OPTIONS & SELECTION GUIDES

TN (Twisted Nematic)

STN (Super Twisted Nematic)
- STN type offers high contrast and wide viewing angle.
- STN type is available with different background colors;
- Yellow-green w/black characters
- Silver-gray w/dark blue characters
- Dark blue w/white characters

FSTN (Film STN)
- Black and white STN with very high contrast ratio for large graphic panels.

TEMPERATURE RANGE

	OPPERATION (°C)	STORAGE (°C)
STANDARD	0 ~ +50	-20 ~ +70
EXTENDED	-20 ~ +70	-30 ~ +80

BACK LIGHT

EL (Electro- luminescent)
- Power efficient

LED with a choice of colors
- Bright and even back lighting
- Long life expectancy, more than 100,000 hours
- Simple to drive. Needs +5 volts only
- Brightness can be easily adjusted

CCFL (Cold Cathode Florescent Light)
- Paper white, best for large graphic displays
- Less power consumption than LED's

DISPLAY TYPE
- Positive image (Dark dots on light background)
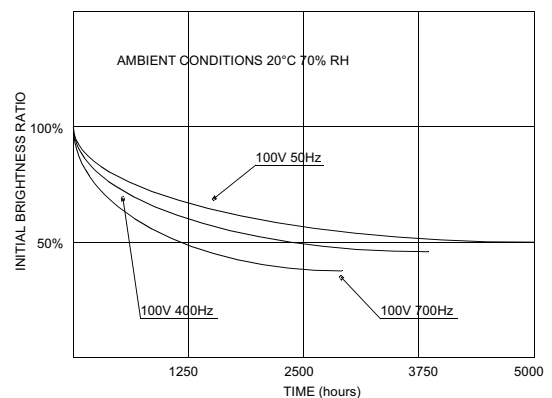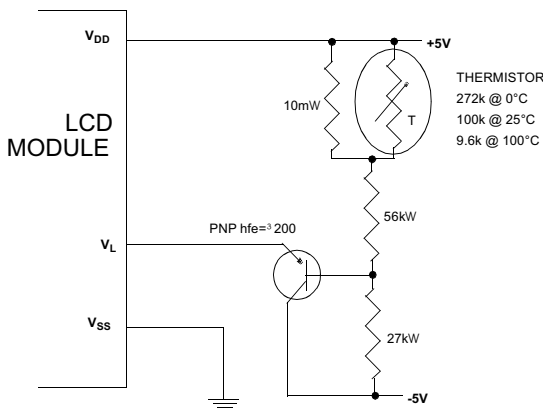- Negative image (Light dots on dark background)

VIEWING ANGLE
- 12:00 (Top) Display is below eye level
- 6:00 (Bottom) Display is above eye level

SELECTION GUIDE

DISPLAY/POLORIZER	DISPLAY DESCRIPTION	OUTDOORS	OFFICE LIGHT	SUBDUED LIGHT	VERY LOW LIGHT	COMMENTS
REFLECTIVE POSITIVE	DARK CHARACTERS ON A LIGHT GREY OR YELLOW BACKGROUND	EXCELLENT	VERY GOOD	POOR	UNUSABLE	CAN'T BE BACK LIT
TRANSFLECTIVE POSITIVE	DARK CHARACTERS ON A LIGHT GREY OR YELLOW BACKGROUND	EXCELLLENT	VERY GOOD	VERY GOOD	EXCELLENT	BEST CHOICE FOR GENERAL USE
TRANSMISSIVE NEGATIVE	LIGHT CHARACTERS ON A DARK BACKGROUND	POOR	GOOD	VERY GOOD	EXCELLENT	MUST BE USED WITH A BACK-LIGHT
TRANSMISSIVE POSITIVE	DARK CHARACTERS ON A LIGHT GRAY OR YELLOW BACKGROUND	GOOD	VERY GOOD	EXCELENT	EXCELLENT	HIGH CONTRAST DISPLAY

