



SPEC. NO	QE-개발-01-9131
ISSUED DATE	99. 11. 30

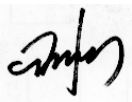
CUSTOMER :
M O D E L : OCM-16216D-5-A2026
DESCRIPTION : LCD MODULE

THIS SPECIFICATION IS APPLIED FOR LCD MODULE
DELIVERED TO YOUR COMPANY BY ORION DISPLAY
TECHNOLOGY CO., LTD

◆ CUSTOMER APPROVAL

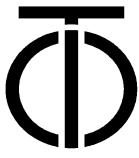
	CHECKED	CHECKED	APPROVAL
APPROVAL			
REMARK			

◆ SUPPLIER APPROVAL

PREPARED	CHECKED		APPROVAL
			CW RYU

ADDRESS : ORION DISPLAY TECHNOLOGY CO., LTD
1631-1, SEOCHO-DONG, SEOCHO-KU, SEOUL, KOREA
(TEL) 82-2-598-0350 (FAX) 82-2-598-0360

 ORION DISPLAY TECHNOLOGY CO.,LTD.

	제 품 시 방 서		Document No.	QE-개발-01-9131
	LCD MODULE SPECIFICATION		Rev. No.	0
	OCM-16216D-5-A2026		Page No	1 OF 17

1. 내용

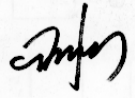
- 1) 제품규격 : 첨부 규격에 따른다.
- 2) 검사규격 : 출하검사규격에 따른다.
- 3) 포장규격 : 제품포장규격에 따른다.

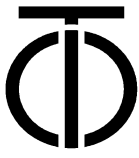
2. 작성, 검토 및 승인

☐ 관 리 분 : _____ ☐ 접수부서 :

☐ 비관리분 : _____ ☐ 접 수 자 :

☐ 본 품질지침서(EI)는 다음 책임자에 의해 작성(개정), 검토 및 승인이 되어야 효력이 있다.

구 분	작성부서		합의부서		합의부서	
	서명	일자	서명	일자	서명	일자
작성(개정)		99. 11. 30				
검 토		99. 11. 30				
검 토		99. 11. 30				
승 인	CW RYU	99. 11. 30				

	제 품 시 방 서	Document No.	QE-개발-01-9131
	LCD MODULE SPECIFICATION	Rev. No.	0
	OCM-16216D-5-A2026	Page No	3 OF 17

CONTENTS

1. FEATURES ----- 4

2. MECHANICAL SPECIFICATION----- 4

3. ABSOLUTE MAXIMUM RATING ----- 5

4. ELECTRICAL CHARACTERISTICS ----- 5

5. ELECTRO-OPTICAL CHARACTERISTICS ----- 6

6. QUALITY STANDARD----- 7

7. RELIABILITY ----- 10

8. PIN CONNECTIONS----- 11

9. BLOCK DIAGRAM ----- 12

10. POWER SUPPLY ----- 12

11. TIMING DIAGRAM ----- 13

12. INSTRUCTION SET ----- 14

13. INITIALIZATION SEQUENCE ----- 14

14. DD RAM ADDRESS ----- 14

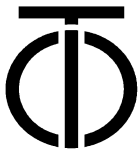
15. FONT TABLE ----- 15

16. PRECAUTION FOR USING -----16

17. EXTERNAL DIMENSION----- 17

NOTE: When using this specification, the reader should keep the followings in mind.

1. This specification may, wholly or partially, be subjected to change without notice.
2. Information contained herein is proprietary information of ORION DISPLAY TECHNOLOGY CO.,LTD. The dissemination use or duplication for any purpose other than for which the information is provided is prohibited by ORION DISPLAY TECHNOLOGY CO.,LTD except by express permission.

