



MULTI-INNO TECHNOLOGY CO., LTD.

## LCD MODULE SPECIFICATION

**Model : MI12864K-G**

Revision	
Engineering	
Date	
Our Reference	

***MODE OF DISPLAY***

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

**GENERAL DESCRIPTION**

Display mode : 128 x 64 dots, graphic COG LCD module

Interface : 8-bit parallel(8080-Series)

Driving method : 1/64 duty, 1/9 bias

Controller IC : Samsung S6B0724 or equivalent  
For the detailed information, please refer to the IC specifications.

**MECHANICAL DIMENSIONS**

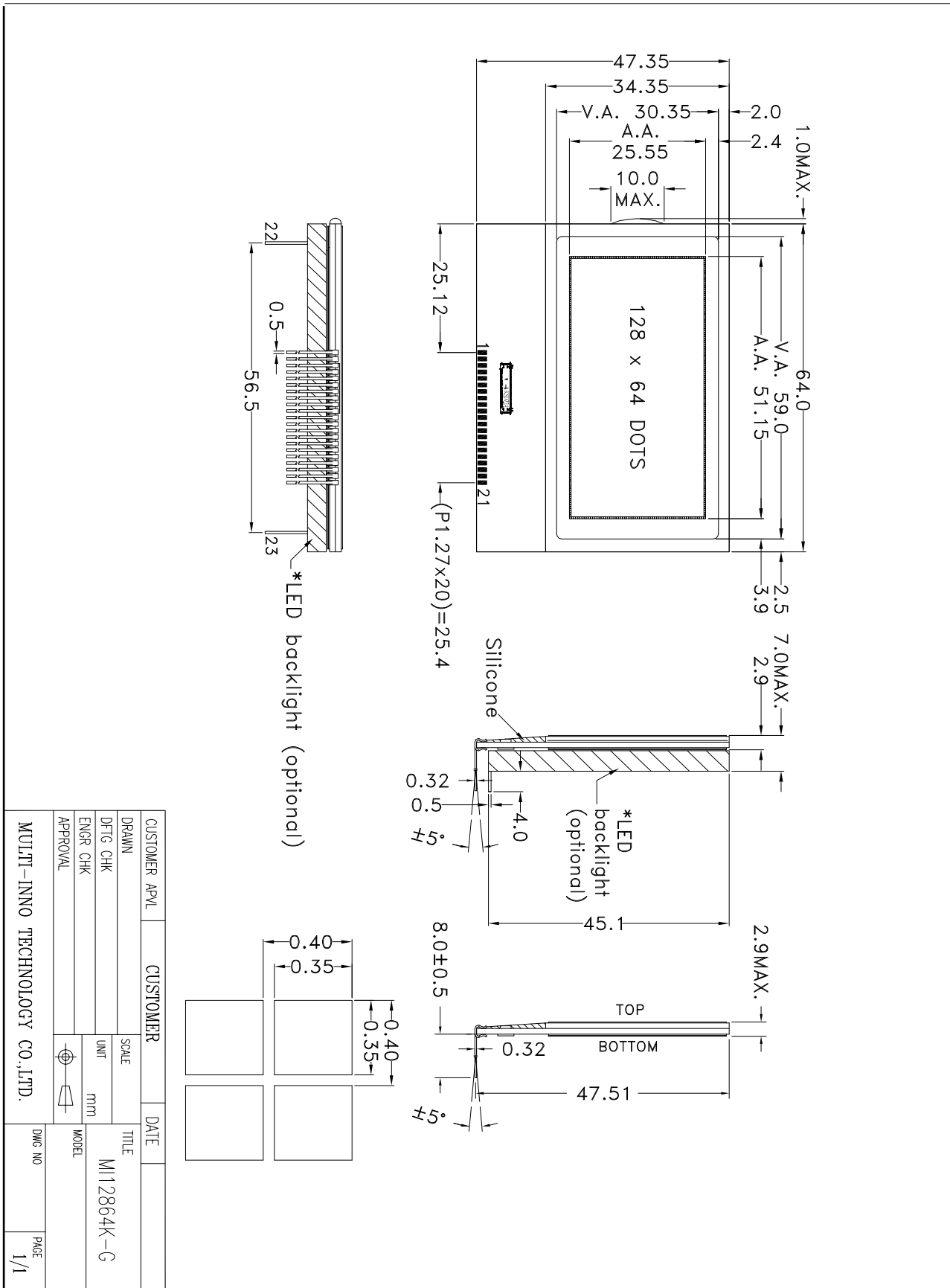
Item	Dimension	Unit	Item	Dimension	Unit
Outline Dimension (LED backlight)	64.0(L)x47.3(W)x7.0MAX.(H)	mm	Dot Pitch	0.40(L)x0.40(W)	mm
Outline Dimension (No backlight)	64.0(L)x47.3(W)x2.9MAX.(H)	mm	Dot Size	0.35(L)x0.35(W)	mm
Viewing Area	59.0(L)x30.3(W)	mm	-	-	-

