	LCD Module Specifications	Approved by	Production Dept.
		Checked by	Quality Assurance Dept.
		Prepared by	Engineering Dept.

Type No.	SSC2F16DLNW-E	Date	2004/05/06

APPROVAL

UNIWORLD TECHNOLOGY CORPORATION	
SALES MANAGER	

Table of Contents

1. General Specifications

ITEM	STANDARD VALUE			UNIT
Number of Characters	16 Characters x 2 Lines			--
Character Format	5 x 7 + cursor			--
Module Dimension	85.0 (W) x 32.6 (H) x 13.2 (T)			mm
LCD Polarizer	STN Transflective / Negative Blue / 6 o'clock			--
Display Viewing Area	65.0 (W) x 16.0 (H)			mm
Display Active Area	56.21 (W) x 11.50 (H)			mm
Character Size	2.96 (W) x 5.56 (H)			mm
Character Pitch	3.55 (W) x 5.94 (H)			mm
Dot Size	0.56 (W) x 0.60 (H)			mm
Dot Pitch	0.60 (W) x 0.70 (H)			mm
LED Backlight Color	White			
LED Backlight Input	DC +3.3V	V	60	mA
LED Backlight Life Time	10,000			HRS

2. Mechanical Diagram
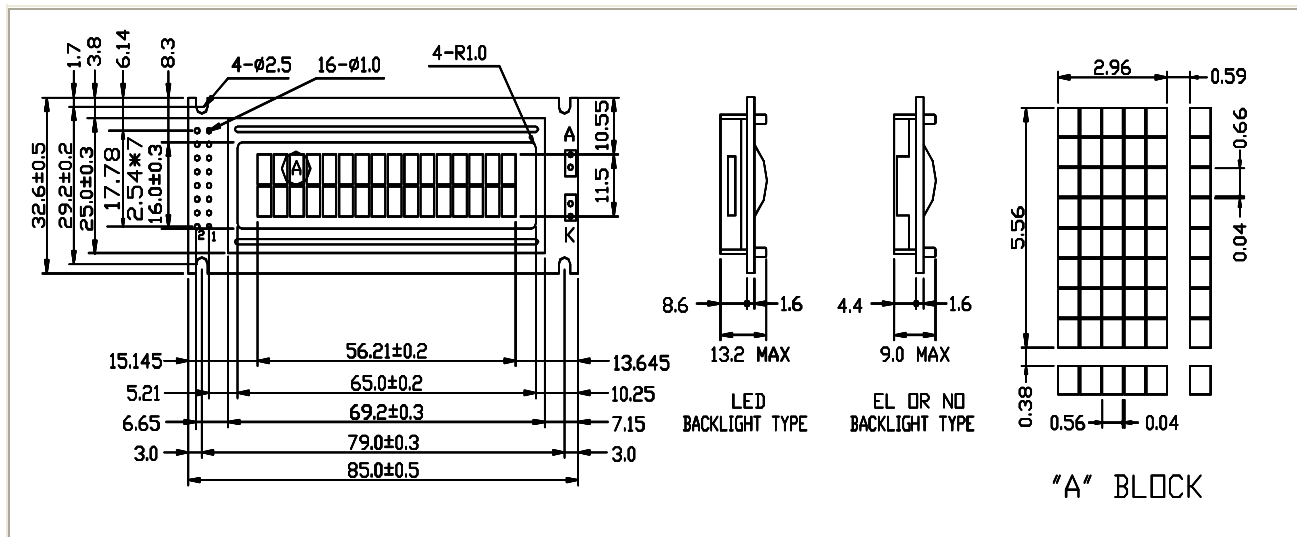
3. Interface Pin Connections

NO	SYMBOL	LEVEL	FUNCTION
1	VSS	--	GND (0V)
2	VDD	H/L	DC +5V
3	VO	H/L	Contrast Adjustment
4	R/S	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
15	A (+)	DC +5V	LED Backlight (+)
16	K (-)	0V	LED Backlight (-)