	제 품 시 방 서 LCD MODULE SPECIFICATION	Document No.	QE-개발-01-9131
	OCM-16216D-5-A2026	Rev. No.	0
		Page No	5 OF 17

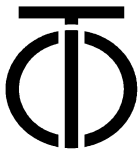
3. ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	CONDITION	STANDARD VALUE		UNIT
			MIN.	MAX.	
Power supply for logic	$V_{DD}-V_{SS}$	$T_a=25^{\circ}\text{C}$	0	7.0	V
Power supply for logic	$V_{DD}-V_{SSS}$	$T_a=25^{\circ}\text{C}$	0	7.0	V
Power supply for LCD	$V_{DD}-V_L$	$T_a=25^{\circ}\text{C}$	0	13.5	V
Input voltage	V_{IN}	$T_a=25^{\circ}\text{C}$	V_{SSS}	V_{DD}	V
Operating temperature	T_{OP}	-	0	50	$^{\circ}\text{C}$
Storage temperature	T_{STG}	-	-20	70	$^{\circ}\text{C}$
LED forward current	I_F	$T_a=25^{\circ}\text{C}$	-	120	mA
LED reverse voltage	V_R	$T_a=25^{\circ}\text{C}$	-	8.0	V
LED power consumption	P_D	$T_a=25^{\circ}\text{C}$	-	520	mW

4. ELECTRICAL CHARACTERISTICS

ITEM	SYMBOL	CONDITION	STANDARD VALUE			UNIT
			MIN.	TYP.	MAX.	
Power supply for logic	V_{DD}	$T_a = 25^{\circ}\text{C}$	2.2	-	V_{DD}	V
Input high voltage	V_{IH}	-	2.2	-	V_{DD}	V
Input low voltage	V_{IL}	-	V_{SS}	-	0.6	V
Output high voltage	V_{OH}	$I_{OH} = -0.205 \text{ mA}$	2.4	-	V_{DD}	V
Output low voltage	V_{OL}	$I_{OL} = 1.2 \text{ mA}$	V_{SS}	-	0.4	V
Power supply current	I_{DD}	$V_{DD}=5.0\text{V}, V_{LCD}=4.6\text{V}$	-	1.5	3.0	mA
Brightness	L	$V_{LED}=4.2\text{V}, I_F=75\text{mA}$	10	15	-	NIT
LED B/L forward voltage	V_F	$I_F=75\text{mA}, T_a = 25^{\circ}\text{C}$	-	4.2	-	V
Power supply for LCD (Note 1) = V_{LCD}	$V_{DD}-V_L$	$T_a = 0^{\circ}\text{C}$	-	-	-	V
		$T_a = 25^{\circ}\text{C}$	-	4.4	-	V
		$T_a = 50^{\circ}\text{C}$	-	-	-	V

Note 1 : Power supply for LCD is available with R_L in accordance with contrast.

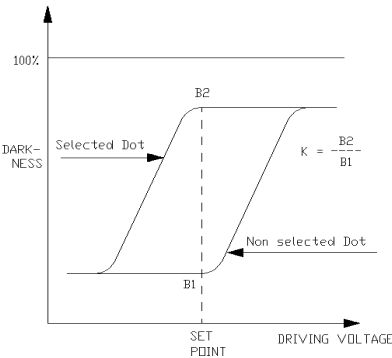
	제 품 시 방 서 LCD MODULE SPECIFICATION	Document No.	QE-개발-01-9131
		Rev. No.	0
	OCM-16216D-5-A2026	Page No	6 OF 17

5. ELECTRO-OPTICAL CHARACTERISTICS (STN)

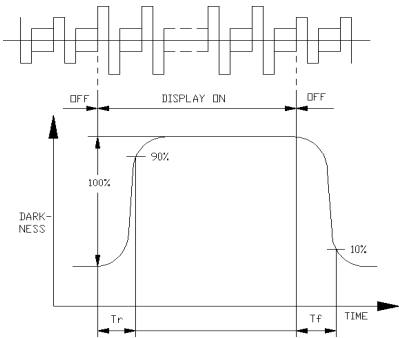
(Ta = 25 ℃)

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Contrast ratio	K	2.0	4.0	–	–	1
Response time (rise)	T _r	–	150	250	ms	2
Response time (fall)	T _f	–	150	250	ms	2
Viewing angle	ϕ	-20 ~ +50			deg.	3,4
	θ	-55 ~ +55				

