

**DISPLAY Elektronik GmbH.**

# DATA SHEET

**LCD MODULE**

**DEM 16209 SBH-PW-N**

*Product Specification*

*Version: 4.1.1*

**08.01.2020**

# GENERAL SPECIFICATION

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## MODULE NO. : DEM 16209 SBH-PW-N

CUSTOMER P/N:

VERSION NO.	CHANGE DESCRIPTION	DATE
0	First Issue	27.10.2009
1	Update Backlight Characteristics	11.12.2009
2	Update Electrical Characteristics	28.04.2011
2.1.0	Change Production Line	09.08.2018
2.1.1	Add Version	10.08.2018
2.1.2	Add Tolerance	13.08.2018
3	Add LED-Lifetime	31.10.2018
4	Correct Label (Print)	20.11.2018
4.1.0	Change Production Line Change Driver IC from NT7603 to NT7605	19.12.2019
4.1.1	Correct the P/N Add the LED lifetime	08.01.2020

PREPARED BY: CC

DATE: 08.01.2020

APPROVED BY: MH

DATE: 08.01.2020



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## 1. FUNCTIONS & FEATURES

### I LCD TYPE:

MODULE	LCD TYPE	REMARK
DEM 16209 SBH-PW-N	STN-Blue Transmissive Negative Mode	

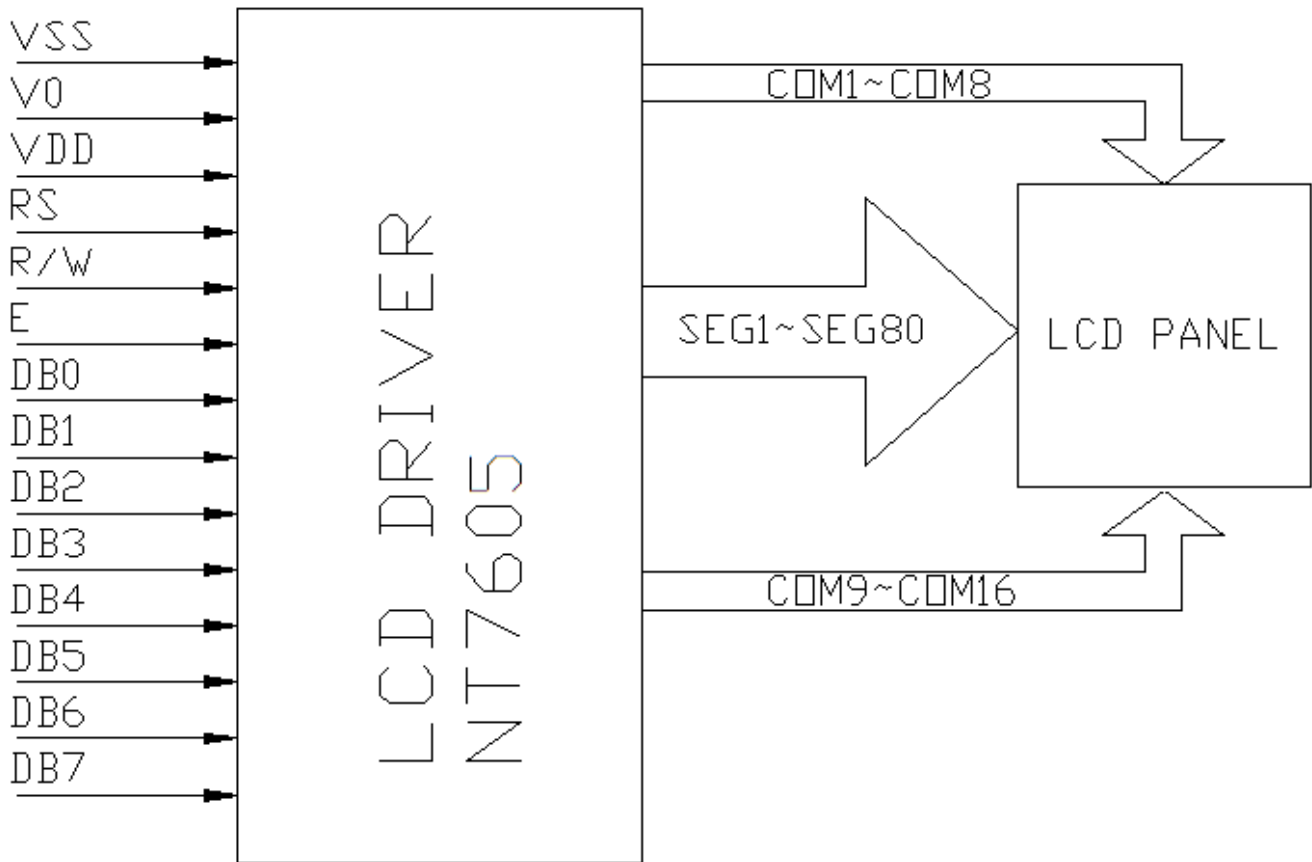
I Viewing Direction	: 6 O'clock
I Driving Scheme	: 1/16 Duty Cycle, 1/5Bias
I Power supply	: 5V
I V <sub>LCD</sub>	: 4.5 V
I Driver IC	: NT7605H
I Backlight	: LED White Lightguide