4. Block Diagram
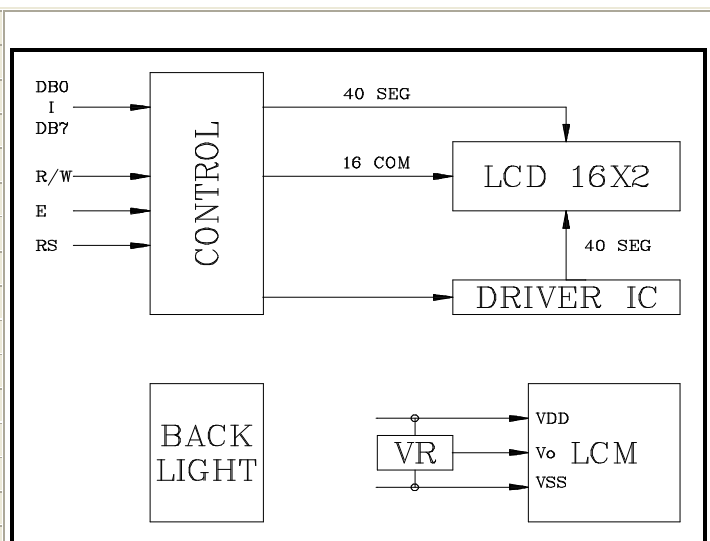
5. Absolute Maximum Ratings

ITEM	SYMBOL	MIN	TYPE	MAX	UNIT
Operating Temperature	TOP	0	--	+50	℃
Storage Temperature	TST	-10	--	+60	℃
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 your are grounded when handling LCM				

6. Electrical Characteristics

ITEM	SYMBOL	CONDITION	MIN	TYPE	MAX	UNIT
Supply Voltage for logic	VDD - VSS	--	4.5	5.0	5.5	V
Supply Voltage	VDD - VO	Ta = 0℃ Ta = 25℃ Ta = 50℃	-- -- --	4.8 4.4 4.1	-- -- --	V V 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	SYMBOL	CONDITION	MIN	TYPE	MAX	UNIT
Viewing Angle (V)	?	CR? 2	-10	--	40	deg
Viewing 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 Ratio	Viewing Angle
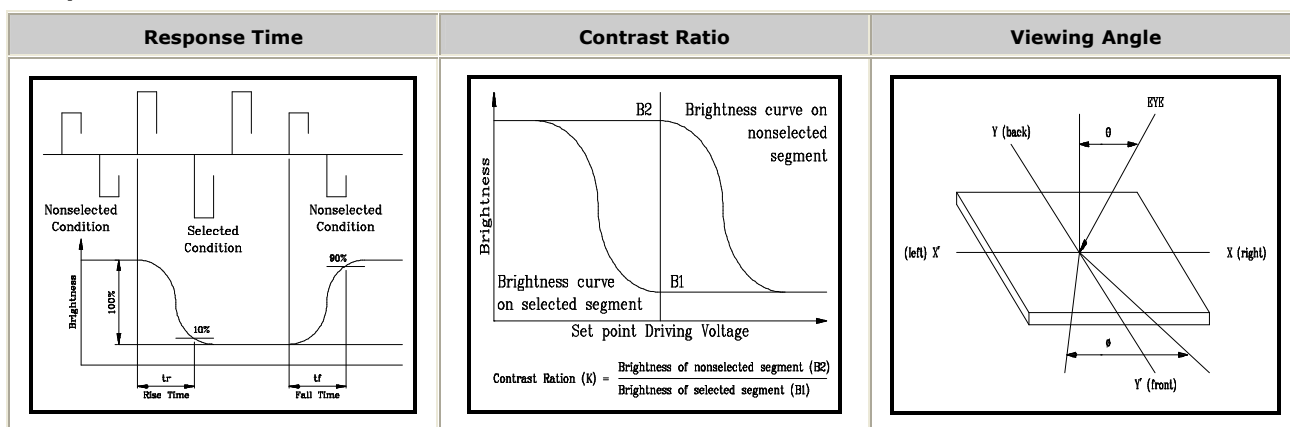
9. Display Address

