SPECIFICATION FOR LCD MODULE

Model No. ___ **TM162NGHWG** ___

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

TIANMA MICROELECTRONICS CO., LTD

Rev. 1.0

REVISION RECORD

Date	Ver.	Ref. Page.	Revision No.	Revision Item

Rev. 1.0

1. General Specifications:

1.1 Display type: FSTN

1.2 Display color*:

    Display color: White

    Background :   Dark Blue

1.3 Polarizer mode: Transmissive/Negative

1.4 Viewing Angle: 6:00

1.5 Driving Method: 1/16 Duty 1/5 Bias

1.6 LCD Operation Voltage: 4.8V

1.7 V_{DD}:   5.0V

1.8 Backlight: Without

1.9 Controller: NT7603H-BDT01

1.10 Data Transfer: 8-Bit Parallel Date Input

1.11 Operating Temperature: -20----+50

    Storage Temperature: -30----+80

1.12 Outline Dimensions: Refer to outline drawing on next page

1.13 Dot Matrix: 16 Characters× 2Lines

1.14 Dot Size: 0.55 × 0.65 (mm)

1.15 Dot Pitch: 0.60 × 0.70 (mm)

1.16 Weight: 10g (Approx)

    * Color tone is slightly changed by temperature and driving voltage.
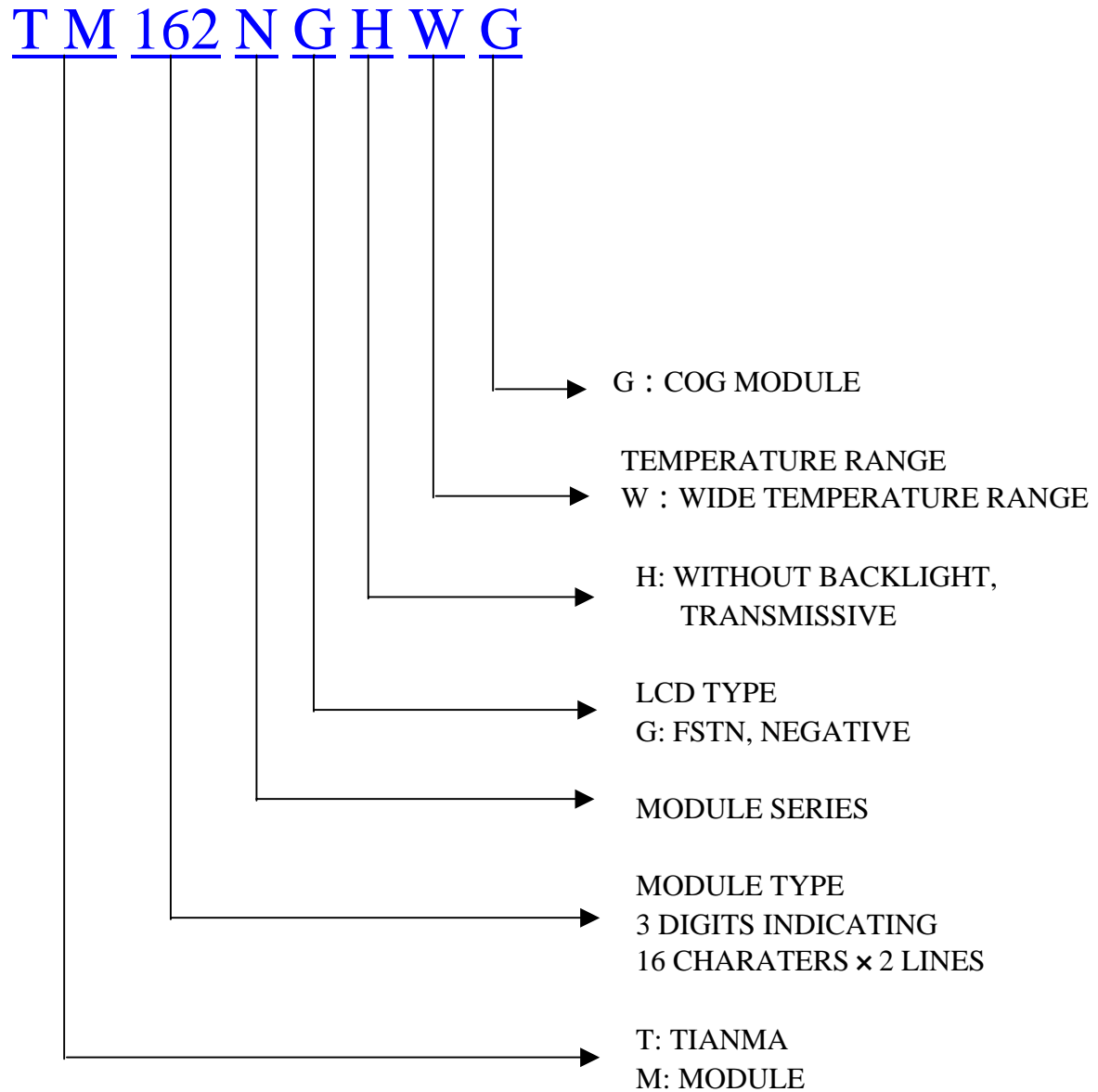
2. Outline Drawing
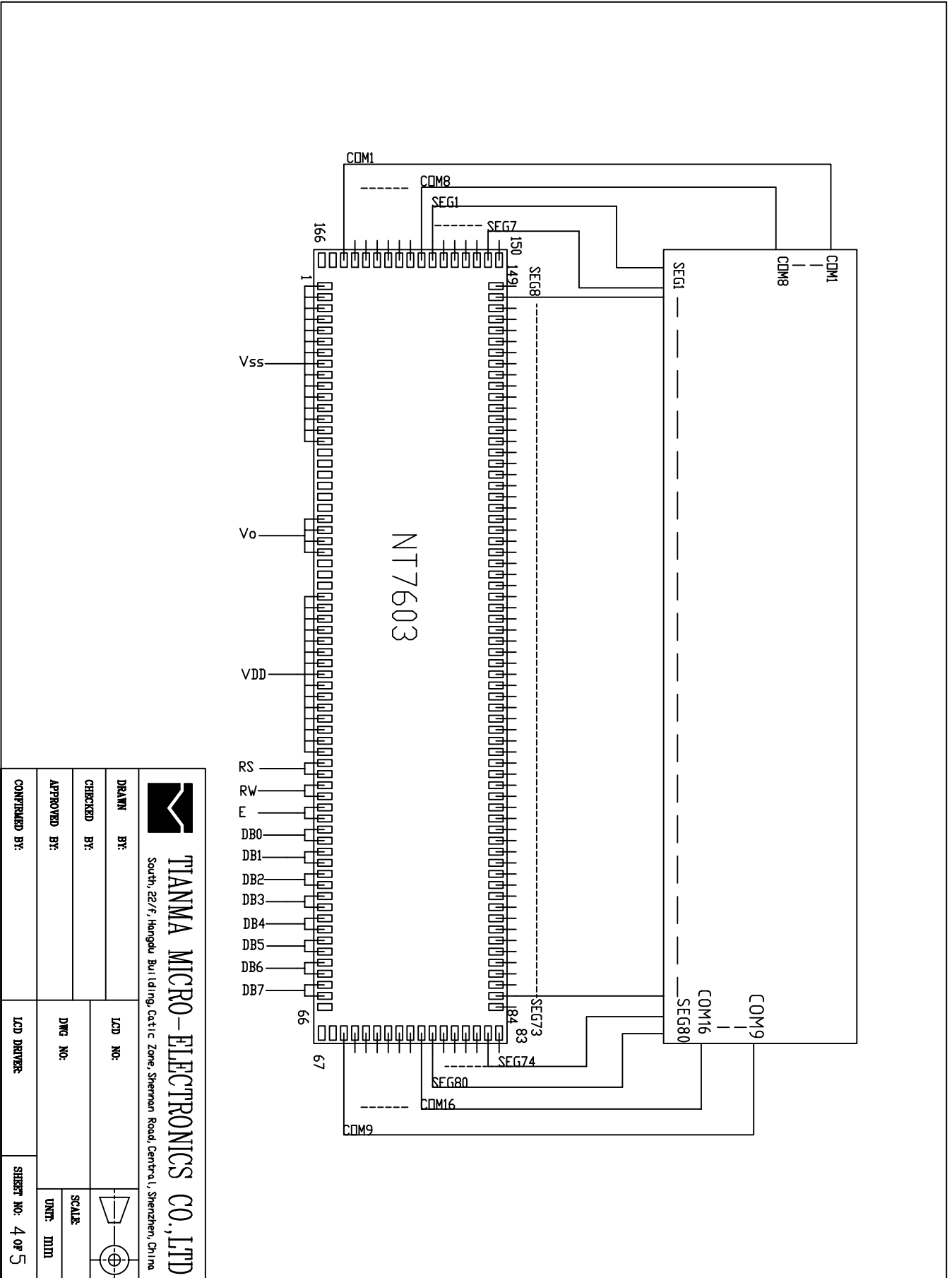