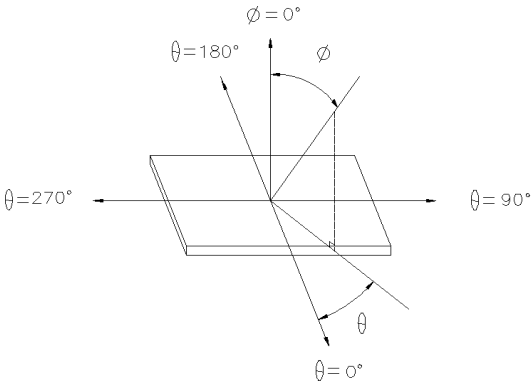
NOTE1. Definition of contrast K



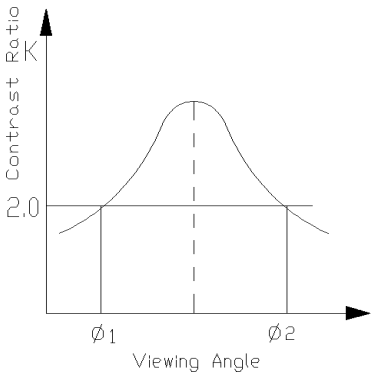
NOTE2. Definition of optical response

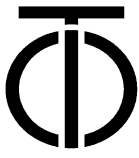


NOTE3. Definition of angle θ and ϕ



NOTE4. Definition of viewing angle ϕ1 and ϕ2



	제 품 시 방 서 LCD MODULE SPECIFICATION	Document No.	QE-개발-01-9131
		Rev. No.	0
	OCM-16216D-5-A2026	Page No	7 OF 17

6. QUALITY SPECIFICATION

6.1 Acceptable Quality Level

INSPECTION ITEM	SAMPLING PROCEDURES	A.Q.L
MAJOR	MIL-STD-105E Inspection Level II Normal Inspection Single sample inspection	1.0
MINOR	MIL-STD-105E Inspection Level II Normal Inspection Single sample inspection	2.5

Major defect :

A major defect is a defect that could result in failure or materially reduce that the usability of the unit of product for its intended purpose.

Minor defect :

A minor defect is one that does not materially reduce the usability of the product for its intended purpose or is a departure from established standards giving no significant bearing on the effective use or operation of the unit.

6.2 Inspection Conditions

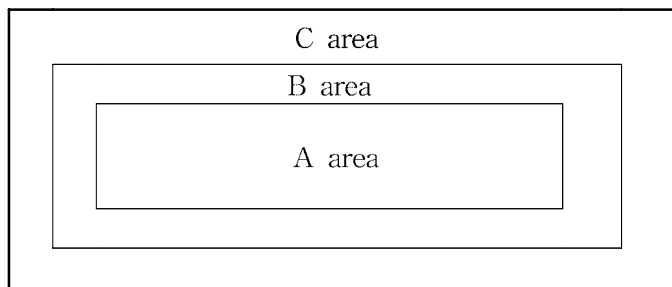
6.2.1 The environmental conditions for inspection shall be as follows

- Room Temperature : $25 \pm 3^{\circ}\text{C}$
- Humidity Temperature : $65 \pm 20\%\text{RH}$

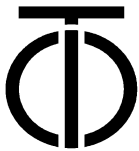
6.2.2 The external visual inspection

- The inspection shall be performed by using 40Watts fluorescent lamp for illumination and the distance between LCD and eyes of the inspector shall be 30cm or more.

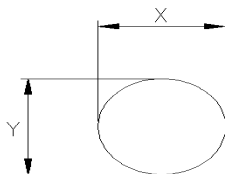
6.3 Definition of the Area

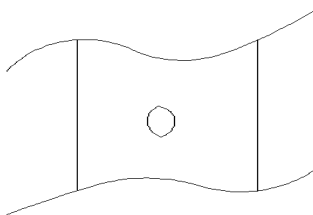
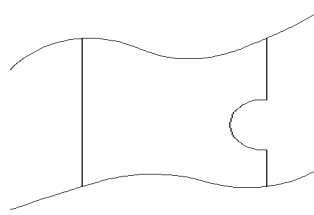


