

**DISPLAY Elektronik GmbH**

# DATA SHEET

**LCD MODULE**

## **DEM 16210 SGH (FPCR)**

*Product specification*

*Version : 5*

**04/Jan/2005**

# GENERAL SPECIFICATION

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MODULE NO. :

**DEM 16210 SGH (FPCR)**

CUSTOMER P/N

VERSION NO.	CHANGE DESCRIPTION	DATE
0	ORIGINAL VERSION	16/06/2000
1	CHANGE PITCH DIMENSION	28/06/2000
2	ADDING FPC	24/10/2000
3	ADDING ELECTRO-OPTICAL CHARACTERISTICS	11/01/2003
4	CHANGED MODULE DRAWING AND FPC DRAWING	07/08/2004
5	CHANGE TEMPERATURE RANGE	04.01.2005

PREPARED BY: CHJ

DATE: 04/01/2005

APPROVED BY: MH

DATE: 04/01/2005

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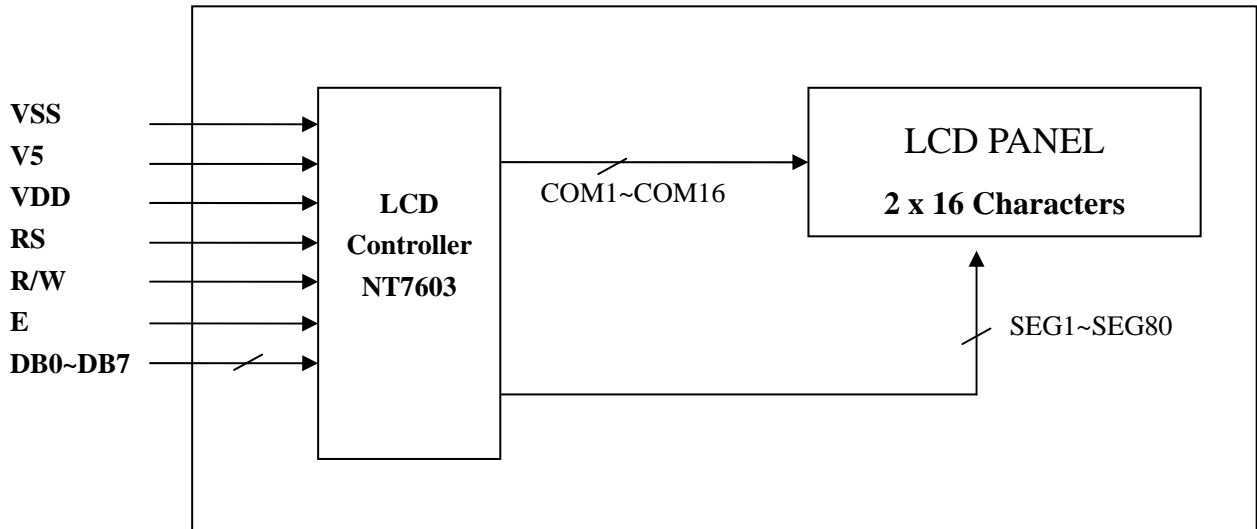
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4. BLOCK DIAGRAM



5. PIN DESCRIPTION

Pin No.	Name	I/O	Description
1	VSS	P	GND: 0V
2	V5	P	Power supply for LCD driver
3	VDD	P	VDD: +5V
4	RS	I	Register select signal 0: instruction register (write), Busy flag, address counter (read) 1: Data register (write, read)
5	R/W	I	Read/Write control signal 0:Write 1:Read
6	E	I	Read/Write start signal
7	DB0	I/O	Lower 4 tri-state bi-directional data bus for transmitting data between MPU and NT7603. not used during 4-bit operation.
8	DB1		
9	DB2		
10	DB3		
11	DB4		
12	DB5		
13	DB6		
14	DB7		

6. DISPLAY DATA RAM (DDRAM)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	← Display position
FIRST LINE	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	← DDRAM Address
SECOND LINE	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	

**7. MAXIMUM ABSOLUTE LIMIT**

Characteristic	Symbol	Value	Unit
Power supply voltage	$V_{DD}$	-0.3 to +7.0	V
Power supply voltage	$V_5$	0 to $V_{DD}+0.3$	V
Input voltage	$V_I$	-0.3 to $V_{DD}+0.3$	V
Operating temperature	$T_{opr}$	-20 to +70	°C
Storage temperature	$T_{stg}$	-30 to +80	°C

\*NOTES: All the voltage levels are based on  $V_{SS} = 0V$ .