NOTES:
1. DISPLAY TYPE: FSTN
2. VIEWING DIRECTION: 6:00
3. POLARIZER MODE: TRANSMISSIVE/NEGATIVE
4. OPERATION TEMP:-20°~+50°
5. STORAGE TEMP: -30°~+80°
6. VDD: 5.0V
7. LCD OPERATION VOLTAGE: 4.8V
8. DRIVE METHOD: DUTY 1/16 BIAS 1/5
9. CONTROLLER: NT7603H-BDT01
10. ALL UNMARKED TOLERANCES: ±0.2mm
11. SILICON COATING AREA MUST BE COVER ITO LINES.
12. WITHOUT BACKLIGHT
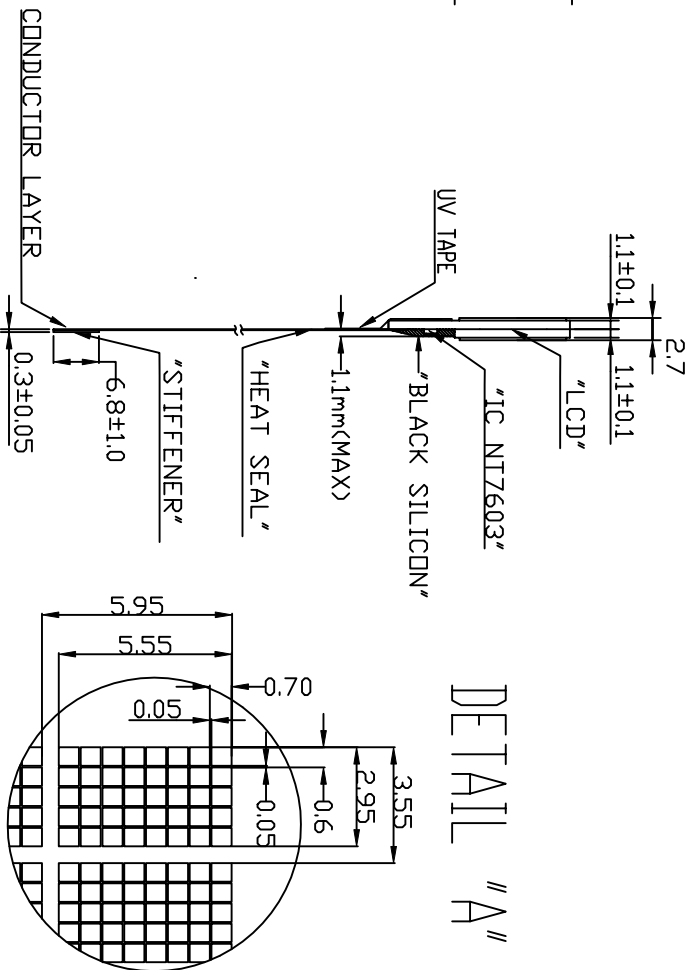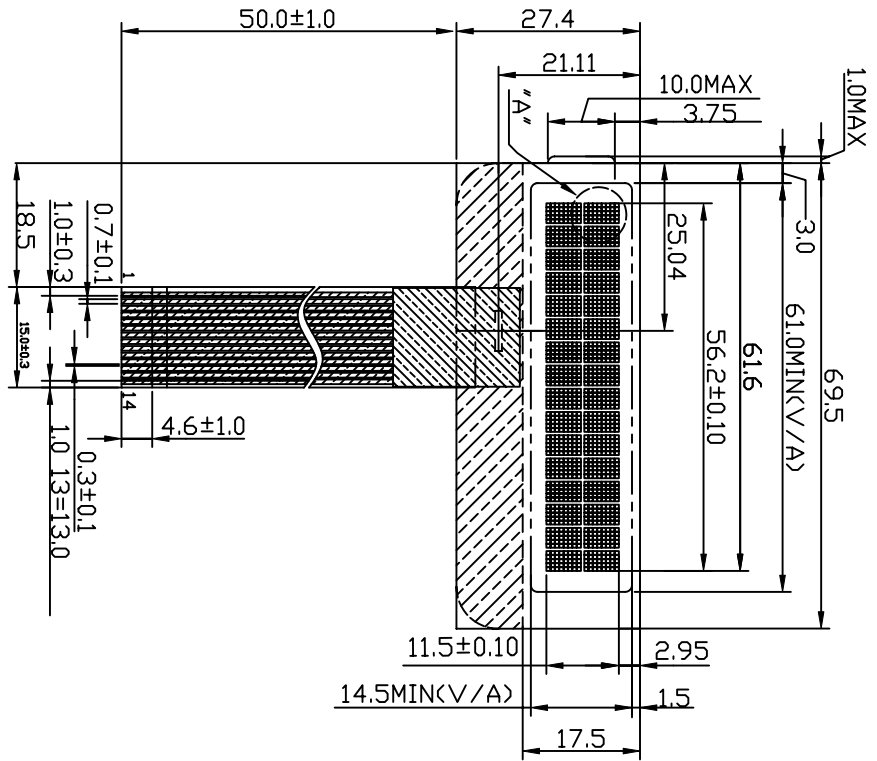
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Vss	Vo	VDD	RS	R/W	E	DB0	DB1	DB2	DB3	DB4	DB5	DB6	DB7