**CONNECTOR PIN ASSIGNMENT**

Pin No.	Symbol	Function	Pin No.	Symbol	Function
1	V0	LCD driver supply voltage	13	DB3	Data bus
2	V4		14	DB2	
3	V3		15	DB1	
4	V2		16	DB0	
5	V1		17	RD	Read signal
6	VLCD	Voltage converter input	18	WR	Write enable
7	VSS	Ground	19	RS	Register select
8	VDD	Power supply for logic	20	RES	Reset
9	DB7	Data bus	21	CS2	Chip enabl
10	DB6		22	VBL	Supply voltage for backlight (+VE)
11	DB5		23	VBL	Supply voltage for backlight (-VE)
12	DB4				

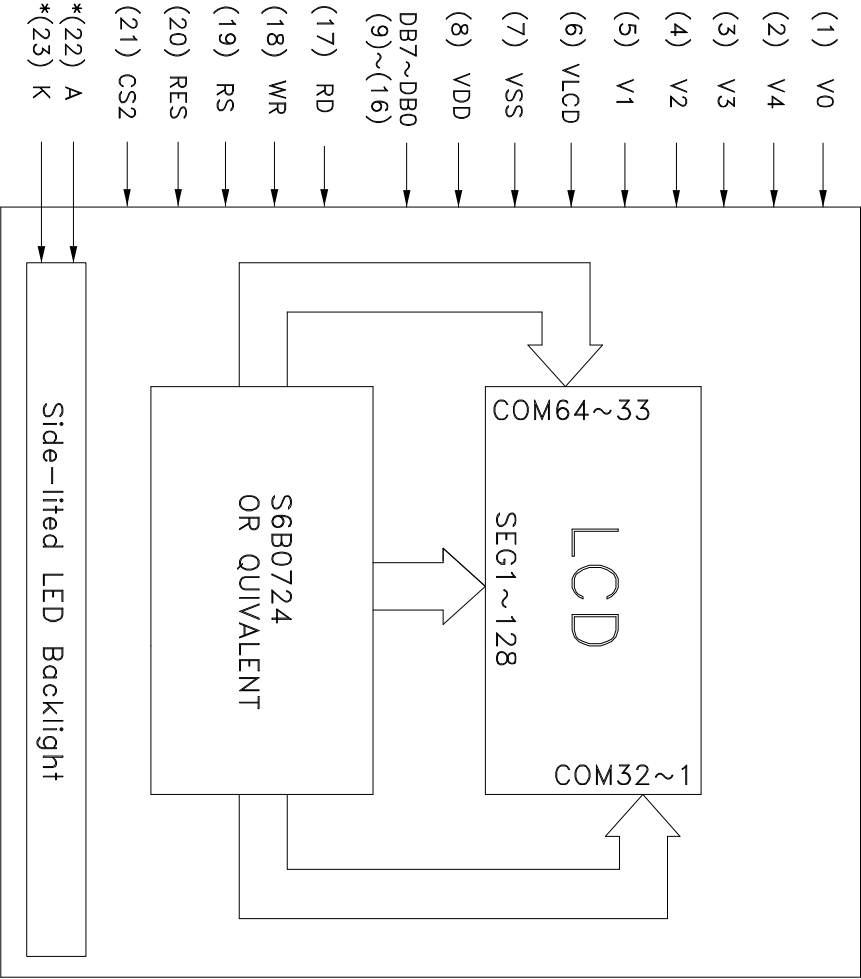
Note (\*): Pin 22, 23 are used for backlight versions only.

# COUNTER DRAWING OF MODULE DIMENSION





COUNTER DRAWING OF PIN OUT & BLOCK DIAGRAM



\*NOTE:Pin22,23 are not used for non backlight version

PIN NUMBER	SYMBOL	FUNCTION
1	V0	LCD driver supply voltage
2	V4	
3	V3	
4	V2	
5	V1	Voltage converter input
6	VLCD	
7	VSS	Ground
8	VDD	Power supply for logic
9	DB7	
10	DB6	
11	DB5	Data bus
12	DB4	
13	DB3	
14	DB2	
15	DB1	Read signal
16	DB0	
17	RD	Write enable
18	WR	Register select
19	RS	Reset
20	RES	Chip enable
21	CS2	Supply voltage for backlight(+VE)
*22	A	Supply voltage for backlight(-VE)
*23	K	