	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
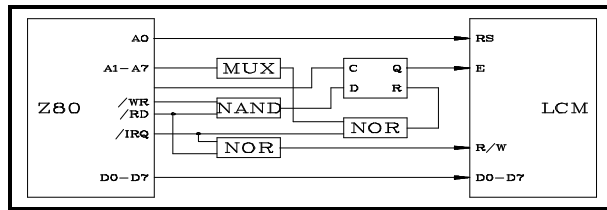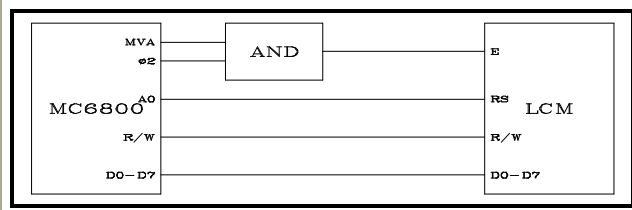
10.3 Interface to 4-bit CPU (HMCS43C)	10.4 Interface to HD6805 MP
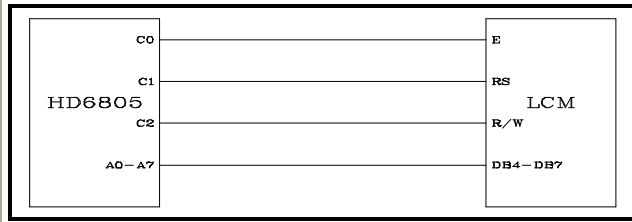
11. Timing Control

11.1 Write and Read Operation

Write Operation	Read Operation
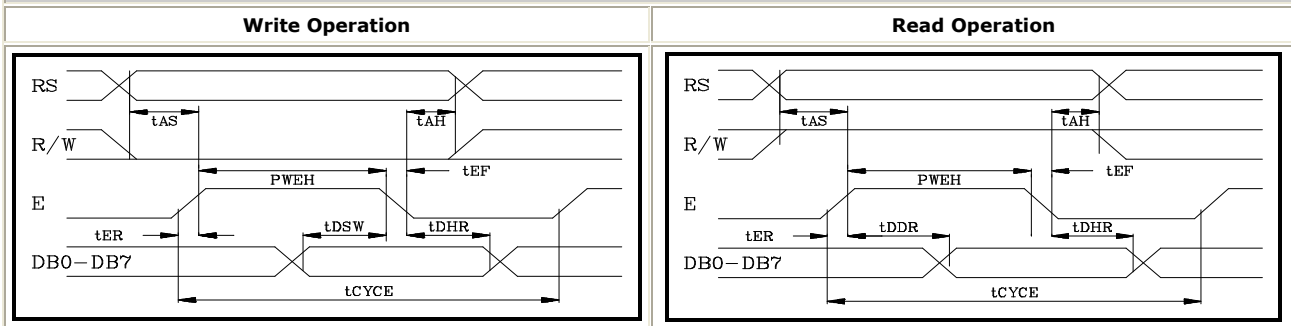
ITEM	SYMBOL	LIMIT (MIN)	LIMIT (MAX)	UNIT
Enable Cycle Time	tCYCE	1000	--	Ns
Enable Pulse Width (High Level)	PWEH	450	--	Ns
Enable Rise/Fall Time	tER, tEF	--	25	Ns
Address Set-Up Time (RS, R/W, E)	tAS	100	--	Ns
Address Hold Time	tAH	10	--	Ns
Data Set-Up Time	tDSW	100	--	Ns
Data Delay Time	tDDR	--	190	Ns
Data Hold Time	tDHR	20	--	ns

