Ocular Inc.
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LCD Character Module Specification

Model: OM16213

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Revision History

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Approved By:

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1 Construction and Outline

Construction: 5 × 8 dots, 16 character 2-lines dot-matrix display unit
Outline: See Mechanical Drawing (Unit Outline Dimension).
Interface signals: See Table 5.
Character pattern details: See Mechanical Drawing.
Font Table : See Table 8.

2 Module Specifications

Table 1

Parameter	Specification	Unit
Outline dimensions	47(W) × 20(H) × 8.0MAX (D)	mm
Effective display area	36.0 (W) × 10.0 (H)	mm
Display format	16 characters × 2 lines	–
Character format	5 × 8 dots	–
Character Size	1.85 (W) × 3.15 (H) (5 × 8 dots)	–
Image Area	34.1 (W) x 7.4 (H)	mm
Dot Size	0.33 (W) × 0.35 (H)	mm
Dot Spacing	0.05	mm
Display Type	Refer to Section 8	–
Display Mode	Refer to Section 8	–
Viewing angle	Refer to Section 8	–
Back light Color	Refer to Section 8	–
Character color	Refer to Section 8	–
Driver Configuration	S6A0069/NT3881DH-01 or compatible	–
Weight	Approx. 50	g

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3 Electrical Specifications and Electrical Configuration

3.1 Absolute maximum ratings

Table 2

Parameter	Symbol	Min.	Max.	Unit	Remark
Power Supply Voltage	V_{DD} - V_{SS}	0	7	V	
Input Voltage	V_{LC}	V_{DD}-7.0	V_{DD}	V	
	V_{IN}	V_{SS}	V_{DD}	V	
Operating Temperature	T_{opr}	0	50	°C	
Storage Temperature	T_{stg}	-20	60	°C	
Supply Current (Backlight LED)	I_{LED}	–	60	mA	Ta = 25°C
Voltage LED Back light	$V_{LED—}$- V_{LED+}	–	5	V	DC

3.2 Electrical characteristics

Table 3 (T_a = 25 °C)

Parameter		Symbol	Min.	Typ.	Max.	Unit	Condition
Supply Voltage (Logic)		V_{DD}-V_{SS}	4.75	5	5.25	V	
Contrast Voltage	Stnd. Ext.	V_{DD}-V_0 V_{DD}-V_0	- -	4.7 5.0	- -	V V	
Input Voltage	Low	V_{IL1}	-0.3	–	0.6	V	
	High	V_{IH1}	2.2	–	V_{DD}	V	
Output Voltage	Low	V_{OL1}	–	–	0.4	V	I_{OL}= 1.2 mA
	High	V_{OH1}	2.4	–	–	V	-I_{OH} =0.205mA
Input Leakage Current		I_{IL1}	–	–	1	µA	
Internal Oscillating Frequency		f_{OSC}		250		kHz	
Supply Current		I_{DD}		1.8	2.5	mA	V_{DD}=5V, V_0=0V
		I_{LED}		-	40	mA	V_{LED+}-V_{LED-} =4.2V
Supply Voltage (Backlight LED)		V_{LED+}-$V_{LED–}$		4.2	4.5	V	

3.3 Timing Characteristics

Table 4

V_{DD} = 5.0V ± 5% , Ta = 0 ~ 50 °C

Parameter	Symbol	Min.	Typ.	Max.	Unit
Enable Cycle Time	t_{cycE}	500	—	—	ns
Enable Pulse Width	PW_{EH}	220	—	—	ns
Enable rise / fall time	t_{Er} , t_{Ef}	—	—	25	ns
RS , R/W Setup Time	t_{AS}	40	—	—	ns
Address Hold Time	t_{AH}	10	—	—	ns
Data Setup Time	t_{DSW}	60	—	—	ns
Data Delay Time	t_{DDR}	—	—	120	ns
Data Hold Time (Write)	t_H	10	—		ns
Data Hold Time (Read)	t_{DHR}	20	—	—	ns