## 2. MECHANICAL SPECIFICATIONS

I Module Size	: 76.00 x 28.70 x 6.00mm
I Viewing Area	: 61.00 x 15.70 mm
I Active Area	: 56.20 x 10.90 mm
I Character Pitch	: 3.55 x 5.75 mm
I Character Size	: 2.95 x 5.15 mm
I Dot Pitch	: 0.60 x 0.65 mm
I Dot Size	: 0.55 x 0.60 mm



**4. BLOCK DIAGRAM**

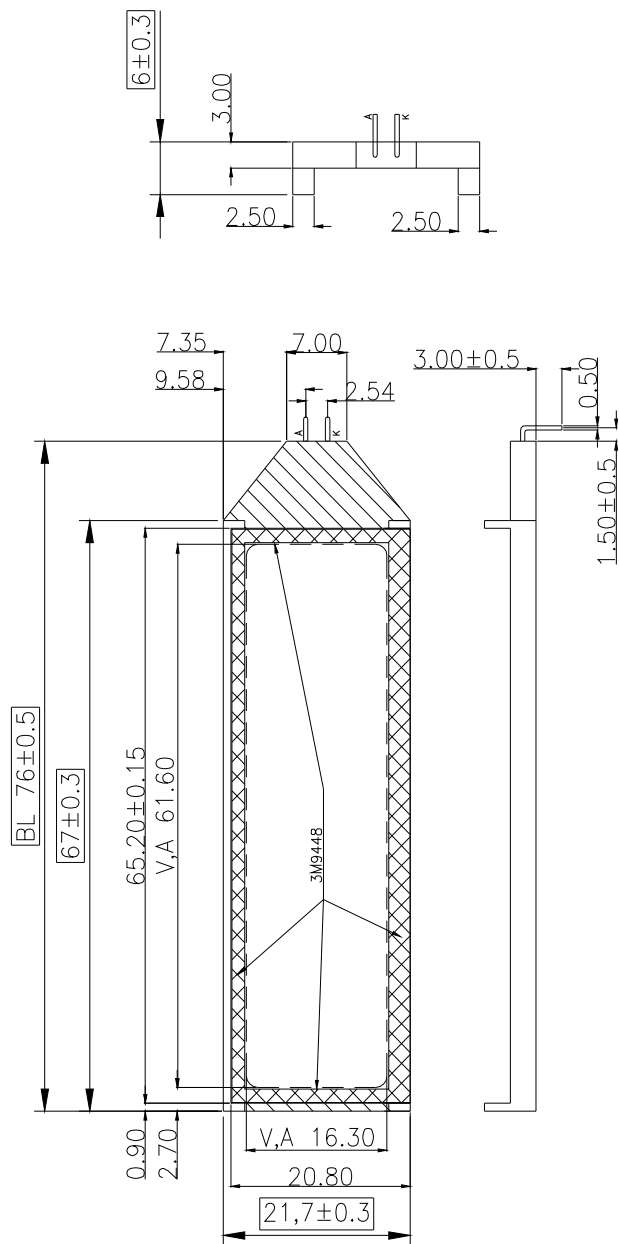


**5. PIN ASSIGNMENT**

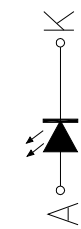
Pin No.	Name	Description
1	VSS	Ground of chip.
2	V0	Power supply for LCD driver
3	VDD	Power supply
4	RS	Register select signal 0: instruction register (write), Busy flag, address counter (read) 1: Data register (write, read)
5	R/W	Read/Write control signal 0:Write 1:Read
6	E	Read/Write start signal
7~14	DB0~DB7	Data Bus Lines

6. BACKLIGHT ELECTRICAL/OPTICAL SPECIFICATIONS

Item	symbol	Condition	Min	Typ	Max	Unit
Forward Voltage	VF	IF=15mA	2.8	3.1	3.4	V
Reverse Current	Ir	VR=5.0V	---	10	---	uA
Luminous Intensity (Without LCD)	Lv	IF=15mA	140	190	---	cd/m <sup>2</sup>
Wave length	$\lambda_p$	IF=15mA	x=0.26 y=0.26	---	x=0.30 y=0.30	
Lifetime	30000 Hour					



Remarks:  
 1. Unmarked tolerance is ±0.3  
 2. All materials comply with RoHs  
 3. [ ] ....critical dimension.