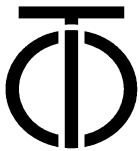
A area: Active Area
B area: Viewing Area
C area: Out of Viewing Area

	제 품 시 방 서 LCD MODULE SPECIFICATION	Document No.	QE-개발-01-9131
	OCM-16216D-5-A2026	Rev. No.	0
		Page No	8 OF 17

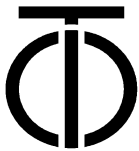
6.4 Inspection Standards

Class of defects	Inspection Item	Criteria of defects				Remarks
MAJOR	Display on inspection	1) No Display 2) Abnormal Operation 3) Short Circuit 4) Pattern Open 5) Off Viewing angle				
	Missing	Component missing				
MINOR	Spot/Dent	Size	Defect size		Acceptable Number	
		A Size	$\phi \leq 0.1 \text{ mm}$		Ignore	
			$0.1 < \phi \leq 0.2 \text{ mm}$		1	
			$\phi > 0.2 \text{ mm}$		0	
		B Size	$\phi \leq 0.1 \text{ mm}$		Ignore	
			$0.1 < \phi \leq 0.2 \text{ mm}$		2	
			$\phi > 0.2 \text{ mm}$		0	
		Cell Size (Viewing Area Criteria) ※ A size < 2500mm ² Spot size= (X+Y)/2 B size ≥ 2500mm ² 				
	Scratch	POSITIVE		NEGATIVE		
		Width X Length	Acceptable Number	Width X Length	Acceptable Number	
		0.1 X 1.5 mm	3	0.1 X 1.5 mm	3	
		0.08 X 3.0 mm	2	0.08 X 3.0 mm	2	
		0.05 X 5.0 mm	1	0.05 X 5.0 mm	1	
		※ Scratches should be separated more than 10mm each other				
	Bubble	1) Round bubble should be treated as spot(positive) 2) Line bubble should be treated as scratch(positive)				

Class of defects	Inspection Item	Criteria of defects				Remarks
MINOR	Pattern Misalignment	Voids in segment  				
	Stain	Stains which cannot be removed even when wiped slightly with a soft cloth.				
	Rainbow	More than 2 colors are noticeable in the viewing direction.				

	제 품 시 방 서 LCD MODULE SPECIFICATION	Document No.	QE-개발-01-9131
	OCM-16216D-5-A2026	Rev. No.	0
		Page No	9 OF 17

Class of defects	Inspection Item	Criteria of defects	Remarks
MINOR	PCB damage	Damage on gold or copper foil	
	Parts alignment	1) IC lead width is more than 50% beyond land pattern 2) Chip component is off center and more than 50% of the leads is off the pad out line.	
	Conductive foreignmatter (solderball, soldersplash)	Conductive foreign matter is not allowed	
	Bezel claw	Bezel claw missing or not bent	

	제 품 시 방 서 LCD MODULE SPECIFICATION	Document No.	QE-개발-01-9131
	OCM-16216D-5-A2026	Rev. No.	0
		Page No	10 OF 17

7. RELIABILITY

- Operating life time : Longer than 50,000 hours
(at room temperature without direct irradiation of sunlight)
- Reliability characteristics shall meet following requirements.

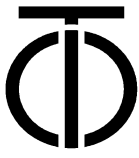
ITEM	TEST	CRITERION
High temp.	70℃ / 200 Hrs	* Total current consumption should be below double of initial value
Low temp.	-20℃ / 200 Hrs	
High humidity	40℃ X 90%RH / 200 Hrs	
Thermal shock	-20℃ → 25℃ → 70℃ → 25℃ / 5 Cycles (30min) (5min) (30min) (5min)	* Contrast ratio should be within initial value $\pm 50\%$
Vibration	1.Operating time : Thirty minutes exposure in each direction(x,y,z) 2.Sweep frequency (1min) : 10Hz →55Hz →10Hz 3.Amplitude : 0.75mm double amplitude	* No defect in cosmetic and operational function is allowable

* Remarks : Samples subjected to the tests shall be “ Not operating ” condition .