Timing Chart : See Fig. 3.1

3.4 Interface Signals

Table 5

Pin No.	Symbol	Description	Connection
1	V_{SS}	Ground Potential	V_{SS} : 0 V
2	V_{DD}	Power Supply	+ 5V
3	V_0	Contrast Adjustment Voltage	Adjust the contrast by changing the supply voltage from -2V to 2V.
4	RS	Register Select Signal	Control Signal Inputs (For Details, See Section 5 and 6). **RS:** H: Data Input; L: Instruction Input; **R/W:** H: Read; L: Write
5	R/W	Read/Write Select Signal	
6	E	Operation (data Read/write enable signal)	
7	DB_0	Code I/O Data LSB	Data Bus Line DB_7 may also be used to check the busy flag. Lines DB_0 ~ DB_3 are not used when interfacing with a 4-bit microprocessor. (For Details, see section 6 and 7.)
8	DB_1	Code I/O Data 2nd Bit	
9	DB_2	Code I/O Data 3rd Bit	
10	DB_3	Code I/O Data 4th Bit	
11	DB_4	Code I/O Data 5th Bit	
12	DB_5	Code I/O Data 6th Bit	
13	DB_6	Code I/O Data 7th Bit	
14	DB_7	Code I/O Data MSB	
15	V_{LED+}	LED Power Supply (+)	Power supply between V_{LED+} and V_{LED-}
16	V_{LED-}	LED Power Supply (–)	

