MULTI-INNO TECHNOLOGY CO., LTD.

LCD MODULE SPECIFICATION

Model : MI1602I-G

Revision	
Engineering	
Date	
Our Reference	

MODE OF DISPLAY

Display mode	Display condition	Viewing direction
TN positive	Reflective type	6 O' clock
TN negative	Transflective type	12 O' clock
STN : Yellow green	Transmissive type	3 O' clock
Grey	Others	9 O' clock
Blue (negative)		
FSTN positive		
FSTN negative		

GENERAL DESCRIPTION

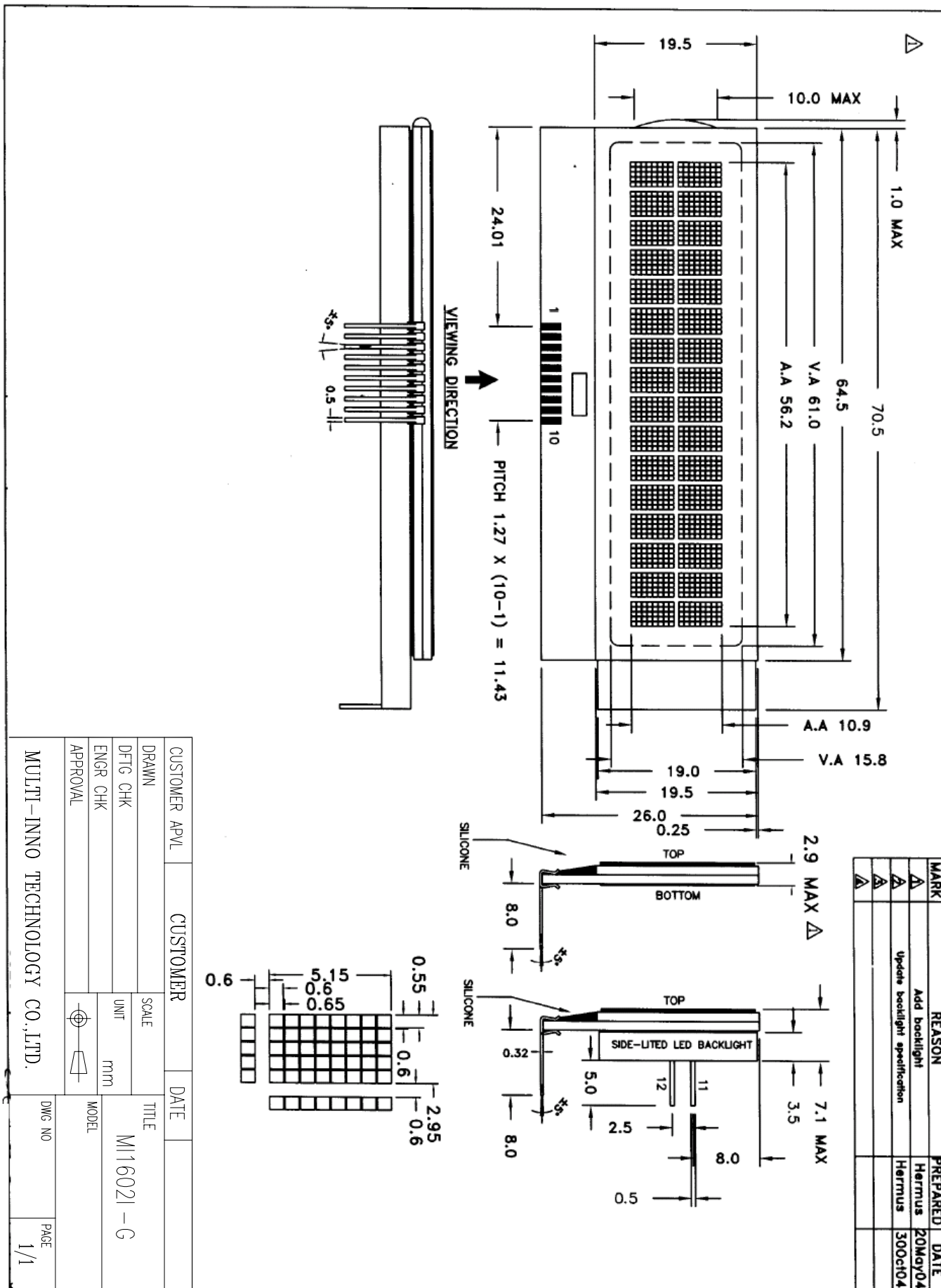|		
Display mode	:	16 characters x 2 lines, COG LCD module.
Interface	:	4 bit parallel
Driving method	:	1/16 duty, 1/5 bias
Controller IC	:	Sunplus SPLC782A or equivalent
		For the detailed information, please refer to the IC specifications.