CUSTOMER APVL		CUSTOMER		DATE	
DRAWN		SCALE		TITLE	
DFTG CHK		UNIT	mm	MI12864K-G	
ENGR CHK		MODEL			
APPROVAL					
MULTI-INNO TECHNOLOGY CO.,LTD.				DWG NO	PAGE
					1/1

**ELECTRICAL CHARACTERISTICS**

Conditions: VSS=0V, @Ta=25

Item	Symbol	MIN.	TYP.	MAX.	Unit	Item	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage for logic	VDD	2.75	3.0	3.25	V	“H”Level Input Voltage	VIH	2.2VDD	-	VDD	V
Supply Current for logic	IDD	-	300	450	μA	“L”Level Input Voltage	VIL	VSS	-	0.6VDD	V
Operating Voltage for LCD	VLCD	12.5	12.0(*)	15.0	V	-	-	-	-	-	-
<b>EL Backlight Voltage (VEL)</b>						<b>Backlight Current</b>					
EL (@ Frequency 400Hz)	-	-	-	-	-	-	-	-	-	-	-
<b>Side-lited LED Backlight Forward Voltage (VF)</b>						<b>Side-lited LED Backlight Forward Current (If)</b>					
White	VBL	3.0	3.2	3.5	V	White	IBL	-	80	100	mA
Blue	VBL	3.0	3.35	4.0	V	Blue	IBL	-	80	100	mA
Yellow Green	VBL	1.8	2.0	2.4	V	Yellow Green	IBL	-	80	90	mA

Note : (\*) Please refer to **REFERENCE CIRCUIT EXAMPLE** (5X Boosting Circuit).**ABSOLUTE MAXIMUM RATINGS**

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

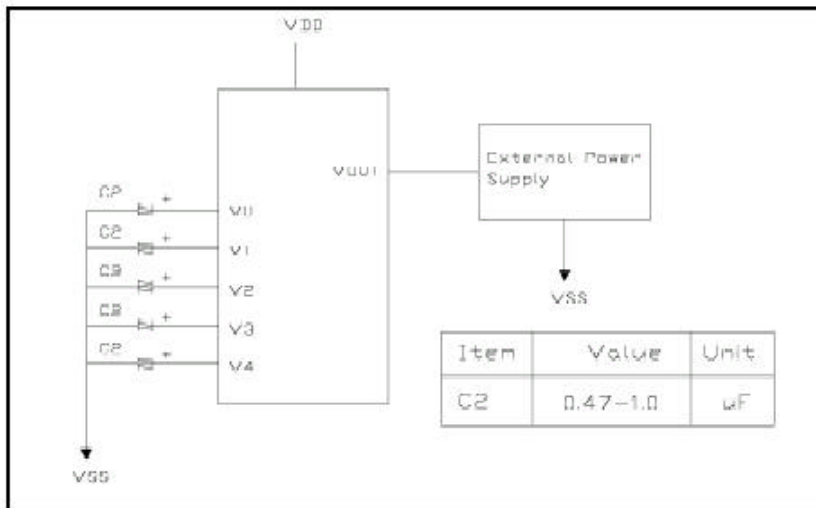
Item	Symbol	Rating (for normal temperature)	Rating (for wide temperature)	Unit
Supply Voltage	VDD	- 0.3 to VDD+ 0.3	- 0.3 to VDD+ 0.3	V
Operating Temperature	T <sub>opr</sub>	0 to 50	-20 to 70	
Storage Temperature	T <sub>stg</sub>	-10 to 60	-30 to 80	

## REFERENCE CIRCUIT EXAMPLE

Note: To operate this module, please note the follow software settings.

- 1) Power Control Register (VC, VR, VF)=(0, 1, 1)
- 2) Regulator Resistor Select (R2, R1, R0)=(1, 1, 1)
- 3) Set Reference Voltage Register (SV5, SV4, SV3, SV2, SV1, SV0)=(1, 1, 0, 1, 0, 1)
- 4) For Optimum Contrast  $V_0=12.0V \pm 0.2V$

### REFERENCE CIRCUIT EXAMPLE



### 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	VDD	7	7	V
Input Voltage	VT	-0.3 to VDD +0.3	-0.3 to VDD +0.3	V
Operating Temperature	Topr	0 to 50	-20 to 70	°C
Storage Temperature	Tstg	-10 to 60	-30 to 80	°C