DETAIL "A"

TIAN-MA MICROELECTRONICS CO.

22/F., HANGDU Building, Shennan Road, Central, Shenzhen, China

DRAWN BY:
CHECKED BY:
APPROVED BY:
CONFIRMED BY:

TITLE: TM162NGHWG
DWG NO: G-3
DWG NAME:TM162NGHWGG-3
SCALE
UNIT: mm
SHEET NO: OF

3/22   Rev. 1.0

3. LCD Module Part Numbering System

<u>T M 162 N G H W G</u>

G   COG MODULE

TEMPERATURE RANGE
W   WIDE TEMPERATURE RANGE

H: WITHOUT BACKLIGHT,
    TRANSMISSIVE

LCD TYPE
G: FSTN, NEGATIVE

MODULE SERIES

MODULE TYPE
3 DIGITS INDICATING
16 CHARATERS× 2 LINES

T: TIANMA
M: MODULE

4. Circuit Block Diagram

Rev. 1.0

5. Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit	Remark
Power Supply Voltage	V_{DD} V_{SS}	-0.3	7.0	V	
LCD Driving Voltage	V_{LCD}	-0.3	13.0		
Operating Temperature Range	T_{OP}	-20	+50		No Condensation
Storage Temperature Range	T_{ST}	-30	+80		

Rev. 1.0

6. Electrical Specifications and Instruction Code

6.1 DC characteristics

Item		Symbol	Min.	Typ.	Max.	Unit
Supply Voltage (Logic)		V_{DD}　V_{SS}	4.75	5.0	5.25	V
Supply Voltage (LCD Drive)		V_{LCD}	-	4.8	5.0	V
Input Signal Voltage	High	V_{IH} V_{DD}=5.0	$0.8V_{DD}$	-	V_{DD}	V
	Low	V_{IL} V_{DD}=5.0	-0.3	-	$0.2V_{DD}$	V
Supply current (Logic)		I_{DD} V_{DD}　V_{SS} =5.0	-	1.5	2.5	mA
Supply current (LCD Drive)		I_{EE}	-	-	5.5	mA

6.2 Interface Signals

Pin No.	Symbol	Level	Function
1	V_{SS}	-	GND(0V)
2	V_O	-	CONTRAST ADJUSTMENT
3	V_{DD}	-	VCC(+5.0V ± 5%)
4	RS	H/L	REGISTER SELECT SIGNAL
5	R/W	H/L	READ/WRITE SELECTION
6	E	H,H→L	ENABLE SIGNAL
7	DB0	H/L	DATA BIT 0
8	DB1	H/L	DATA BIT 1
9	DB2	H/L	DATA BIT 2
10	DB3	H/L	DATA BIT 3
11	DB4	H/L	DATA BIT 4
12	DB5	H/L	DATA BIT 5
13	DB6	H/L	DATA BIT 6
14	DB7	H/L	DATA BIT 7

