHz	
Supply Voltage (LED)	V_{LED}	-	9.9	-	V	
Supply current (LED)	I_{LED}		15.0	20.0	mA	

6.2 Interface Signals

Pin No.	Symbol	Level	Description
1	GND	0V	Ground
2	D07	H/L	Data bus bit 7
3	D06	H/L	Data bus bit 6
4	D05	H/L	Data bus bit 5
5	D04	H/L	Data bus bit 4
6	D03	H/L	Data bus bit 3
7	D02	H/L	Data bus bit 2
8	D01	H/L	Data bus bit 1
9	D00	H/L	Data bus bit 0
10	RD	H/L	READ SIGNAL
11	WR	H/L	WRITE SIGNAL
12	RS	0V	SELECTS THE REGISTER
13	CS	H/L	CHIP SELECT
14	VCC_	3V	SUPPLY POWER
15	VCC	3V	SUPPLY POWER
16	GND	0V	Ground
17	GND	0V	Ground
18	RESET	H/L	RESET
19	VCC	3V	SUPPLY POWER
20	GND	0V	Ground

6.3 Interface Timing Chart



6.4 Instruction code

Register No.	Register	Upper Code															Lower Code															Instructions
		R/W	RS	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0													
R	Index	0	0	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	IB0	Set the index register value.												
SR	Status read	1	0	L7	L6	L5	L4	L3	L2	L1	L0	0	0	0	0	0	0	0	ID0	Reads the driving raster-row position (L7-0).												
R00h	Oscillation Start	0	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	Starts the oscillation mode while standby period.												
R00h	Device code read	1	1	0	0	0	0	0	1	1	0	1	1	1	0	0	0	1	1	Reads '0773'H.												
R01h	Driver output control	0	1	0	0	0	0	0	SM	GS	SS	0	0	NL4	NL3	NL2	NL1	NL0	Set the gate driver shing direction (GS), source driver shift direction (SS), and number of driving lines (NL4-0).													
R02h	LCD drive AC control	0	1	0	0	0	0	FLD1	FLD0	B/C	EOR	0	0	NW5	NW3	NW2	NW1	NW0	Set the LCD drive AC waveform (B/C), number of interfaced field (FLD1-0), EOR output (DOR)m, and the number of n-raster-rows (NW5-0) at C-pattern													
R03h	Power control (1)	0	1	0	0	0	0	0	BT2	BT1	BT0	DC2	DC1	DC0	AP1	AP0	SLP	STB	Set the standby mode (STB), LCD power on (AP2-0), sleep mode (SLP), boosting cycle DC2-0, boosting output multiplying factor (BT3-0).													
R04h	Power control (2)	0	1	CAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Set the configuration of retention volume (CAD).													
R05h	Entry mode	0	1	DIT	0	0	BGR	0	0	HWM	0	0	0	VD1	VD0	AM	LG2	LG1	Specifies the logical operation (LG2-0), AC counter mode (AM), increment/decrement mode (ID1-0), high-speed-write mode (HWM),BGR mode, and hard dither mode (DIT).													
R06h	Compare register	0	1	CP15	CP14	CP13	CP12	CP11	CP10	CP9	CP8	CP7	CP6	CP5	CP4	CP3	CP2	CP1	CP0	Set the compare register (CP15-0).												
R07h	Display control	0	1	0	0	0	0	PT1	P0	VLE2	VLE1	SPT	0	GON	DTE	CL	REV	D1	D0	Specifies display on (D1-0), reversed display (REV), number of display colors (CL), DISPTMG enable (DTE), gate output on (GON), screen division driving (SPT), and vertical scroll (VLE2-1), and source output condition (P11-0).												
R08h	Frame cycle control	0	1	NO1	NO0	SDT1	SDT0	EQ1	EQ0	DIV1	DIV0	0	0	0	0	RTN3	RTN2	RTN1	RTN0	Set the 1H period (RTN3-0) and operating clock frequency-division ratio (DV1-0), the equalizing period (EQ1-0), delay volume of the source output (STD1-0), non-overlap volume of the gate output (NO1-0).												
R0Ch	Power control (3)	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	V2	V1	V0	Set an adjustment factor for the Vci voltage (VC2-0).												