**8. ELECTRICAL CHARACTERISTICS**

**8-1 DC Characteristics**

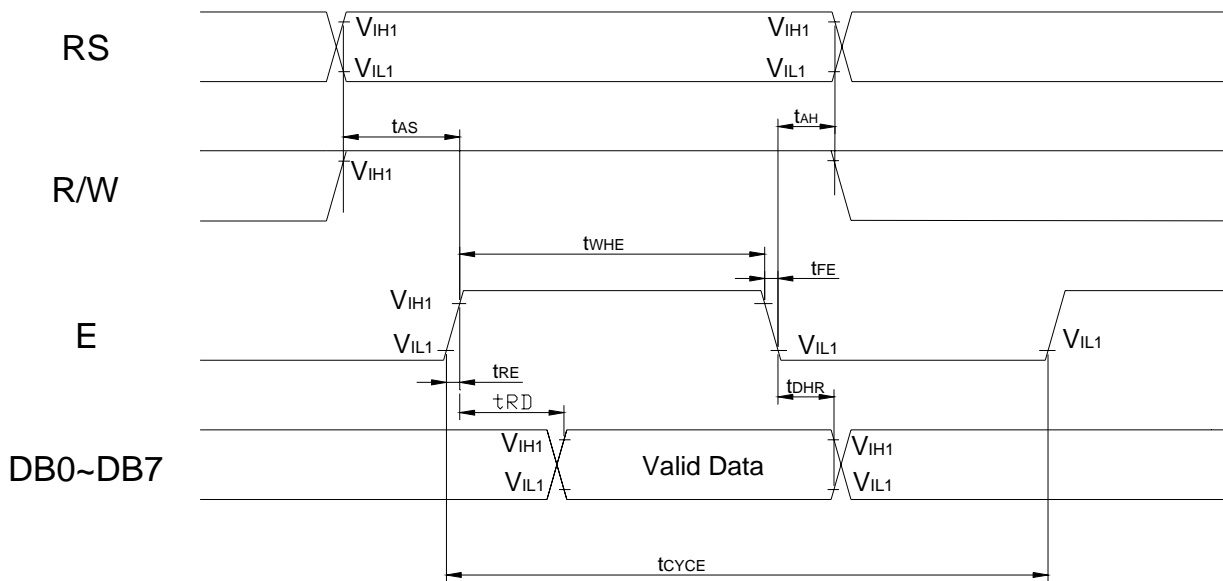
( $V_{DD}=5.0V, GND = 0V, T_a=25^\circ C$ )

Item	Symbol	Standard Value			Test Condition	Unit	Applicable Pin
		MIN	TYP.	MAX			
Operating Voltage	$V_{DD}$	4.5	5.0	5.5	-----	V	
“H” Level input Voltage	$V_{IH1}$	2.2	-	$V_{DD}$	-----	V	DB0~DB7 RS, R/W,E
“L” Level input Voltage	$V_{IL1}$	-0.3	-	0.8	-----	V	
“H” Level output Voltage	$V_{OH1}$	2.4	-	-	$I_{OH}=-0.25mA$	V	DB0 ~DB7 (TTL)
“L” Level output Voltage	$V_{OL1}$	-	-	0.4	$I_{OL}=1.2mA$	V	
Driver Voltage Descending (COM)	$V_{COM}$	-	-	0.3	$I_D=5\mu A$	V	COM1~16
Driver Voltage Descending (SEG)	$V_{SEG}$	-	-	0.3	$I_D=5\mu A$	V	SEG1~80
Input Leakage Current	$I_{IL}$	-1	-	1	$V_{IN}=0$ to $V_{DD}$	$\mu A$	
Pull-up MOS Current	$-I_P$	50	125	250	$V_{DD}=5V$	$\mu A$	RS,R/W, DB0 ~DB7
Supply Current Power supply Current	$I_{OP}$	-	1	1.5	Rf oscillation, from external clock $V_{DD}=5V, f_{osc}=f_{CP}=540KHz,$ include LCD bias current.	mA	$V_{DD}$
Internal Clock Operation (Built-in RC Oscillator )							
Oscillator Frequency	$f_{OSC}$	380	540	700	$R_f=50k\Omega$ (reference only)	KHz	
LCD Driving Voltage	$V_{LCD1}$	4.6	-	$V_{DD}$	$V_{DD}-V_5$	V	
	$V_{LCD2}$	3.0					