CIRCUIT DIAGRAM  
 Color :WHITE

## 7. MAXIMUM ABSOLUTE LIMIT

Characteristic	Symbol	Value	Unit
Power Supply Voltage	V <sub>DD</sub>	-0.3 to+7.0	V
Power Supply Voltage	V <sub>0</sub>	0 to V <sub>DD</sub> +0.3	V
Input Voltage	V <sub>in</sub>	-0.3 to V <sub>DD</sub> +0.3	V
Operating Temperature Range	TOPR	-20 to +70	°C
Storage Temperature Range	TSTR	-30 to +80	°C

## 8. ELECTRICAL CHARACTERISTICS

### 8-1.DC Characteristics

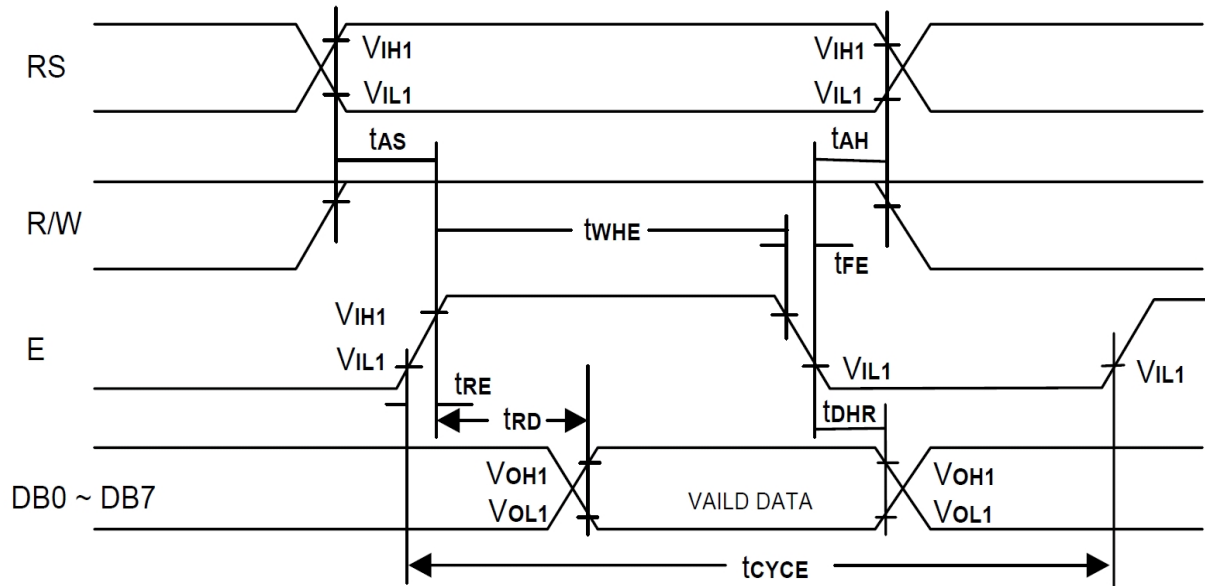
Item	Symbol	Standard Value			Unit
		MIN	TYP	MAX	
Operating Voltage	VDD	4.7	5.0	5.3	V
LCD Driving Voltage	VLCD	4.2	4.5	4.8	V
Supply Current	IDD	----	TBD	----	mA