R0Dh	Power control (4)	0	1	0	0	0	0	VRL3	VRL2	VRL1	VRL0	0	0	PON	VRH3	VRH2	VRH1	VRH0	Set the amplification factor for VREGOUT1 voltage (VRH4-0) and for VREGOUT2 voltage (VRL3-0). Step-up circuit 3 starts operation (VCM4-0).													
R0Eh	Power control (5)	0	1	0	0	VCOMG	VDV4	VDV3	VDV2	VDV1	VDV0	0	0	VCM4	VCM3	VCM2	VCM1	VCM0	Set VcomH voltage (VCM4-0), AC-cycle oscillation of Vcom and Vgolf (VDV4-0) and voltage to VCOM (VCOMG).													
R0Fh	Gate scan starting position	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Set the scanning starting position (SCN4-0) of the gate driver.												
R11h	vertical scroll control	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Specifies the screen display scroll volume (VL7-0).												
R14h	First display drive position	0	1	SE17	SE16	SE15	SE14	SE13	SE12	SE11	SE10	SS17	SS16	SS15	SS14	SS13	SS12	SS11	SS10	Set 1st-screen driving start (SS17-10) and end (SE17-10).												
R15h	Second display drive position	0	1	SE27	SE26	SE25	SE24	SE23	SE22	SE21	SE20	SS27	SS26	SS25	SS24	SS23	SS22	SS21	SS20	Set 2nd-screen driving start (SS27-10) and end (SE27-10).												
R16h	Horizontal RAM address position	0	1	HEA7	HEA6	HEA5	HEA4	HEA3	HEA2	HEA1	HEA0	HSA7	HSA6	HSA5	HSA4	HSA3	HSA2	HSA1	HSA0	Set the start (HSA7-0) and end (HEA7-0) of the horizontal RAM address												
R17h	Vertical RAM address position	0	1	VEA7	VEA6	VEA5	VEA4	VEA3	VEA2	VEA1	VEA0	VSA7	VSA6	VSA5	VSA4	VSA3	VSA2	VSA1	VSA0	Set the start (VSA7-0) and end (VEA7-0) for the vertical RAM address range.												
R20h	RAM write data mask	0	1	WM15	WM14	WM13	WM12	WM11	WM10	WM9	WM8	WM7	WM6	WM5	WM4	WM3	WM2	WM1	WM0	Specifies write data mask (WM15-0) at RAM write.												
R21h	RAM address set	0	1	AD7-0 (Lower)															Initially sets the RAM address to the address counter (AC).													
R22h	RAM data write	0	1	Write Data (Upper)															Write data to RAM.													
R22h	RAM data read	1	1	Read Data (Upper)															Read data to RAM.													
R30h	control (1)	0	1	0	0	0	0	PKP12	PKP11	PKP10	0	0	0	0	0	0	PKP02	PKP01	PKP00	Adjust the Gamma control.												
R31h	control (2)	0	1	0	0	0	0	PKP32	PKP31	PKP30	0	0	0	0	0	0	PKP22	PKP21	PKP20	Adjust the Gamma control.												
R32h	control (3)	0	1	0	0	0	0	PKP52	PKP51	PKP50	0	0	0	0	0	0	PKP42	PKP41	PKP40	Adjust the Gamma control.												
R33h	control (4)	0	1	0	0	0	0	PRP12	PRP11	PRP10	0	0	0	0	0	0	PRP02	PRP01	PRP00	Adjust the Gamma control.												
R34h	control (5)	0	1	0	0	0	0	PKN12	PKN11	PKN10	0	0	0	0	0	0	PKN02	PKN01	PKN00	Adjust the Gamma control.												
R35h	control (6)	0	1	0	0	0	0	PKN32	PKN31	PKN30	0	0	0	0	0	0	PKN22	PKN21	PKN20	Adjust the Gamma control.												
R36h	control (7)	0	1	0	0	0	0	PKN52	PKN51	PKN50	0	0	0	0	0	0	PKN42	PKN41	PKN40	Adjust the Gamma control.												
R37h	control (8)	0	1	0	0	0	0	PRN12	PRN11	PRN10	0	0	0	0	0	0	PRN02	PRN01	PRN00	Adjust the Gamma control.												
R3Ah	control (9)	0	1	0	0	0	0	VRP14	VRP13	VRP12	VRP11	VRP10	0	0	0	0	VRP03	VRP02	VRP01	Adjust the Gamma control.												
R3Bh	control (10)	0	1	0	0	0	0	VRN14	VRN13	VRN12	VRN11	VRN10	0	0	0	0	VRN03	VRN02	VRN01	Adjust the Gamma control.												