TEMPERATURE COMPENSATION & EL LIFE TIME

8. NT7605 Series Commands

Command	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Function
			Command Code								
(1)Display Clear	0	0	0	0	0	0	0	0	0	1	Clear entire display area, Restore display from shift, and load address counter with DD RAM address 00H.
(2)Display/Cursor Home	0	0	0	0	0	0	0	0	1	*	Restore display from shift and load address counter with DD RAM address 00H.
(3)Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Specify direction of cursor movement and display shift mode. This operation takes place after each data transfer (read/write).
(4)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).
(5)Display/Cursor Shift	0	0	0	0	0	1	S/C	R/L	*	*	Shift display or move cursor.
(6)Function Set	0	0	0	0	1	DL	N	F	*	*	Set interface data length (DL) number of display line (N),and character font (F).
(7)RAM Address Set	0	0	0	1	(		ACG			)	Load the address counter with a CG RAM address. Subsequent data access is for CG RAM data.
(8)DD RAM Address Set	0	0	1	(			ADD			)	Load the address counter with a DD RAM address. Subsequent data access is for DD RAM data.
(9)Busy Flag/Address Counter Read	0	1	BF	(			AC			)	Read Busy Flag (BF) and contents of Address Counter (AC).
(10)CG RAM/DD RAM Data Write	1	0	(			Write data				)	Write data to CG RAM or DD RAM.
(11)CG RAM/DD RAM Data Read	1	1	(			Read data				)	Read data to CG RAM or DD RAM.

I/D=1: Increment	I/D=0: Decrement	DD RAM :Display Data RAM
S=1: Display Shift ON		CG RAM :Character Generator RAM
D=1: Display ON		ACG :Character Generator RAM Address
C=1: Cursor Display ON		ADD :Display Data RAM Address
B=1: Cursor Blink ON		AC : Address Counter
S/C=1: Shift Display	S/C=0: Move Cursor	
R/L=1: Shift Right	R/L=0: Shift Left	
DL=1: 8—Bit	DL=0: 4—Bit	
N=1: Dual Line	N=0: Signal Line	
F=1: 5X10 Dots	F=0: 5X8 Dots	
BF=1: Internal Operation	BF=0: Ready for Instruction	

Note 1: Symbol "*" signifies an insignificant bit (disregard).

Note 2: Correct input value for "N" is predetermined for each model.

