

QP-5515

**DOT MATRIX
LIQUID CRYSTAL DISPLAY
MODULE**

USER'S MANUAL

**ELECTUS
DISTRIBUTION**

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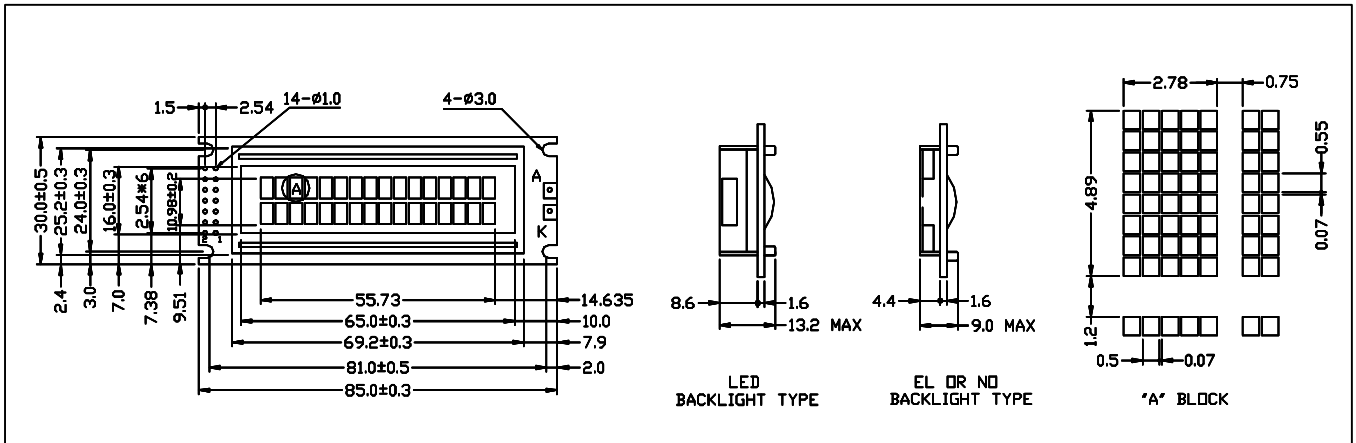
CONTENTS

	PAGE
1. Mechanical Specification	3
2 Mechanical Diagram	3
3. Interface Pin Connections	3
4. Block Diagram	3
5. Absolute Maximum Rating	4
6. Electrical Characteristics	4
7. Optical Characteristics	4
8. Optical Definitions	4
9. Display Address	4
10. Interface to MPU	5
10.1 Interface to Z-80 CPU	5
10.2 Interface to MC6800 CPU	5
10.3 Interface to 4-bit CPU (HMCS43C)	5
10.4 Interface to HD6805 MP	5
11. Timing Control	6
11.1 Write and Read Operation	6
11.2 Busy flag check timing	6
12. Initialization of LCM	6
13. Instruction Set	8
14. User Font Patterns	9
15. Software Example	10
16. Reliability Condition	11
17. Character Generator ROM Map	12

1. Mechanical Specification

ITEM	STANDARD VALUE	UNIT
NUMBER OF CHARACTERS	16 CHARACTERS X 2 LINES	--
CHARACTER FORMAT	5 X 8 DOTS	--
MODULE DIMENSION	85.0 (W) X 30.0 (H) X 9.0 (T) | 85.0 (W) X 30.0 (H) X 13.2 (T)	mm
VIEWING DISPLAY AREA	65.0 (W) X 16.0 (H)	mm
ACTIVE DISPLAY AREA	56.21 (W) X 10.98 (H)	mm
CHARACTER SIZE	2.78 (W) X 4.89 (H)	mm
CHARACTER PITCH	3.53 (W) X 6.09 (H)	mm
DOT SIZE	0.50 (W) X 0.55 (H)	mm
DOT PITCH	0.57 (W) X 0.62 (H)	mm
DISPLAY	STN , Yellow Green , 1/16 Duty , 6 O'clock	

