

**DISPLAY Elektronik GmbH.**

# DATA SHEET

**LCD MODULE**

**DEM 16209 FGH**

*Product Specification*

*Version: 1*

**12.06.2020**

# GENERAL SPECIFICATION

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## MODULE NO. : DEM 16209 FGH

CUSTOMER P/N

| VERSION NO. | CHANGE DESCRIPTION   | DATE       |
|-------------|--|------------|
| 0           | ORIGINAL VERSION   | 08.06.2020 |
| 1           | Change the LCD to FSTN reflective on page 2;<br>Update the module drawing on page 3;<br>Add the supply current on page 5;<br>Cancel definition of contrast(negative) on page 12. | 12.06.2020 |
|             |  |            |
|             |  |            |
|             |  |            |
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|             |  |            |
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|             |  |            |
|             |  |            |

PREPARED BY: XJ

DATE: 12.06.2020

APPROVED BY: MHI

DATE: 12.06.2020



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**1. FUNCTIONS & FEATURES****I LCD TYPE:**

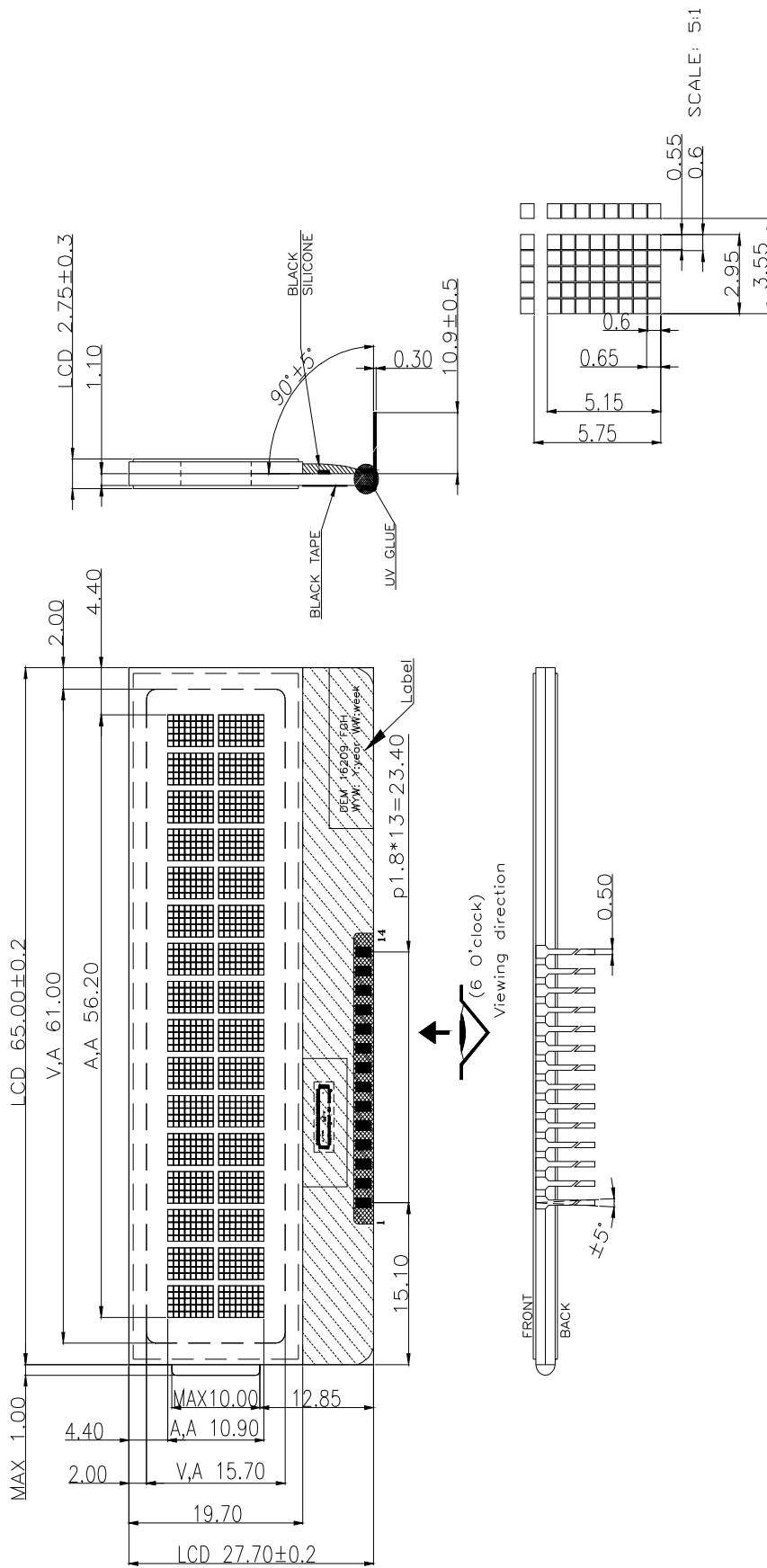
| MODULE        | LCD TYPE                 | REMARK |
|---------------|--------------------------|--------|
| DEM 16209 FGH | FSTN reflective Positive |        |