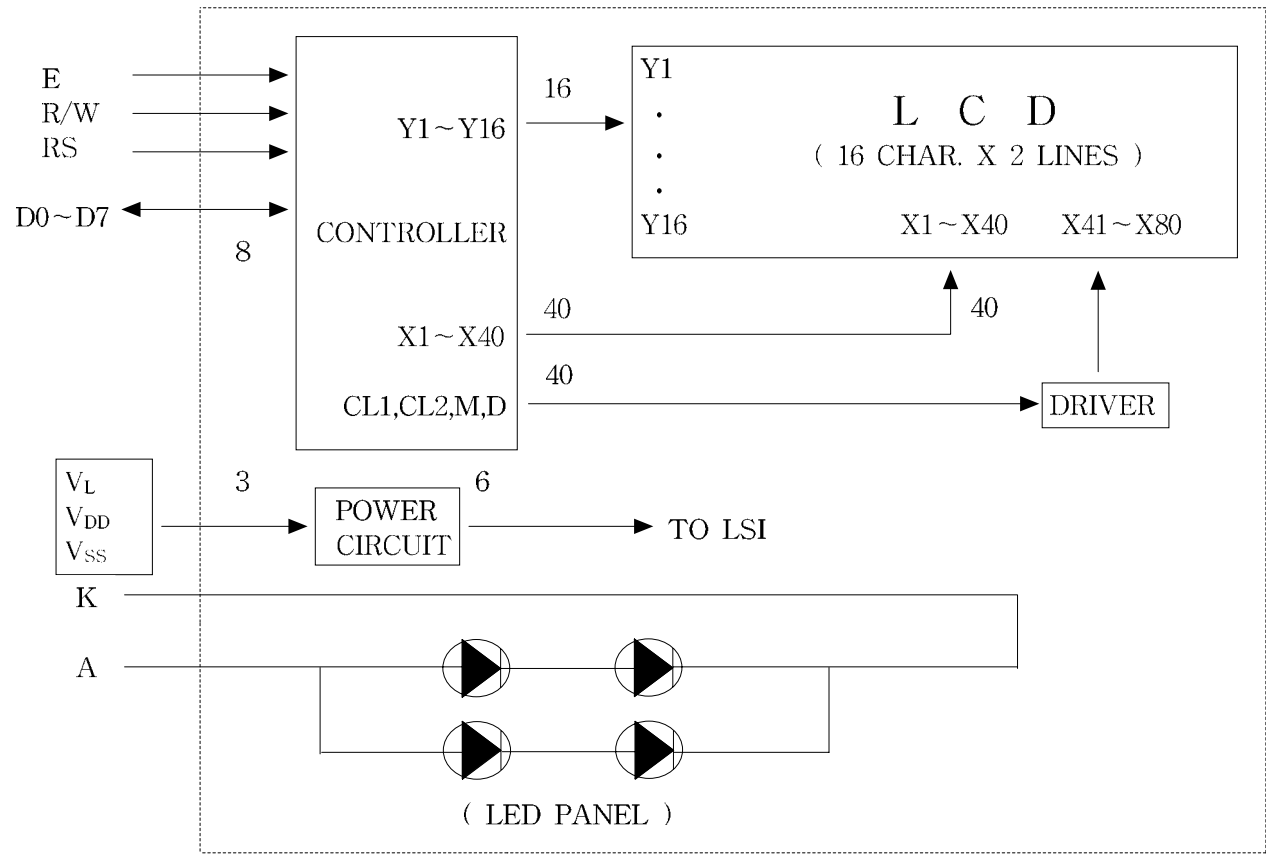
8. PIN CONNECTIONS

PIN CONNECTIONS					
PIN NO.	SYMBOL	LEVEL	FUNCTION		
1.	V _{SS}	-	GND	Ground	POWER SUPPLY
2.	V _{DD}	-	5 V	Power supply for logic	
3.	V _L	-	-	Operating voltage for LCD driving	
4.	RS	H / L	H : Data input L : Instruction data input		
5.	R/W	H / L	H : Data read (CPU ← LCM) L : Data write (CPU → LCM)		
6.	E	H.H→L	Enable (Operating start signal for data read / write)		
7.	D0	H / L	Data bus line		
8.	D1	H / L			
9.	D2	H / L			
10.	D3	H / L			
11.	D4	H / L			
12.	D5	H / L			
13.	D6	H / L			
14.	D7	H / L			
15.	A	(+)	LED Anode		
16.	K	(-)	LED Cathode		

