CLOVER DISPLAY LTD.

LCD MODULE SPECIFICATION

Model: CG12864D - _ _ - _ _ - _ _ - _

Revision	00
Engineering	Jackson Fung
Date	31 MAR 2015
Our Reference	V9053

MODE OF DISPLAY

Display mode	Display condition	Viewing direction
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		

LCD MODULE NUMBER NOTATION:

CG12864D- N N - S R - N 6 – T
   | | | | | | | |
  (1)   (2) (3) (4) (5) (6) (7) (8)

*(1)---Model number of standard LCD Modules
*(2)---Backlight type
         N – No backlight
         E – EL backlight
         L – Side-lited LED backlight
         M– Array LED backlight
         C – CCFL
*(3)---Backlight color
         N – No backlight
         A – Amber
         B – Blue
         O– Orange
         W–White
         Y – Yellow green
         G – Green
         R – Red
*(4)---Display mode
         T – TN
         V – TN (Negative)
         S – STN Yellow green
         G – STN Grey
         B – STN Blue (Negative)
         F – FSTN
         N – FSTN (Negative)
         E – EBTN (Negative)
*(5)---Rear polarizer type
         R – Reflective
         F – Transflective
         T – Transmissive
*(6)---Temperature range
         N – Normal
         W– Extended
*(7)---Viewing direction
         6 – 6 O'clock
         2 – 12 O'clock
         3 – 3 O'clock
         9 – 9 O'clock
*(8)---Special code for other requirements
         (Can be omitted if not used)

GENERAL DESCRIPTION

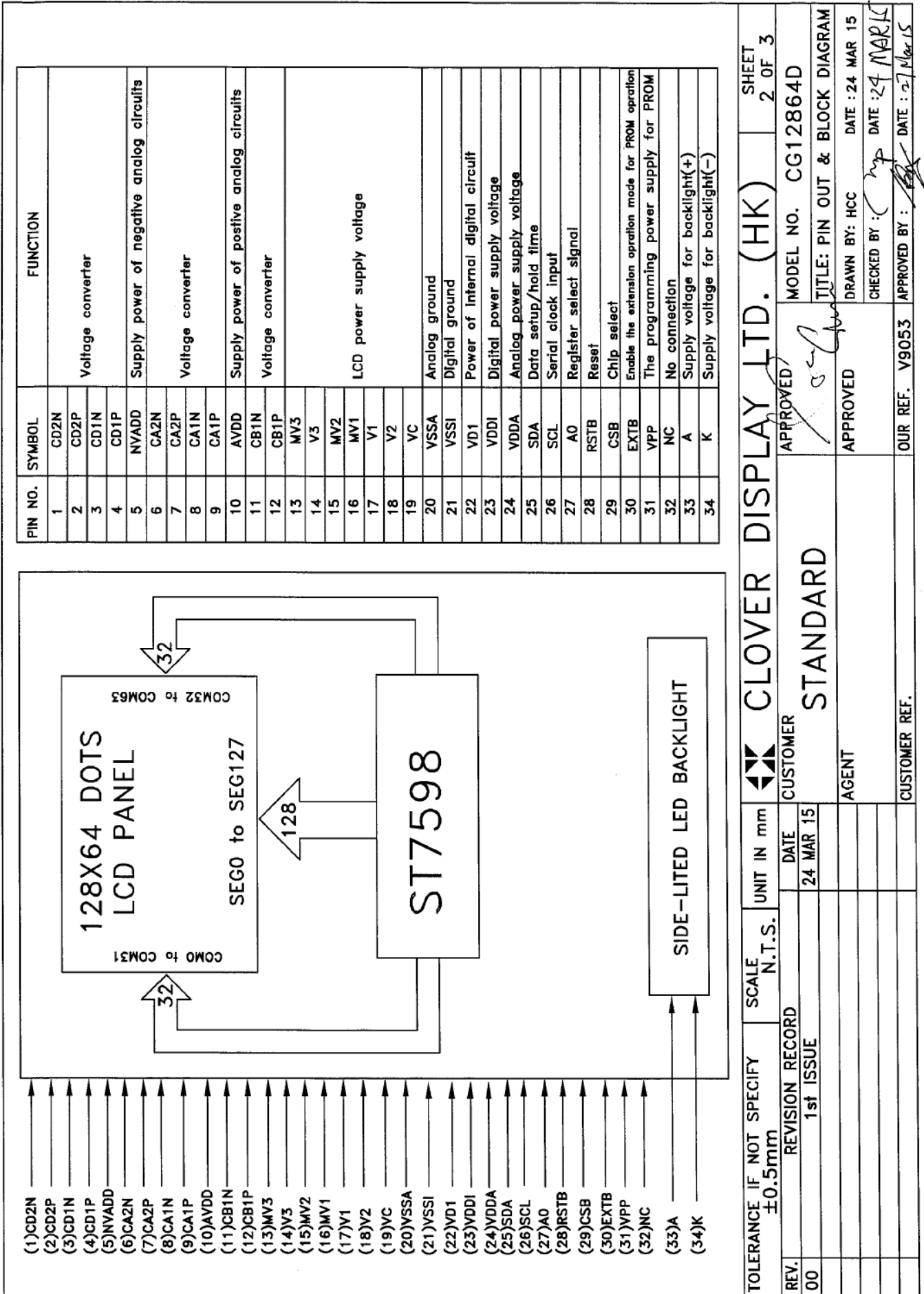|		
Display mode	:	128 x 64 dots, Graphic EBTN COG LCD module
Interface	:	serial
Driving method	:	1/64 duty, 1/9 bias
Controller IC	:	Sitronix ST7598 or equivalent
		For the detailed information, please refer to the IC specifications