MECHANICAL DIMENSIONS

Item	Dimension	Unit	Item	Dimension	Unit
Outline Dimension	64.5(L)x26.0(W)x2.8(H)	mm	Character Pitch	3.55 (L)x 5.75W)	mm
Viewing Area	61.0(L)x15.8(W)	mm	Dot Size	0.55(L)x0.6(W)	mm
Character Size	2.95 (L)x5.15 (W)	mm			

CONNECTOR PIN ASSIGNMENT

Pin No.	Signal	Function	Pin No.	Signal	Function
1	DB7	DATA BUS	6	RW	READ/WRITE SELECT
2	DB6	DATA BUS	7	RS	REGISTER SELECT
3	DB5	DATA BUS	8	VPP	POWER SUPPLY FOR LCD
4	DB4	DATA BUS	9	VDD	POWER SUPPLY FOR LOGIC
5	E	ENABLE SIGNAL	10	VSS	GROUND (0V)

COUNTER DRAWING OF MODULE DIMENSION

COUNTER DRAWING OF PIN OUT & BLOCK DIAGRAM

BLOCK DIAGRAM

(1) DB7
(2) DB6
(3) DB5
(4) DB4
(5) E
(6) RW
(7) RS
(8) VO
(9) VDD.
(10) VSS
*(11) K
*(12) A

Note (*): Pin11,12 are used for backlight version

SIDE-LITED LED BACKLIGHT

COMMON 1-16

LCD 1-80

SPLC782A OR EQUIVALENT

SEG
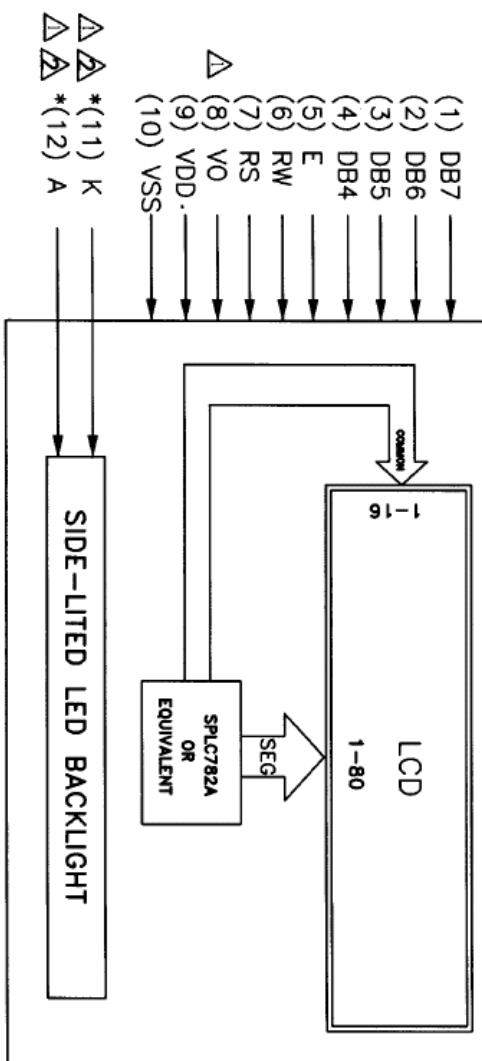
PIN NUMBER	SYMBOL	FUNCTION
1.	DB7	DATA BUS
2.	DB6	DATA BUS
3.	DB5	DATA BUS
4.	DB4	DATA BUS
5.	E	ENABLE SIGNAL
6.	RW	READ/WRITE SELECT
7.	RS	REGISTER SELECT
8.	VO	INPUT VOLTAGE FOR LCD
9.	VDD	SUPPLY VOLTAGE FOR LOGIC
10.	VSS	GROUND
*11.	K	Supply Voltage for Backlight (-VE)
*12.	A	Supply Voltage for Backlight (+VE)