**8-2. AC Characteristics**

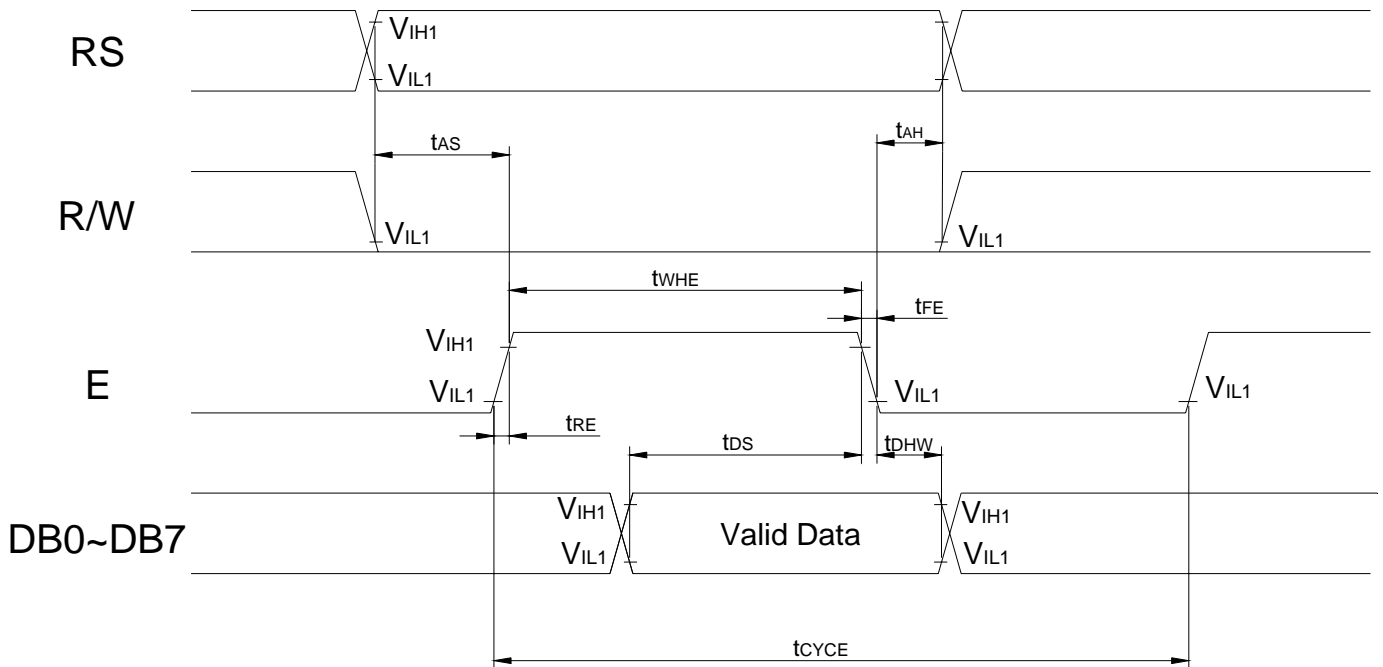
7-2-1. Read Cycle ( $V_{DD}=5.0V$ ,  $GND=0V$ ,  $T_a=25^{\circ}C$ ).

Characteristic	Symbol	Min	Typ.	Max	Unit
Enable Cycle Time	$t_{CYCE}$	500	---	---	ns
Enable "H" Level Pulse Width	$t_{WHE}$	300	---	---	
Enable Rise/Fall Time	$t_{RE}, t_{FE}$	---	---	25	
RS, R/W Setup Time	$t_{AS}$	$60^1$	---	---	
		$100^2$			
RS, R/W Address Hold Time	$t_{AH}$	10	---	---	
Read Data Output Delay	$t_{RD}$	---	---	190	
Read Data Hold Time	$t_{DHR}$	20	---	---	



**8-2-2. Write Cycle (V<sub>DD</sub>=5.0V, GND=0V, Ta=25°C)**

Characteristic	Symbol	Min	Typ.	Max	Unit
Enable Cycle Time	t <sub>CYCE</sub>	500	---	---	ns
Enable "H" Level Pulse Width	t <sub>WHE</sub>	300	---	---	
Enable Rise/Fall Time	t <sub>RE</sub> , t <sub>FE</sub>	---	---	25	
RS, R/W Setup Time	t <sub>AS</sub>	60 <sup>1</sup>	---	---	
		100 <sup>2</sup>			
RS, R/W Address Hold Time	t <sub>AH</sub>	10	---	---	
Data Output Delay	t <sub>DS</sub>	100	---	---	
Data Hold Time	t <sub>DHR</sub>	10	---	---	