8-bit busy flag check timing

RS / R/W / E / Internal / DB7

Instruction Write | Flag check | Flag check | Flag check | Instruction Write

Data | Busy | Busy | No Busy | Data

4-bit busy check timing

RS / R/W / E / Internal / DB7

IR7 IR3 | Busy AC3 | No Busy AC3 | D7 D3

Instruction Write | Flag check | Flag check | Instruction Write
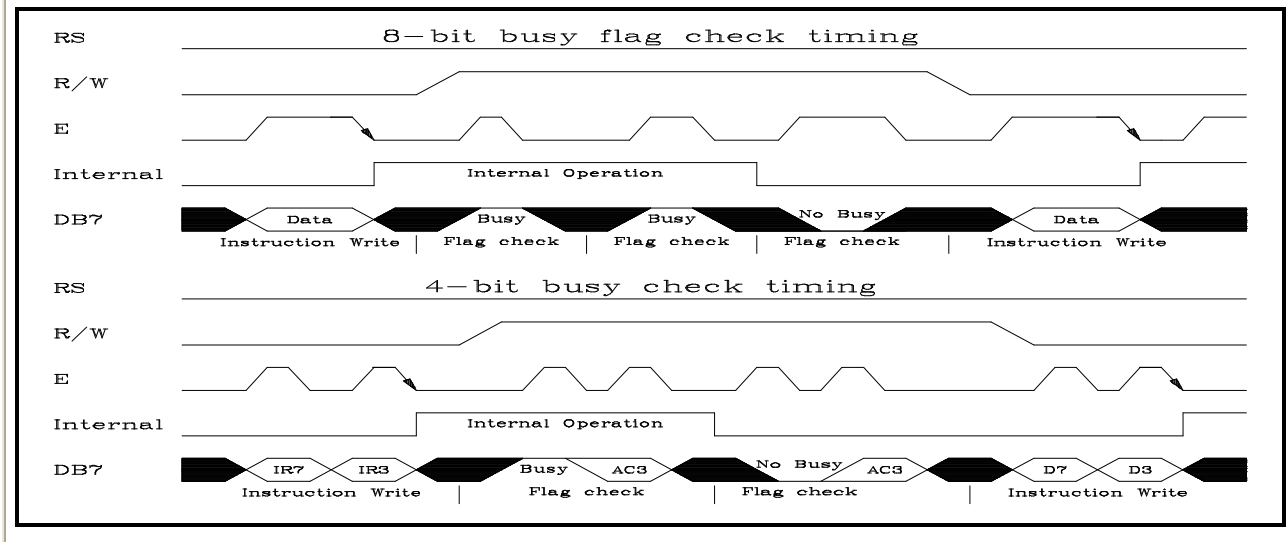
12. Initialization of LCM

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

Vcc   0.2V   4.5V   trcc   toff
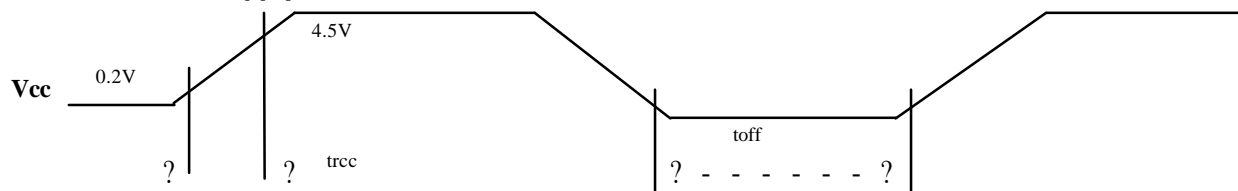
(Note 1) 10 ms ? trcc ? 0.1 ms , toff ? 1 ms.