## INSTRUCTIONS

**(Note) \*: disabled data**

Command	Command Code										Function	
	A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1		D0
(1) Display ON/OFF	0	1	0	1	0	1	0	1	1	1	0	LCD display ON/OFF 0: OFF, 1: ON
(2) Display start line set	0	1	0	0	1	Display start address						Sets the display RAM display start line address
(3) Page address set	0	1	0	1	0	1	1	Page address				Sets the display RAM page address
(4) Column address set upper bit	0	1	0	0	0	0	1	Most significant column address				Sets the most significant 4 bits of the display RAM column address.
Column address set lower bit	0	1	0	0	0	0	0	Least significant column address				Sets the least significant 4 bits of the display RAM column address.
(5) Status read	0	0	1	Status				0	0	0	0	Reads the status data
(6) Display data write	1	1	0	Write data							Writes to the display RAM	
(7) Display data read	1	0	1	Read data							Reads from the display RAM	
(8) ADC select	0	1	0	1	0	1	0	0	0	0	0	Sets the display RAM address SEG output correspondence 0: normal, 1: reverse
											1	Sets the LCD display normal/

**RECOMMENDED INITIAL SETTINGS**

Display Start Line Set : 40H

ADC Select : A0H

LCD Bias Set : A2H

Common Output Mode Select : C8H

Power Control Set: 2FH

V0 Voltage Regulator Internal Resistor Ratio Set : 27H

Electronic Volume Register Set : 2CH

Booster Ratio Set : 01H

**DISPLAY DATA RAM (DDRAM)**

The display data RAM stores the dot data for the LCD. It has a 65 (8 page x 8 bit +1) x 132 bit structure. As is shown in below, the D7 to D0 display data from the MPU corresponds to the LCD display common direction; there are few constraints at the time of display data transfer when multiple ST7565P are used, thus and display structures can be created easily and with a high degree of freedom. Moreover, reading from and writing to the display RAM from the MPU side is performed through the I/O buffer, which is an independent operation from signal reading for the liquid crystal driver. Consequently, even if the display data RAM is accessed asynchronously during liquid crystal display, it will not cause adverse effects on the display (such as flickering).

D0	0	1	1	1		0
D1	1	0	0	0		0
D2	0	0	0	0		0
D3	0	1	1	1		0
D4	1	0	0	0		0
-						

Display data RAM

COM0						
COM1						
COM2						
COM3						
COM4						
-						

Liquid crystal display





### PAGE ADDRESS CIRCUIT

Page address of the display data RAM is specified through the Page Address Set Command. The page address must be specified again when changing pages to perform access. Page address 8 (D3, D2, D1, D0 = 1, 0, 0, 0) is a special RAM for icons, and only display data D0 is used.

### COLUMN ADDRESS

The display data RAM column address is specified by the Column Address Set command. The specified column address is incremented (+1) with each display data read/write command. This allows the MPU display data to be accessed continuously. Moreover, the incrementing of column addresses stops with 83H. Because the column address is independent of the page address, when moving, for example, from page 0 column 83H to page 1 column 00H, it is necessary to respect both the page address and the column address. Furthermore, the ADC command (segment driver direction select command) can be used to reverse the relationship between the display data RAM column address and the segment output. Because of this, the constraints on the IC layout when the LCD module is assembled can be minimized.