**9. INSTRUCTION DESCRIPTION**

Instruction	Code										Function	
	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.	
Display /Cursor Home	0	0	0	0	0	0	0	0	1	*	Restore display from shift and load address counter with DDRAM address 00H.	
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)	
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)	
Display/ Cursor Shift	0	0	0	0	0	1	S/C	R/L	*	*	Shift display or move cursor.	
Function Set	0	0	0	0	1	DL	N	F	*	*	Set interface data length (DL), number of display line (N), and character font (F)	
RAM Address Set	0	0	0	1	ACG						Load the address counter with a CGRAM address. Subsequent data access is for CGRAM data.	
DD RAM Address Set	0	0	1	ADD						Load the address counter with a DDRAM address. Subsequent data access is for DDRAM data		
Busy Flag/Address Counter Read	0	1	AC						Read Busy Flag (BF) and contents of Address Counter (AC)			
CGRAM/ DDRAM Data Write	1	0	Write data						Write data to CGRAM or DDRAM			
CGRAM /DDRAM Data Read	1	1	Read data						Read data from CGRAM or DDRAM			
	I/D= 1: Increment S =1: Display Shift ON D =1: Display On C =1: Cursor Display On B =1: Cursor Blink On S/C = 1: Shift Display R/L = 1: Shift Right DL = 1: 8-Bit N = 1: Dual Line F =1: 5 x 10 dots BF=1: Internal Operation BF=0: Ready for Instruction				I/D=0: Decrement    S/C=0: Move Cursor R/L =0: Shift Left DL = 0: 4-Bit N=0: Signal Line F=0: 5 x 8 dots				DDRAM : Display Data RAM  CGRAM: Character Generator RAM  ACG: Character Generator RAM address ADD: Display Data RAM Address AC: Address Counter			

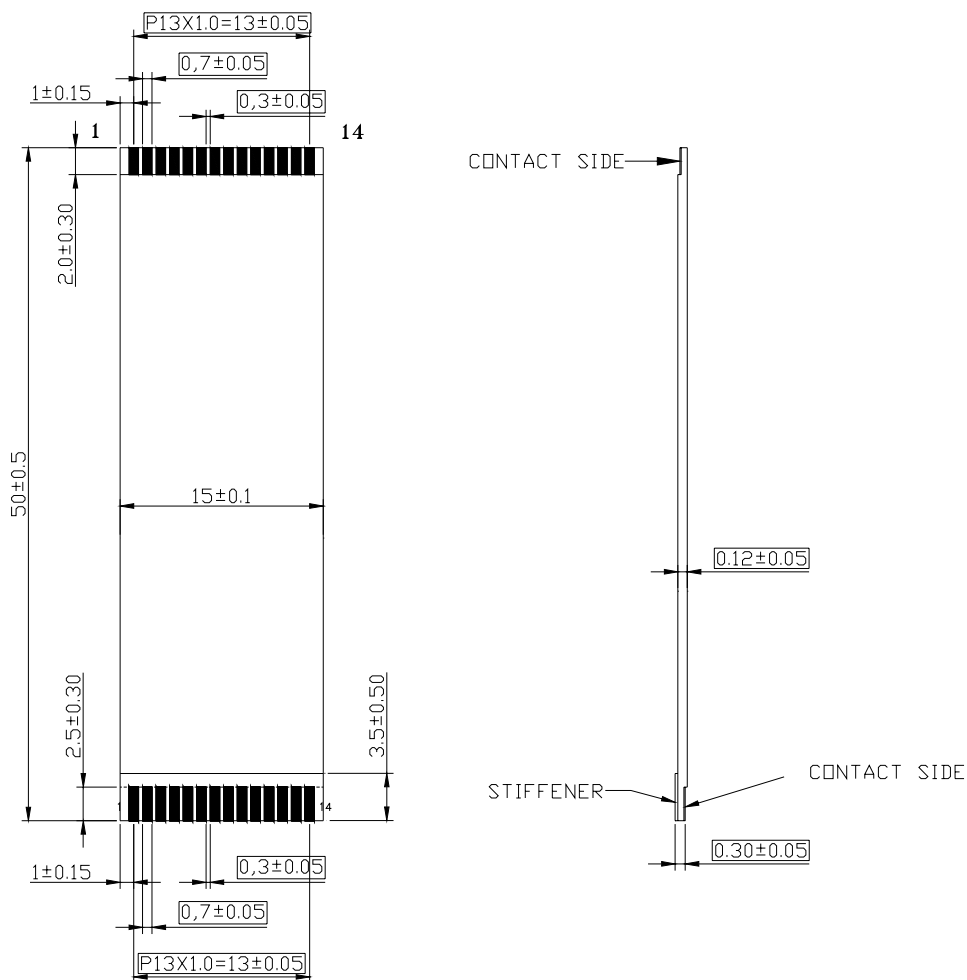
**NOTES:**

1. Symbol “\*” signifies an insignificant bit (disregard).
2. Correct input value for “N” is predetermined for each model.