6.3 AC Characteristics

AC Characteristics (continued)

Read Cycle (V$_{DD}$ = 3.0V, GND = 0V, T$_A$ = 25°C)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
t$_{CYCE}$	Enable Cycle Time	500	-	-	ns	Figure 1
t$_{WHE}$	Enable "H" Level Pulse Width	300	-	-	ns	Figure 1
t$_{RE}$, t$_{FE}$	Enable Rising/Falling Time	-	-	25	ns	Figure 1
t$_{AS}$	RS, R/W Setup Time	60[1] 100[2]	-	-	ns	Figure 1
t$_{AH}$	RS, R/W Address Hold Time	10	-	-	ns	Figure 1
t$_{RD}$	Read Data Output Delay	-	-	190	ns	Figure 1
t$_{DHR}$	Read Data Hold Time	20	-	-	ns	Figure 1

Write Cycle (V$_{DD}$ = 3.0V, GND = 0V, T$_A$ = 25°C)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
t$_{CYCE}$	Enable Cycle Time	500	-	-	ns	Figure 2
t$_{WHE}$	Enable "H" Level Pulse Width	300	-	-	ns	Figure 2
t$_{RE}$, t$_{FE}$	Enable Rising/Falling Time	-	-	25	ns	Figure 2
t$_{AS}$	RS, R/W Setup Time	60[1] 100[2]	-	-	ns	Figure 2
t$_{AH}$	RS, R/W Address Hold Time	10	-	-	ns	Figure 2
t$_{DS}$	Data Output Delay	150	-	-	ns	Figure 2
t$_{DHW}$	Data Hold Time	10	-	-	ns	Figure 2

Notes: 1: 8-bit operation mode
    2: 4-bit operation mode

Power Supply Conditions Using Internal Reset Circuit

(V$_{DD}$ = 3.0V, GND = 0V, T$_A$ = 25°C)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
t$_{RON}$	Power Supply Rising Time	0.1	-	10	ms	Figure 3
t$_{OFF}$	Power Supply OFF Time	1	-	-	ms	Figure 3

Timing Waveforms
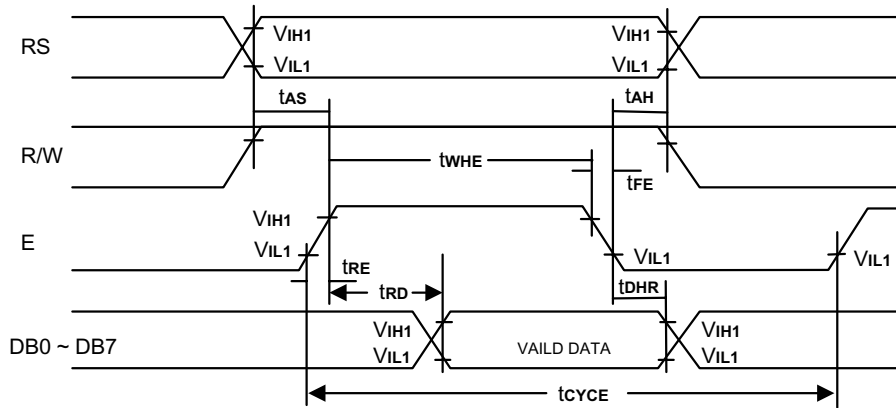
Read Operation

Figure 1. Bus Read Operation Sequence
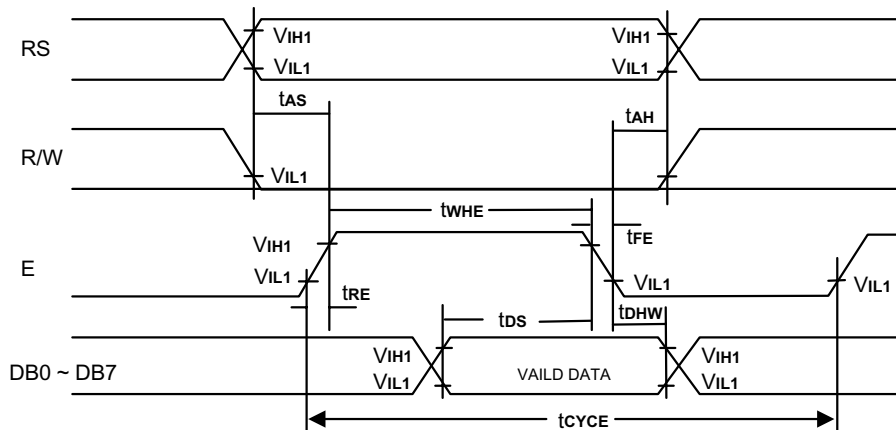(Reading out data from NT7603 to 8-bit MPU)