### 8-2. AC Characteristics

#### 8-2-1 Read Cycle

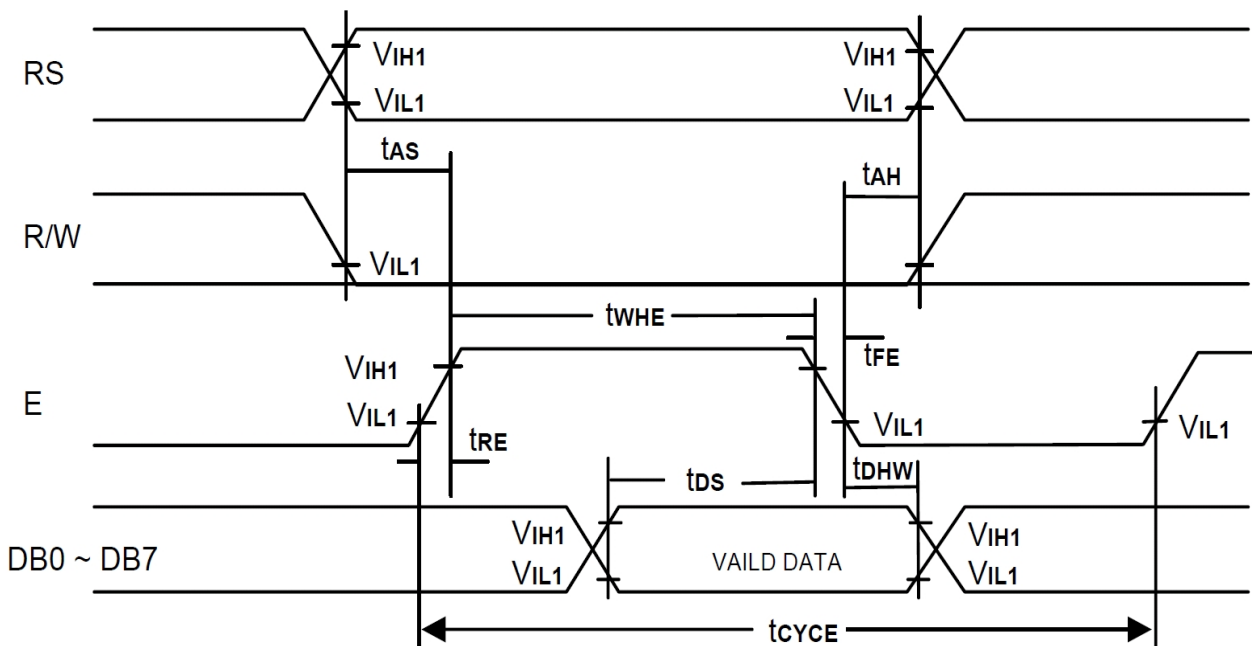
Symbol	Parameter	Min.	Typ.	Max.	Unit
t <sub>cyCE</sub>	Enable Cycle Time	500	-	-	ns
t <sub>wHE</sub>	Enable "H" Level Pulse Width	300	-	-	ns
t <sub>RE</sub> , t <sub>FE</sub>	Enable Rising/Falling Time	-	-	25	ns
t <sub>AS</sub>	RS, R/W Setup Time	60 <sup>1</sup>	-	-	ns
		100 <sup>2</sup>			
t <sub>AH</sub>	RS, R/W Address Hold Time	10	-	-	ns
t <sub>RD</sub>	Read Data Output Delay	-	-	190	ns
t <sub>DHR</sub>	Read Data Hold Time	20	-	-	ns





8-2-2. Write Cycle

Symbol	Parameter	Min.	Typ.	Max.	Unit
tCYCE	Enable Cycle Time	500	-	-	ns
twHE	Enable "H" Level Pulse Width	300	-	-	ns
tRE, tFE	Enable Rising/Falling Time	-	-	25	ns
tAS	RS, R/W Setup Time	60 <sup>1</sup>	-	-	ns
		100 <sup>2</sup>			
tAH	RS, R/W Address Hold Time	10	-	-	ns
tDS	Data Output Delay	100	-	-	ns
tDHW	Data Hold Time	10	-	-	ns



## 9. INSTRUCTION DESCRIPTION

Instruction	Code										Function	Execution time (max) (fOSC = 540KHz)	
	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).	40 $\mu$ s	
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).	40 $\mu$ s	
Display/ Cursor Shift	0	0	0	0	0	1	S/C	R/L	*	*	Shift display or move cursor.	40 $\mu$ s	
Function Set	0	0	0	0	1	DL	N	F	*	*	Set interface data length (DL), number of display line (N), and character font (F).	40 $\mu$ s	
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.	40 $\mu$ s	
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.	40 $\mu$ s		
Busy Flag/ Address Counter Read	0	1	BF	AC						Read Busy Flag (BF) and contents of Address Counter (AC).	1 $\mu$ s		
CG RAM/ DD RAM Data Write	1	0	Write data						Write data to CG RAM or DD RAM.	40 $\mu$ s			
CG RAM/ DD RAM Data Read	1	1	Read data						Read data from CG RAM or DD RAM.	40 $\mu$ s			
	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 : 5x10 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	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.