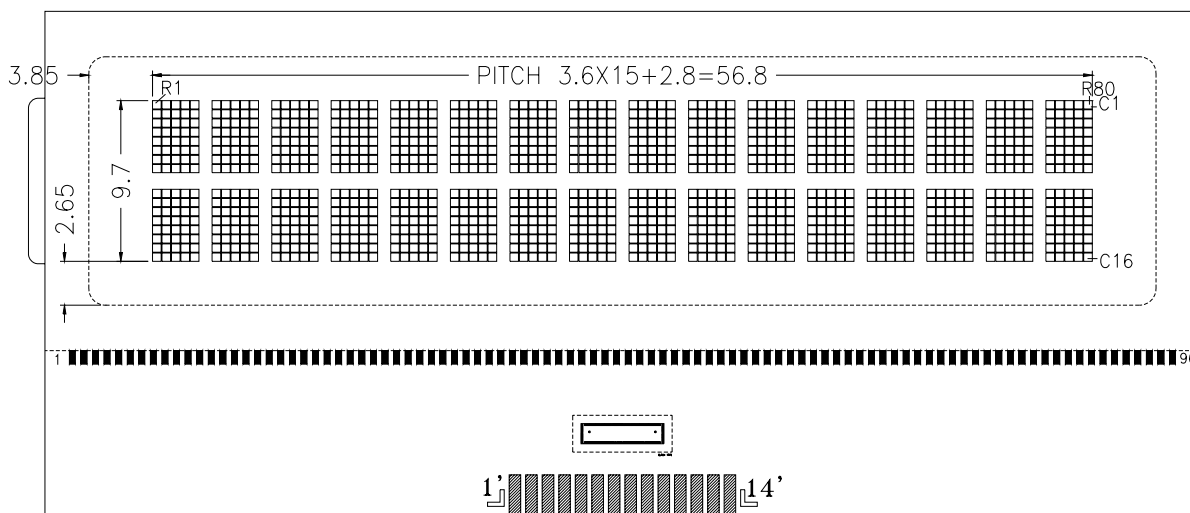
10. STANDARD CHARACTER PATTERN (NT7603-01)]

Upper(4bit) \ Lower(4bit)		Upper(4bit)															
		LLLL	LLLH	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
Lower(4bit)	CG RAM																
	(1)																
	(2)																
	(3)																
	(4)																
	(5)																
	(6)																
	(7)																
(8)																	
(1)																	
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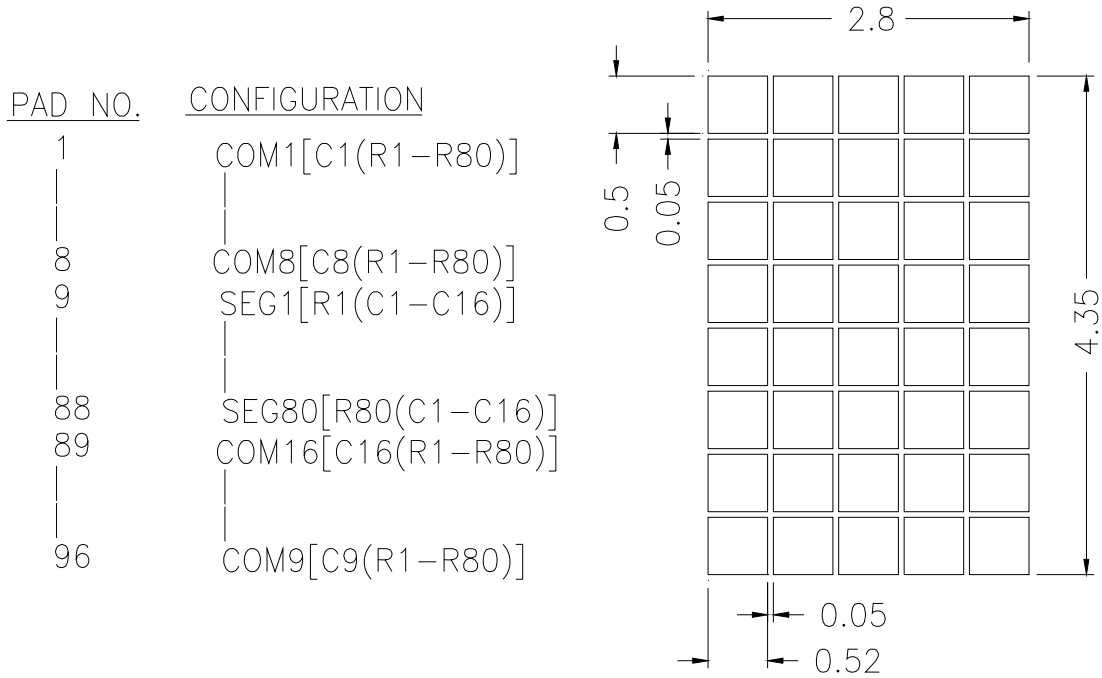
**11. FPC DIMENSIONS**



