

<부록 2> 텍스트형 LCD 모듈 HC16202NY-LY

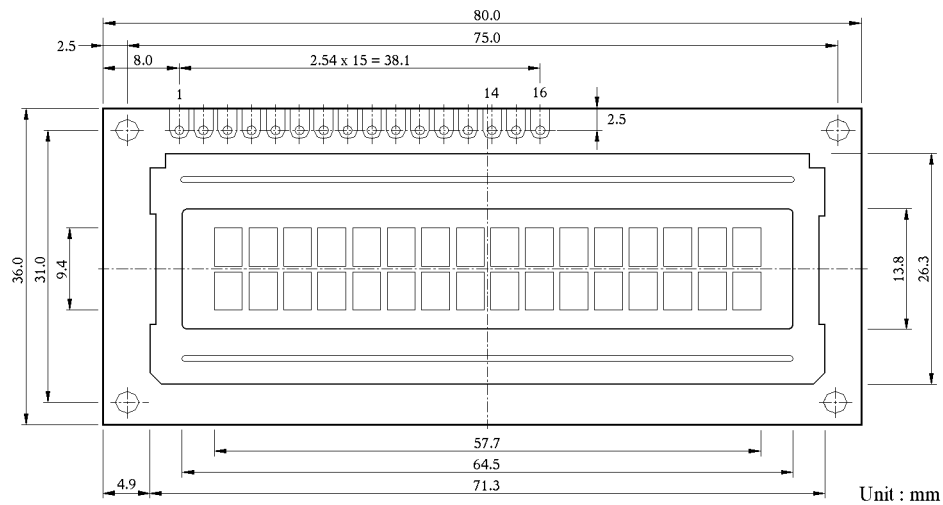
○ 제조 회사 : 현대 LCD

이 데이터 시트는 제조회사의 여러가지 자료를 바탕으로 저자가 다시 요약 정리한 것입니다.

(1) FEATURES

- Display Mode : STN, Positive, Transmissive, Normal temperature
- Display Color : Yellow green
- Display Format : 16 Characters × 2 Lines
- Input Data : 8-bit or 4-bit parallel interface to a MPU
- Viewing Direction : 6 O'Clock
- Back Light : LED, Yellow green

(2) EXTERNAL DIMENSION



(3) MECHANICAL SPECIFICATIONS

Item	Specification	Unit
Maximum Module Size	80.0(W)×36.0(H)×10.0(T) for EL or no backlight 80.0(W)×36.0(H)×15.0(T) for LED backlight	mm
Viewing Area	64.5(W)×13.8(H)	mm
Character Font	5×7	dots
Character Size	2.95(W)×3.80(H)	mm
Character Pitch	3.65(W)×5.05(H)	mm
Dot Size	0.55(W)×0.50(H)	mm

(4) ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Value			Unit	Condition
		Min.	Typ.	Max.		
Logic Supply Voltage	Vdd-Vss	-0.3	-	7.0	V	Ta=25℃
LCD Drive Supply Voltage	Vdd-Vo	-0.3	-	13.5	V	Ta=25℃
Input Voltage	Vi	-0.3	-	Vdd+0.3	V	Ta=25℃
Operating Temperature	Ta	0/-20	-	+50/+70	℃	Std/Ext
Storage Temperature	Tstg	-20/-30	-	+70/+85	℃	Std/Ext

(5) ELECTRICAL CHARACTERISTICS(Ta=-20℃ ~ +75℃)

Item	Symbol	Value			Unit	Condition
		Min.	Typ.	Max.		
Logic Supply Voltage	Vdd-Vss	4.5	5.0	5.5	V	
Logic Supply Current	Idd	-	2.0	3.0	mA	Vdd=5V
LCD Operating Voltage	Vdd-Vo	4.2/7.5	4.4/7.8	4.6/8.1	V	Std/Ext
LCD Drive Supply Current	Io	-	1.0	1.5	mA	Vdd=5V
Input Voltage "High" Level	V _{IH}	2.2	-	Vdd	V	
Input Voltage "Low" Level	V _{IL}	-0.3	-	0.55	V	
Output Voltage "High" Level	V _{OH}	2.4	-	-	V	I _{OH} =-0.2mA
Output Voltage "Low" Level	V _{OL}	-	-	0.4	V	I _{OL} =1.2mA
Clock Frequency (Rf=91kΩ)	Fosc	190	270	350	kHz	Vdd=5V