CHARACTER MODULE INITIALIZATION

Internal Reset Circuit

The module is automatically initialized when the power is applied. The following commands are executed during initialization. The busy flag is kept in the busy state until initialization is complete. The busy state lasts for 10 ms after V_{DD} reaches 4.5 volts.
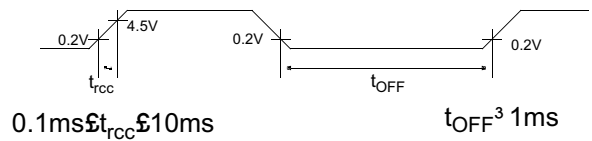
> 1) Clear Display
> 2) Function set
>   DL=1.......8-bit data length for interface
>   N=0.........Single-line display
>   F=0.........5x7 dot matrix character font
> 3) Display ON/OFF Control
>   D=0........Display OFF
>   C=0........Cursor OFF
>   B=0........Blink function OFF
> 4) Entry Mode Set
>   I/D=1......Increment Mode
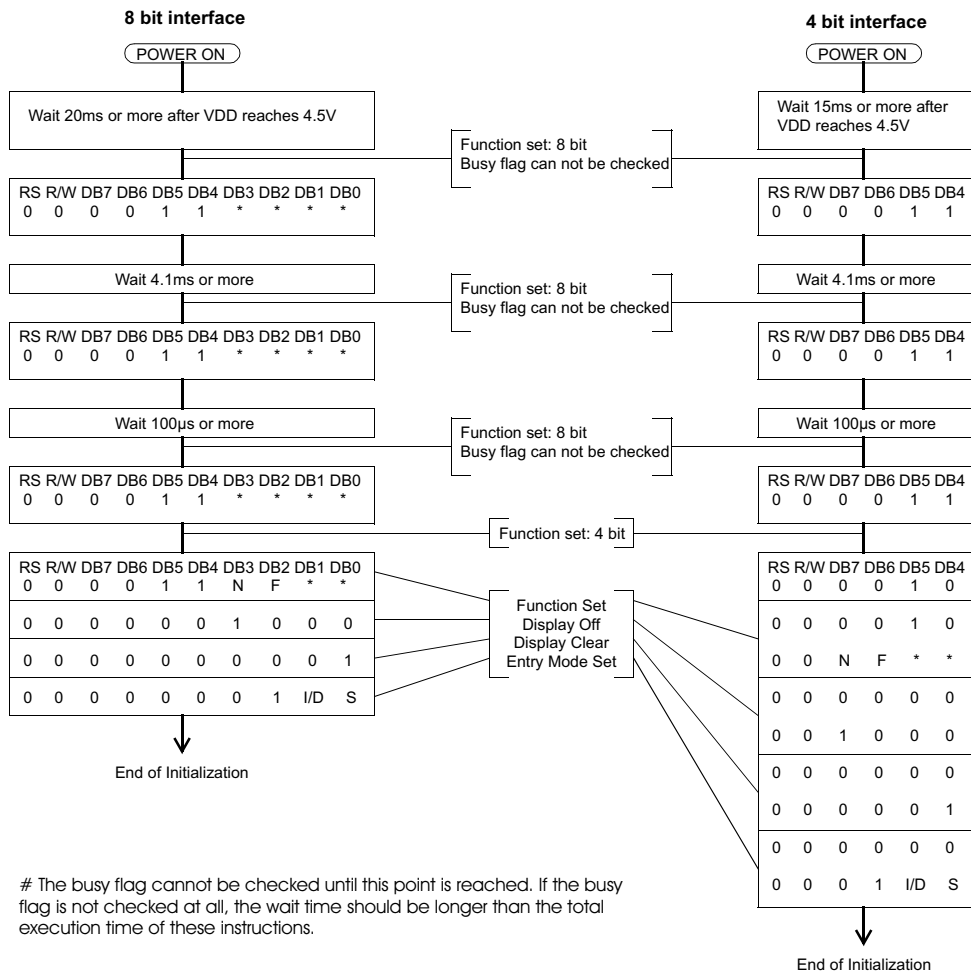>   S=0........Display shift OFF

NOTE:
If the following power conditions are not satisfied, the internal reset circuit does not function properly. In this case, the initialization should be executed by the series of instructions from outside the MPU (Software Initialization).

Power Conditions for Internal Reset

ITEM	SYMBOL	MIN	TYP	MAX	UNIT
Power Supply Rise Time	trcc	0.1	-	10	ms
Power Supply Off Time	tOFF	1.0	-	-	ms

$0.1ms \le t_{rcc} \le 10ms$　　　　$t_{OFF} \ge 1ms$

Software Initialization

8 bit interface

POWER ON

Wait 20ms or more after VDD reaches 4.5V

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

— Function set: 8 bit / Busy flag can not be checked

Wait 4.1ms or more

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

— Function set: 8 bit / Busy flag can not be checked

Wait 100µs or more

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

— Function set: 8 bit / Busy flag can not be checked

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	1	N	F	*	*
0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	1	I/D	S

Function Set
Display Off
Display Clear
Entry Mode Set

End of Initialization

The busy flag cannot be checked until this point is reached. If the busy flag is not checked at all, the wait time should be longer than the total execution time of these instructions.

4 bit interface

POWER ON

Wait 15ms or more after VDD reaches 4.5V

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

Wait 4.1ms or more

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

Wait 100µs or more

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

— Function set: 4 bit

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

End of Initialization

DISPLAY CHARACTER POSITION AND CHARACTER ADDRESS

1) 8 x 1: HDM08111H-1

	1	2	3	4	5	6	7	8	← DISPLAY POSITION
FIRST LINE	00	01	02	03	04	05	06	07	← DD RAM ADDRESS

2) 8 x 2: HDM08216H-1, HDM08216H-3, HDM08216L-3

	1	2	3	4	5	6	7	8	← DISPLAY POSITION
FIRST LINE	00	01	02	03	04	05	06	07	DD RAM ADDRESS
SECOND LINE	40	41	42	43	44	45	46	47	

3) 12 x 2: HDM12216H, HDM12216L

	1	2	3	4	5	6	7	8	9	10	11	12	← DISPLAY POSITION
FIRST LINE	00	01	02	03	04	05	06	07	08	09	0A	0B	DD RAM ADDRESS
SECOND LINE	40	41	42	43	44	45	46	47	48	49	4A	4B	