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

ITEM	SYMBOL	TEST COND.	LIMIT (MIN)	LIM (MAX)	UNIT
Power Supply Rise Time	trcc	--	0.1	10	ms
Power Supply Off Time	toff	--	1	--	ms

1) 8 Bit Interface

Power ON

Wait 40 ms or more after VDD reaches 4.5V

Busy flag can't be reached
Function set: 8bits

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	1	*	*	*	*

Wait 4.1 ms or more

Busy flag can't be reached
Function set: 8bits

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	1	*	*	*	*

Wait 100 μs or more

Busy flag can't be reached
Function set: 8bits

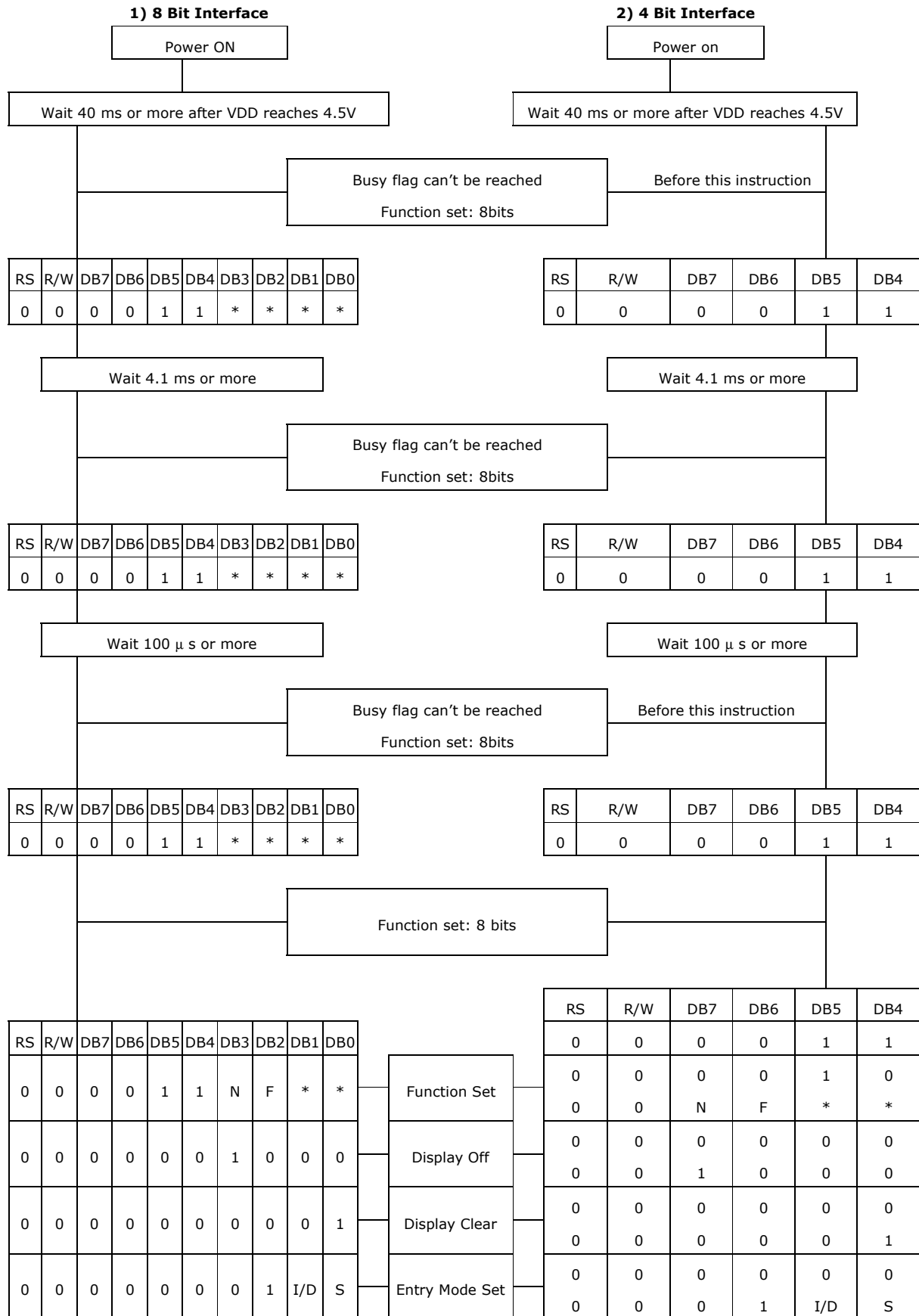| RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	1	*	*	*	*