Write Operation

Figure 2. Bus Write Operation Sequence
(Writing data from 8-bit MPU to NT7603)
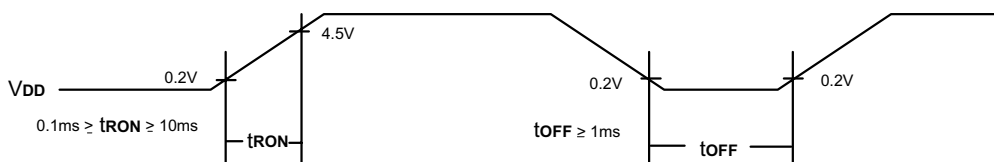
Interface Signals with Segment Driver LSI

Figure 3. t_{OFF} stipulates the time of power OFF for instantaneous
Power supply to or when power supply repeats ON and OFF

Rev. 1.0

6.4 Instruction Code

Character code table showing Higher 4-bit (D4 to D7) of Character Code (Hexadecimal) as columns (0–F) and Lower 4-bit (D0 to D3) of Character Code (Hexadecimal) as rows (0–F). Column 0 is labeled CG RAM (1) through CG RAM (8).

6.5 Instruction Set

Instruction Set

Instruction	Code										Function	Executio time (max) (fosc = 250KHz)
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Display Clear	0	0	0	0	0	0	0	0	0	1	Clear entire display area, Restore display from shift, and load address counter with DD RAM address 00H.	1.64ms
Display/ Cursor Home	0	0	0	0	0	0	0	0	1	*	Restore display from shift and load address counter with DD RAM address 00H.	1.64ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Specify direction of cursor movement and display shift mode. This operation takes place after each data transfer (read/write).	40μs
Display ON/OFF	0	0	0	0	0	0	1	D	C	B	Specify activation of display (D) cursor (C) and blinking of character at cursor position (B).	40μs
Display/ Cursor Shift	0	0	0	0	0	1	S/C	R/L	*	*	Shift display or move cursor.	40μs
Function Set	0	0	0	0	1	DL	N	F	*	*	Set interface data length (DL), number of display line (N), and character font (F).	40μs
RAM Address Set	0	0	0	1	ACG						Load the address counter with a CG RAM address. Subsequent data access is for CG RAM data.	40μs
DD RAM Address Set	0	0	1	ADD							Load the address counter with a DD RAM address. Subsequent data access is for DD RAM data.	40μs
Busy Flag/ Address Counter Read	0	1	BF	AC							Read Busy Flag (BF) and contents of Address Counter (AC).	1μs
CG RAM/ DD RAM Data Write	1	0	Write data								Write data to CG RAM or DD RAM.	40μs
CG RAM/ DD RAM Data Read	1	1	Read data								Read data from CG RAM or DD RAM.	40μs
	I/D = 1 : Increment I/D = 0 : Decrement S = 1 : Display Shift On D = 1 : Display On C = 1 : Cursor Display On B = 1 : Cursor Blink On S/C = 1 : Shift Display S/C = 0 : Move Cursor R/L = 1 : Shift Right R/L = 0 : Shift Left DL = 1 : 8-Bit DL = 0 : 4-Bit N = 1 : Dual Line N = 0 : Signal Line F = 1 : 5x10 dots F = 0 : 5 X 8 dots BF = 1 : Internal Operation BF = 0 : Ready for Instruction										DD RAM : Display Data RAM CG RAM : Character Generator RAM ACG : Character Generator RAM Address ADD : Display Data RAM Address AC : Address Counter	