7. Optical Characteristics

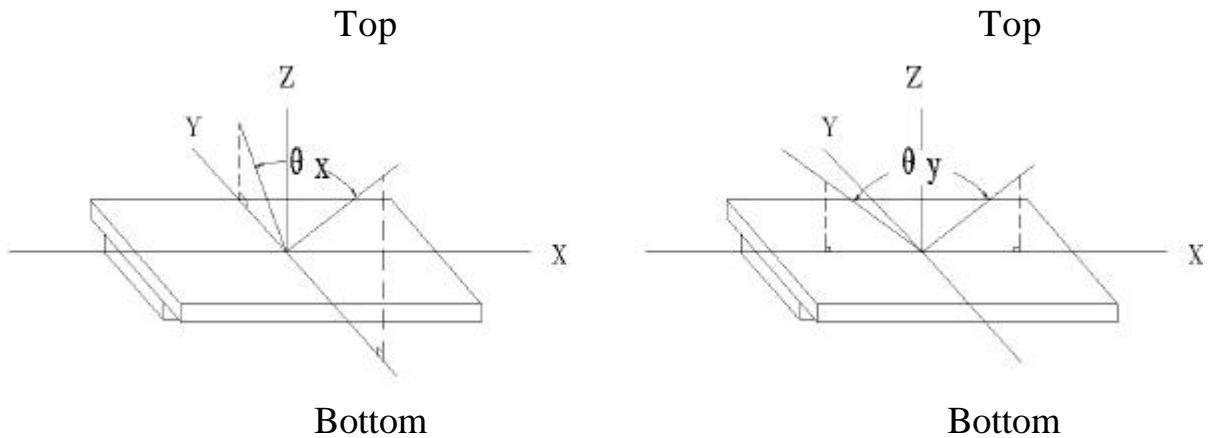
7.1 Optical Characteristics

$V_{LCD}=15.6V$ $T_a=25$

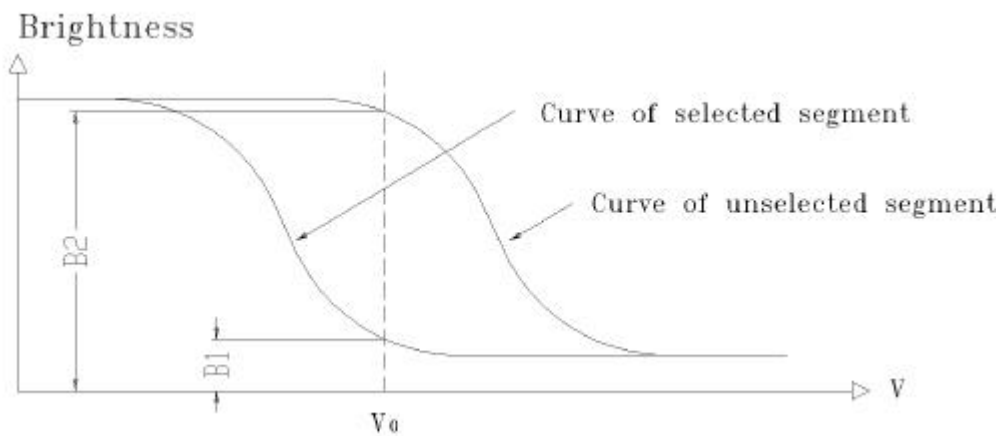
Item	Symbol	Condition	Min.	Typ.	Max.	Unit	
Viewing Angle	x	$C_r=10$	$y=0^\circ$	-45	--	+45	Deg
	y		$x=0^\circ$	-35	--	+15	
Contrast Ratio	C_r	$x=0^\circ$ $y=0^\circ$		150	-		
Response Time			--	40		ms	
Color Of CIE Coord-Inate	Red	x	$x=0^\circ$	-	0.593	-	
		y	$y=0^\circ$	-	0.333	-	
	Green	x	$x=0^\circ$	-	0.314	-	
		y	$y=0^\circ$	-	0.545	-	
	Blue	x	$x=0^\circ$	-	0.138	-	
		y	$y=0^\circ$	-	0.160	-	