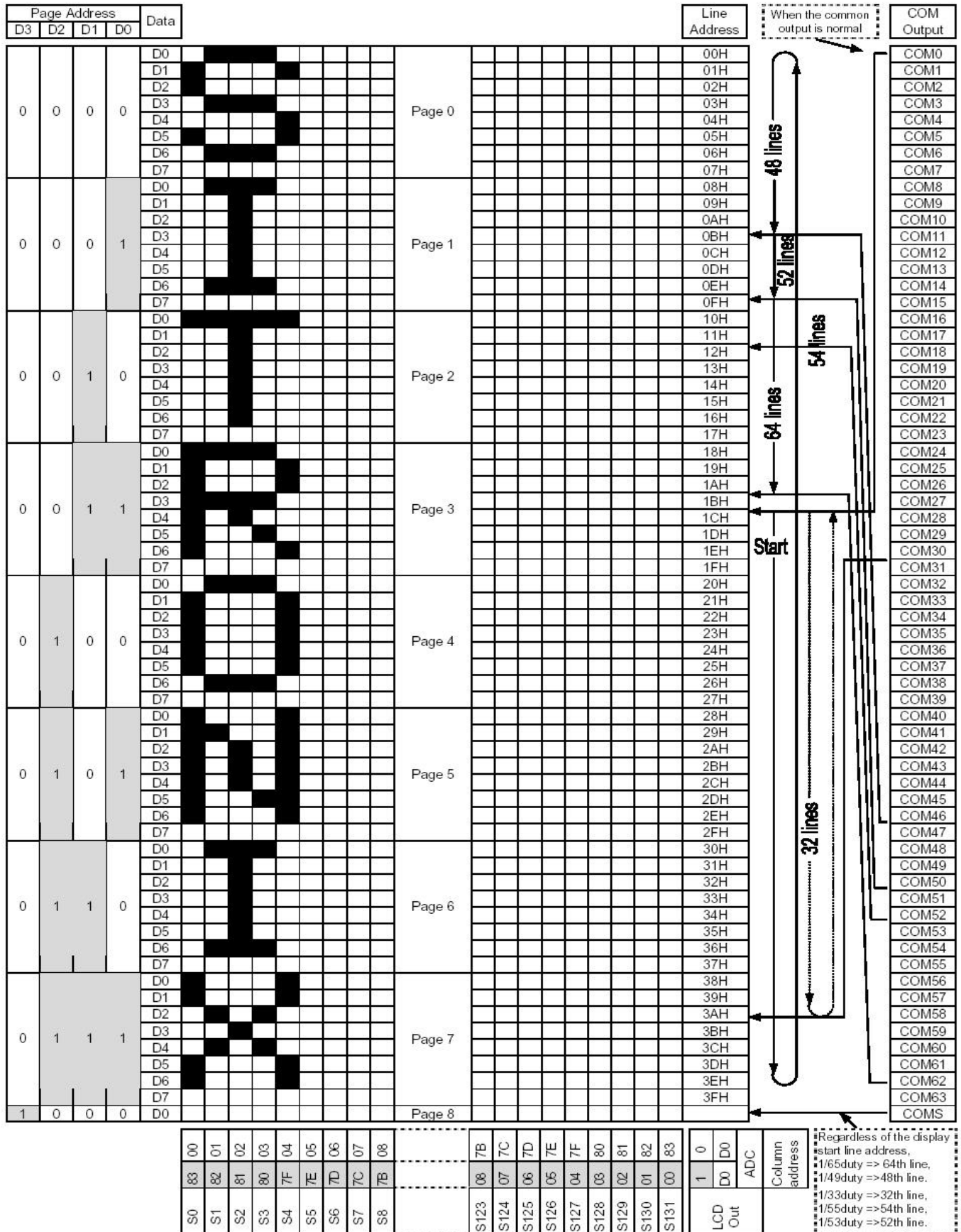
SEG Output ADC	SEG0	SEG 131
(D0) "0"	0 (H) → Column Address →	83 (H)
(D0) "1"	83 (H) ← Column Address ←	0 (H)

### LINE ADDRESS CIRCUIT

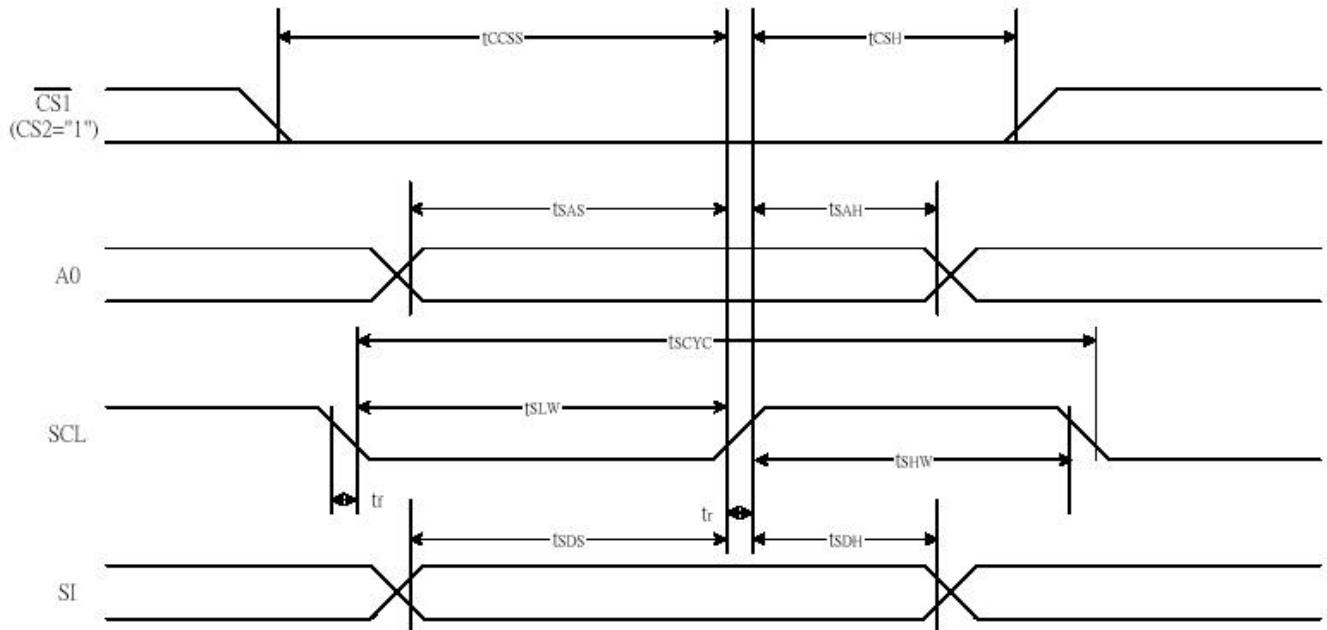
The line address circuit, specifies the line address relating to the COM output when the contents of the display data RAM are displayed. Using the display start line address set command, what is normally the top line of the display can be specified (this is the COM0 output when the common output mode is normal, and the COM63 output. for ST7565P , The display area is a 65 line area for the ST7565P. If the line addresses are changed dynamically using the display start line address set command, screen scrolling, page swapping, etc. can be performed.