4) 16 x 1: HDM16116H-L, HDM16116L-L

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	← DISPLAY POSITION
FIRST LINE	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	← DD RAM ADDRESS

5) 16 x 1: HDM16116H-2, HDM16116L, HDM16116L-7

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	← DISPLAY POSITION
FIRST LINE	00	01	02	03	04	05	06	07	40	41	42	43	44	45	46	47	← DD RAM ADDRESS

6) 16 x 2: HDM16216H-2, HDM16216H-4, HDM16216H-5, HDM16216H-B, HDM16216H-S
HDM16216L-2, HDM16216L-5, HDM16216L-6, HDM16216L-7, HDM16216L-B, HDM16216L-S

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

7) 16 x 4: HDM16416H, HDM16416L

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	← DISPLAY POSITION
FIRST LINE	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	
SECOND LINE	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	DD RAM ADDRESS
THIRD LINE	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F	
FORTH LINE	50	51	52	53	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F	

8) 20 x 2: HDM20216H-3, HDM20216H-L, HDM20216L, HDM20216L-L

DISPLAY POSITION / DD RAM ADDRESS

DISPLAY POSITION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
FIRST LINE	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13
SECOND LINE	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	51	52	53

9) 20 x 4: HDM20416H, HDM20416L

DISPLAY POSITION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
FIRST LINE	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13
SECOND LINE	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	51	52	53
THIRD LINE	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F	20	21	22	23	24	25	26	27
FORTH LINE	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F	60	61	62	63	64	65	66	67

10) 24 x 2: HDM24216H-2, HDM24216L-2

DISPLAY POSITION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
FIRST LINE	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13	14	15	16	17
SECOND LINE	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	51	52	53	54	55	56	57

11) 24 x 4: HDM24416H, HDM24416L

DISPLAY POSITION	1	2	3	4	5	6	7	...	21	22	23	24
FIRST LINE	00	01	02	03	04	05	06		14	15	16	17
SECOND LINE	20	21	22	23	24	25	26		34	35	36	37
THIRD LINE	40	41	42	43	44	45	46		54	55	56	57
FORTH LINE	60	61	62	63	64	65	66		74	75	76	77

12) 40 x 1: HDM40108H-2

DISPLAY POSITION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	...	37	38	39	40
FIRST LINE	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E		24	25	26	27

13) 40 x 2: HDM40216H-4, HDM40216L

DISPLAY POSITION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	...	37	38	39	40
FIRST LINE	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E		24	25	26	27
SECOND LINE	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E		64	65	66	67

14) 40 x 4: HDM40416H-5, HDM40416L-4

DISPLAY POSITION	1	2	3	4	5	6	7	...	37	38	39	40
FIRST LINE	00	01	02	03	04	05	06		24	25	26	27
SECOND LINE	40	41	42	43	44	45	46		64	65	66	67
THIRD LINE	00	01	02	03	04	05	06		24	25	26	27
FORTH LINE	40	41	42	43	44	45	46		64	65	66	67