- 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

**2. MECHANICAL SPECIFICATIONS**

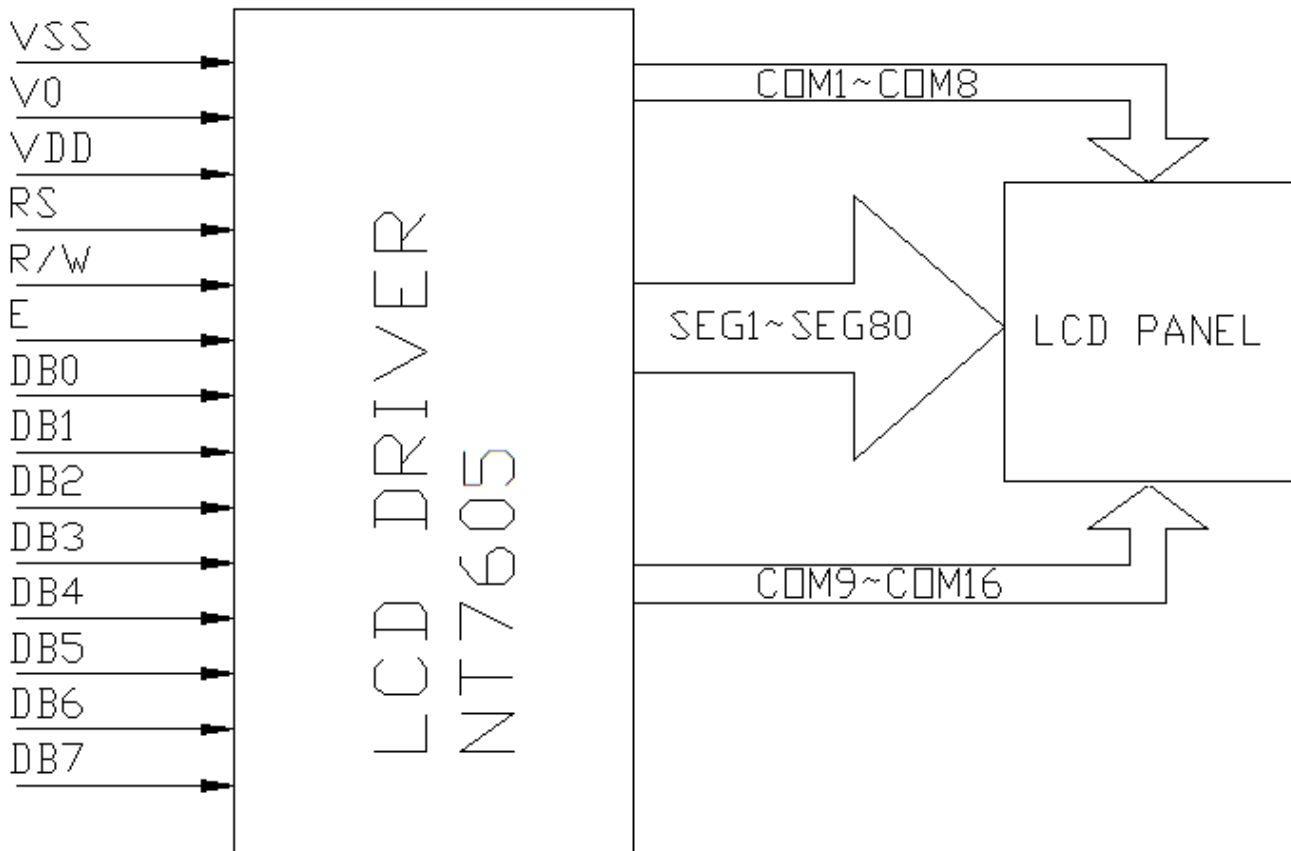
- I Module Size** : 65.00 x 27.70 x2.75mm
- I Viewing Area** : 61.00 x 15.70 mm
- I Active Area** : 56.20 x 10.90 mm
- I Character Pitch** : 3.55 x 5.75 mm
- I Character Size** : 2.95 x 5.15 mm
- I Dot Pitch** : 0.60 x 0.65 mm
- I Dot Size** : 0.55 x 0.60 mm