## PAGE ADDRESS AND LINE ADDRESS CIRCUIT

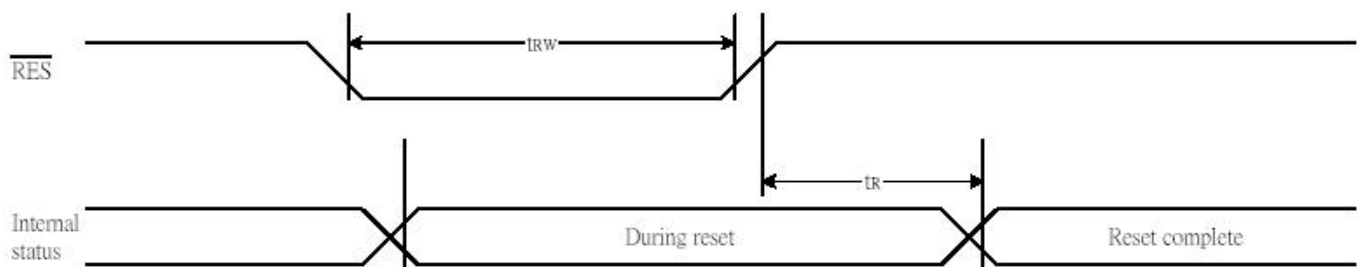


## TIMING CHARACTERISTICS (FOR SERIAL INTERFACE)



Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Serial Clock Period	SCL	$T_{scyc}$		100	—	ns
SCL "H" pulse width		$T_{shw}$		50	—	
SCL "L" pulse width		$T_{SLW}$		50	—	
Address setup time	A0	$T_{SAS}$		20	—	
Address hold time		$T_{SAH}$		10	—	
Data setup time	SI	$T_{SDS}$		20	—	
Data hold time		$T_{SDH}$		10	—	
CS-SCL time	$\overline{CS}$	$T_{css}$		20	—	
CS-SCL time		$T_{csh}$		40	—	