CUSTOMER APVL		CUSTOMER		
DRAWN		SCALE		
DFTG CHK		UNIT	mm	
ENGR CHK		MODEL		
APPROVAL		TITLE	MI1602I-G	
		DWG NO		
		DATE		PAGE 1/1

MULTI-INNO TECHNOLOGY CO.,LTD.

ELECTRICAL CHARACTERISTICS

Conditions: VSS=0V, Ta=25

Item	Symbol	MIN.	TYP.	MAX.	Unit	Item	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage for Logic	V_{DD}	4.75	5.0	5.25	V	"H"Level Input Voltage	V_{IH}	0.7VDD		VDD	V
Supply Current for Logic	I_{DD}		0.8		mA	"L"Level Input Voltage	V_{IL}	-0.3		0.55	V
Input Voltage for LCD	VO		4.5		V						
EL Backlight Voltage (V$_{EL}$)											
EL (@ Frequency 400Hz)	V_{BL}				Vrms						
Side-lited LED Backlight Forward Voltage (V$_F$)						**Side-lited LED Backlight Forward Current (I$_F$)**					
White (Current @40mA)	V_{BL}		3.5	4.3	V	White	I_{BL}		40		mA
Blue (Current @40mA)	V_{BL}		3.3	4.0	V	Blue	I_{BL}		40		mA
Yellow Green (Current @40mA)	V_{BL}		5.0		V	Yellow Green	I_{BL}		40		mA
Array LED Backlight Forward Voltage (V$_F$)						**Array LED Backlight Forward Current (I$_F$)**					
Yellow Green	V_{BL}				V	Yellow Green	I_{BL}				mA
Amber	V_{BL}				V	Amber	I_{BL}				mA
Orange	V_{BL}				V	Orange	I_{BL}				mA
Soft Orange	V_{BL}				V	Soft Orange	I_{BL}				mA

ABSOLUTE MAXIMUM RATINGS

Please make sure not to exceed the following maximum rating values under the worst application conditions

Item	Symbol	Rating (for normal temperature)	Rating (for wide temperature)	Unit
Supply Voltage	V_{DD}	-0.3 to 7.0	-0.3 to 7.0	V
Input Voltage	V_{IN}	-0.3 to V_{DD}+0.3	-0.3 to V_{DD}+0.3	V
Operating Temperature	T_{opr}	0 to 50	-20 to 70	
Storage Temperature	T_{stg}	-10 to 60	-30 to 80	

INSTRUCTION TABLE

Instruction	Instruction Code										Description	Execution time (fosc = 270KHz)
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM and set DDRAM address to "00H" from AC	1.52ms
Return Home	0	0	0	0	0	0	0	0	1	-	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.52ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Assign cursor moving direction and enable the shift of entire display	38μs
Display ON/ OFF Control	0	0	0	0	0	0	1	D	C	B	Set display(D), cursor(C), and blinking of cursor(B) on/off control bit.	38μs
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	-	-	Set cursor moving and display shift control bit, and the direction, without changing of DDRAM data.	38μs
Function Set	0	0	0	0	1	DL	N	F	-	-	Set interface data length (DL: 8-bit/4-bit), numbers of display line (N: 2-line/1-line) and, display font type (F:5x10 dots/5x8 dots)	38μs
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter.	38μs
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter	38μs
Read Busy Flag and Address Counter	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	38μs
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM).	38μs