3. EXTERNAL DIMENSIONS



- Remarks:
1. Unmarked tolerance is  $\pm 0.3$
  2. All materials comply with RoHs
  3.  ...:critical dimension.

**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<br>0: instruction register (write), Busy flag, address counter (read)<br>1: Data register (write, read) |
| 5       | R/W     | Read/Write control signal<br>0:Write 1:Read  |
| 6       | E       | Read/Write start signal  |
| 7~14    | DB0~DB7 | Data Bus Lines   |

### 6. MAXIMUM ABSOLUTE LIMIT

| Characteristic              | Symbol   | Value                | Unit |
|-----------------------------|----------|----------------------|------|
| Power Supply Voltage        | $V_{DD}$ | -0.3 to +7.0         | V    |
| Power Supply Voltage        | $V_0$    | 0 to $V_{DD}+0.3$    | V    |
| Input Voltage               | $V_{in}$ | -0.3 to $V_{DD}+0.3$ | V    |
| Operating Temperature Range | TOPR     | -20 to +70           | °C   |
| Storage Temperature Range   | TSTR     | -30 to +80           | °C   |

### 7. ELECTRICAL CHARACTERISTICS

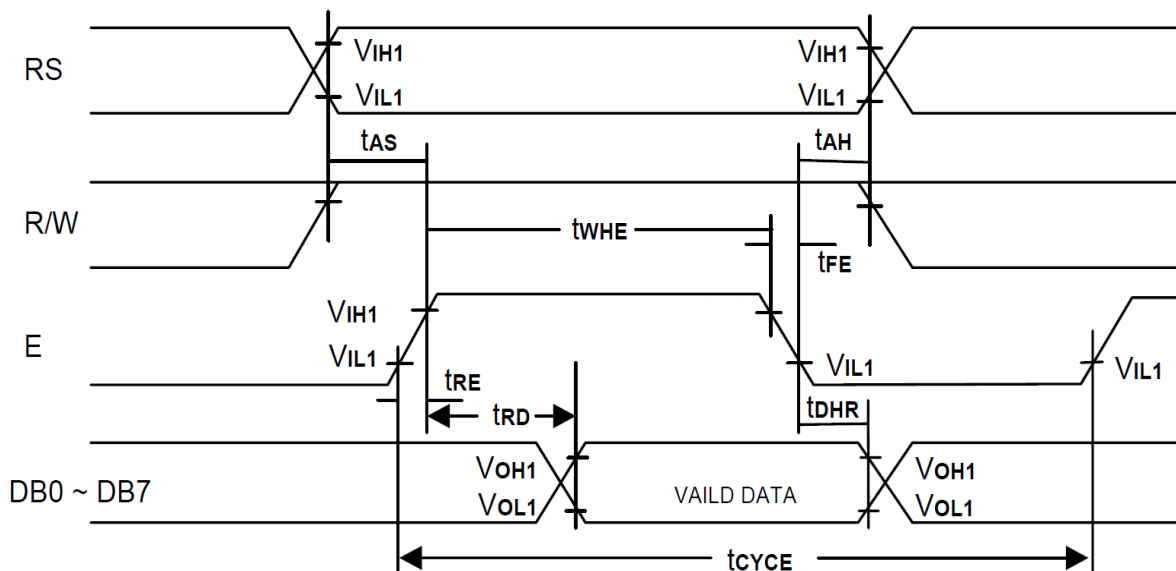
#### 7-1.DC Characteristics

| 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    | ----           | 1.16 | 1.74 | mA   |