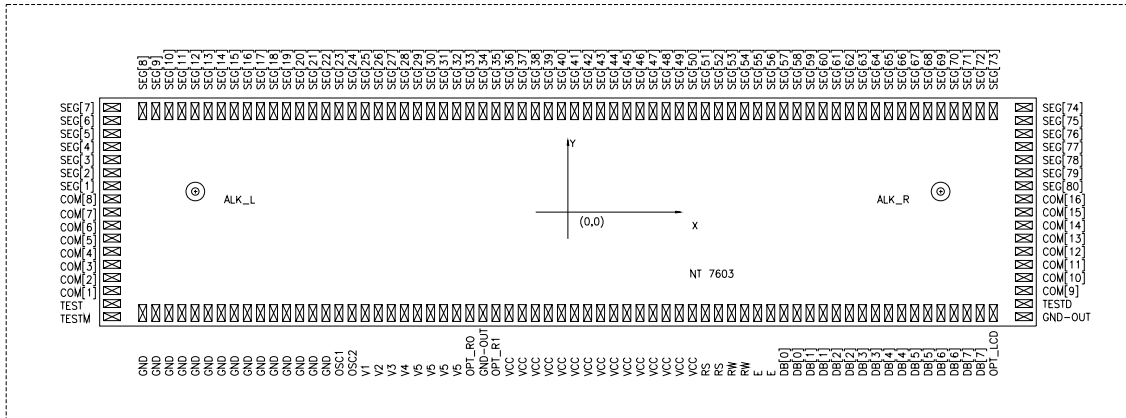
**12. LABELLING**



**13. PAD CONFIGURATION AND GRAPHIC DIMMENSION**



**14. IC NO. CONFIGURATION & PAD CONFIGURATION**



BLACK TAPE

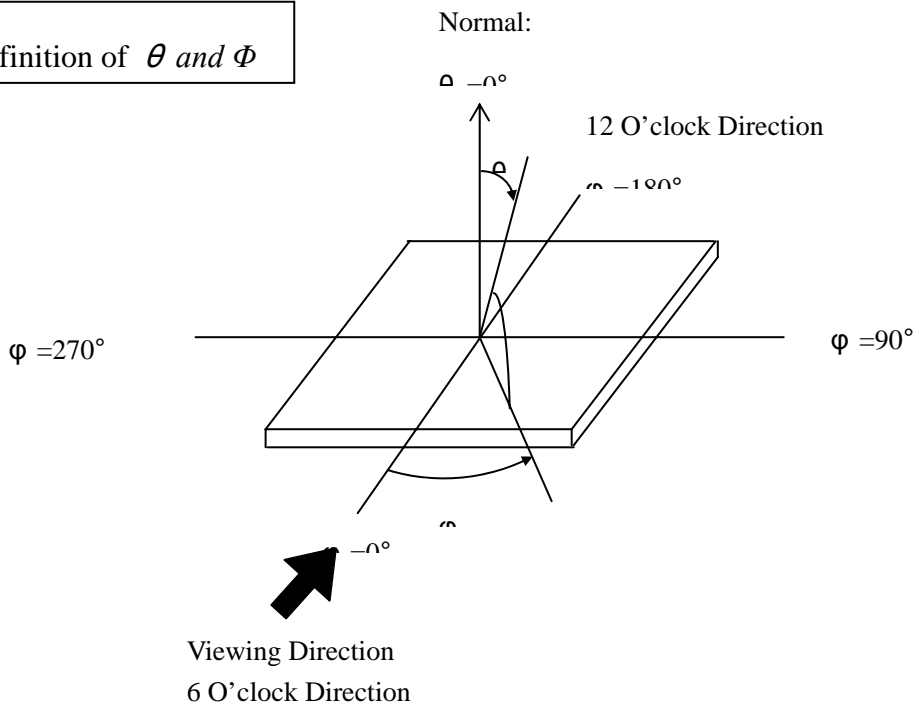
IC_NO.	CONFIGURATION
1'	GND
2'	V5
3'	VCC
4'	RS
5'	RW
6'	E
7'	DB[0]
8'	DB[1]
9'	DB[2]
10'	DB[3]
11'	DB[4]
12'	DB[5]
13'	DB[6]
14'	DB[7]