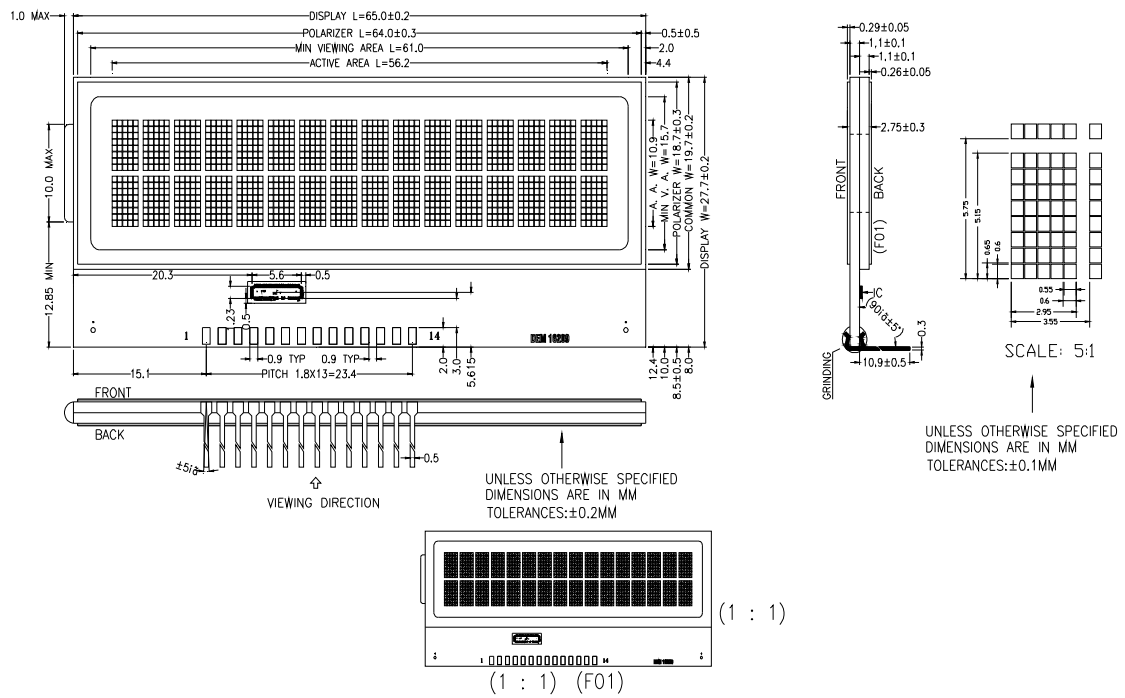
Note 3: The variation of execution time depends on the change of oscillator frequency; for example:

if fOSC = 380KHz, then execution time = 40  $\mu$ s  $\times$  (540KHz / 380KHz) = 57  $\mu$ s

10. STANDARD CHARACTER PATTERN

		Higher 4-bit (D4 to D7) of Character Code (Hexadecimal)															
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Lower 4-bit (D0 to D3) of Character Code (Hexadecimal)	0	CG RAM (1)			0	1	2	3									
	1	CG RAM (2)	!	1	A	0	a	a									
	2	CG RAM (3)	"	2	B	R	b	r									
	3	CG RAM (4)	#	3	C	S	c	s									
	4	CG RAM (5)	\$	4	D	T	d	t									
	5	CG RAM (6)	%	5	E	U	e	u									
	6	CG RAM (7)	&	6	F	V	f	v									
	7	CG RAM (8)	'	7	G	W	g	w									
	8	CG RAM (1)	(	8	H	X	h	x									
	9	CG RAM (2)	)	9	I	Y	i	y									
	A	CG RAM (3)	*	A	J	Z	j	z									
	B	CG RAM (4)	+	B	K	[	k	[									
	C	CG RAM (5)	,	C	L	]	l	]									
	D	CG RAM (6)	-	D	M	^	m	^									
	E	CG RAM (7)	.	E	N	_	n	_									
	F	CG RAM (8)	/	F	O	`	o	`									