7.2 Definition of Optical Characteristics

7.2.1 Definition of Viewing Angle



7.2.2 Definition of Contrast Ratio

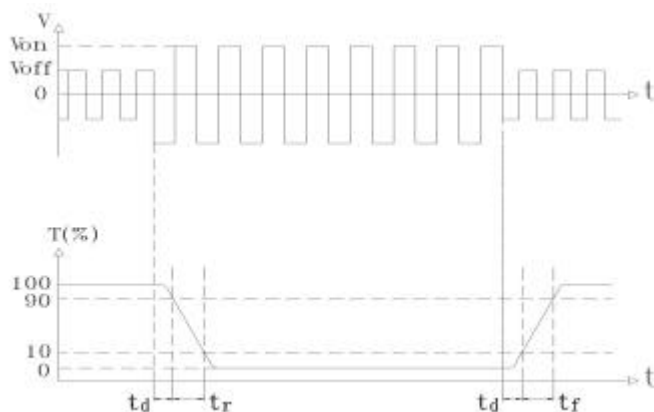


$$\text{Contrast Ratio} = B2/B1 = \frac{\text{unselected state brightness}}{\text{selected state brightness}}$$

Measuring Conditions:

- 1) Ambient Temperature: 25 ;
- 2) Frame frequency: 70.0Hz

7.2.3 Definition of Response time



Turn on time: $t_{on} = t_d + t_r$

Turn off time: $t_{off} = t_d + t_f$

Measuring Condition:

- 1) Operating Voltage: 15.6V
- 2) Frame frequency: 70.0Hz

7.3 Brightness Characteristic

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Brightness	Bp	Ta=25 ±3	100	-	-	cd/m ²
Uniformity	Bp	30-80%RH	-	80	-	%

Note:

1. The data is measured after LED are turned on for 5 minutes.
2. Testing conditions LED: V_{LED} = 9.9 V (DC)
 LCD: All dots are on (White color)
3. Brightness in the center of the LCD panel.
4. Definition of Uniformity (Bp)
 - Bp = Bp (Min.) / Bp (Max.) X 100 (%)
 - Bp (Max.) = Maximum brightness in 9 measurement spots
 - Bp (Min.) = Minimum brightness in 9 measurement spots

8. Reliability

8.1 Content of Reliability Test

Ta=25

No.	Test Item	Content of Test	Test condition
1	High Temperature Storage	Endurance test applying the high storage temperature for a long time	80 240H
2	Low Temperature Storage	Endurance test applying the low storage temperature for a long time	-40 240H
3	High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the thermal stress to the element for a long time	70 240H
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time	-20 240H
5	High Temperature /Humidity Storage	Endurance test applying the high temperature and high humidity storage for a long time	65 90%RH 240H
6	Temperature Cycle	Endurance test applying the low and high temperature cycle -40 25 80 25 30min 5min 30min 5min 1 cycle	-40 /80 10 cycles
7	Vibration Test (package state)	Endurance test applying the vibration during transportation	10Hz~150Hz, 100m/s ² , 120min
8	Shock Test (package state)	Endurance test applying the shock during transportation	Half- sine wave, 300m/s ² , 18ms
9	Atmospheric Pressure Test	Endurance test applying the atmospheric pressure during transportation by air	25kPa 16H