Note: "--": don't care

DISPLAY DATA RAM (DD RAM) AND CHARACTER POSITION

16x2, 1/16 Duty Cycle

	1	2		16	DISPLAY POSITION
line 1	00	01		0F	DD RAM ADDRESS
line 2	40	41		4F	

AC CHARACTERISTICS

Write mode (Writing data from MPU to SPLC782A)

Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
E Cycle Time	t_C	500	-	-	ns	Pin E
E Pulse Width	t_{PW}	230	-	-	ns	Pin E
E Rise/Fall Time	t_R, t_F	-	-	20	ns	Pin E
Address Setup Time	t_{SP1}	40	-	-	ns	Pins: RS, R/W, E
Address Hold Time	t_{HD1}	10	-	-	ns	Pins: RS, R/W, E
Data Setup Time	t_{SP2}	80	-	-	ns	Pins: DB0 - DB7
Data Hold Time	t_{HD2}	10	-	-	ns	Pins: DB0 - DB7

Read mode (Reading Data from SPLC782A to MPU)

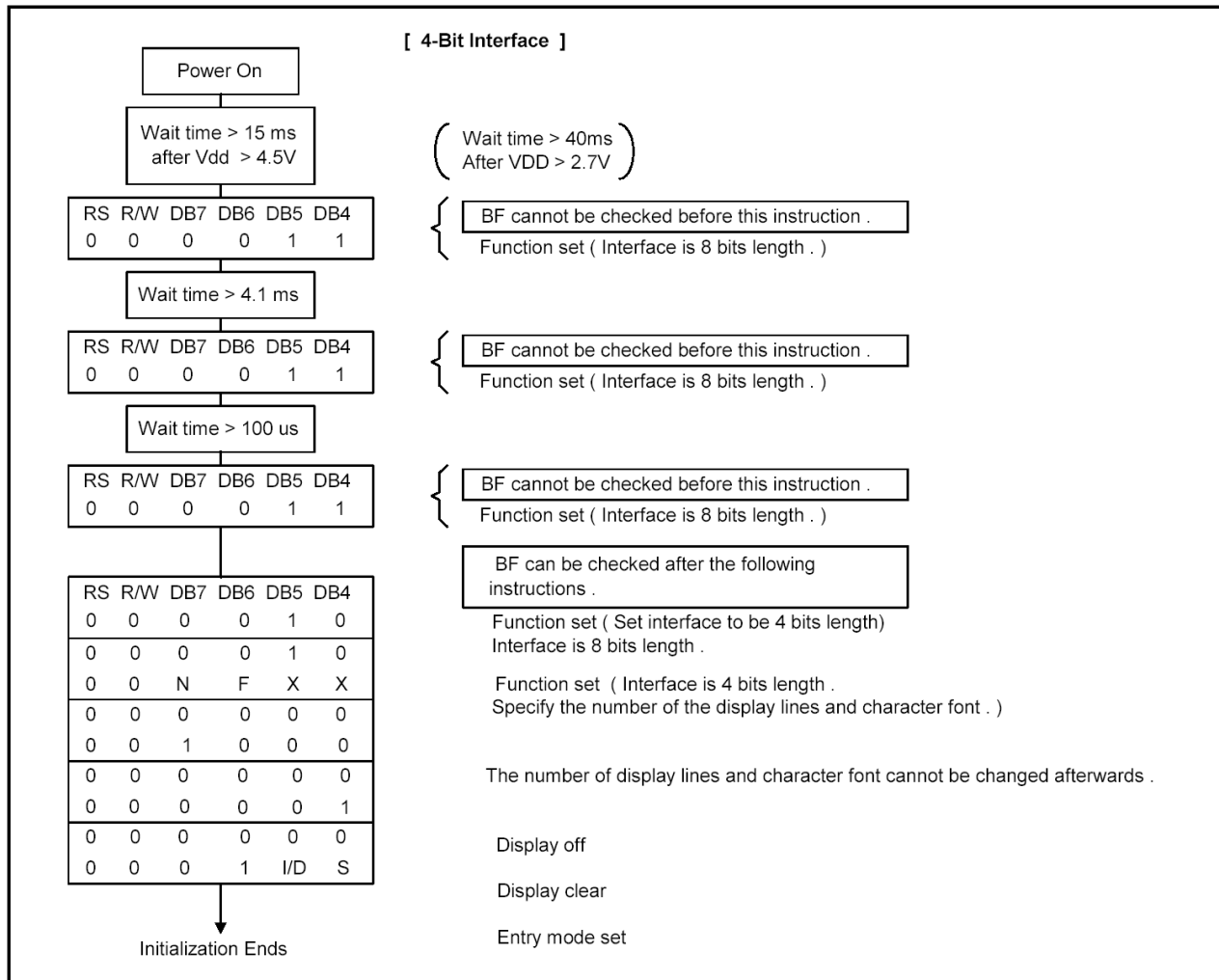| Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
E Cycle Time	t_C	500	-	-	ns	Pin E
E Pulse Width	t_W	230	-	-	ns	Pin E
E Rise/Fall Time	t_R, t_F	-	-	20	ns	Pin E
Address Setup Time	t_{SP1}	40	-	-	ns	Pins: RS, R/W, E
Address Hold Time	t_{HD1}	10	-	-	ns	Pins: RS, R/W, E
Data Output Delay Time	t_D	-	-	160	ns	Pins: DB0 - DB7
Data hold time	t_{HD2}	5.0	-	-	ns	Pins: DB0 - DB7