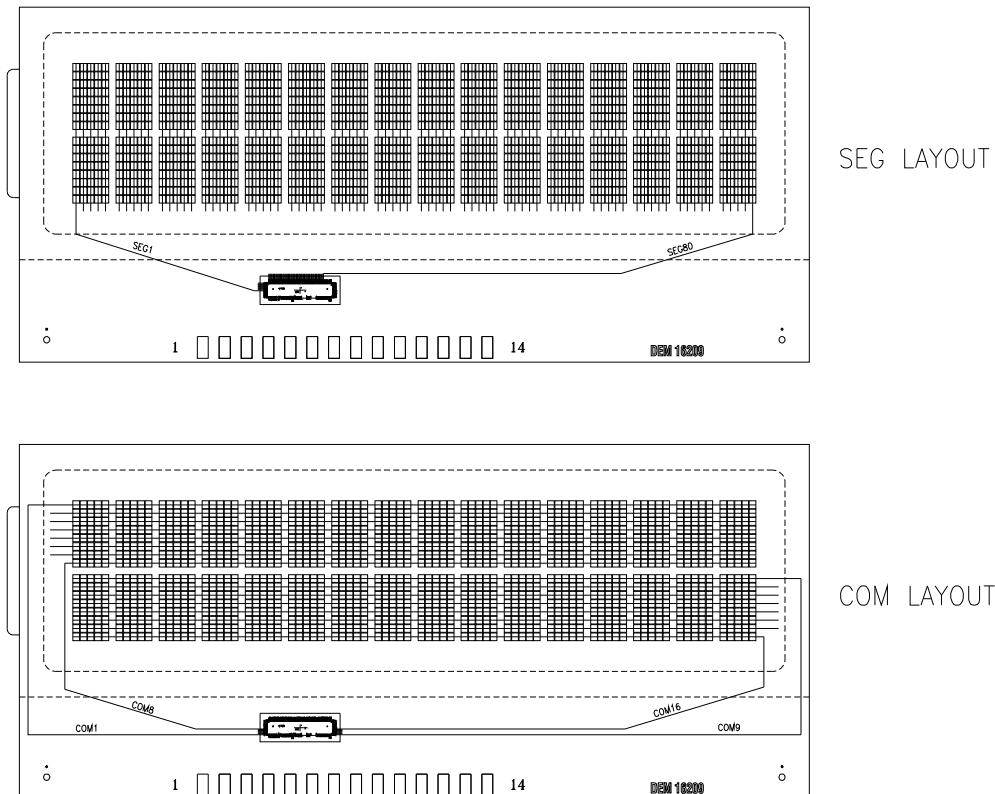
### 11. LCD ARTWORK



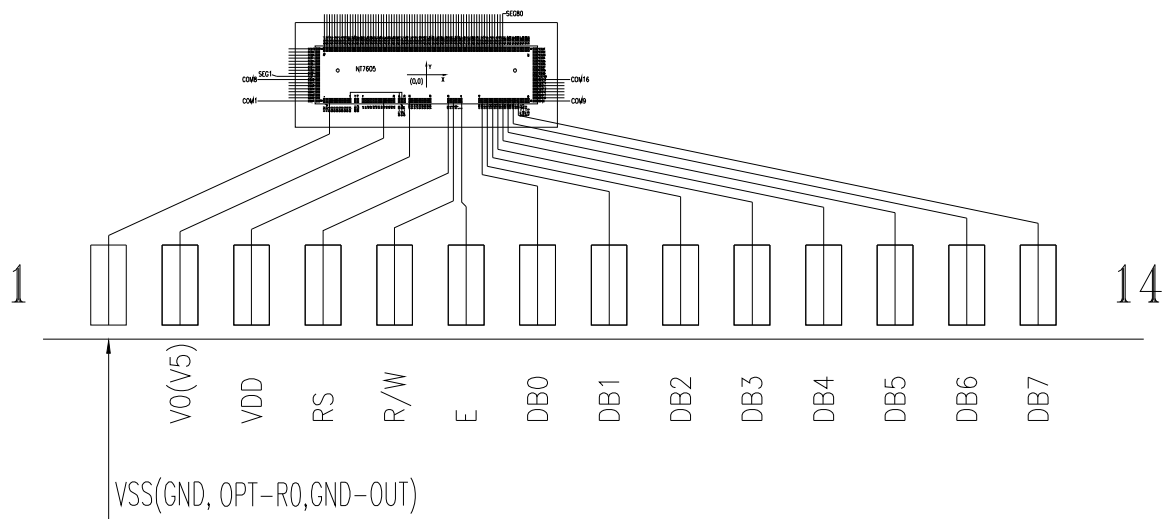
PIN Interface(LCD)

PIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14
NAME	VSS	VO(V5)	VDD	RS	R/W	E	DB0	DB1	DB2	DB3	DB4	DB5	DB6	DB7

### 12. SEG LAYOUT & COM LAYOUT



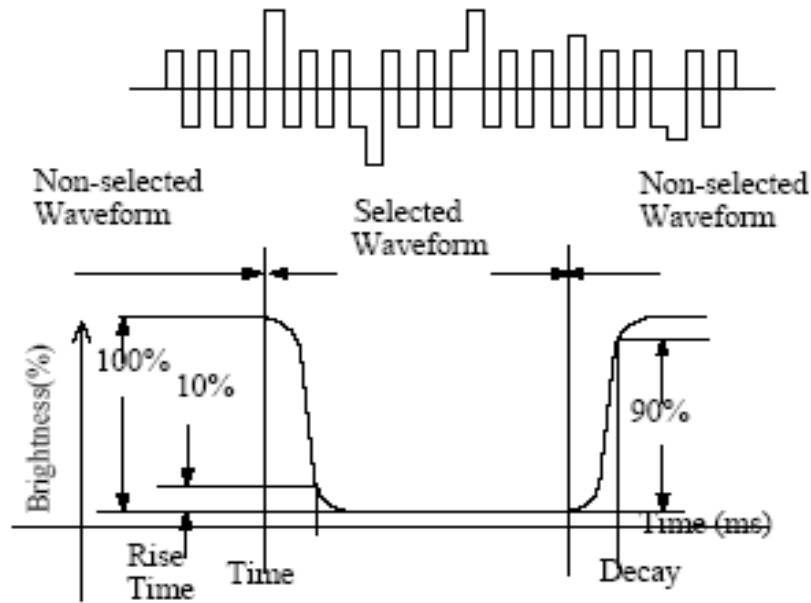
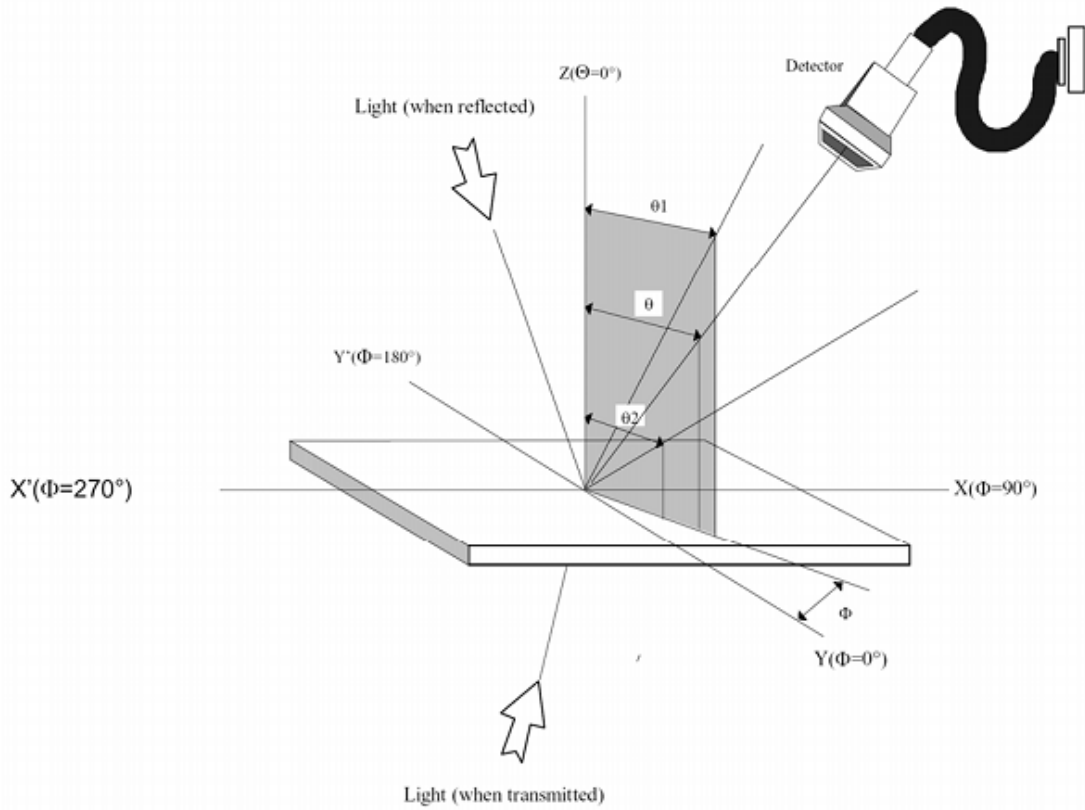
13. IC LAYOUT