#### 7-2. AC Characteristics

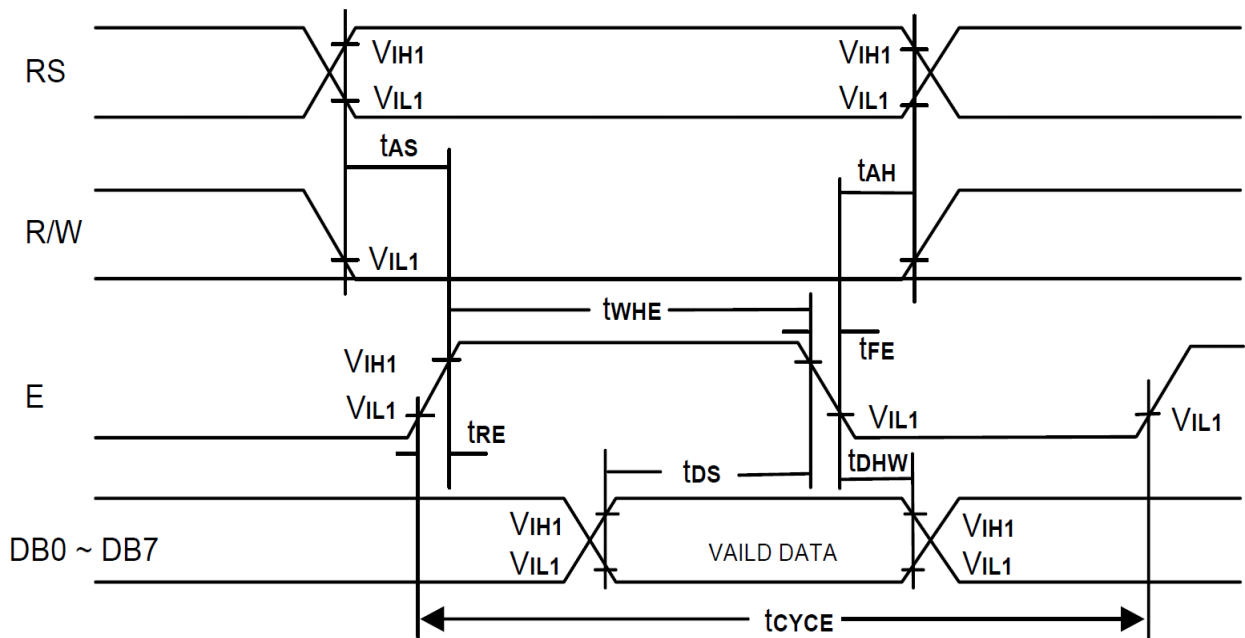
##### 7-2-1 Read Cycle

| 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   |
| tRD      | Read Data Output Delay       | -                | -    | 190  | ns   |
| tDHR     | Read Data Hold Time          | 20               | -    | -    | ns   |



7-2-2. Write 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>DS</sub>                   | Data Output Delay            | 100              | -    | -    | ns   |
| t <sub>DHW</sub>                  | Data Hold Time               | 10               | -    | -    | ns   |





8. INSTRUCTION DESCRIPTION

| Instruction                     | Code   |    |            |     |     |   |     |                                  |  |  | Function   | Execution time (max)<br>(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).                                   | 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<br>S = 1 : Display Shift On<br>D = 1 : Display On<br>C = 1 : Cursor Display On<br>B = 1 : Cursor Blink On<br>S/C = 1 : Shift Display<br>R/L = 1 : Shift Right<br>DL = 1 : 8-Bit<br>N = 1 : Dual Line<br>F = 1 : 5x10 dots<br>BF = 1 : Internal Operation<br>BF = 0 : Ready for Instruction |    |            |     |     | I/D = 0 : Decrement<br>S/C = 0 : Move Cursor<br>R/L = 0 : Shift Left<br>DL = 0 : 4-Bit<br>N = 0 : Signal Line<br>F = 0 : 5 X 8 dots |     |                                  |  |  | DD RAM : Display Data RAM<br>CG RAM : Character Generator RAM<br>ACG : Character Generator RAM Address<br>ADD : Display Data RAM Address<br>AC : Address Counter |   |

Note 1: Symbol "\*" signifies an insignificant bit (disregard).