Write Mode Timing Diagram (Writing Data from MPU to SPLC782A)
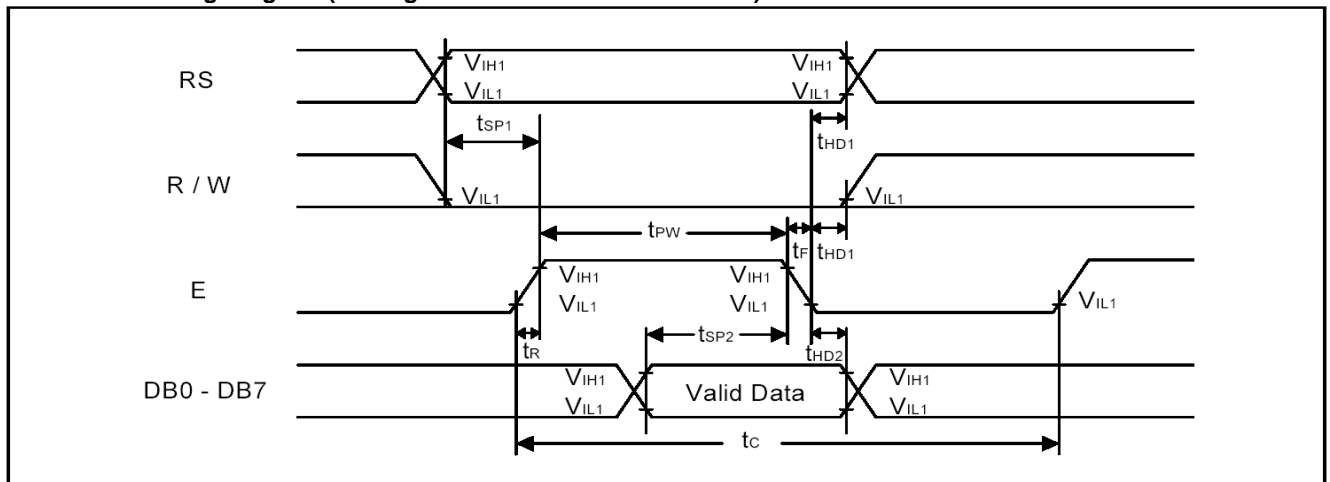
Read Mode Timing Diagram (Reading Data from SPLC782A to MPU)
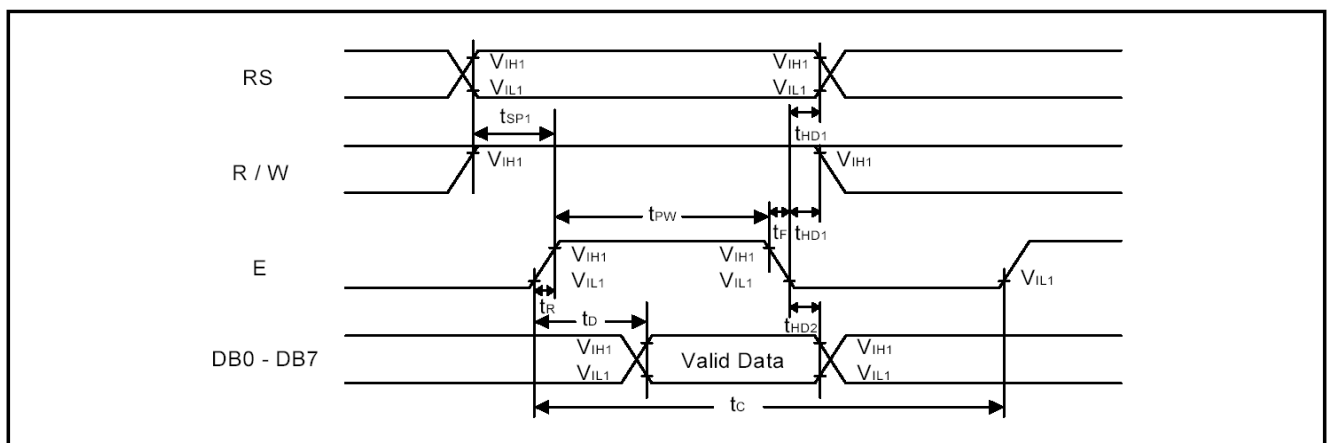
INITIALIZATION FLOWCHART