14. ELECTRO-OPTICAL DEFINITION

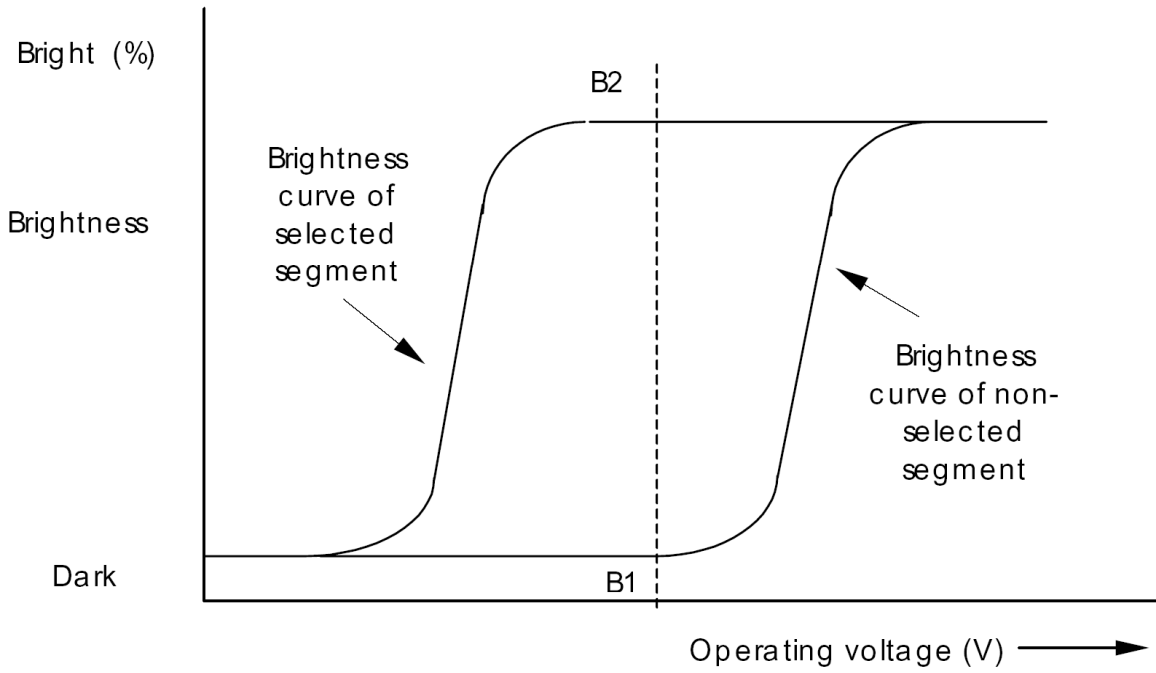
Optical Characteristics

Item	Symbol	Description	Condition	Min	Typ	Max	Unit
Operating Voltage of LCD	V <sub>LCD</sub>	---	Ta=-20°C	4.7	5.0	5.3	V
		---	Ta=25°C	4.2	4.5	4.8	
		---	Ta=70°C	3.7	4.0	4.3	
Response Time	Tr	Rise	25°C	---	100	160	ms
	Tf	Fall	25°C	---	150	200	ms
Contrast	Cr		VDD=5.0V±3%, 25°C	---	6	---	
Viewing Angle	θ	6 o'clock axis	Cr≥2.0 VDD=5.0V±3%, 25°C	---	50	---	
		12 o'clock axis	VDD=5.0V±3%, 25°C	---	40	---	
		3 o'clock axis	VDD=5.0V±3%, 25°C	---	40	---	
		9 o'clock axis	VDD=5.0V±3%, 25°C	---	40	---	



Definition of contrast

$$Cr. = \frac{B1}{B2} = \frac{\text{Brightness of not selected segment}}{\text{Brightness of selected segment}}$$



## 15. 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 x 96hrs
Low Temperature Storage	-30°C x 4hrs
High Temperature Operation	+70°C x 96hrs
Low Temperature Operation	-20°C x 4hrs
High Temperature, High Humidity (Storage)	+60°C x 95% RH x 96hrs
Thermal Shock	<p style="text-align: center;">           -20°C x 30min. ←            10s ↓      5Cycles            +70°C x 30min. —         </p>
Vibration Test	Frequency x Swing x Time 40Hz x 4mm x 4hrs
Drop Test	Drop height x Times 1.0m x 6times

## 16. MODULE ACCEPT QUALITY LEVEL (AQL)

Inspection Standard: ANSI Z-1.4 Table Normal Inspection Single Sampling Level II.

## 17. LCD MODULES HANDLING PRECAUTIONS

- n The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
- n 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.
- n Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- n The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarize carefully.
- n 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.

### n 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.



**18. OTHERS**

- n** 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.
  
- n** 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.
  
- n** 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