Std = standard version, Ext = extended temperature(high reliability) version

(6) PIN CONFIGURATION

Pin No.	Symbol	Level	Function
1	Vss	0V	Ground
2	Vdd	+5V	Logic Supply Voltage
3	Vo	-	LCD Driving Voltage, Operating Voltage
4	Rs	H/L	Register Select : H = Data, L = Instruction
5	R/W	H/L	H = Read(LCD → MPU), L = Write(MPU → LCD)
6	E	H, HL	Enable for read/write operation
7	DB0	H/L	Data Bit 0 (LSB)
8	DB1	H/L	Data Bit 1
9	DB2	H/L	Data Bit 2
10	DB3	H/L	Data Bit 3
11	DB4	H/L	Data Bit 4
12	DB5	H/L	Data Bit 5
13	DB6	H/L	Data Bit 6
14	DB7	H/L	Data Bit 7 (MSB)
15	A(EL1)	-	LED(+) or EL Backlight Connection
16	K(EL2)	-	LED(-) or EL Backlight Connection

(7) BACKLIGHTING CHARACTERISTICS(Ta=25℃)

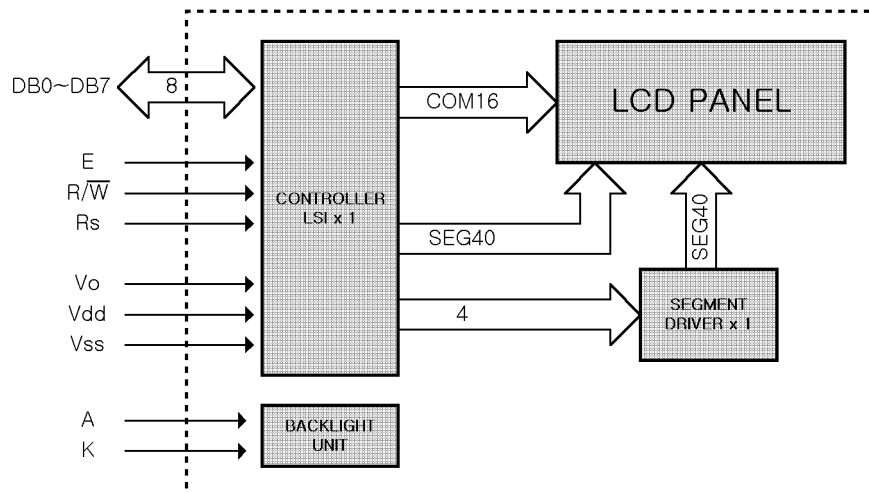
■ LED Backlight

Item	Symbol	Value			Unit	Condition
		Min.	Typ.	Max.		
Supply Voltage	V _{LED}	3.9	4.1	4.3	V	
Power Consumption	Pd	-	656	-	mW	
Luminous		70	-	-	cd/m ²	If=110mA

■ EL Backlight

Item	Symbol	Value			Unit	Condition
		Min.	Typ.	Max.		
Applied Voltage	V _{EL}	80	100	120	AC Vrms	
Applied Frequency	Fa	-	400	-	Hz	
Current	Ia	-	1.66	-	mA	Va=100V Fa=400Hz
Power Consumption	Pd	-	166	-	mW	
Luminous		45	55	-	cd/m ²	Va=100V, Fa=400Hz

(8) BLOCK DIAGRAM



(9) MPU INTERFACE TIMING CHARACTERISTICS

■ MPU Interface Timing ($V_{dd}=+5.0V \pm 10\%$, $V_{ss}=0V$, $T_a=-20^{\circ}C \sim +75^{\circ}C$)

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Enable cycle time	t_{cyc}	500	-	-	ns	Fig. 1, 2
Enable high level width	PW_{EH}	230	-	-	ns	Fig. 1, 2
Enable rise time	t_{Er}	-	-	25	ns	Fig. 1, 2
Enable fall time	t_{Ef}	-	-	25	ns	Fig. 1, 2
Address setup time	t_{AS}	40	-	-	ns	Fig. 1, 2
Address hold time	t_{AH}	10	-	-	ns	Fig. 1, 2
Data setup time(write)	t_{DSW}	80	-	-	ns	Fig. 1
Data delay time(read)	t_{DDR}	-	-	160	ns	Fig. 2
Data hold time(write)	t_H	10	-	-	ns	Fig. 1
Data hold time(read)	t_{DHR}	20	-	-	ns	Fig. 2