MECHANICAL DIMENSIONS

Item	Dimension	Unit	Item	Dimension	Unit
Outline Dimension	78.4(L)x53.0(W)x7.0(H)	mm	Dot Size	0.49(L)x0.49(W)	mm
Viewing Area	70.6(L)x38.6(W)	mm	Dot Pitch	0.52(L)x0.52 (W)	mm

CONNECTOR PIN ASSIGNMENT

Pin No.	Symbol	Function
1	CD2N	Voltage converter
2	CD2P	
3	CD1N	
4	CD1P	
5	NVADD	Supply power of negative analog circuits
6	CA2N	Voltage converter
7	CA2P	
8	CA1N	
9	CA1P	
10	AVDD	Supply power of positive analog circuits
11	CB1N	Voltage converter
12	CB1P	
13	MV3	LCD power supply voltage
14	V3	
15	MV2	
16	MV1	
17	V1	
18	V2	
19	VC	
20	VSSA	Analog ground
21	VSSI	Digital ground
22	VD1	Power of internal digital circuit
23	VDDI	Digital power supply voltage
24	VDDA	Analog power supply voltage
25	SDA	Data setup/hold time
26	SCL	Serial clock input
27	A0	Register select signal
28	RSTB	Reset
29	CSB	Chip select
30	EXTB	Enable the extension opration mode for PROM opration
31	VPP	The programming power supply for PROM
32	NC	No connection
33	A	Supply voltage for backlight(+)
34	K	Supply voltage for backlight(-)

COUNTER DRAWING OF MODULE DIMENSION

CLOVER DISPLAY LTD. (HK)

STANDARD

MODEL NO.	CG12864D	
TITLE:	MODULE DIMENSION	
DRAWN BY: HCC	DATE :24 MAR 15	
CHECKED BY :	DATE : 24 MAR 15	
APPROVED BY :	DATE : 27 May 15	
OUR REF.	V9053	

CUSTOMER

AGENT

CUSTOMER REF.