Function set: 8 bits

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
0	0	0	0	1	1	N	F	*	*	Function Set	
0	0	0	0	0	0	1	0	0	0	Display Off	
0	0	0	0	0	0	0	0	0	1	Display Clear	
0	0	0	0	0	0	0	1	I/D	S	Entry Mode Set	

2) 4 Bit Interface

Power on

Wait 40 ms or more after VDD reaches 4.5V

Before this instruction

RS	R/W	DB7	DB6	DB5	DB4
0	0	0	0	1	1

Wait 4.1 ms or more

RS	R/W	DB7	DB6	DB5	DB4
0	0	0	0	1	1

Wait 100 μs or more

Before this instruction

RS	R/W	DB7	DB6	DB5	DB4
0	0	0	0	1	1

RS	R/W	DB7	DB6	DB5	DB4
0	0	0	0	1	1
0	0	0	0	1	0
0	0	N	F	*	*
0	0	0	0	0	0
0	0	1	0	0	0
0	0	0	0	0	0
0	0	0	0	0	1
0	0	0	0	0	0
0	0	0	1	I/D	S

- Busy flag is checked after instructions are completed. If busy flay isn't checked, the waiting time between instructions should be longer than execution time of these instructions.

13. Instructions Set

FUNCTION	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	DESCRIPTION	Execution Time (max) (when fcp or fosc is 250 KHz)
Clear Display	0	0	0	0	0	0	0	0	0	1	Clears entire display and sets DD RAM address 0 in address counter	1.64 ms
Return Home	0	0	0	0	0	0	0	0	1	*	Sets DD RAM address 0 in address counter. Also returns display being shifted to original position. DD RAM contents remain unchanged	1.64 ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Sets cursor move direction and specifies shift of display. These operations are performed during data write and read.	40 μ 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.	40 μ 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.	40 μ s
Function Set	0	0	0	0	1	DL	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.	40 μ s
Set CG RAM Address	0	0	0	1	ACG						Set CG RAM address. CG RAM data is sent and received after this setting.	40 μ s
Set DD RAM Address	0	0	1	ADD							Set DD RAM address. DD RAM data is sent and received after this setting	40 μ s
Read Busy Flag & Address	0	1	BF	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.	40 μ s
Read Data for CG/DDRAM	1	1	READ DATA								Read data from DD RAM or CG RAM	40 μ s

14. User Font Patterns (CD ROM 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
			0 0 0	x x x	1	1	1	1	0
			0 0 1	x x x	1	0	0	0	1
			0 1 0	x x x	1	0	0	0	1
0 0 0 0 x 0 0 0		0 0 0	0 1 1	x x x	1	1	1	1	0
			1 0 0	x x x	1	0	1	0	0
			1 0 1	x x x	1	0	0	1	0
			1 1 0	x x x	1	0	0	0	1
			1 1 1	x x x	0	0	0	0	0
			0 0 0	x x x	1	0	0	0	1
			0 0 1	x x x	0	1	0	1	0
			0 1 0	x x x	1	1	1	1	1
0 0 0 0 x 0 0 1		0 0 1	0 1 1	x x x	0	0	1	0	0
			1 0 0	x x x	1	1	1	1	1
			1 0 1	x x x	0	0	1	1	0
			1 1 0	x x x	0	0	1	0	0
			1 1 1	x x x	0	0	0	0	0
----------------		----------------		--------------------------------					
			0 0 0						
			0 0 1						
			0 1 0						
0 0 0 0 x 1 1 1		1 1 1	0 1 1						
			1 0 0						
			1 0 1						
			1 1 0						
			1 1 1						