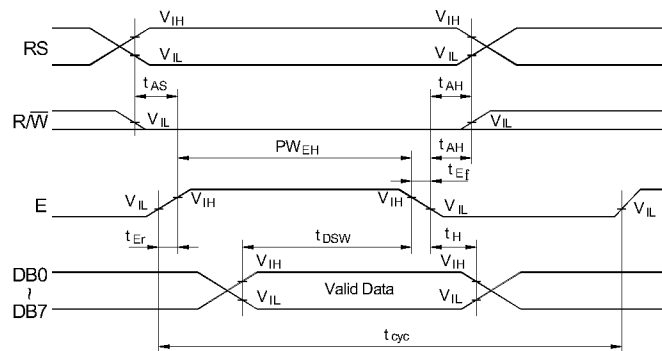


Fig. 1 Write Operation (MPU → LCD)

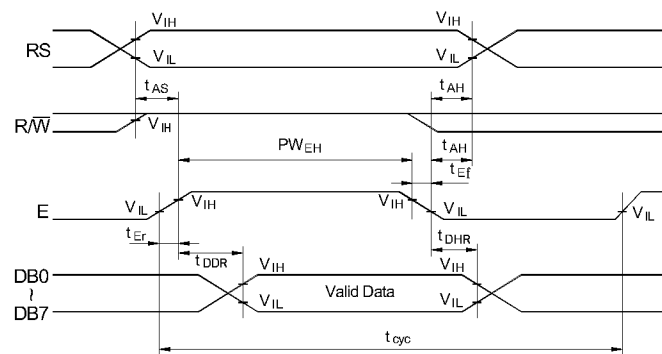
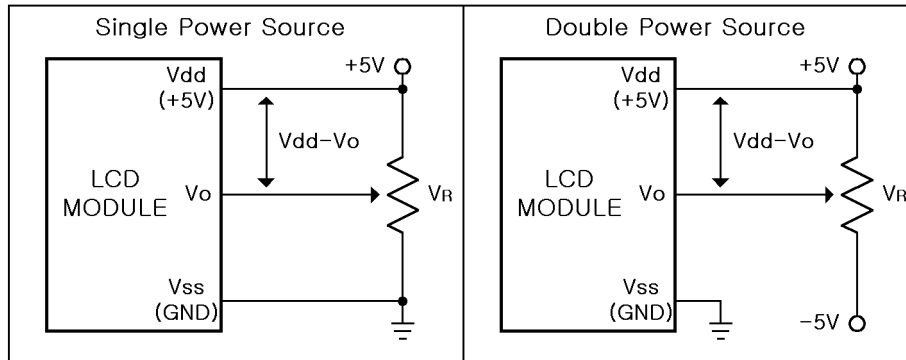


Fig. 2 Read Operation (LCD → MPU)

(10) POWER SUPPLY



$V_{dd}-V_o$: LCD driving voltage

$V_R = 10k\Omega \sim 20k\Omega$

(11) INSTRUCTION SET

Instruction	Signal		Code								Exec. Time (Max.) Fosc=250kHz
	R _S	R/ \overline{W}	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
Clear display	0	0	0	0	0	0	0	0	0	1	1.64 ms
Return home	0	0	0	0	0	0	0	0	1	*	1.64 ms
Entry mode set	0	0	0	0	0	0	0	1	I/D	S	40 μ s
Display ON/OFF control	0	0	0	0	0	0	1	D	C	B	40 μ s
Cursor or display shift	0	0	0	0	0	1	S/C	R/L	*	*	40 μ s
Function set	0	0	0	0	1	DL	N	F	*	*	40 μ s
Set CG RAM address	0	0	0	1	CG RAM address						40 μ s
Set DD RAM address	0	0	1	DD RAM address						40 μ s	
Read busy flag and address	0	1	BF	Address Counter						0 μ s	
Data write to CG RAM or DD RAM	1	0	write data								40 μ s
Data read from CG RAM or DD RAM	1	1	read data								40 μ s

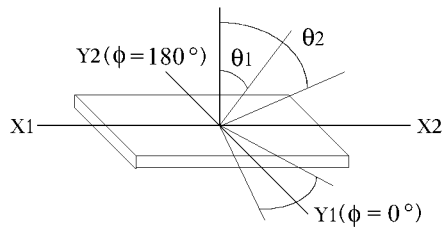
Remark :

- (1) * means no effect or don't care condition.
- (2) Execution time changes when frequency changes. For example, when fosc is 270kHz, $1.64ms \times 250/270 = 1.52ms$ and $40\mu s \times 250/270 = 37\mu s$.