15. ELECTRO-OPTICAL DEFINITION

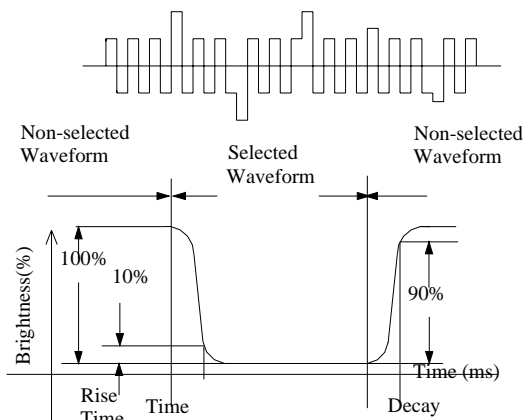
Optical Characteristics

Item	Symbol	Temp.	Condition	Min.	Typ.	Max.	unit
Response time	Rise time	0°C	$\varphi = 0^\circ$	-	-	-	ms
		25°C		-	52.4	-	
	Decay time	0°C	$\theta = 0^\circ$	-	-	-	
		25°C		-	167.2	-	
Contrast ratio	Cr	25°C	$\varphi = 0^\circ$ $\theta = 0^\circ$	-	5.24	-	-
Viewing angle (CR $\geq$ 2)	$\theta$	25°C	$\varphi = 0^\circ$	-	40	-	Degree
			$\varphi = 90^\circ$	-	42	-	
		25°C	$\varphi = 180^\circ$	-	36	-	
			$\varphi = 270^\circ$	-	43	-	

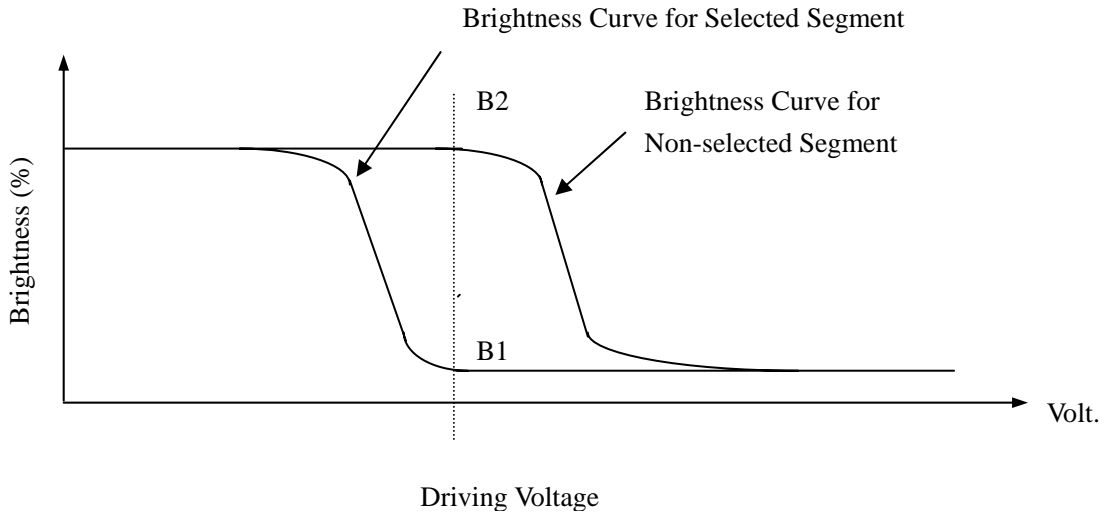
Note1: Definition of  $\theta$  and  $\Phi$