15. Software Example
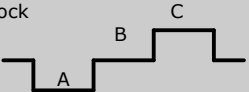
15.1 8-bit operation (8 bits 2 lines)

FUNCTION	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	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	0	1	1	U_	Write "U". Cursor incremented by one and shift to right.
Write data to CG/DD RAM	1	0	0	1	0	0	0	1	0	0	UTC_	Write "T" and "C".
	1	0	0	1	0	0	0	1	0	1		
	1	0	0	1	0	0	0	0	1	1		
Set DD RAM	0	0	1	1	0	0	0	0	0	0	UTC _	Set RAM address so that the cursor is propositioned at the head of the second line.
Write data to CG/DD RAM		*									UTC TR_	Write "T", and "R".
		*										
Cursor or display shift	0	0	0	0	0	1	0	0	x	x	UTC TR	Shift only the cursor position to the left.
Write data to CG/DD RAM		*									UTC TECH_	Write "ECH"
		*										
Entry Mode Set	0	0	0	0	0	0	0	1	1	1	UTC TECH_	Set display mode shift at the time during writing operation.
Write data to CG/DD RAM	1	0	0	1	1	1	1	0	0	0	UTC TECH x_	Write " x". Cursor incremented by one and shift to right. (The display moves to left)
Write data to CG/DD RAM		*										Write other characters.
		*										
Return Home	0	0	0	0	0	0	0	0	1	0	UTC TECH	Return both display and cursor to the original position (Set address to zero).

15.2 4-bit operation (4-bit, 1 line)

FUNCTION	RS	R/W	DB7	DB6	DB5	DISPLAY	DESCRIPTION
Power on delay							Initialization. No display appears.
Function set	0	0	0	0	1	0	Sets to 4-bit operation. In this case, operation is handled as 8-bits by initialization, and only this instruction completes with one write.
Function set	0 0	0 0	0 0	0 0	1 x	0 x	Sets 4-bit operation and selects 1-line display and 5x7 dot character font on and resetting is needed. (Number of display lines and character fonts cannot be changed hence after).
Display ON/OFF Control	0 0	0 0	0 1	0 1	0 1	_	Turn on display and cursor.
Entry Mode Set	0 0	0 0	0 0	0 1	0 1	_	Set mode to incremented 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 1	0 0	0 0	1 0	0 1	S_	Write "S". Cursor incremented by one and shift to right.
Same as 8-bit operation							

16. 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 Life		50,000 Hours	50,000 Hours	50,000 Hours	50,000 Hours

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

17. Function Test & Inspection Criteria

17.1 Sample plan

Sample plan according to MIL-STD-105D level 2, and acceptance/rejection criteria is.
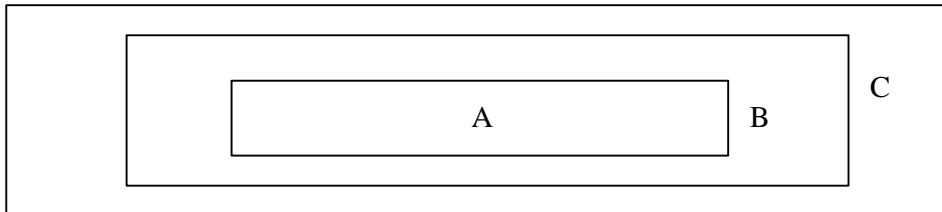
Base on: Major defect: AQL 0.65   Minor defect: AQL 2.5

17.2 Inspection condition

Viewing distance for cosmetic inspection is 30cm with bare eyes, and under an environment of 800 lus (20W) light intensity.

All direction for inspecting the sample should be within 45˚against perpendicular line.

17.3 Definition of Inspection Zone in LCD

```
┌─────────────────────────────────────────────────┐
│  ┌──────────────────────────────────────┐        │
│  │     ┌────────────────────────┐        │   C    │
│  │     │           A            │   B    │        │
│  │     └────────────────────────┘        │        │
│  └──────────────────────────────────────┘        │
└─────────────────────────────────────────────────┘
```

Zone A :   Character / Digit area

Zone B :   Viewing area except Zone A (Zone A + Zone B = minimum Viewing area)

Zone C :   Outside viewing area (invisible area after assembly in customer's product)

Note :   As a general rule, visual defects in Zone C are permissible, when it is no trouble for quality and assembly of

customer's product.