Note 2: Correct input value for "N" is predetermined for each model.

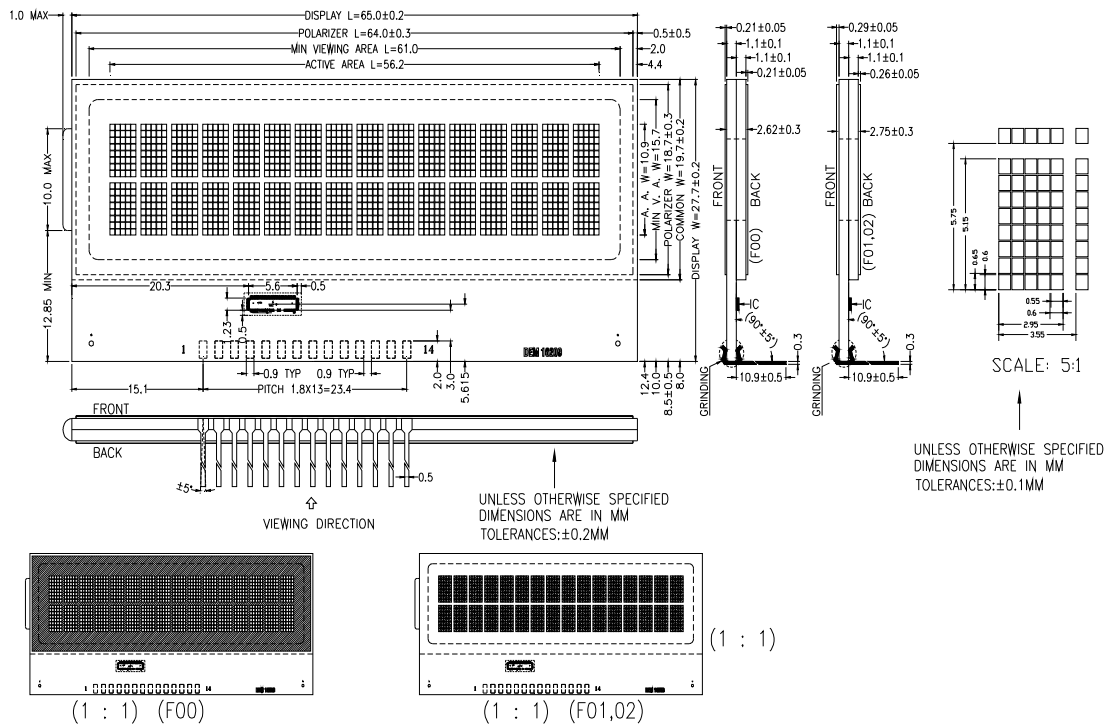
Note 3: The variation of execution time depends on the change of oscillator frequency; for example:

if fOSC = 380KHz, then execution time = 40 µs × (540KHz / 380KHz) = 57 µs

9. 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)  |   | ! | ! | ! | ! | ! | ! |   |   |   |   |   |   |   |   |
|  | 2 | CG RAM (3)  |   | " | " | " | " | " | " |   |   |   |   |   |   |   |   |
|  | 3 | CG RAM (4)  |   | # | # | # | # | # | # |   |   |   |   |   |   |   |   |
|  | 4 | CG RAM (5)  |   | * | * | * | * | * | * |   |   |   |   |   |   |   |   |
|  | 5 | CG RAM (6)  |   | % | % | % | % | % | % |   |   |   |   |   |   |   |   |
|  | 6 | CG RAM (7)  |   | @ | @ | @ | @ | @ | @ |   |   |   |   |   |   |   |   |
|  | 7 | CG RAM (8)  |   | ^ | ^ | ^ | ^ | ^ | ^ |   |   |   |   |   |   |   |   |
|  | 8 | CG RAM (1)  |   | € | € | € | € | € | € |   |   |   |   |   |   |   |   |
|  | 9 | CG RAM (2)  |   | § | § | § | § | § | § |   |   |   |   |   |   |   |   |
|  | A | CG RAM (3)  |   | * | * | * | * | * | * |   |   |   |   |   |   |   |   |
|  | B | CG RAM (4)  |   | + | + | + | + | + | + |   |   |   |   |   |   |   |   |
|  | C | CG RAM (5)  |   | , | , | , | , | , | , |   |   |   |   |   |   |   |   |
|  | D | CG RAM (6)  |   | - | - | - | - | - | - |   |   |   |   |   |   |   |   |
|  | E | CG RAM (7)  |   | . | . | . | . | . | . |   |   |   |   |   |   |   |   |
|  | F | CG RAM (8)  |   | / | / | / | / | / | / |   |   |   |   |   |   |   |   |