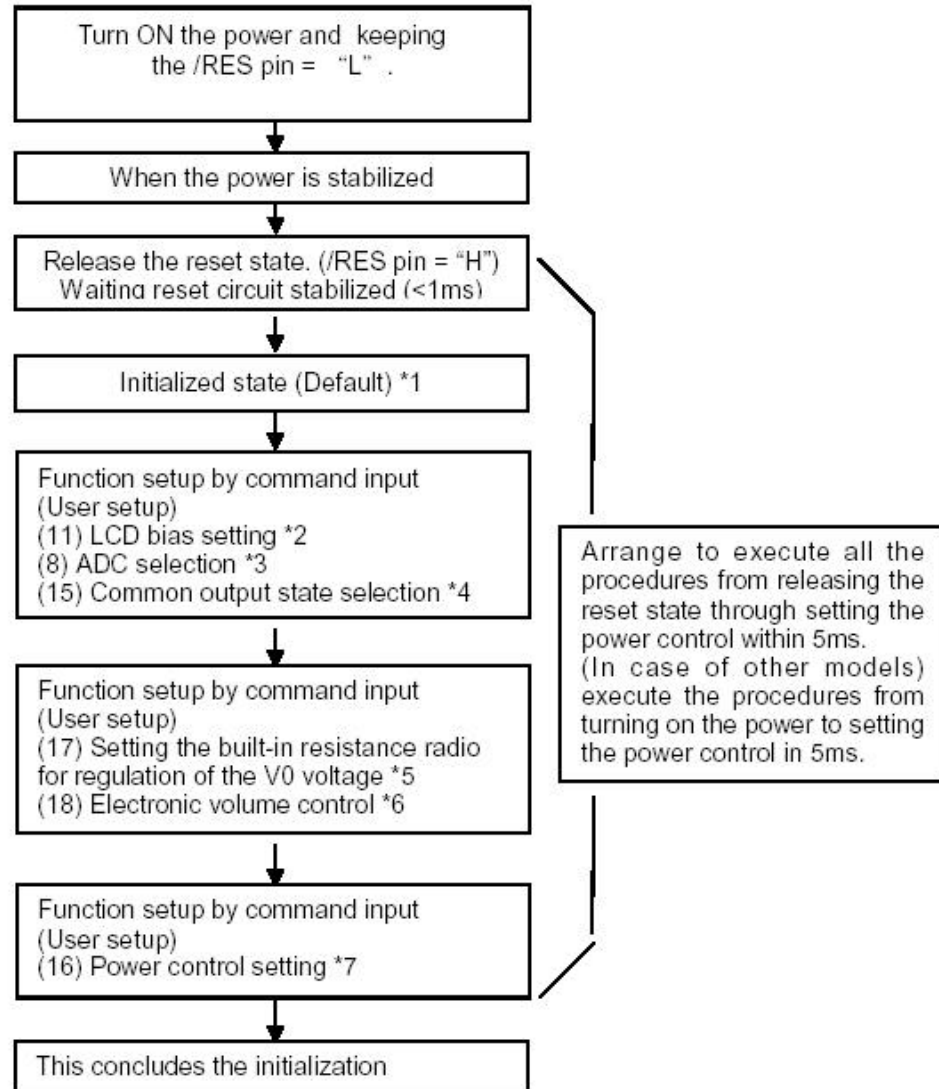
## RESET TIMING



Item	Signal	Symbol	Condition	Rating			Units
				Min.	Typ.	Max.	
Reset time		$t_r$		—	—	1.0	us
Reset "L" pulse width	$\overline{RES}$	$t_{RW}$		1.0	—	—	us

## INITIALIZATION METHOD

With built-in power supply circuit:



\* The target time of 5ms will result to vary depending on the panel characteristics and the capacitance of the smoothing

capacitor. Therefore, we suggest you to conduct an operation check using the actual equipment.

Notes: Refer to respective sections or paragraphs listed below.

\*1: Description of functions; Resetting circuit

\*2: Command description; LCD bias setting

\*3: Command description; ADC selection

\*4: Command description; Common output state selection

\*5: Description of functions; Power circuit & Command description; Setting the built-in resistance ratio for regulation of the V0 voltage

\*6: Description of functions; Power circuit & Command description; Electronic volume control

\*7: Description of functions; Power circuit & Command description; Power control setting

**ELECTRO-OPTICAL CHARACTERISTICS**

MEASURING CONDITION: POWER SUPPLY =  $V_{OP}$  / 64 Hz  
TEMPERATURE =  $22 \pm 5$  °C  
RELATIVE HUMIDITY =  $60 \pm 15$  %

ITEM	SYMBOL	UNIT	TYP. STN
RESPONSE TIME	Ton	ms	220
	Toff	ms	280
CONTRAST RATIO	Cr	-	12
VIEWING ANGLE (Cr $\geq 2$ )	V3:00	°	40
	V6:00	°	70
	V9:00	°	40
	V12:00	°	50

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	$\text{MAX}(a,b) \leq 1/4 W$	MINOR	1
EXCESS SEGMENT	$\text{MAX}(c,d) \leq 1/4 T$	MINOR	1
BUBBLES	$d^* \geq 0.2$ QTY=0	MINOR	2
BLACKS SPOTS	$d \leq 0.3$ N.A.** $0.3 < d \leq 0.4$ QTY $\leq 1$ $0.4 < d$ QTY=0	MINOR	2
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<sub>1</sub>,d<sub>2</sub>)

\*\* N. A . = NOT APPLICABLE

DEFECT TABLE : B

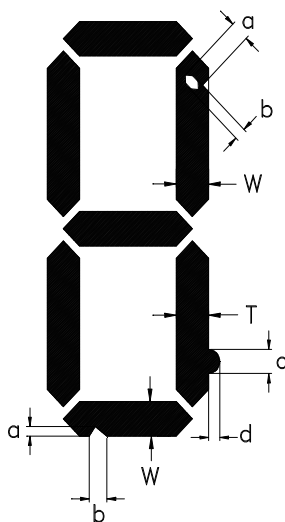
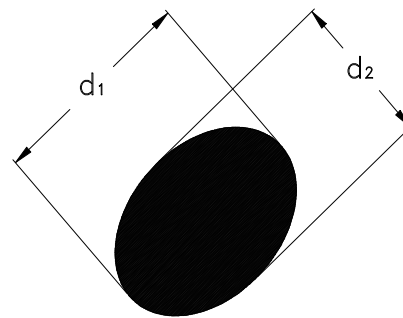
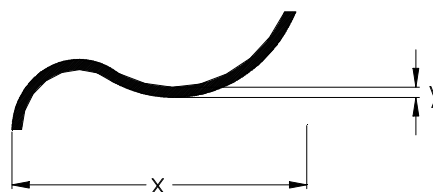