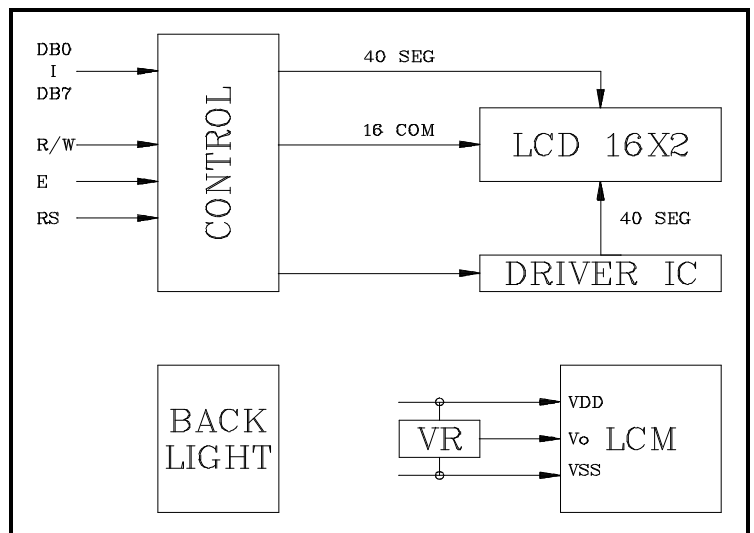
2. Mechanical Diagram



3. Interface Pin Connections

NO	SYMBOL	LEVEL	FUNCTION
1	VDD	--	DC +5V
2	VSS	--	GND (0V)
3	VO	H/L	Contrast Adjust
4	RS	H/L	Register select
5	R/W	H/L	Read/Write
6	E	H,H→L	Enable signal
7	DB0	H/L	Data Bit 0
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
	A+ (EL1)	--	A (EL Backlight 1)
	K- (EL2)	--	K (EL Backlight 2)

4. Block Diagram



5. Absolute Maximum Ratings

ITEM	SYMBOL	MIN.	TYPE	MAX.	UNIT
OPERATING TEMPERATURE	TOP	0/-20	--	+50/+70	?
STORAGE TEMPERATURE	TST	-10/-30	--	+60/+80	?
INPUT VOLTAGE	VI	VSS	--	VDD	V
SUPPLY VOLTAGE FOR LOGIC	VDD-VSS	--	5.0	6.5	V
SUPPLY VOLTAGE FOR LCD	VDD-VO	--	--	6.5	V
STATIC ELECTRICITY	Be sure that you are grounded when handing LCM.				

6. Electrical Characteristics

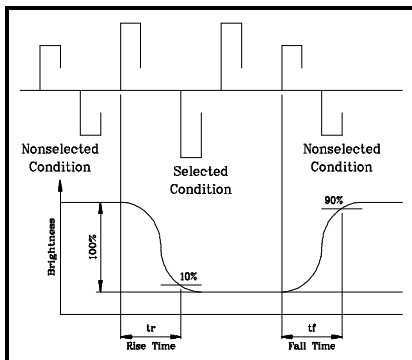
ITEM	SYN	CONDITION	MIN.	TYPE	MAX.	UNIT
SUPPLY VOLTAGE FOR LOGIC	VDD-VSS	--	4.5	5.0	5.5	V
SUPPLY VOLTAGE FOR LCD	VDD-VO	Ta= 0/-20 ?	--	4.8/5.0	--	V
		Ta= 25?	--	4.4	--	V
		Ta= +50/+70 ?	--	4.1/3.9	--	V
INPUT HIGH VOLTAGE	VIH	--	2.2	--	VDD	V
INPUT LOW VOLTAGE	VIL	--	0	--	0.6	V
OUTPUT HIGH VOLTAGE	VOH	--	2.4	--	--	V
OUTPUT LOW VOLTAGE	VOL	--	--	--	0.4	V
SUPPLY CURRENT	IDD	VDD=+5V	--	3.0	4.5	mA

7. Optical Characteristics

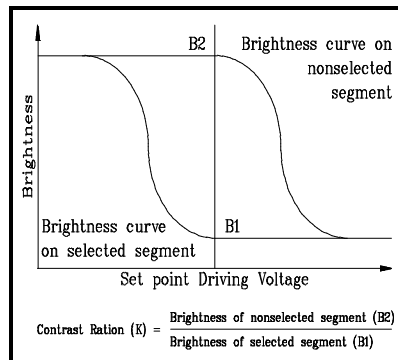
ITEM	SYM	CONDITION	MIN.	TYPE	MAX.	UNIT
VIEW ANGLE (V)	?	CR? 2	-10	--	40	deg.
VIEW ANGLE (H)	f	CR? 2	-30	--	30	deg.
CONTRAST RATIO	CR	--	--	5	--	--
RESPONSE TIME	TON	--	--	180	230	mS
RESPONSE TIME	TOFF	--	--	100	150	mS