Note 1: Symbol "*" signifies an insignificant bit (disregard).
Note 2: Correct input value for "N" is predetermined for each model.
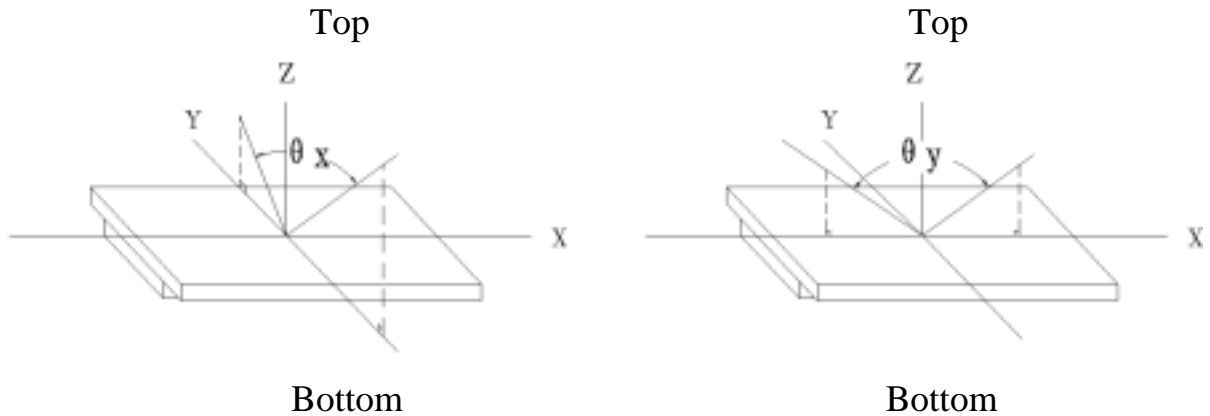
7. Optical Characteristics

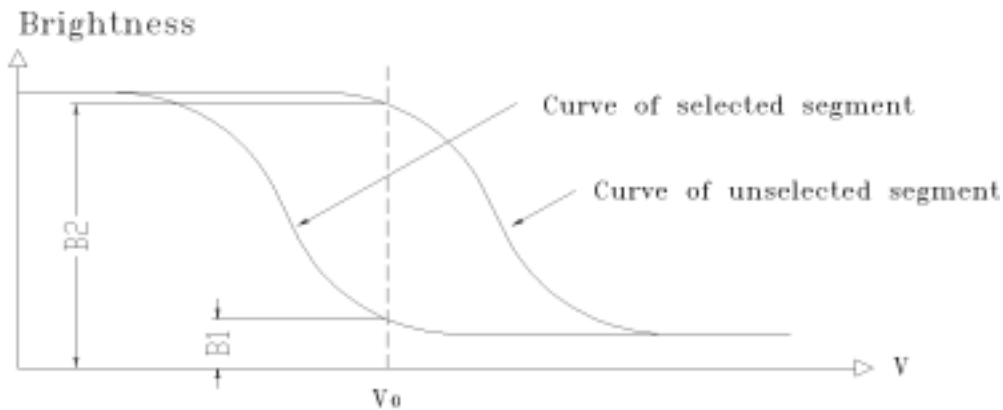7.1 Optical Characteristics   Ta=25

Item		Symbol	Condition		Min.	Typ.	Max.	Unit
Viewing Angle		x	Cr≥2	y=0°	-35	--	20	Deg
		y		x=0°	-30	--	30	
Contrast Ratio		Cr	x=0° y=0°		4.0	-	-	
Response Time	Turn on	T$_{on}$	x=0° y=0°		-	-	250	ms
	Turn off	T$_{off}$			-	-	250	

7.2 Definition of Optical Characteristics

7.2.1 Definition of Viewing Angle

Top

Top

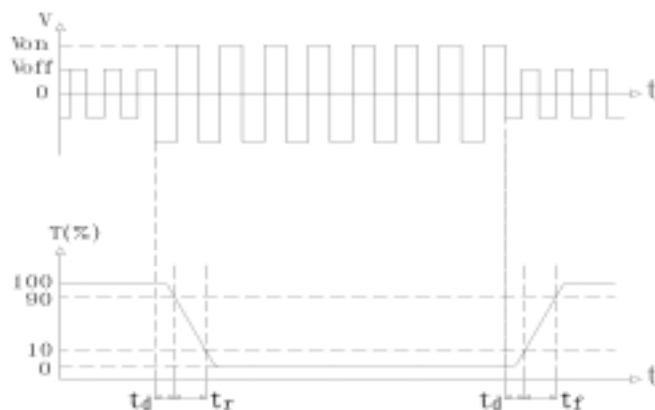
Bottom

Bottom

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: 64Hz

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: 4.8V 2) Frame frequency: 64Hz