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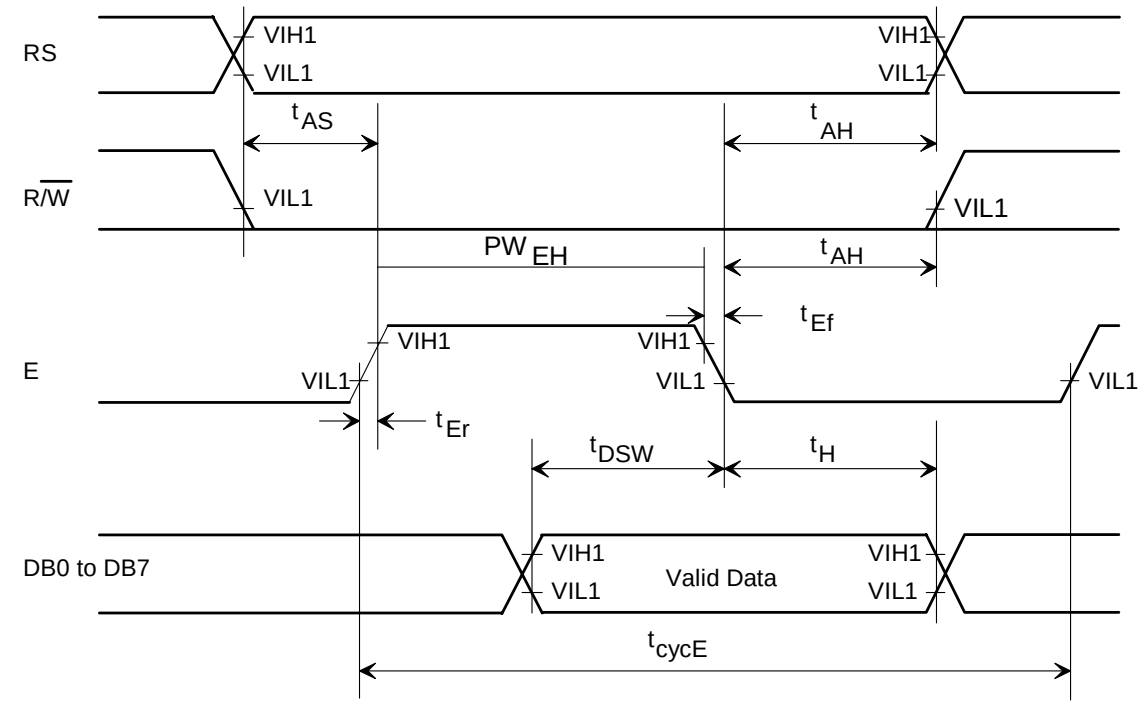
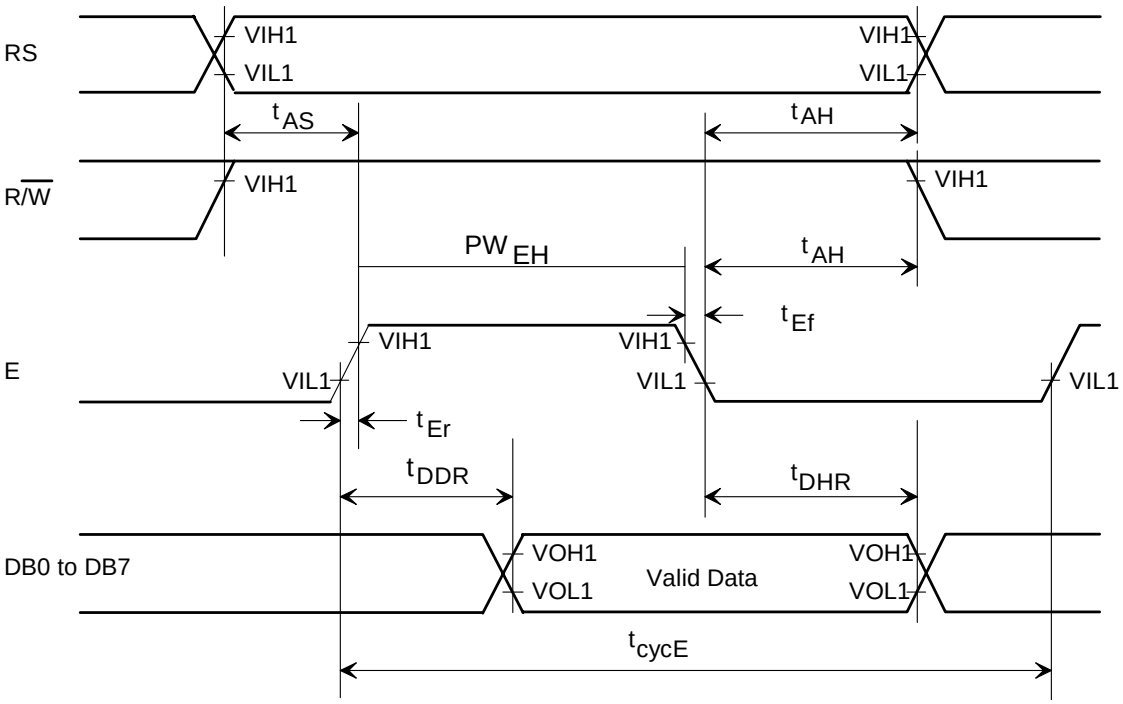


Write Operations



Read Operations

Fig. 3.1

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4 Optical Characteristics

4.1 When Backlight LED is OFF state

Note: Data is typical for "-GSS" module configuration.

Table 6

Parameter		Symbol	Condition		Min.	Typ.	Max.	Unit	Remark
Viewing Angle Range		$\theta_2 - \theta_1$	$\phi = 0°$	$C_O \geq 2.0$	60	—	—	º	Note 1.
		θ_1	$\theta_1 < \theta_2$	$C_O = 2.0$	—	—	-25	º	Note 1.
		θ_2			25	—	—	º	Note 1.
		$\theta_2 - \theta_1$	$\phi = 45°$	$C_O \geq 2.0$	60	—	—	º	Note 1.
		θ_1	315°	$C_O = 2.0$	—	—	-25	º	Note 1.
		θ_2	$\theta_1 < \theta_2$		25	—	—	º	Note 1.
Contrast ratio		C_O	$\theta = 15°$		5	8	—		Note 2.
Response Time	Rise	t_r	$\theta = 15°$		—	150	300	ms	Note 3.
	Decay	t_d	$\theta = 15°$		—	200	400	ms	Note 3.