8. Optical Definitions

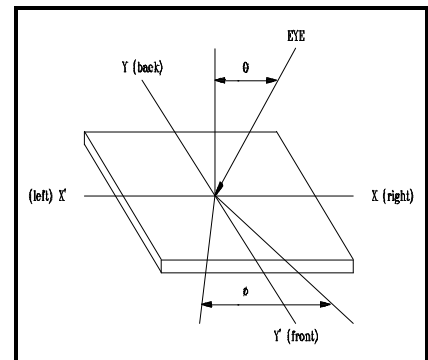
Response Time



Contrast Ration



View Angle

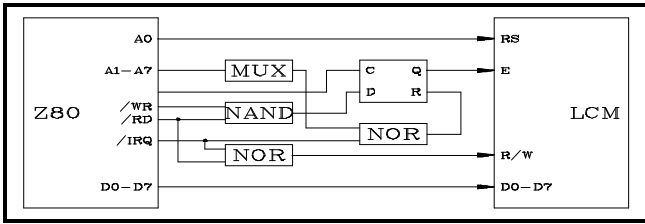


9. Display Address

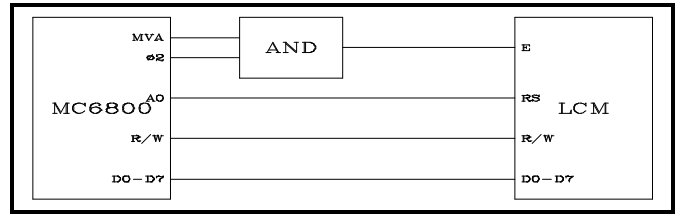
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Line 1	80	81	82	83	84	85	86	87	88	89	8A	8B	8C	8D	8E	8F
Line 2	C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	CA	CB	CC	CD	CE	CF