PROCESSOR INTERFACING

8051 CPU ... **LCD MODULE**

$\overline{RD}$
$\overline{WR}$
E

A15
A14
A13

ADDRESS
DECODER

ALE

AD0
AD7

ADDRESS
LATCH

A0
A1

R/S
R/$\overline{W}$
D0
D7

6800 CPU ... **LCD MODULE**

VmA
$\overline{AE}$2
E

A15
A14
A13

ADDRESS
DECODER

R/$\overline{W}$ ... R/$\overline{W}$

D0
D7

D0
D7

A0 ... R/S
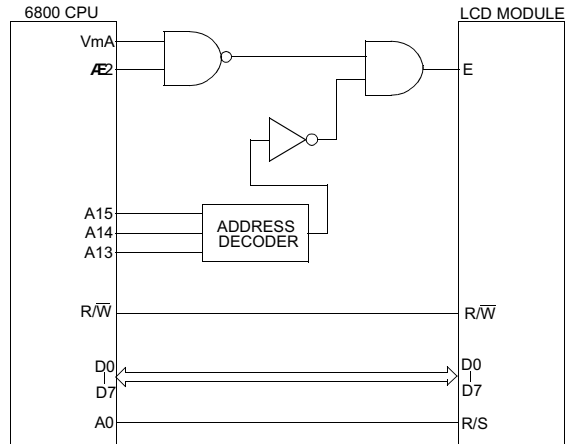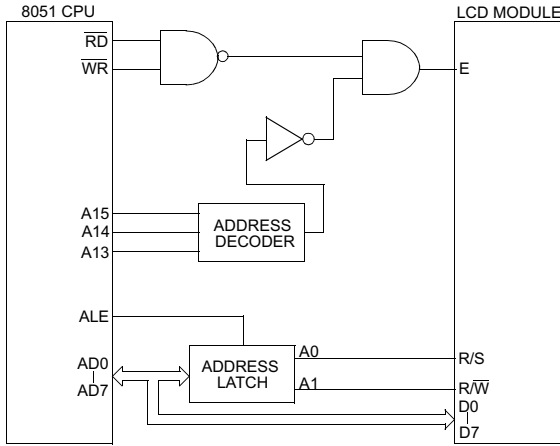
TIMING CHARACTERISTICS

ITEM	SYMBOL	MAX.	MIN.	UNIT
ENABLE CYCLE TIME	T_{CYC}		500	nS
ENABLE PULSE WIDTH	P_W		230	nS
ENABLE RISE/FALL TIME	T_{ER}, T_{EF}	20		nS
RS, R/W SET UP TIME	T_{AS}		40	nS
DATA DELAY TIME	T_{DDR}	360		nS
DATA SETUP TIME	T_{DSW}		60	nS
HOLD TIME	T_H		10	nS

POWER SUPPLY EXAMPLES

V_{DD} +5V
V_L 10-20K
LCD MODULE
V_{SS}
SINGLE POWER

V_{DD} +5V
V_L 10-20K
LCD MODULE
V_{SS}
-5V
DUAL POWER

DATA READ

RS 2.2V 0.6V 2.2V 0.6V

T_{AS} T_H

R/W 2.2V 2.2V

T_H

P_W T_{EF}

E 0.6V 2.2V 2.2V 0.6V

T_{ER}

T_{DDR} T_H

D_0-D_7 2.2V 0.6V VALID DATA 2.2V 0.6V

T_{CYC}

DATA WRITE

RS 2.2V 0.6V 2.2V 0.6V

T_{AS} T_H

R/W 0.6V 0.6V

T_H

P_W T_{EF}

E 0.6V 2.2V 2.2V 0.6V

T_{ER}

T_{DDR} T_{DSW} T_H

D_0-D_7 2.2V 0.6V VALID DATA 2.2V 0.6V

T_{CYC}
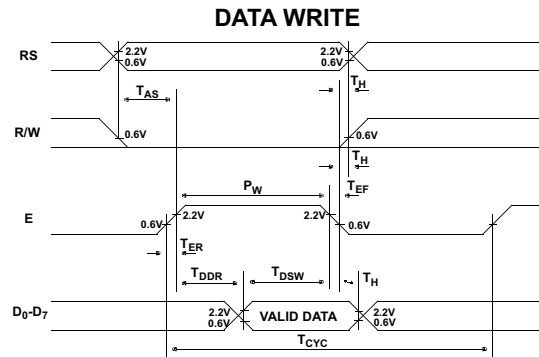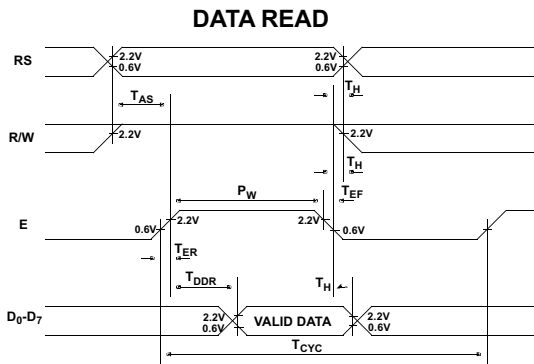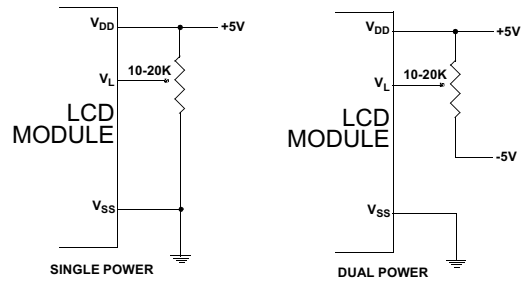
HANDLING LCD'S & LCD MODULES