8.2 Failure Judgment Criterion

Criterion Item	Test Item No.									Failure Judgement Criterion	
	1	2	3	4	5	6	7	8	9		
Basic Specification	v	v	v	v	v	v	v	v	v	v	Out of the basic Specification
Electrical specification	v	v	v	v	v						Out of the electrical specification
Mechanical Specification							v	v			Out of the mechanical specification
Optical Characteristic	v	v	v	v	v	v				v	Out of the optical specification
Note	For test item refer to 8.1										
Remark	Basic specification = Optical specification + Mechanical specification										

9. Quality Level

Examination or Test	At $T_a=25$ (unless otherwise stated)	Inspection				
		Min.	Max.	Unit	IL	AQL
External Visual Inspection	Under normal illumination and eyesight condition, the distance between eyes and LCD is 25cm.	See Appendix A			II	Major 1.0 Minor 2.5
Display Defects	Under normal illumination and eyesight condition, display on inspection.	See Appendix B			II	Major 1.0 Minor 2.5
Note: Major defects: Open segment or common, Short, Serious damages, Leakage Miner defects: Others Sampling standard conforms to GB2828						

10. Precautions for Use of LCD Modules

10.1 Handling Precautions

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

10.1.2 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, promptly wash it off using soap and water.

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

10.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

10.1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. 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

10.1.6 Do not attempt to disassemble the LCD Module.

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

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

- a. Be sure to ground the body when handling the LCD Modules.
- 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 care when peeling off this protective film since static electricity may be generated.

10.2 Storage precautions

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

10.2.2 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 : 0 ~ 40

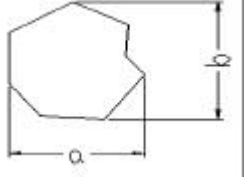
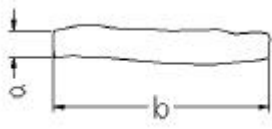
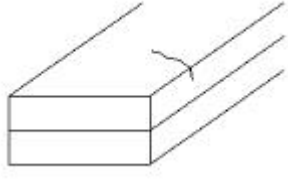
Relatively humidity: 80%

10.2.3 The LCD modules should be stored in the room without acid, alkali and harmful gas.

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

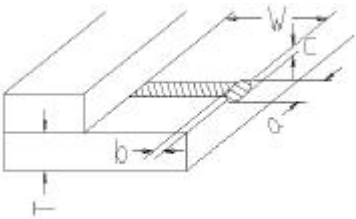
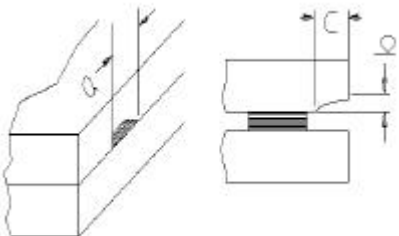
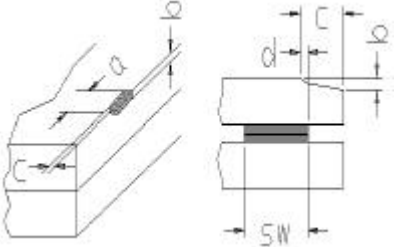
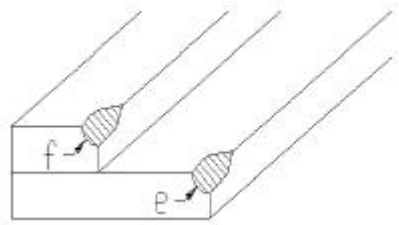
Appendix A

Inspection items and criteria for appearance defects

Items	Contents	Criteria		
Leakage		Not permitted		
Rainbow		According to the limit specimen		
Polarizer	Wrong polarizer attachment	Not permitted		
	Bubble between polarizer and glass	Not counted	Max. 3 defects allowed	
		$\phi < 0.3\text{mm}$	0.3mm ϕ 0.5mm	
	Scratches of polarizer	According to the limit specimen		
Black spot (in viewing area)		Not counted	Max. 3 spots allowed	Max. 3 spots (lines) allowed
		$X < 0.2\text{mm}$	0.2mm X 0.5mm	
		$X = (a+b)/2$		
Black line (in viewing area)		Not counted	Max. 3 lines allowed	
		$a < 0.02\text{mm}$	0.02mm a 0.05mm b 2.0mm	
Progressive cracks		Not permitted		