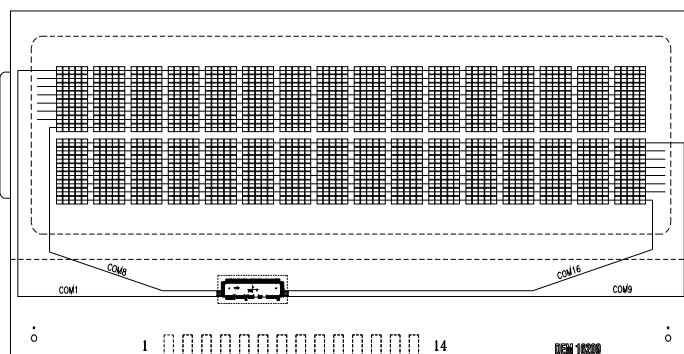
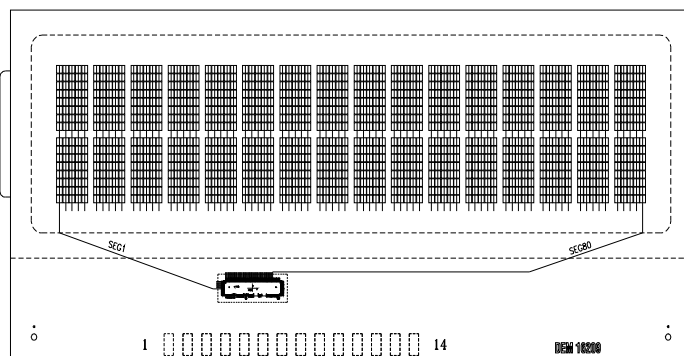
### 10. LCD ARTWORK



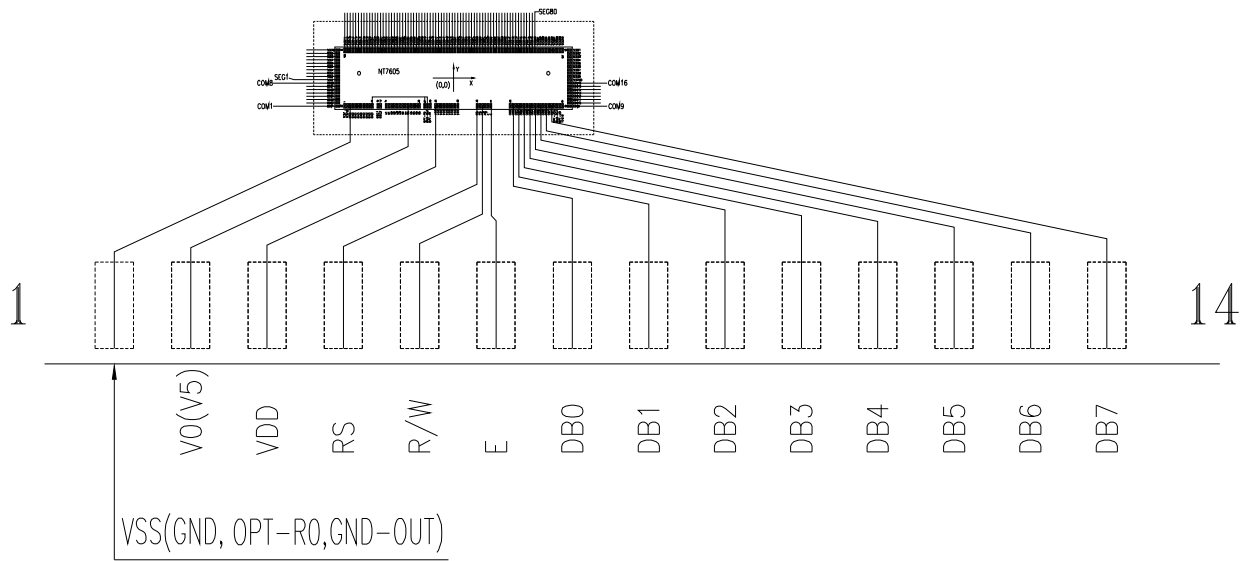
PIN Interface(LCD)