[**4-Bit Interface**]

Power On

Wait time > 15 ms
after Vdd > 4.5V

(Wait time > 40ms
After VDD > 2.7V)

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

BF cannot be checked before this instruction .
Function set (Interface is 8 bits length .)

Wait time > 4.1 ms

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

BF cannot be checked before this instruction .
Function set (Interface is 8 bits length .)

Wait time > 100 us

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

BF cannot be checked before this instruction .
Function set (Interface is 8 bits length .)

BF can be checked after the following
instructions .

RS	R/W	DB7	DB6	DB5	DB4
0	0	0	0	1	0
0	0	0	0	1	0
0	0	N	F	X	X
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

Function set (Set interface to be 4 bits length)
Interface is 8 bits length .

Function set (Interface is 4 bits length .
Specify the number of the display lines and character font .)

The number of display lines and character font cannot be changed afterwards .

Display off

Display clear

Entry mode set

Initialization Ends

ELECTRO-OPTICAL CHARACTERISTICS
MEASURING CONDITION:　　　POWER SUPPLY = V_{OP} / 64 Hz
　　　　　　　　　　　　　　TEMPERATURE = 22 ± 5 °C
　　　　　　　　　　　　　　RELATIVE HUMIDITY = 60 ± 15 %

ITEM	SYMBOL	UNIT	TYP. TN	TYP. STN
RESPONSE TIME	T_{on}	ms	130	150
	T_{off}	ms	170	190
CONTRAST RATIO	Cr	-	8	15
	$V_{3:00}$	°	70	45
VIEWING ANGLE	$V_{6:00}$	°	45	70
(6 O'clock)	$V_{9:00}$	°	70	45
Cr ≥ 2	$V_{12:00}$	°	5	60

THE ELECTRO-OPTICAL CHARACTERISTICS ARE MEASURED VALUE BUT NOT GUARANTEED ONES.