Note 1) The viewing angle range is defined as shown below:

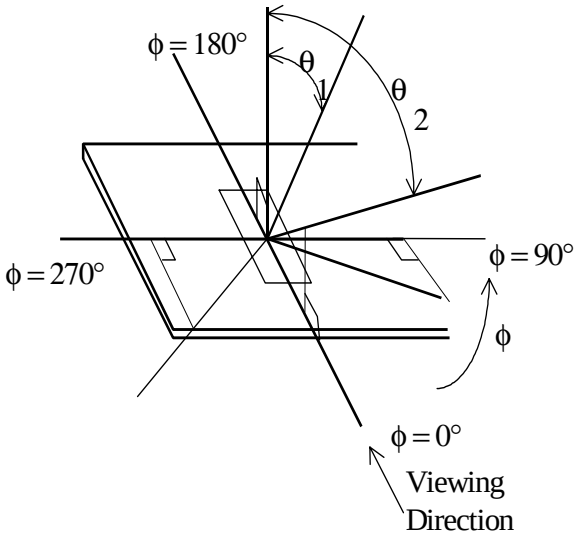

Fig. 4.1.1: Definition of viewing angle

*Angles θ_1, θ_2 and ϕ shall fall within the range over which the displayed character can be read.

Note 2) Contrast ratio is defined as follows:
When input signal is applied to the unit to select (turn on), the LCD dots (pixels) to be measured in the optical characteristics test method as defined in Fig. 3:

$$\text{Contrast ratio} = \frac{\text{Photodetector output voltage with non-select waveform being applied}}{\text{Photodetector output voltage with select waveform being applied}}$$

Note 3) When input signal for selecting or non-selecting the dots to be measured are applied using the optical characteristics test method shown in Fig. 3. The response characteristics of the photo-detector output are measured as shown in Fig. 4.

Note 4) This optical data is specified on condition that the LCD temperature is 25°C. When designing, be sure to check the rating of V_0 in table 3.

Note 5) The response characteristics of photo-detector output are measured as shown in Fig. 4, assuming that input signals are applied so as to select and deselect the dots to be measured, in the optical characteristics test method shown in Fig. 3.

Note 6) Table 6 shows the optical characteristics detected when the LCD applied voltage waveforms are in the highest frequency *.
* The most critical condition for the characteristics of LCD.