| 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 |

### 11. SEG LAYOUT & COM LAYOUT



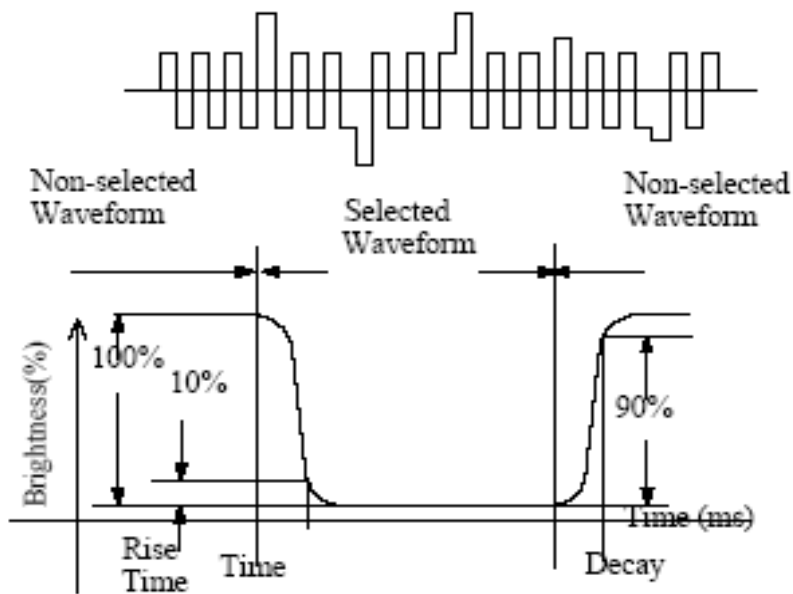
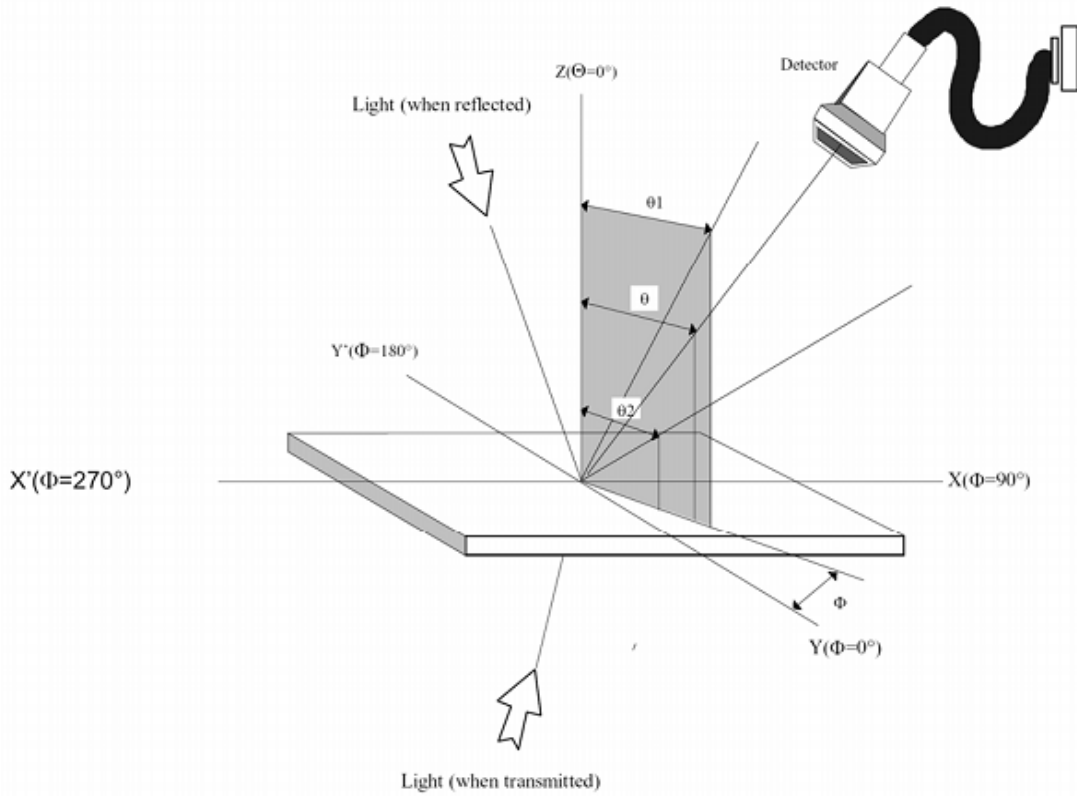
12. IC LAYOUT