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	-30 240H
3	High Temperature Operation	Endurance test applying the electric stress (voltage current) and the thermal stress to the element for a long time	50 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	40 95%RH 240H
6	Temperature Cycle	Endurance test applying the low and high temperature cycle -30 25 80 25 30min 5min 30min 5min 1 cycle	-30 /80 10 cycles
7	Vibration Test (package state)	Endurance test applying the vibration during transportation	10Hz~500Hz, 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	√	√	√	√	√	√	√	√	√	Out of the basic Specification
Electrical specification	√	√	√	√	√					Out of the electrical specification
Mechanical Specification							√	√		Out of the mechanical specification
Optical Characteristic	√	√	√	√	√	√			√	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 Ta=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:
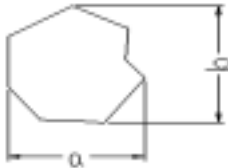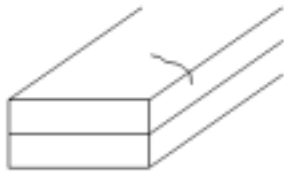
        Temperature :   0   40

        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.
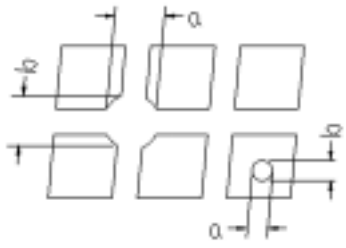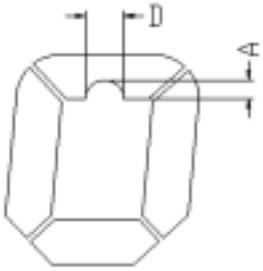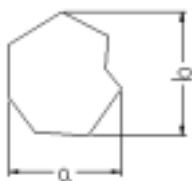
Appendix A

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	
		ϕ<0.3mm	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<0.2mm	0.2mm X 0.5mm	
		X=(a+b)/2		
Black line (in viewing area)		Not counted	Max. 3 lines allowed	
		a<0.02mm	0.02mm a 0.05mm b 2.0mm	
Progressive cracks		Not permitted		
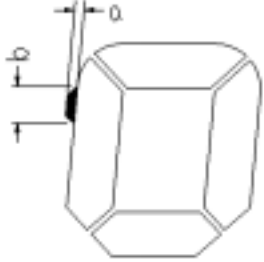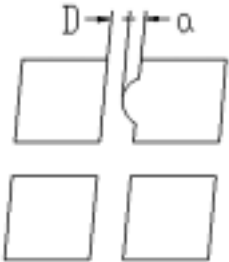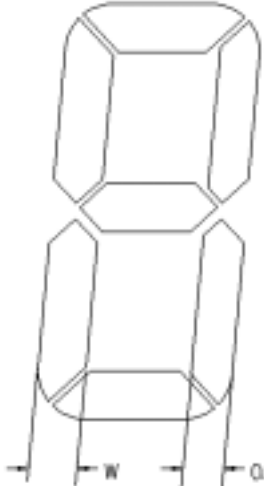
Appendix B

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 radio 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<0.1mm	0.1mm X 0.2mm	
			X=(a+b)/2		
			Not counted	Max.2 dots allowed	
			A<0.1mm	0.1mm A 0.2mm D<0.25mm	
Black spot (in viewing area)			Not counted	Max.3 spots allowed	Max.3 spots (lines) allowed
			X<0.1mm	0.1mm X 0.2mm	
			X=(a+b)/2		
Black line (in viewing area)			Not counted	Max.3 lines allowed	
			a<0.02mm	0.02mm a 0.05mm b 0.5mm	

Appendix B

Inspection items and criteria for display defects (continued)

Items	Content	Criteria		
Transfor-mation of segment		Not counted	Max. 2 defects allowed	Max.3 defects allowed
		x 0.1mm	0.1mm x 0.2mm	
		x=(a+b)/2		
		Not counted	Max. 1 defects allowed	
		a 0.1mm	0.1mm a 0.2mm D>0	
		Max.2 defects allowed 0.8W a 1.2W a=measured value of width W=nominal value of width		