10. Interface to MPU

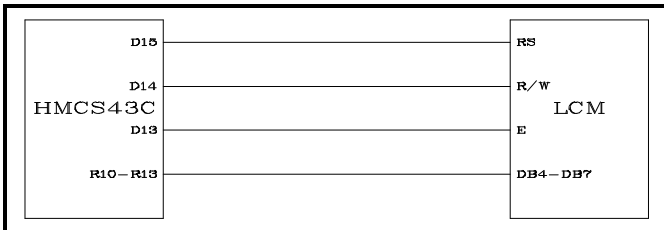
10.1 Interface to Z-80 CPU



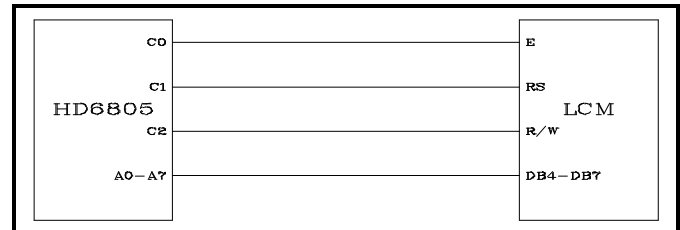
10.2 Interface to MC6800 CPU



10.3 Interface to 4-bit CPU (HMCS43C)



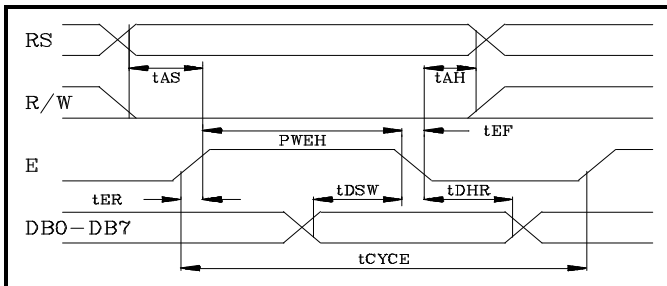
10.4 Interface to HD6805 MP



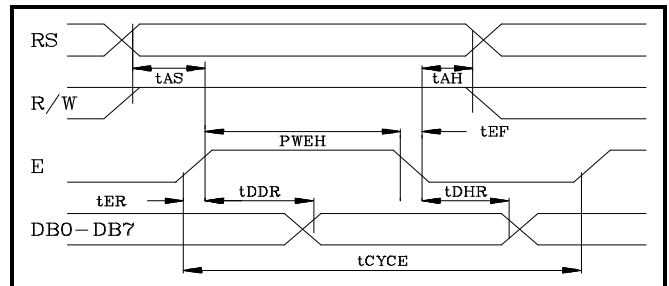
11. Timing Control

11.1 Write and Read Operation

Write Operation

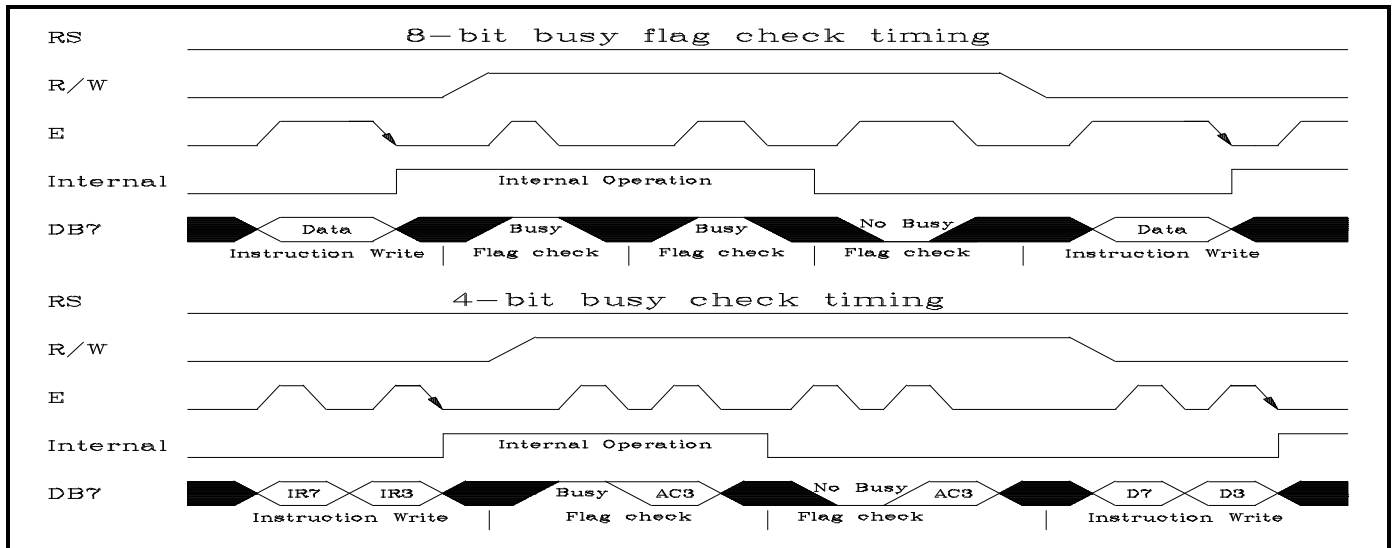


Read Operation



Item	Symbol	Limit (Min.)	Limit (Max.)	Unit
Enable Cycle Time	tCYCE	1000	--	ns
Enable Pules Width (High level)	PWEH	450	--	ns
Enable Rise/Fall Time	tER,tEF	--	25	ns
Address Set-Up Time (RS,R/W,E)	tAS	100	--	ns
Address Hole Time	tAH	10	--	ns
Data Set-Up Time	tDSW	100	--	ns
Data Delay Time	tDDR	--	190	ns
Data Hold Time	tDHR	20	--	ns

11.2 Busy flag check timing

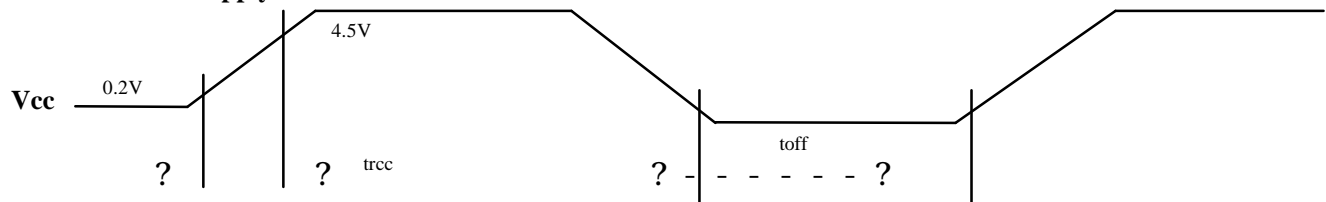


Note : IR7, IR3 : Instruction 7th bit , 3rd bit ; AC3 : Address Counter 3rd bit.