MARK	REASON	PREPARED	DATE
	Change VDD	HCC	24 MAR 15

128 X 64 DOTS

PITCH0.5X(32-1)=15.5

STIFFENER
SILICONE
FPC
CONTACT SIDE

TOLERANCE IF NOT SPECIFY ±0.5mm	UNIT IN mm	SCALE N.T.S.	DATE 24 MAR 15
REV.	REVISION RECORD		
00	1st ISSUE		

SHEET 1 OF 3

COUNTER DRAWING OF PIN OUT & BLOCK DIAGRAM

PIN NO.	SYMBOL	FUNCTION
1	CD2N	Voltage converter
2	CD2P	Voltage converter
3	CD1N	Voltage converter
4	CD1P	
5	NVADD	Supply power of negative analog circuits
6	CA2N	Voltage converter
7	CA2P	Voltage converter
8	CA1N	
9	CA1P	
10	AVDD	Supply power of positive analog circuits
11	CB1N	Voltage converter
12	CB1P	
13	MV3	LCD power supply voltage
14	V3	
15	MV2	
16	MV1	
17	V1	
18	V2	
19	VC	
20	VSSA	Analog ground
21	VSSI	Digital ground
22	VD1	Power of internal digital circuit
23	VDDI	Digital power supply voltage
24	VDDA	Analog power supply voltage
25	SDA	Data setup/hold time
26	SCL	Serial clock input
27	A0	Register select signal
28	RSTB	Reset
29	CSB	Chip select
30	EXTB	Enable the extension opration mode for PROM opration
31	VPP	The programming power supply for PROM
32	NC	No connection
33	A	Supply voltage for backlight(+)
34	K	Supply voltage for backlight(−)

Block diagram:

128X64 DOTS LCD PANEL

COM0 to COM31 / COM32 to COM63

SEG0 to SEG127

ST7598

32 / 128 / 32

SIDE−LITED LED BACKLIGHT

(1)CD2N
(2)CD2P
(3)CD1N
(4)CD1P
(5)NVADD
(6)CA2N
(7)CA2P
(8)CA1N
(9)CA1P
(10)AVDD
(11)CB1N
(12)CB1P
(13)MV3
(14)V3
(15)MV2
(16)MV1
(17)V1
(18)V2
(19)VC
(20)VSSA
(21)VSSI
(22)VD1
(23)VDDI
(24)VDDA
(25)SDA
(26)SCL
(27)A0
(28)RSTB
(29)CSB
(30)EXTB
(31)VPP
(32)NC
(33)A
(34)K

CLOVER DISPLAY LTD. (HK)

STANDARD

MODEL NO. CG12864D
TITLE: PIN OUT & BLOCK DIAGRAM
DRAWN BY: HCC   DATE : 24 MAR 15
CHECKED BY :   DATE :24 MAR 15
APPROVED BY :   DATE : 27 Mar 15
SHEET 2 OF 3

CUSTOMER
AGENT
CUSTOMER REF.
OUR REF. V9053

APPROVED
APPROVED

TOLERANCE IF NOT SPECIFY ±0.5mm | SCALE N.T.S. | UNIT IN mm

REV.	REVISION RECORD	DATE
00	1st ISSUE	24 MAR 15

ELECTRICAL CHARACTERISTICS

Conditions: VSS=0V, @Ta=25℃

Item	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage for Logic	VDD	4.75	5.0	5.25	V
Supply Current for Logic	IDD	—	4.22	—	mA
Operating Voltage for LCD (*)	V0	15.7	16.5	17.3	V
'High' Level Input Voltage	VIH	0.8VDD	—	VDD	V
'Low' Level Input Voltage	VIL	VSS	—	0.2VDD	V

Note (*): There is tolerance in optimum LCD driving voltage during production and it will be within the specified range.