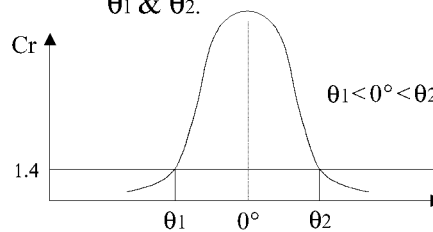
(12) ELECTRO-OPTICAL CHARACTERISTICS(1/16 duty, 1/5 bias)

Item	Symbol	Value			Unit	Condition	Note
		Min.	Typ.	Max.			
Viewing Angle	$\theta_2 - \theta_1$	$\phi = 0^\circ$	50	60	-	deg	1,2
		$\phi = 90^\circ$	50	60	-		
Contrast Ratio	Cr	3	5	-	-	$\theta = 0^\circ, \phi = 0^\circ$	3
Response Time(rise)	Tr	-	100	150	ms	$\theta = 0^\circ, \phi = 0^\circ$	4
Response Time(fall)	Tf	-	150	150	ms	$\theta = 0^\circ, \phi = 0^\circ$	4

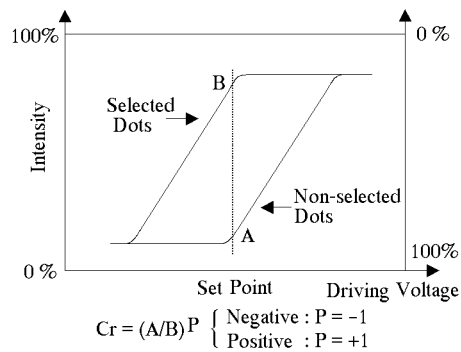
Note 1: Definition of angle θ & ϕ .



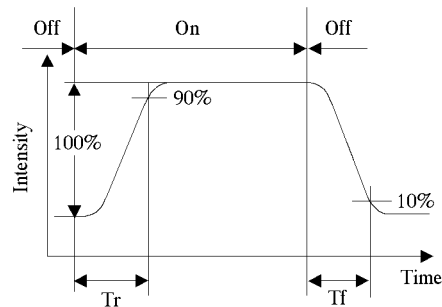
Note 2: Definition of viewing angle θ_1 & θ_2 .



Note 3: Definition of contrast Cr



Note 4: Definition of optical response



★휴게식★ 현대 LCD의 LCD 모듈 모델명을 정하는 규칙

H - -

<1> <2> <3> <4> <5> <6> <7> <8> <9> <10> <11> <12>

No.	Item	Symbol	Description
<1>	LCD Type	C G B P T	Character Type Module - PCB Graphic Type Module - PCB COB(Chip on Board) Type Module COG(Chip on Glass) Type Module TAB(Tape Automated Bonding) Type Module
<2>	① Character Type ② Graphic Type		Number of Character per Line Number of Column Dots(Upper 2 Digits Only)
<3>	① Character Type ② Graphic Type		Number of Line LSI Controller(5=With Controller, 6=Without Controller)
<4>	Development Number	01 ~ 99	
<5>	Display Mode	Nil P N Q F R	TN Extended Temperature TN STN Extended Temperature STN FSTN Extended Temperature FSTN
<6>	LCD Color	Nil Y B G	White(TN, FSTN) Yellow/Green(STN) Blue(STN), Black(TN, FSTN) Gray(STN)
<7>	Viewing Direction	Nil U L R	6:00 O'Clock 12:00 O'Clock 9:00 O'Clock 3:00 O'Clock
<8>	Backlight	Nil T X E M L D G H	Without Backlight + Reflective Without Backlight + Transflective Without Backlight + Transmissive EL + Transflective EL + Transmissive LED + Transmissive LED + Transflective CCFL + Transmissive CCFL + Transflective
<9>	Backlight Color	Nil A B R W Y	Without Backlight Amber(LED) Blue/Green(EL) Red(LED) White(EL, CCFL) Yellow/Green(LED)
<10>	Holder	Nil Z J K S P	Black Coating Zinc Natural Zinc White Nickel Coating Stainless Plastic
<11>	Connector	Nil C F O	Without Connector Pin Header Cable Other Connector
<12>	Revision Number	01 ~ 99	