12. Initialization of LCM

The LCM automatically initializes (reset) when power is turned on using the internal reset circuit. If the power supply conditions for correctly operating of the internal reset circuit are not met, initialization by instruction is required. Use the procedure is next page for initialization.

Internal Power Supply reset



(Note 1) 10 ms ? tr_{cc} ? 0.1 ms , to_{ff} ? 1 ms.

(Note 2) to_{ff} stipulates the time of power OFF for momentary power supply dip or when power supply cycles ON and OFF.

Item	Symbol	Test condition	Limit (Min.)	Limit (Max.)	Unit
Power supply rise time	tr_{cc}	--	0.1	10	ms
Power supply off time	to_{ff}	--	1	--	ms

(a) 8-bit interface

(b) 4-bit interface

Power ON										Power ON										
?										?										
Wait more than 15ms after V_{DD} rises to $0.9V_{DD}$										Wait more than 15ms after V_{DD} rises to $0.9V_{DD}$										
?										?										
Function Set										Function Set										
RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	RS	R/W	DB7	DB6	DB5	DB4					
0	0	0	0	1	1	*	*	*	*	0	0	0	0	1	1					
?										?										
Wait more than 4.1 ms										Wait more than 4.1 ms										
?										?										
Function Set										Function Set										
RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	RS	R/W	DB7	DB6	DB5	DB4					
0	0	0	0	1	1	*	*	*	*	0	0	0	0	1	1					
?										?										
Wait more than 100μ s										Wait more than 100μ s										
?										?										
Function Set										Function Set										
RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	RS	R/W	DB7	DB6	DB5	DB4					
0	0	0	0	1	1	*	*	*	*	0	0	0	0	1	1					
?										?										
Wait more than 100μ s or Busy Flag Check										Wait more than 100μ s or Busy Flag Check										
?										?										
Function Set										Function Set										
RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	RS	R/W	DB7	DB6	DB5	DB4					
0	0	0	0	1	1	N	F	*	*	0	0	0	0	1	1					
?										?										
Display Off										Function Set										
RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	RS	R/W	DB7	DB6	DB5	DB4					
0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0					
?										0						0	N	F	*	*
Display Clear										?										
RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Display Off										
0	0	0	0	0	0	0	0	0	1	RS	R/W	DB7	DB6	DB5	DB4					
?										0	0	0	0	0	0					
Entry Mode Set										0						0	1	0	0	0
RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	?										
0	0	0	0	0	0	0	1	I/D	S	Display Clear										
?										RS	R/W	DB7	DB6	DB5	DB4					
Write data to the DD/CG RAM and set the Instruction										0	0	0	0	0	0					
										0	0	0	0	0	1					
										?										
										Entry Mode Set										
										RS	R/W	DB7	DB6	DB5	DB4					
										0	0	0	0	0	0					
										0	0	0	1	I/D	S					
										?										
										Write data to the DD/CG RAM and set the Instruction										