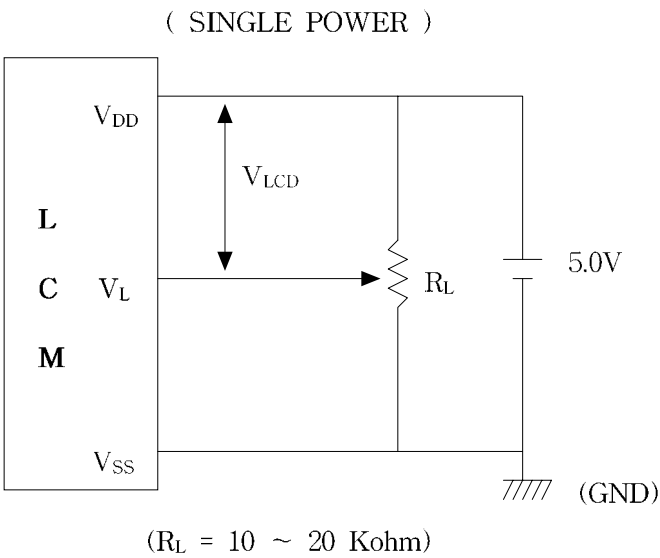
* In case of 4 bits instruction, data is transferred by twice using only 4 buses of D4 to D7, and D0 to D3 are not used, first operation is higher order 4 bits and second is lower 4bits of 8 bits, but in case of 8 bits instruction data is transferred by data bus of D0 to D7.

	제 품 시 방 서	Document No.	QE-개발-01-9131
	LCD MODULE SPECIFICATION	Rev. No.	0
	OCM-16216D-5-A2026	Page No	11 OF 17