RELIABILITY OF LCD MODULE

ITEM	TEST CONDITION FOR NORMAL TEMPERATURE	TEST CONDITION FOR WIDE TEMPERATURE	TIME
High temperature operating	50°C	70°C	240 hours
Low temperature operating	0°C	-20°C	240 hours
High temperature storage	60°C	80°C	240 hours
Low temperature storage	-10°C	-30°C	240 hours
Temperature-humidity storage	40°C 90% R.H.	60°C 90% R.H.	96 hours
Temperature cycling	-10°C to 60°C 30 Min Dwell	-30°C to 80°C 30 Min Dwell	5 cycle
Vibration Test at LCM Level	Freq 10-55 Hz Sweep rate: 10-55-10 at 1 min Sweep mode Linear Displacement: 2 mm p-p 1 Hour each for X, Y, Z	Freq 10-55 Hz Sweep rate: 10-55-10 at 1 min Sweep mode Linear Displacement: 2 mm p-p 1 Hour each for X, Y, Z	—

SAMPLING METHOD

SAMPLING PLAN: MIL-STD 105E

CLASS OF AQL: LEVEL II/ SINGLE SAMPLING
                  MAJOR-0.65%   MINOR – 1.5%

QUALITY STANDARD

DEFECT	CRITERIA		TYPE	FIGURE
SHORT CIRCUIT	-		MAJOR	-
MISSING SEGMENT	-		MAJOR	-
UNEVEN / POOR CONTRAST	-		MAJOR	-
CROSS TALK	-		MAJOR	-
PIN HOLE	MAX(a,b) $\leq$ 1 / 4 W		MINOR	1
EXCESS SEGMENT	MAX(c,d) $\leq$ 1 / 4 T		MINOR	1
BUBBLES	d* $\geq$ 0.2	QTY=0	MINOR	2
BLACKS SPOTS	d $\leq$ 0.3	N.A.**	MINOR	2
	0.3<d$\leq$0.4	QTY$\leq$1		
	0.4<d	QTY=0		
LINE SCRATCHES	x$\geq$0.7 y$\geq$0.05	QTY=0	MINOR	3
BLACK LINE	x$\geq$0.7 y$\geq$0.05	QTY=0	MINOR	3

*d = MAX (d$_1$,d$_2$)   ** N. A . = NOT APPLICABLE   DEFECT TABLE : B
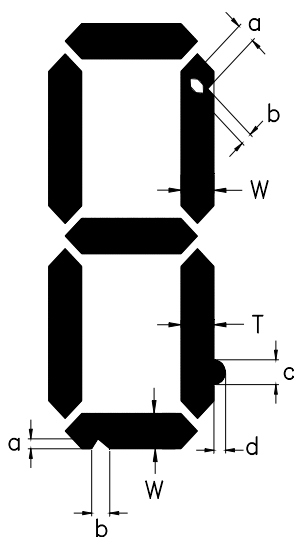
fig . 1
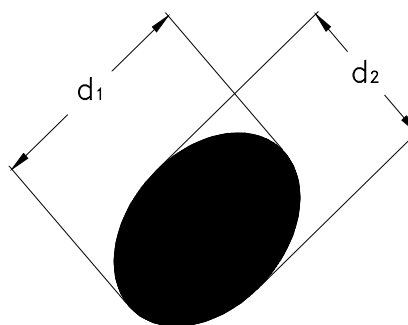
POLARIZER BUBBLES / SPOTS
fig . 2
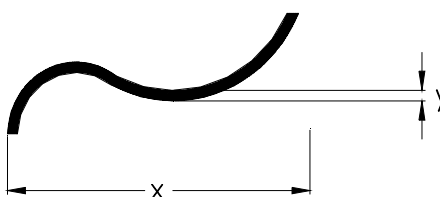
LINE SCRATCHES / BLACK LINE
fig . 3

QUALITY STANDARD (CONT .)