13. Instruction Set

FUNCTION	R S	R /W	D B 7	D B 6	D B 5	D B 4	D B 3	D B 2	D B 1	D B 0	DESCRIPTION	EXECU. TIME* (MAX.)
Clear Display	0	0	0	0	0	0	0	0	0	1	Clears entire display and returns the cursor to home position (address 0).	1.64ms
Return Home	0	0	0	0	0	0	0	0	0	1 x	Return the cursor to the home position. Also returns the display being shifted to the original position. DD RAM contents remain unchanged.	1.64ms
Entry mode set	0	0	0	0	0	0	0	0	1	I / D S	Set cursor move direct and specifies display shift. These operations are performed during data rite/read. For normal operation, set S to zero. I/D=1 : increment ; 0 :decrement ;S=1 : accompanies display shift when data is written, for normal operation, set to zero.	40μ s
Display ON/OFF control	0	0	0	0	0	0	1	D	C	B	Set ON/OFF all display(D),cursor ON/OFF(C), and blink of cursor position character(B). D=1: ON display; 0:OFF display. C=1: ON cursor;0: OFF cursor. B=1: ON blink cursor; 0: OFF blink cursor.	40μ s
Cursor or Display shift	0	0	0	0	0	1	S / C	R / L	x	x	Move the cursor and shift the display without changing DD RAM contents. S/C=1: Display shift; 0:Cursor move. R/L=1: shift to right; 0: shift to left.	40μ s
Function Set	0	0	0	0	1	D L	N	F	x	x	Set the interface data length (DL). Number of display lines (N) and character font (F). DL=1: 8 bits; 0:4 bits. N=1: 2 lines; 0: 1 lines. F=1: 5x10 dots; 0: 5x7 dots.	40μ s
Set CG RAM address	0	0	0	1	ACG					Set CG RAM address. CG RAM data is sent and received after this setting.	40μ s	
Set DD RAM address	0	0	1	ADD					Set DD RAM address. DD RAM data is sent and received after this setting	40μ s		
Read busy flag & address	0	1	B F	AC					Reads Busy Flag (BF) indicating internal operation is being performed and reads address counter contents. BF=1: internally operating. 0: can accept instruction	1 μ s		
Write Data to CG/DDRAM	1	0	WRITE DATA					Write data into DD RAM or CG RAM.			40μ s	
Read Data for CG/DDRAM	1	1	READ DATA					Read data from DD RAM or CG RAM			40μ s	

14. User Font Patterns (CG RAM Character)

Character Code (DD RAM data)			CG RAM Address		Character Pattern (CG RAM data)							
Hi	7 6 5 4 3 2 1 0	Lo	5 4 3	2 1 0	Hi	7 6 5	4	3	2	1	0	Lo
0000x000				000		xxx	1	1	1	1	0	
				001		xxx	1	0	0	0	1	
			000	010		xxx	1	0	0	0	1	
				011		xxx	1	1	1	1	0	
				100		xxx	1	0	1	0	0	
				101		xxx	1	0	0	1	0	
				110		xxx	1	0	0	0	1	
				111		xxx	0	0	0	0	0	
0000x001				000		xxx	1	0	0	0	1	
				001		xxx	0	1	0	1	0	
			001	010		xxx	1	1	1	1	1	
				011		xxx	0	0	1	0	0	
				100		xxx	1	1	1	1	1	
				101		xxx	0	0	1	1	0	
				110		xxx	0	0	1	0	0	
				111		xxx	0	0	0	0	0	
-----			-----		-----							
0000x111				000								
				001								
				010								
			111	011								
				100								
				101								
				110								
				111								

15. Software Example

15.1 8-bit operation (8 bits 2 lines)

Function	R S	R w	D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0	Display	Description
Power on delay												Initialization. No display appears.
Function set	0	0	0	0	1	1	0	0	x	x		Sets to 8-bit operation and selects 2-line display and 5x7 dots character font. (Note: number of display lines and character fonts cannot be changed after this.)
Display OFF	0	0	0	0	0	0	1	0	0	0		Turn off display.
Display ON	0	0	0	0	0	0	1	1	1	0	_	Turn on display and cursor
Entry Mode Set	0	0	0	0	0	0	0	1	1	0	-	Set mode to increment the address by one and to shift the cursor to the right, at the time of write, to the DD/CG RAM Display is not shifted.
Write data to CG/DD RAM	1	0	0	1	0	1	0	1	0	0	T_	Write "T". Cursor incremented by one and shift to right.
Write data to CG/DD RAM	1	0	0	1	0	0	0	1	0	1	TEST_	Write "E", "S", and "T".
Write data to CG/DD RAM	1	0	0	1	0	1	0	0	1	1		
Write data to CG/DD RAM	1	0	0	1	0	1	0	1	0	0		
Set DD RAM	0	0	1	1	0	0	0	0	0	0	TEST	Set RAM address so that the cursor is positioned at the head of the second line.
Write data to CG/DD RAM					*						TEST	Write "C", and "R".
Write data to CG/DD RAM					*						CR_	
Cursor or display shift	0	0	0	0	0	1	0	0	x	x	TEST	Shift only the cursor position to the left.
Write data to CG/DD RAM					*						TEST	Write "WORDS".
Write data to CG/DD RAM					*						WORDS_	
Entry Mode Set	0	0	0	0	0	0	0	1	1	1	TEST	Set display mode shift at the time during writing operation.
Write data to CG/DD RAM											TEST	Write " x". Cursor incremented by one and shift to right. (The display move to left.)
Write data to CG/DD RAM	1	0	0	1	1	1	1	0	0	0	WORDS x_	
Write data to CG/DD RAM					*							Write other characters.
Write data to CG/DD RAM					*							
Return Home	0	0	0	0	0	0	0	0	1	0	TEST	Return both display and cursor to the original position (Set address to zero).
Return Home											WORDS x.	