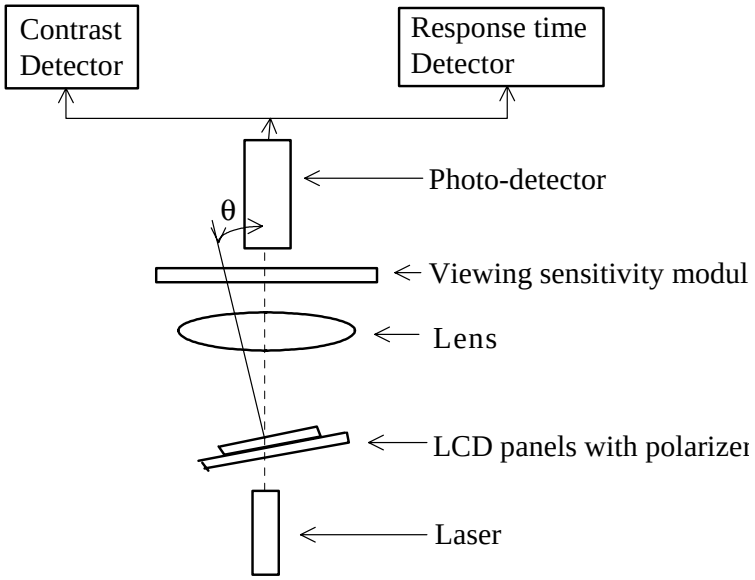

Fig. 4.1.2 Optical Characteristics Test Method

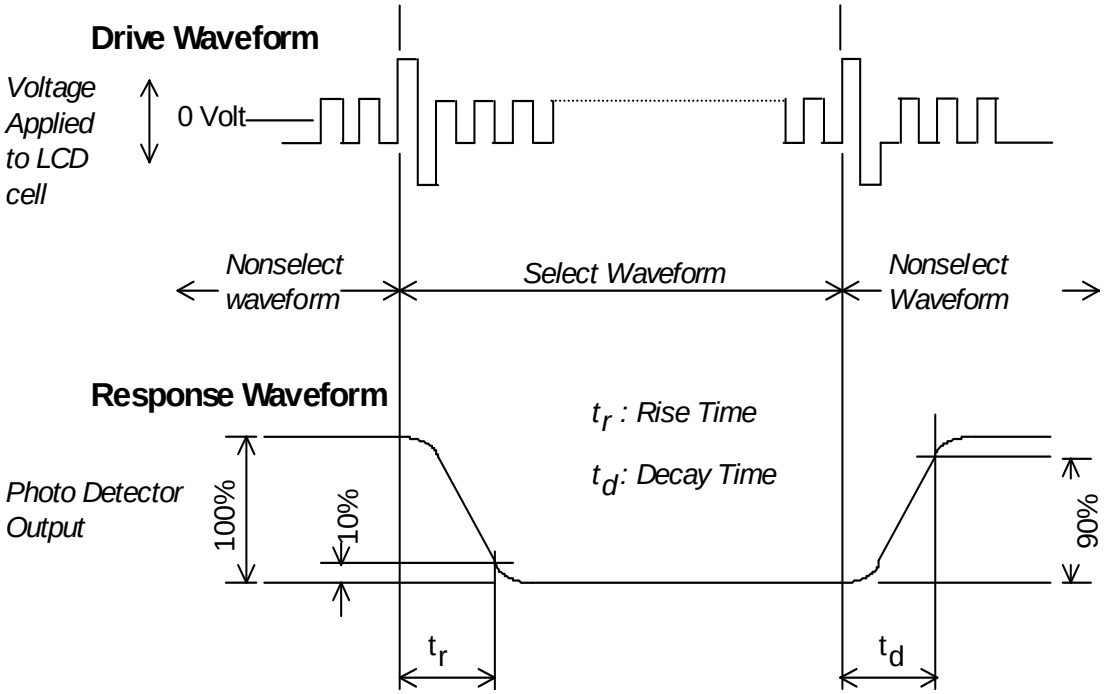

Figure 4.1.3: Definition of Response Time

4.2 Characteristics of Typical Yellow Green Array LED Backlight

(When LCD is OFF state)

Table 7

T_a = 25°C, V_{LED+} - $V_{LED—}$ = 4.2V

Parameter	Min.	Typ.	Max.	Unit	Remark
Luminance *	10	27	—	cd/m^2	
Peak emission wavelength	—	565	—	nm	
Spectrum radiation bandwidth	—	30	—	nm	

* Note : Center of the unit with array type LED backlight lit.

5 Pin Description

1) V_{DD} and V_{SS} Pins
   V_{DD} and V_{SS} pins are for power supply. V_{SS} pin is grounded, and V_{DD} pin is supplied with +5V. Each bias voltage necessary to drive LCD is generated in the unit.
2) RS Pin
   The controller LSI has two 8-bit registers; an instruction register (IR) and a data register (DR). RS signal selects these registers.
   IR stores instruction codes such as display clear, shift, etc., and also stores address information for the display data RAM (DD RAM), character generator RAM (CG RAM); DR is used for temporarily storing data to be written into DD RAM and CG RAM.
   " L " : Instruction register (when writing)
   Busy flag register; address counter (when reading).
   " H " : Data register (read / write).
3) R/W Pin
   Read or write select signal pin.
   " L " : Writing
   " H " : Reading
4) E Pin
   Data read or write operation enable signal pin.
5) DB_0 ~ DB_7 Pins
   Data bus with three-state, bidirectional function for use in data transactions with MPU. DB_7 may also be used to check the busy flag. DB_0 ~ DB_3 are not used when interfacing with a 4-bit microprocessor.
6) V_5 Pin
   Viewing angle is varied and contrast is adjusted by changing voltage between -2V~ +2V.
7) V_{LED+} and $V_{LED—}$
   Power supply for LED backlight. (By changing the supply voltage, backlight luminance can be adjusted.).