17.4 Major Defect

All functional defects such as open (or missing segment), short, contrast differential, excess power consumption, smearing,

leakage, etc. and overall outline dimension beyond the drawing. Are classified as major defects.

17.5 Minor Defect

Except the Major defects above, all cosmetic defects are classified as minor defects.

NO.	Item to be Inspected	Inspection Standard					Classification of defects
1	Spot defect (Defects in spot from)	Zone size (mm)	Acceptable Qty				Minor
			A	B	C		
		$F ? 0.15$	Acceptable (clustering of spot not allowed)		Acceptable		
		$0.15 ? F ? 0.20$	1	2			
		$0.20 ? F ? 0.25$	0	1			
		$F > 0.25$	0	0			
		Remarks : for dark/white spot, size F is defined as $F = 1/2(X+Y)$					
2	Line defect (Defects in line form)	Size (mm)		Acceptable Qty			Minor
		L	W	Zone			
				A	B	C	
		Acceptable	$W ? 0.02$	Acceptable		Acceptable	
		$L ? 3.0$	$W ? 0.03$	2			
		$L > 2.5$	$W ? 0.03$	0			
		$L ? 3.0$	$0.03 < W ? 0.05$	2			
		$L > 2.5$	$0.03 < W ? 0.05$	0			
			$W > 0.05$	Counted as spot defect (Follows item 17.5.1)			
		Remarks: The total of spot defect and line defect shall not exceed four.					
3	Orientation defect (such as misalignment of L/C)	Not allowed inside viewing area (Zone A or Zone B)					Minor
4	Polarizing	17.5.4.1 Polarizer Position 1. Shifting in position should not exceed the glass outline dimension. 2. Incomplete covering of the viewing area due to Shifting is not allowed.					Minor
		17.5.4.2 Scratches, bubble or dent on Glass/Polarizer/Reflector, Bubble between Polarizer & Reflector/Glass:					
		Size (mm)	Acceptable Qty				
			Zone				
			A	B	C		
		$F ? 0.20$	Acceptable		Acceptable		
		$0.20 < F ? 0.50$	3				
		$0.50 < F ? 1.00$	2				
		$F > 1.00$	0				

18. Character Generator ROM Map

CHARACTER PATTERN CHART (5X7 DOTS + CURSOR)																
Higher 4 bit		Upper 4-bit (D4 to D7) of Character Code (Hexadecimal)														
Lower 4 bit		0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
XXXX0000	CG RAM (1)				0	@	P	`	p				—	タ	ミ	W	p
XXXX0001	(2)			!	1	A	Q	a	q				ロ	ア	チ	ム	ä	q
XXXX0010	(3)			"	2	B	R	b	r				「	イ	ツ	メ	ß	θ
XXXX0011	(4)			#	3	C	S	c	s				」	ウ	テ	モ	ε	∞
XXXX0100	(5)			$	4	D	T	d	t				、	エ	ト	ヤ	μ	Ω
XXXX0101	(6)			%	5	E	U	e	u				・	オ	ナ	ユ	σ	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	ク	ネ	リ	√	X
XXXX1001	(2)			)	9	I	Y	i	y				ウ	ケ	ノ	ル	¨	y
XXXX1010	(3)			*	:	J	Z	j	z				エ	コ	ハ	レ	j	千
XXXX1011	(4)			+	;	K	[	k	{				オ	サ	ヒ	ロ	×	万
XXXX1100	(5)			,	<	L	¥	l	|				ヤ	シ	フ	ワ	¢	円
XXXX1101	(6)			-	=	M	]	m	}				ユ	ス	ヘ	ン	£	÷
XXXX1110	(7)			.	>	N	^	n	→				ヨ	セ	ホ	゛	ñ	
XXXX1111	(8)			/	?	O	_	o	←				ツ	ソ	マ	゜	ö	█

CG RAM is character generator RAM having a character pattern storage function, which enables the user to change easily.