Reliability Condition

		TN Type		STN Type		
		Normal Temp.	Wide Temp.	Normal Temp.	Wide Temp.	
Viewing Angle	Horizontal F	±30°	±30°	±30°	±30°	
	Vertical T (?)	10° to 30°	10° to 30°	-10° to 40°	-10° to 40°	
Operating Temperature		-10 to 70?	-25 to 80?	0 to 50?	*-20 to 70?	
Storage Temperature		-20 to 80?	-35 to 90?	-20 to 70?	*-30 to 80?	
High Temperature (Power Off)		240 Hours @70?	240 Hours @90?	240 Hours @65?	240 Hours @75?	
Low Temperature (Power Off)		240 Hours @-20?	240 Hours @-35?	240 Hours @-15?	240 Hours @-25?	
High Temperature (Power On)		240 Hours @70?	240 Hours @80?	240 Hours @60?	240 Hours @70?	
Low Temperature (Power On)		240 Hours @-10?	240 Hours @-25?	240 Hours @-10?	240 Hours @-20?	
High Temperature & High Humidity		55? /90%RH 240 Hours	75? /90%RH 240 Hours	45? /90%RH 240 Hours	65? /90%RH 240 Hours	
Thermal Shock 5 Cycle		A	60min@-20?	60min@-35?	60min@-20?	60min@-30?
		B	5min@25?	5min@25?	5min@25?	5min@25?
		C	60min@70?	60min@90?	60min@70?	60min@80?
Expected Lift		50,000 Hours	50,000 Hours	50,000 Hours	50,000 Hours	

*Wide temp. version may not available for some products, Please consult our sales engineer or representative.

CHARACTER PATTERN CHART (5×7 DOTS +CURSOR)

Higher 4 bit Lower 4 bit	0000	0010	0011	0100	0101	0110	0111	1010	1011	1100	1101	1110	1111
XXXX0000	CG RAM (1)		0	@	P	`	P		-	9	≡	Ω	ρ
XXXX0001	(2)	!	1	A	Q	a	9	。	ア	チ	△	Δ	α
XXXX0010	(3)	"	2	B	R	b	r	「	イ	ツ	×	β	θ
XXXX0011	(4)	#	3	C	S	c	s	」	ウ	テ	ε	ε	∞
XXXX0100	(5)	\$	4	D	T	d	t	、	エ	ト	ト	μ	Ω
XXXX0101	(6)	%	5	E	U	e	u	・	オ	ナ	1	ε	ü
XXXX0110	(7)	&	6	F	V	f	v	ヲ	カ	ニ	ヨ	ρ	Σ
XXXX0111	(8)	'	7	G	W	g	w	ア	キ	ヌ	ラ	q	π
XXXX1000	(1)	(	8	H	X	h	x	イ	ウ	ネ	リ	γ	×
XXXX1001	(2)	)	9	I	Y	i	y	ウ	ケ	ル	ル	´	υ
XXXX1010	(3)	*	:	J	Z	j	z	エ	コ	ハ	ロ	i	≠
XXXX1011	(4)	+	;	K	[	k	[	オ	サ	ヒ	ワ	*	π
XXXX1100	(5)	,	<	L	¥	l	l	カ	シ	フ	ン	φ	π
XXXX1101	(6)	-	=	M]	m]	ユ	ヌ	ハ	ン	ε	÷
XXXX1110	(7)	.	>	N	^	n	+	ヨ	セ	ホ	”	π	
XXXX1111	(8)	/	?	O	_	o	+	ツ	リ	マ	”	ö	■

NOTICE:

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