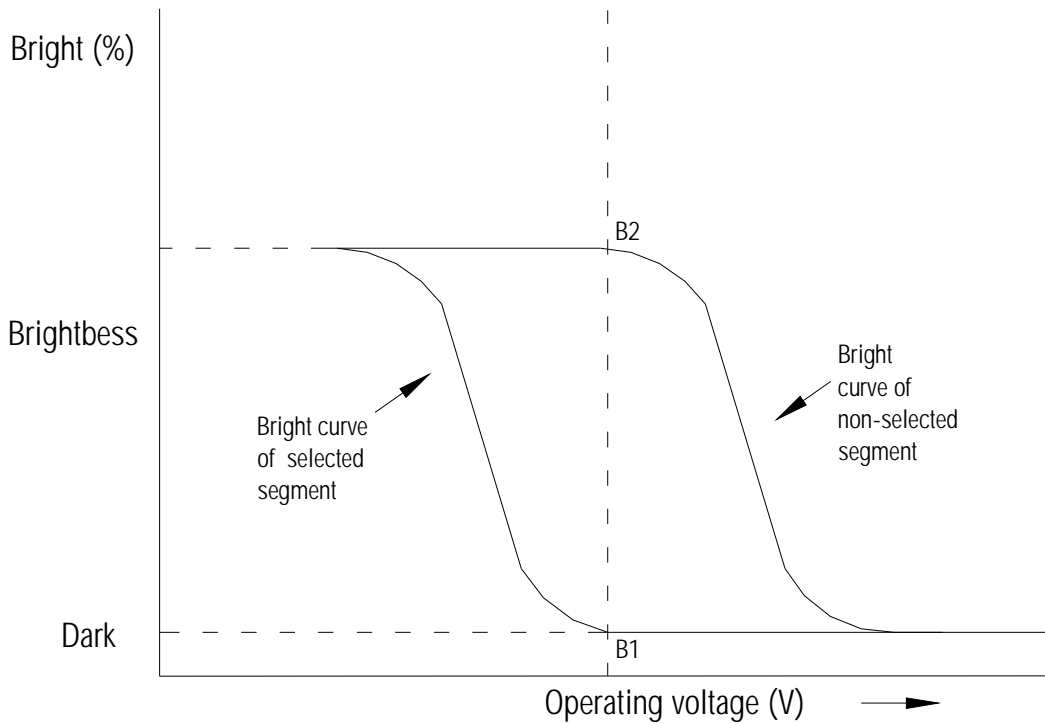
13. ELECTRO-OPTICAL DEFINITION

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           | --- | 4   | --- |      |
| Viewing Angle            | θ                | 6 o'clock axis  | Cr≥2.0<br>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  $Cr. = \frac{B2}{B1} = \frac{\text{Bright curve of not selected segment}}{\text{Bright curve of selected segment}}$



Positive LCD Mode

**14. 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  |
| Low Temperature Storage                   | -30°C * 4hrs  |
| High Temperature Operation                | +70°C *96hrs  |
| Low Temperature Operation                 | -20°C *4hrs   |
| High Temperature, High Humidity (Storage) | +60°C * 95%RH *96hrs                                |
| Thermal Shock                             | -20°C *30min. ←<br>10s ↓ 5Cycles<br>+70°C *30min. → |
| Vibration Test                            | Frequency *Swing * Time<br>40Hz * 4mm * 4hrs        |
| Drop Test                                 | Drop height*Times<br>1.0m * 6times                  |

**15. MODULE ACCEPT QUALITY LEVEL (AQL)**

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

## 16. 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.

## 17. 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