Side BL:

Constant voltage driving:

Item	Symbol	MIN.	TYP.	MAX.	Unit	Condition
White	I_{BL}	—	40	60	mA	$V_{BL} = 3.3V$

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 6.0	-0.3 to 6.0	V
Input Voltage	Vi	-0.3 to VDD+0.3	-0.3 to VDD+0.3	V
Operating Temperature	T_{opr}	0 to 50	-20 to 70	℃
Storage Temperature	T_{stg}	-10 to 60	-30 to 80	℃

REFERENCE CIRCUIT EXAMPLE
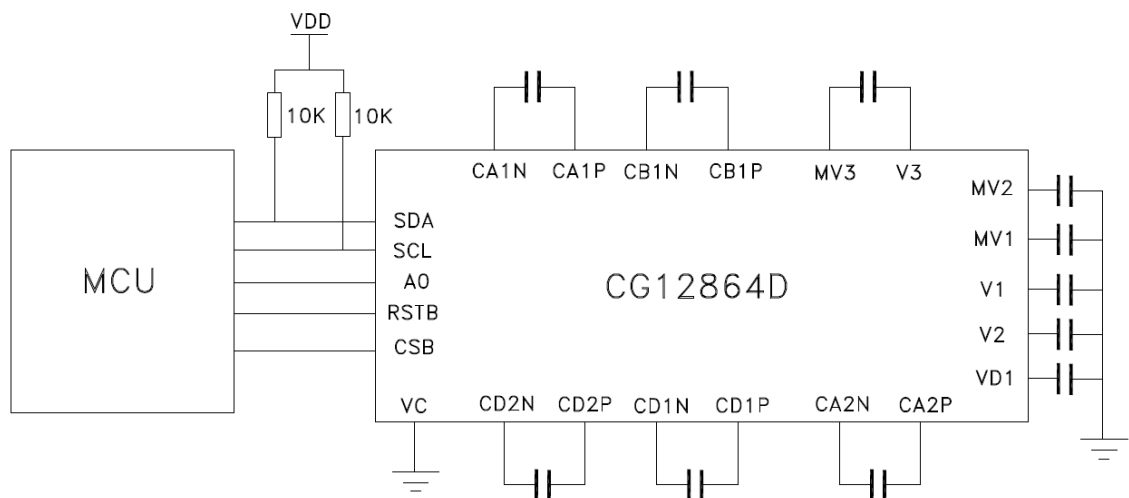
INSTRUCTION TABLE