CLEANING
l   Wipe gently with cotton or soft material soaked in petroleum benzine.

l   Do not use acetone, toluene, ethanol or isopropyl alcohol.

l   Contact with water for a long period of time may damage the display.
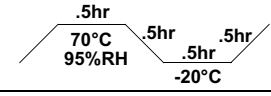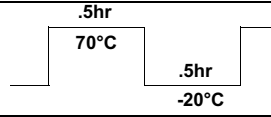
SAFETY
l   The toxicity of liquid crystal fluid is very low, but wash it off immediately with soap and water if fluid touches the skin or clothing.

HANDLING
l   Do not touch display area with bare hands.

l   Do not touch exposed polarizer with hard objects.

l   Do not expose the CMOS IC's to static electricity.

l   Avoid exposing the module to excessive shock or pressure.

l   Do not allow the storage temperature to exceed the specified range.

RELIABILITY DATA

SUMMARY: LIFETIME AND ENVIORNMENTAL TESTS

TEST ITEMS	TEST CONDITIONS	TEST TIME	NUMBR OF UNITS TESTED	FAILURE RATE (%)
TEMPERATURE LIFETIME	60°C, 5V, 32hZ 30°C, 5V, 32hZ	7,000hr 7,000hr	50 50	0 0
HIGH TEMPERATURE	70°C 95°C 60°C	1,000hr 100hr 5,000hr	300 300 300	0 0 0
LOW TEMPERATURE	-40°C -30°C	100hr 1,000hr	300 300	0 0
HIGH TEMPERATURE AND HUMIDITY	70°C, 95%RH 40°C, 95%RH	100hr 500hr	300 300	0 0
TEMPERATURE AND HUMIDITY CYCLE	.5hr / 70°C 95%RH / .5hr / .5hr / .5hr / -20°C	25 CYCLES	50	0
POLARIZER AND REFLECTOR RELIABILITY	70°C, DRY 90°C, DRY	1,000hr 100hr	300 300	0 0
ULTRAVIOLET LIGHT	OUTDOOR EXPOSURE	5,000hr	50	0
HEAT SHOCK	.5hr / 70°C / .5hr / -20°C	25 CYCLES	50	0
VIBRATION	10 - 50Hz, 1g, X,YX,Z DIRECTIONS 51 - 300Hz, 0.5g, X,Y,Z DIRECTIONS	1hr	50	0
MECHANICAL	50g 15ms ± X,Y,Z	3 TIMES EACH	50	0

SUMMARY: LIFE EXPECTANCY

| COMPONENT	TYPICAL LIFETIME
LCD DISPLAY (GLASS ASSEMBLY)	50,000hr (5.7yr)
LCD ELECTRONICS	100,000hr (12yr) min
EL BACK LIGHT	5,000hr (7mo)[1, 2]
CCFL BACK LIGHT	15,000hr (20mo)[2]
LED BACKLIGHT	100,000hr (12yr) min

NOTES:
1. It is recommended that the product be designed so that the EL back light is not left on continuously. This will greatly extend the lifo of the back light element.