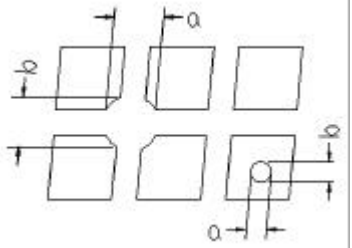
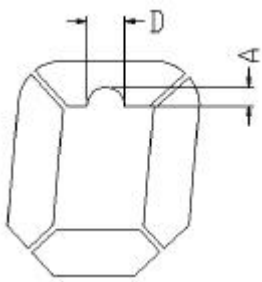
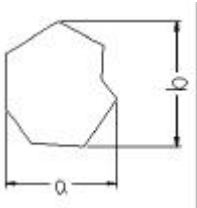

Appendix A

Inspection item and criteria for appearance defects (continued)

Items	Contents	Criteria							
Glass Cracks	Cracks on pads 	a	b	c	Max. 2 cracks allowed	Max. 5 cracks allowed			
		3mm	W/5	T/2					
		2mm	W/5	$T/2 < C < T$					
	Cracks on contact side 	a	b		Max. 2 cracks allowed				
		3mm	T/2						
		2mm	$T/2 < b < T$						
		C shall be not reach the seal area							
	Cracks on non-contact side 	a	b		Max. 2 cracks allowed				
		3mm	T/2						
		2mm	$T/2 < b < T$						
	C 0.5mm								
	d SW/3								
Corner cracks 	$e < 2.0\text{mm}^2$ $f < 2.0\text{mm}^2$			Max. 3 cracks allowed					

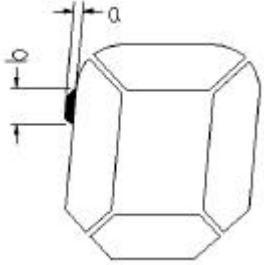
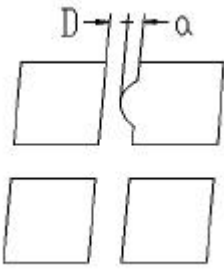
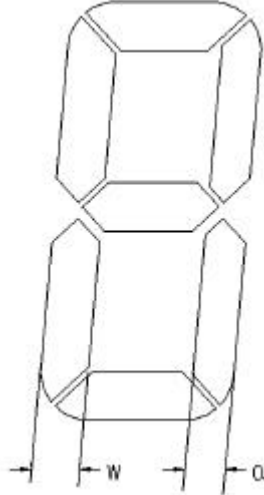
Appendix B

Inspection items and criteria for display defects

Items	Contents	Criteria		
Open segment or open common		Not permitted		
Short		Not permitted		
Wrong viewing angle		Not permitted		
Contrast ratio uneven		According to the limit specimen		
Crosstalk		According to the limit specimen		
Pin holes and cracks in segment (DOT)		Not counted	Max.3 dots allowed	Max.3 dots allowed
		$X < 0.1\text{mm}$	0.1mm X 0.2mm	
		$X = (a+b)/2$		
		Not counted	Max.2 dots allowed	
$A < 0.1\text{mm}$		0.1mm A 0.2mm $D < 0.25\text{mm}$		
Black spot (in viewing area)		Not counted	Max.3 spots allowed	Max.3 spots (lines) allowed
		$X < 0.1\text{mm}$	0.1mm X 0.2mm	
		$X = (a+b)/2$		
Black line (in viewing area)		Not counted	Max.3 lines allowed	
		$a < 0.02\text{mm}$	0.02mm a 0.05mm b 0.5mm	

Appendix B

Inspection items and criteria for display defects (continued)

Items	Content	Criteria		
Transformation of segment		Not counted	Max. 2 defects allowed	Max.3 defects allowed
		$x < 0.1\text{mm}$	0.1mm x 0.2mm	
		$x=(a+b)/2$		
		Not counted	Max. 1 defects allowed	
		$a < 0.1\text{mm}$	0.1mm a 0.2mm $D > 0$	
		Max.2 defects allowed $0.8W \leq a \leq 1.2W$ a =measured value of width W =nominal value of width		