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6 Instruction Set

Table 8

Instruction	Code										Function	Exec Time
	RS	R/W	DB_7	DB_6	DB_5	DB_4	DB_3	DB_2	DB_1	DB_0		
Display Clear	0	0	0	0	0	0	0	0	0	1	Clear entire display area, restore display from shift, and load address counter 00_H.	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 00_H.	1.64ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Specify cursor advance direction and display shift mode. This operation takes place after each data transfer	40 us
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 us
Display/ Cursor Shift	0	0	0	0	0	1	S/C	R/L	*	*	Shift display or move cursor.	40 us
Function Set	0	0	0	0	1	DL	1	0	*	*	Set interface data length (DL).	40 us
CG RAM Address Set	0	0	0	1	A_{CG}						Load the address counter with a CG RAM address. Subsequent data is CG RAM data.	40 us
DDRAM Address Set	0	0	1	A_{DD}							Load the address counter with a DD RAM address. Subsequent data is DD RAM data.	40 us
BusyFlag/ Address Counter Read	0	1	BF	AC							Read Busy Flag (BF) and contents of address counter (AC).	40 us
CG/DD RAM Data Write	1	0	Write Data								Write data to CG RAM or DD RAM.	40 us
CG/DD RAM Data Read	1	1	Read Data								Read data from CG RAM or DD RAM.	40 us

I/D = 1: Increment; I/D = 0: Decrement; S/C = 1: Shift Display; S/C = 0: Move Cursor;
S = 1: Shift Display; S = 0: Freeze Display; R/L = 1: Shift right; R/L = 0: Shift Left;
D = 1: Display ON; D = 0: Display Off; DL = 1: 8 bit; DL = 0: 4-bit
C = 1: Cursor ON C = 0: Cursor Off; BF = 1: During Internal Operation BF = 0: End of Internal Operation;

B = 1:Character at cursor position blinks B = 0:Character at cursor position unblinks