DEFECT		CRITERIA	TYPE	FIGURE
CHIPS	CONTACT EDGE	e≤1/2T f≤1/3W g≤3.5	MINOR	4
	BOTTOM GLASS	p≤1.0 q≤3.5 r≤1/2T		4
	CORNER	a≤1.5 b≤W		4
	TOP GLASS	a≤3.0 b≤1/3T c≤1/2W		5
GLASS PROTRUSION		a ≤ 1/4 W	MINOR	6
RAINBOW		-	MINOR	-

UNLESS STATE OTHERWISE , ALL UNIT ARE IN MILLIMETER .   DEFECT TABLE : B
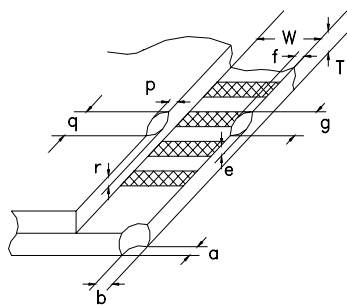
fig . 4
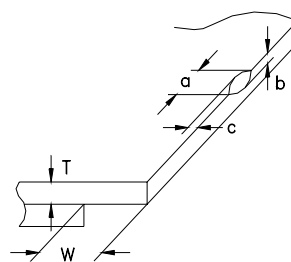
fig . 5
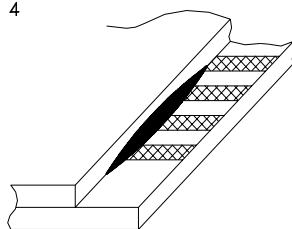
fig . 6

HANDLING PRECAUTIONS

(1) CAUTION OF LCD HANDLING & CLEANING
Use soft cloth with solvent (recommended below) to clean the display surface and wipe lightly.
- Isopropyl alcohol, ethyl alcohol, trichlorotriflorothane

Do not wipe the display surface with dry or hard materials that will damage the polarizer surface. Do not use the following solvent;
-water, ketone, aromatics

(2) CAUTION AGAINST STATIC CHARGE
The LCD modules use CMOS LSI drivers, so customers are recommend that any unused input terminal would be connected to V_{DD} or V_{SS}, do not input any signals before power is turned on, and ground your body, work/assembly areas, assembly equipment to protect against static electricity.

Remove the protective film slowly and, if possible, under ESD control device like ion blower and humidity of working room should be kept over 50%RH to reduce risk of static charge.

(3) PACKAGING
Avoid intense shock and falls from a height and do not operate or store them exposed direct to sunshine or high temperature/humidity.

(4) CAUTION FOR OPERATION
It is an indispensable condition to drive LCD's within the specified voltage limit since the higher voltage than the limit causes the shorter LCD life. The use of direct current drive should be avoided because an electrochemical reaction due to direct current causes LCD's undesirable deterioration.

Response time will be extremely delayed at low temperature, and LCD's show dark color at high temperature. However those phenomena do not mean malfunction or out of order with LCD's.

Some font will be abnormally displayed when the display area is pushed hard during operation. But it resumes normal condition after turning off once.

(5) SOLDERING (for Pin type)
It is recommended to complete dip soldering at 270 ^{o}C or hand soldering at 280 ^{o}C within 3 seconds. The soldering position is at least 3mm apart from the pin head. Wave or reflow soldering are not recommended. Metal pins should not be soldered for more than 3 times and each soldering should be done after cool down of metal pins

(6) SAFETY
For crash damaged or unnecessary LCD's, it is recommended to wash off liquid crystal by either of solvents such as acetone and ethanol and should be burned up later.

When any liquid leaked out of a damaged glass cell comes in contact with your hands, wash it off with soap and water.

WARRANTY
Multi-Inno will replace or repair any of her LCD module in accordance with her LCD specification for a period of one year from date of shipment. The warranty liability of Multi-Inno is limited to repair and/or replacement. Muti-Inno will not be responsible for any subsequent or consequential event.