2. Usable lifetime of the back light is reached when the light output reaches 50% of the original brightness.

POWER SUPPLY SEQUENCING (Graphics Modules Only)

The power supply voltages should be sequenced according to the following timing diagram. This will insure that the internal electronics have time to begin operation before the negative voltage is applied. The sequence of events should be as follows: Apply V_{DD} first. When V_{DD} is stable at 5v, apply the input signals and then apply V_L/V_{EE}. The shut down sequence is exactly the opposite. Failure to follow this procedure may result in permanent damage to the LCD fluid or to the CMOS electronics on the module.
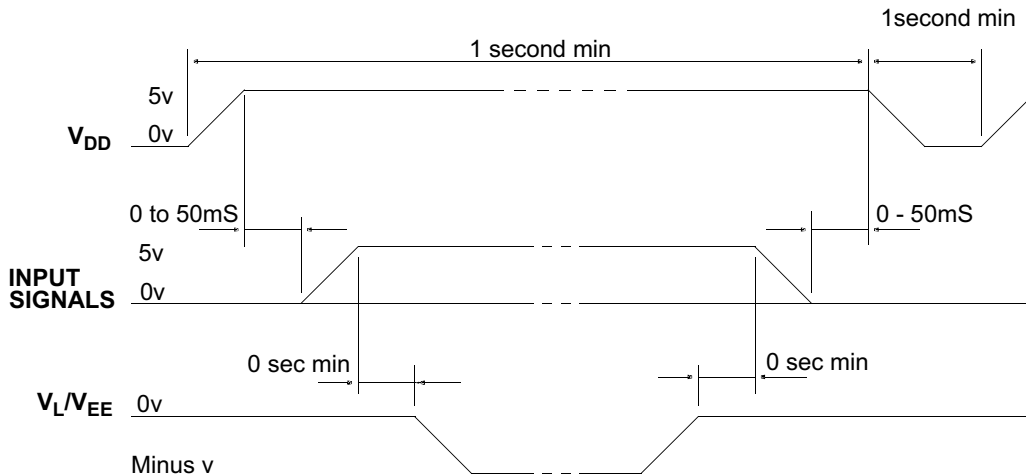
CHARACTER MODULE FONT TABLE (Standard font)

Character modules with built in controllers and Character Generator (CG) ROM & RAM will display 96 ASCII and special characters in a dot matrix format. Then first 16 locations are occupied by the character generator RAM. These locations can be loaded with the user designed symbols and then displayed along with the characters stored in the CG ROM.

CHARACTER FONT TABLE

LOWER 4 BITS \ UPPER 4 BITS	0000	0010	0011	0100	0101	0110	0111	1010	1011	1100	1101	1110	1111
0000	CG RAM (1)		0	@	P	`	p		－	ﾀ	ﾐ	α	p
0001	(2)	!	1	A	Q	a	q	｡	ｱ	ﾁ	ﾑ	ä	q
0010	(3)	"	2	B	R	b	r	｢	ｲ	ﾂ	ﾒ	β	θ
0011	(4)	#	3	C	S	c	s	｣	ｳ	ﾃ	ﾓ	ε	∞
0100	(5)	$	4	D	T	d	t	､	ｴ	ﾄ	ﾔ	μ	Ω
0101	(6)	%	5	E	U	e	u	･	ｵ	ﾅ	ﾕ	σ	Ü
0110	(7)	&	6	F	V	f	v	ｦ	ｶ	ﾆ	ﾖ	ρ	Σ
0111	(8)	'	7	G	W	g	w	ｧ	ｷ	ﾇ	ﾗ	g	π
1000	(1)	(	8	H	X	h	x	ｨ	ｸ	ﾈ	ﾘ	√	x̄
1001	(2)	)	9	I	Y	i	y	ｩ	ｹ	ﾉ	ﾙ	‐	y
1010	(3)	*	:	J	Z	j	z	ｪ	ｺ	ﾊ	ﾚ	j	∓
1011	(4)	+	;	K	[	k	{	ｫ	ｻ	ﾋ	ﾛ	×	万
1100	(5)	,	<	L	¥	l	|	ｬ	ｼ	ﾌ	ﾜ	¢	円
1101	(6)	-	=	M	]	m	}	ｭ	ｽ	ﾍ	ﾝ	£	÷
1110	(7)	.	>	N	^	n	→	ｮ	ｾ	ﾎ	ﾞ	ñ	
1111	(8)	/	?	O	_	o	←	ｯ	ｿ	ﾏ	ﾟ	ö	█