Note 2. Definition of response time wave form

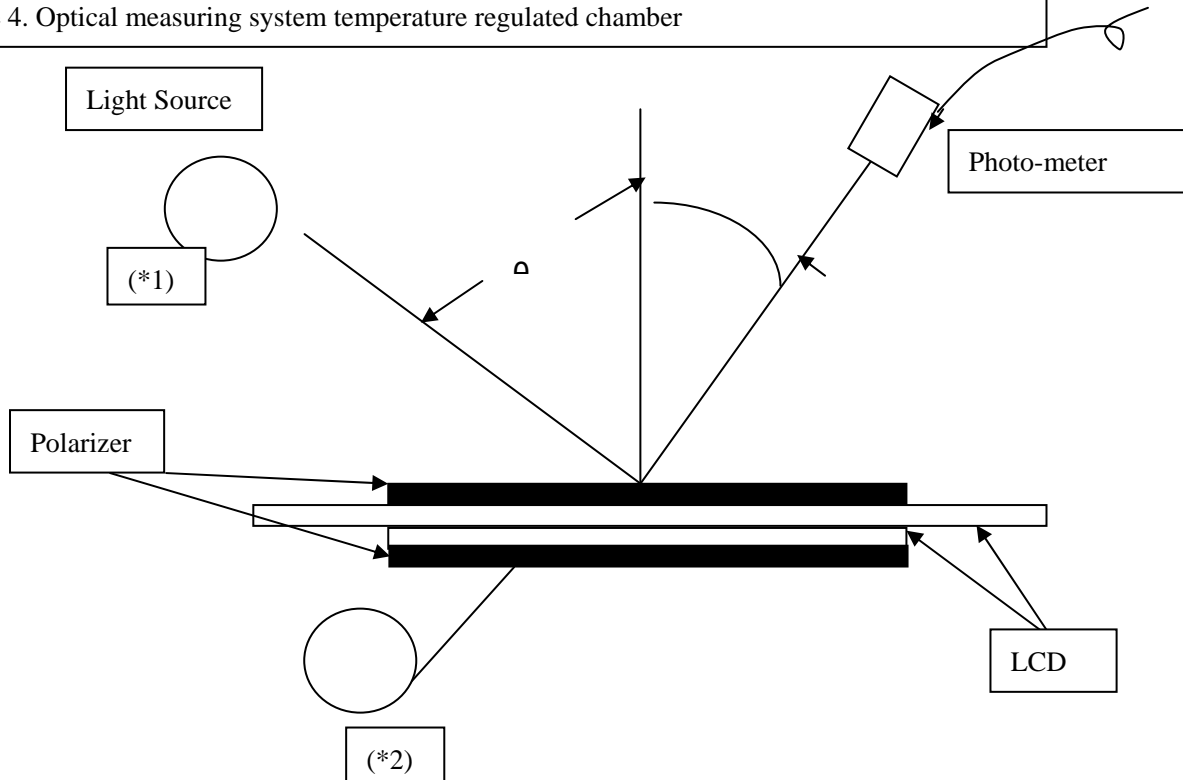


Note 3. Definition of Contrast ratio (Cr)



$$Cr = \frac{\text{Brightness of Non-selected Segment (B2)}}{\text{Brightness of Selected Segment (B1)}}$$

Note 4. Optical measuring system temperature regulated chamber



\*1 Light Source Position For Measuring Of Reflective Type LCD

\*2 Light Source Position For Measuring Of Transmissive/ Transflective Type LCD

**16. RELIABILITY TEST**

Operating life time: Longer than 50000 hours (at room temperature without direct irradiation of sunlight)

Reliability characteristics shall meet following requirements.

TEMPERATURE TESTS	NORMAL GRADE
High temperature storage	+80°C *96hrs (Without Polarizer)
Low temperature storage	-30°C* 4hrs
High temperature operation	+70°C *96hrs
Low temperature operation	-20°C *4hrs
High temperature, High humidity	+70°C* 95%RH *96hrs (Without Polarizer)
Thermal shock	-20°C *30min. ← 10s ↓ 5Cycles +70°C *30min.
Vibration test	Frequency *Swing * Time 40Hz * 4mm * 4hrs
Drop test	Drop height*Times 1.0m * 6times

**19. LCD MODULES HANDLING PRECAUTIONS**

- The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
- If the display panel is damaged and the liquid crystal substance inside it leaks out, do not get any in your mouth. If the substance come into contact with your skin or clothes promptly wash it off using soap and water. Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarize carefully.
- To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
  - Be sure to ground the body when handling the LCD module.
  - Tools required for assembly, such as soldering irons, must be properly grounded.
  - To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.
  - The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.
- Storage precautions  
 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps. Keep the modules in bags designed to prevent static electricity charging under low temperature / normal humidity conditions (avoid high temperature / high humidity and low temperatures below 0°C). Whenever possible, the LCD modules should be stored in the same conditions in which they were shipped from our company.

**20. OTHERS**

- Liquid crystals solidify at low temperature (below the storage temperature range) leading to defective orientation of liquid crystal or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subjected to a strong shock at a low temperature.
  
- If the LCD modules have been operating for a long time showing the same display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. Abnormal operating status can be resumed to be normal condition by suspending use for some time. It should be noted that this phenomena does not adversely affect performance reliability.
  
- To minimize the performance degradation of the LCD modules resulting from caused by static electricity, etc. exercise care to avoid holding the following sections when handling the modules:
  - Exposed area of the printed circuit board
  - Terminal electrode sections