9. BLOCK DIAGRAM

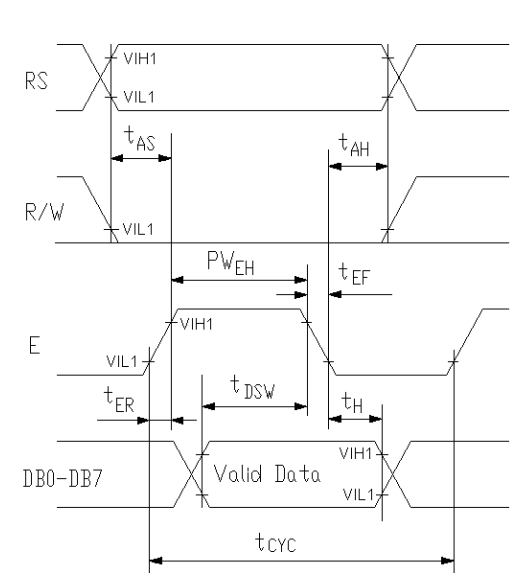


10. POWER SUPPLY



11. TIMING DIAGRAM

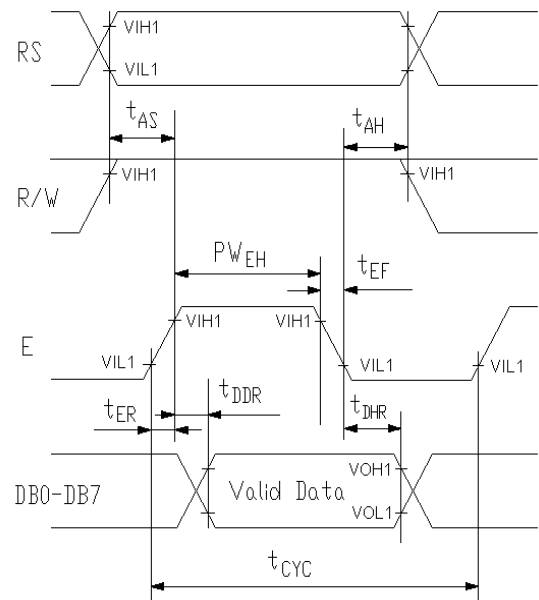
• WRITE OPERATION



• TIMING OF DATA WRITE

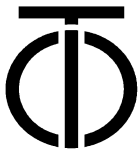
ITEM	SYMBOL	VALUE
Enable cycle time	t _{CYC}	500 ns min.
Enable Pulse width	PW _{EH}	220 ns min.
Enable rise/fall time	t _{Er} , t _{Ef}	25 ns max.
Address set up time	t _{AS}	40 ns min.
Address hold time	t _{AH}	10 ns min.
Data set up time	t _{DSW}	60 ns min.
Data hold time	t _H	10 ns min.

• READ OPERATION



• TIMING OF DATA READ

ITEM	SYMBOL	VALUE
Enable cycle time	t _{CYC}	500 ns min.
Enable Pulse width	PW _{EH}	220 ns min.
Enable rise/fall time	t _{Er} , t _{Ef}	25 ns max.
Address set up time	t _{AS}	40 ns min.
Address hold time	t _{AH}	10 ns min.
Data set up time	t _{DDR}	120 ns max.
Data hold time	t _{DHR}	20 ns min.

	제 품 시 방 서				Document No.	QE-개발-01-9131
	LCD MODULE SPECIFICATION				Rev. No.	0
	OCM-16216D-5-A2026				Page No	13 OF 17

12. INSTRUCTION SET ($R_{osc} = 91 \text{ kHz}$)

INSTRUCTION	CODE										DESCRIPTION	$f_{osc} = 250\text{kHz}$
	RS	R/W	D7	D6	D5	D4	D3	D2	D1	D0		
Clear display	0	0	0	0	0	0	0	0	0	1	Clears entire display	1.64 μs
Return home	0	0	0	0	0	0	0	0	1	*	Returns display being shifted to original position	1.64 μs
Entry mode set	0	0	0	0	0	0	0	1	I/D	S	Sets cursor move direction and specifies shift of display	40 μs
Display on/off control	0	0	0	0	0	0	1	D	C	B	D : Display ON/OFF C : Cursor ON/OFF B : Cursor blink/not	40 μs
Cursor or display shift	0	0	0	0	0	1	S/C	R/L	*	*	Moves cursor and shifts display	40 μs
Function set	0	0	0	0	1	DL	N	F	*	*	DL : Interface data length L : Number of display lines F : Character font	40 μs
Set CG RAM address	0	0	0	1	CG RAM address						Sets CG RAM address	40 μs
Set DD RAM address	0	0	1	DD RAM address: corresponds to cursor address							Sets DD RAM address	40 μs
Read busy flag and address	0	1	BF	Address counter used for both DD and CG RAM address							BF : Busy flag Reads address counter contents	1 μs
Write data to CG or DD RAM	1	0	Write data								Writes data into DD RAM or CG RAM.	40 μs
Read data from CG or DD RAM	1	1	Read data								Reads data from DD RAM or CG RAM.	40 μs

** REMARK **

I/D=1: Increment

S =1: Accompanies display shift

S/C=1: Display shift

R/L=1: Shift to the right

DL =1: 8 bits

N =1: 2 lines

F =1: 5 x 10 dots

BF =1: Internally operating

DD RAM : Display data RAM

* : No effect (Don't care)

I/D =0: Decrement

S/C =0: Cursor move

R/L =0: Shift to the left

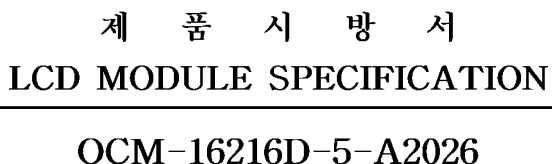
DL =0: 4 bits

N =0: 1 line

F =0: 5 x 7 dots

BF =0: Can accept instruction

CG RAM : Character generator RAM



QE-개발-01-9131

0

14 OF 17

(8-Bit interface)

POWER ON

Wait more than 15 ms after
V_{DD} rises to 4.5 V

** In case of 4-bits interface, refer to PIN CONNECTIONS and INSTRUCTION SET.

RS	R/W	D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	1	1	1	0	*	*

BF cannot be checked before this instruction.