fig . 1



POLARIZER BUBBLES / SPOTS

fig . 2



LINE SCRATCHES / BLACK LINE

fig . 3

## QUALITY STANDARD ( CONT . )

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

UNLESS STATE OTHERWISE , ALL UNIT ARE IN MILLIMETER .

DEFECT TABLE : B

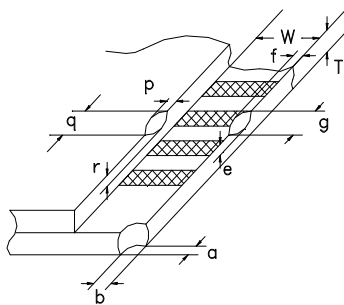


fig . 4

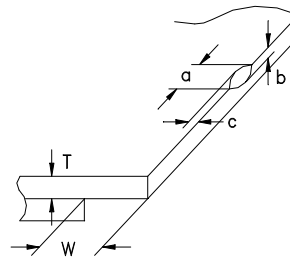


fig . 5

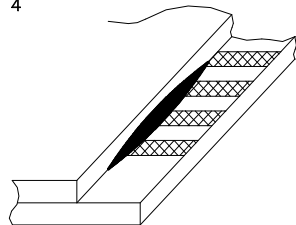


fig . 6





## 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, trichlorotrifluoroethane

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 recommended 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 °C or hand soldering at 280 °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. MULTI-INNO will not be responsible for any subsequent or consequential event.

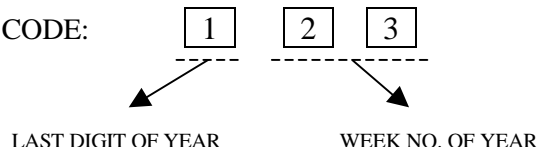


## APPENDIX

### LOT INDICATION OF LCD MODULE

#### CODING SYSTEM:

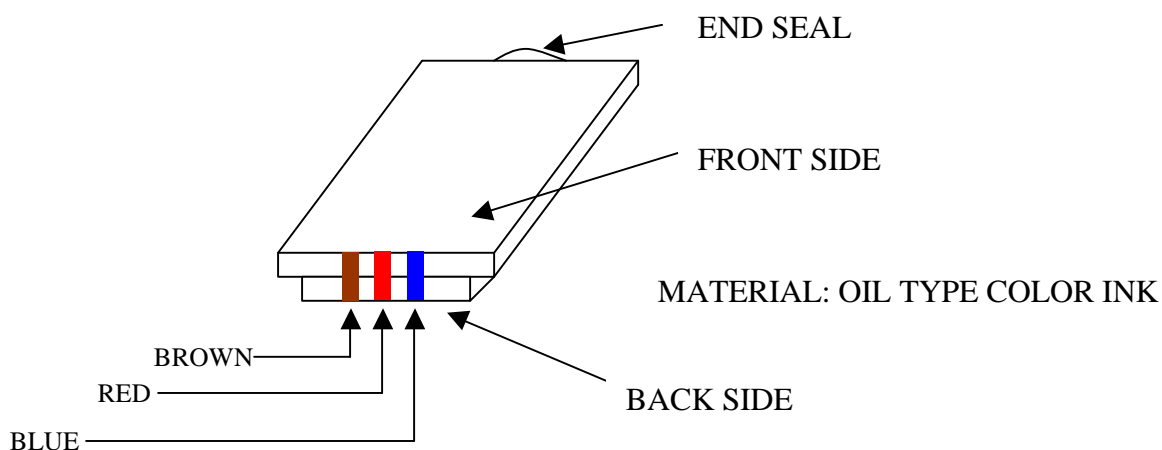
3-DIGIT COLOR CODE:



#### COLOR CODE:

	COLOR
0	BLACK
1	BROWN
2	RED
3	ORANGE
4	YELLOW
5	GREEN
6	BLUE
7	PURPLE
8	GREY
9	WHITE

LOCATION AS SHOWN BELOW:



e.g. WEEK 26 OF YEAR 2001