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7 Font Table

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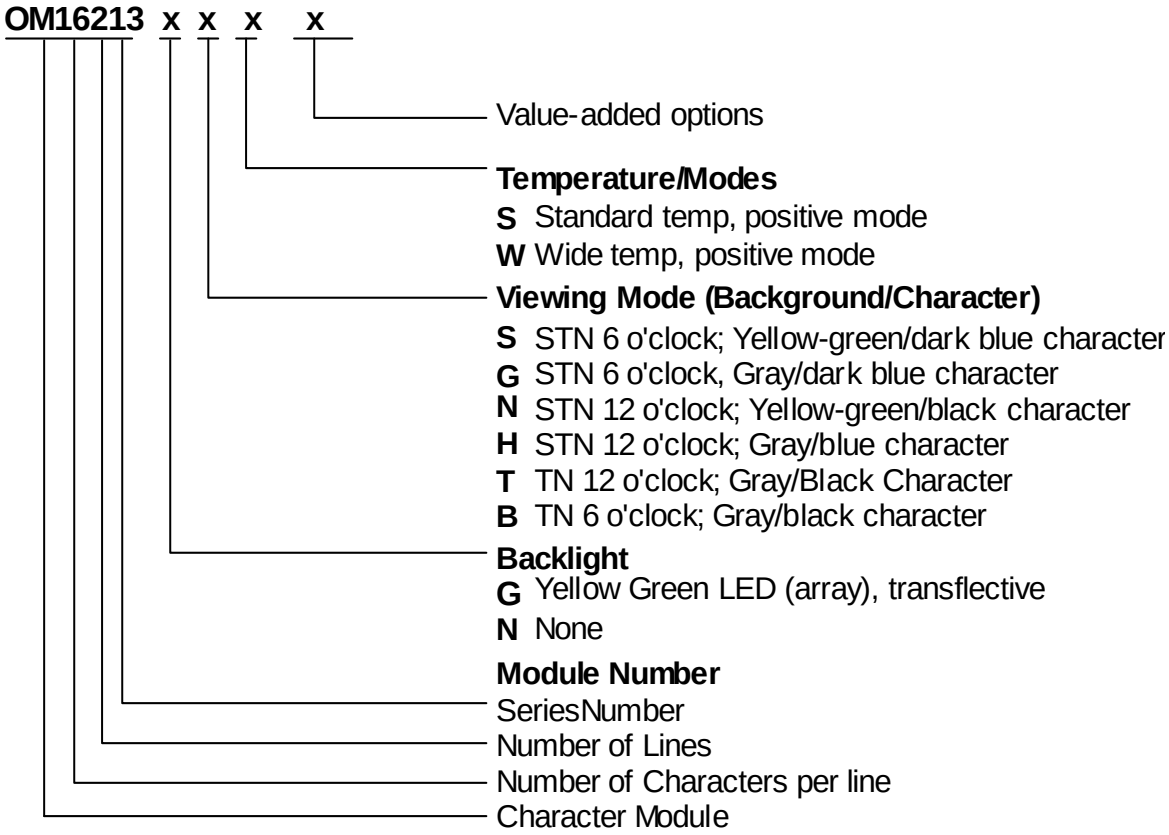
8 Explanation of Part Numbering System



Note: Not all possible configurations are possible or available for all models. If a specific configuration is required but is not listed as a current configuration, contact Ocular directly for availability.

9 Precautions Relating to Product Handling

The following precautions will guide you in handling our product correctly.

1) Liquid crystal display devices
    1. The liquid crystal display device panel used in the liquid crystal display module is made of glass. Avoid any strong mechanical shock. If the glass should break, handle it with care.
    2. The polarizer on the surface of the LCD is relatively soft. Care must be taken to prevent scratches.
2) Protection of liquid crystal display module against static electricity discharge
    1. When working with the module, be sure to ground your body and any electrical equipment you may be using. We strongly recommend using anti-static mats, to protect worktables against the hazards of electrical shock.
    2. We recommend wearing a ESP grounding strap when handling the module.
    3. Slowly and carefully remove the protective film from the LCD module, since this can generate static electricity.

3) When the LCD modules must be stored for long periods of time
    1. Protect the modules from high temperatures and humidity.
    2. Keep the modules away from direct sunlight or direct exposure to ultraviolet rays.

4) Use the module with a power supply that is equipped with over current protection since the module does not employ current limiting protection circuitry.

5) Do not ingest the LCD fluid if it should leak out of a damaged LCD module. If hands or clothing come in contact with the LCD fluid, wash immediately with soap and water.

6) Conductivity is not guaranteed for models that use metal holders where solder connections between the metal holder and the PCB are not used. Please contact us to discuss appropriate ways to assure conductivity.

7) For models which use CCFL backlighting:
    1. CCFL backlights operate at voltage levels greater than 200 volts. Precautions must be taken to avoid electrical shock.
    2. Using CCFL backlighting for extended periods of time at low temperatures will significantly shorten their service life.

8) For models which used touch panels:
    1. Do not stack modules because they can be damaged by components on neighboring modules.
    2. Do not place heavy objects on top of the product because this can cause the glass to break.

9) Models which use flexible cable, heat seal or TAB:
    1. In order to maintain reliability, do not touch or hold by the connector area.
    2. Avoid bending, pulling, or any other excessive forces, which can result in broken connectors.

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10 Mechanical Drawing