Function set (Interface is 8 bits long.)

Wait more than 4.1 ms

RS	R/W	D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	1	1	1	0	*	*

BF cannot be checked before this instruction.

Wait more than 100 μs

RS	R/W	D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	1	1	1	0	*	*

BF cannot be checked before this instruction.

Function set (Interface is 8 bits long.)

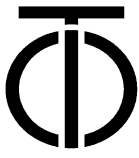
BF can be checked after the following instruction. When BF is not checked, the waiting time between instructions is longer than the execution instruction time.

Function Set(Interface is 8 bits long. Specify the number of display lines and character font.)
The number of display lines and character font cannot be changed afterwards.

In data, MSB(D7) should be '1' and other 7 bits (D0 to D6) are cursor position.

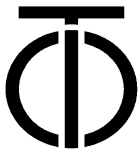
(2) DATA means the ASCII CODES.

DIGIT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	DISPLAY POSITION
1 LINE	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	DD RAM ADDRESS
2 LINE	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	

	제 품 시 방 서		Document No.	QE-개발-01-9131
	LCD MODULE SPECIFICATION		Rev. No.	0
	OCM-16216D-5-A2026		Page No	15 OF 17

15. FONT TABLE

Upper 4bit lower 4bit	LLLL	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
LLLL	CG RAM (1)														
LLH	(2)														
LLHL	(3)														
LLHH	(4)														
LHLL	(5)														
LHLH	(6)														
LHHL	(7)														
LHHH	(8)														
HLLL	(1)														
HLLH	(2)														
HLHL	(3)														
HLHH	(4)														
HHLL	(5)														
HHLH	(6)														
HHHL	(7)														
HHHH	(8)														

	제 품 시 방 서 LCD MODULE SPECIFICATION	Document No.	QE-개발-01-9131
	OCM-16216D-5-A2026	Rev. No.	0
		Page No	16 OF 17

16. PRECAUTION FOR USING

● HANDLING

- * Refrain from storing mechanical shock and from applying any force to LCD MODULE.
It may cause mis_operation or damage of LCD.
- * Do not touch, press or rub the display panel with a hard, stiff tool or object as the polarizers in the panel are easily scratched.
- * If LCD is broken and liquid crystal material flow out, ingestion, inhalation, or contact with skin should be avoided. If liquid crystal material contact with skin, wash immediately with alcohol and rinse thoroughly with water.
- * Never use organic solvents to clear the display panel as these solvent may adversely affect the polarizer. To clean the display panel dampen a bit of absorbent cotton with petroleum benzene and gently wipe the panel, or contaminations by using a scotch tape.
- * Refrain from discharge of high electro-static voltage, it will damage C-MOS LSI in the MODULE.
- * Do not leave the MODULE in high temperature, especially in high humidity for a long time. It is recommended to store the MODULE where the temperature is in the range of 0℃ to 35℃ and the humidity is lower than 70%.
- * Store the MODULE without exposure to direct sunlight or fluorescent lamp.
- * Ultra violet cut filter is necessary for outdoor operation.
- * Avoid condensation of water, it may cause misoperation or disconnection of electrode.

● OPERATION

- * Never connect or disconnect the LCD MODULE from the main system while power is being supplied.
- * When supplying the M signal from the external unit to a GRAPHIC MODULE, set the duty to 50%±1%.
If the duty deviates too greatly from the value, a DC voltage will be applied to the liquid crystal, which could induce an electrochemical reaction and reduce the life of the MODULE.
- * Do not exceed the maximum rating values under the worst conditions taking account of the supply voltage variation, input voltage variation, and environmental temperature, etc. Otherwise LCD module may be damaged.

	제 품 시 방 서 LCD MODULE SPECIFICATION	Document No.	QE-개발-01-9131
		Rev. No.	0
	OCM-16216D-5-A2026	Page No	17 OF 17

17. EXTERNAL DIMENSION