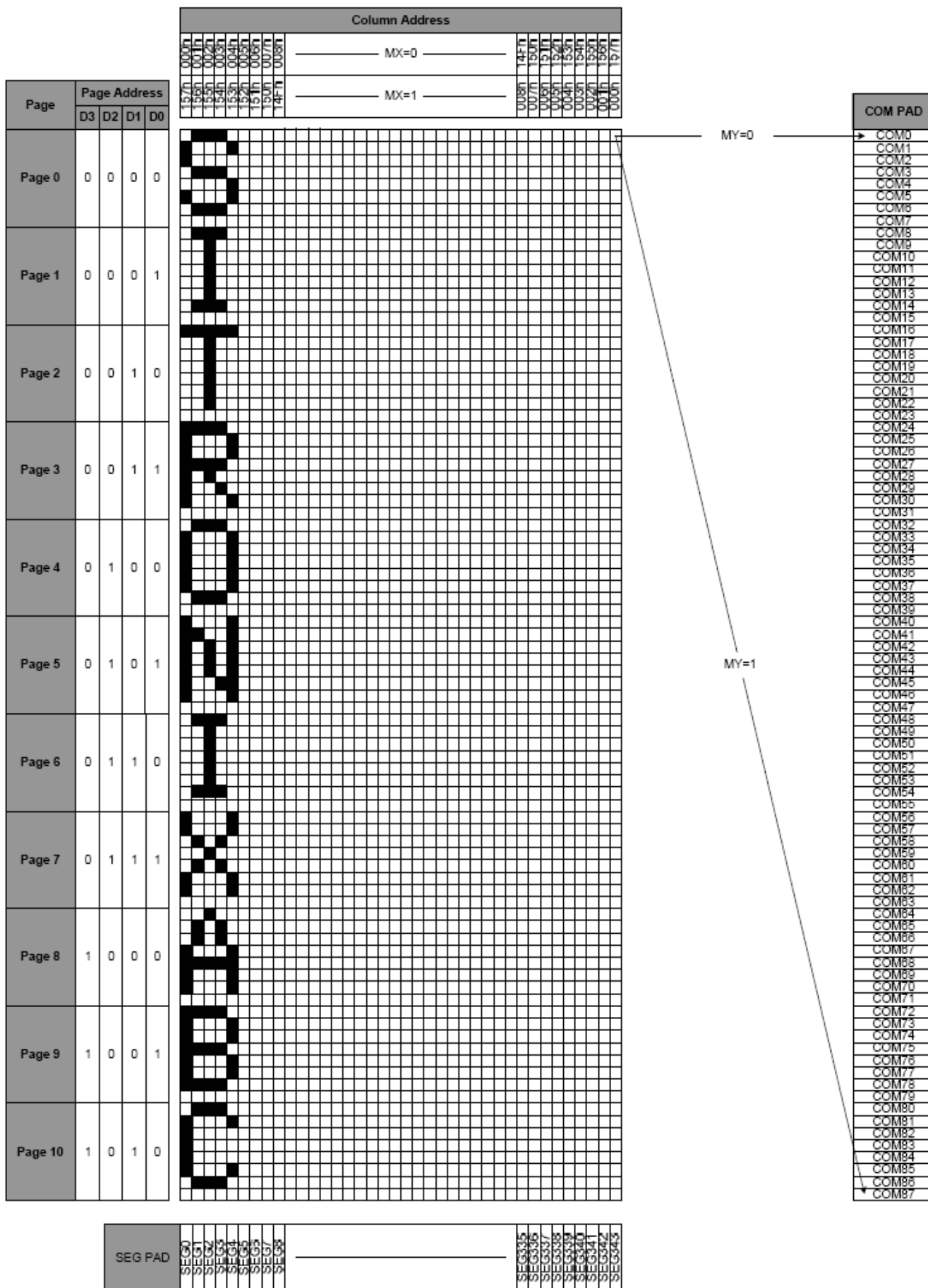| INSTRUCTION	A0	R/W	COMMAND BYTE								DESCRIPTION
			D7	D6	D5	D4	D3	D2	D1	D0	
Display ON/OFF	0	0	1	0	1	0	1	1	1	D	Set LCD display mode D=0: display off D=1: display on
Display Inverse	0	0	1	0	1	0	0	1	1	INV	Set inverse display mode INV=0: normal display INV=1: inverse display
Display All Pixel ON	0	0	1	0	1	0	0	1	0	AP	Set all pixel on mode AP=0: normal display AP=1: all pixel on
COM Scan Direction	0	0	1	1	0	0	0	1	0	0	MY=0: COM0→COM87 MY=1: COM87→COM0
	1	0	0	0	0	0	0	0	1	MY	
Page Address	0	0	1	0	1	1	0	0	0	1	Set the page address of DDRAM
	1	0	0	0	0	0	Y3	Y2	Y1	Y0	
Column Address	0	0	0	0	0	1	0	0	1	1	Set the column address of DDRAM
	1	0	-	-	-	-	-	-	-	X8	
	1	0	X7	X6	X5	X4	X3	X2	X1	X0	
Display Data Write	0	0	0	0	0	1	1	1	0	1	Write display data to DDRAM
	1	0	D7	D6	D5	D4	D3	D2	D1	D0	
Display Data Read	0	0	0	0	0	1	1	1	0	0	Read display data from DDRAM
	1	1	D7	D6	D5	D4	D3	D2	D1	D0	
Display Data Input/Output Direction	0	0	1	0	0	0	0	1	0	DIR	Set DDRAM data input direction DIR=0: column direction DIR=1 : page direction
Column Address Direction	0	0	1	0	1	0	0	0	0	MX	Set column addressing direction MX=0: SEG0→SEG343 MX=1: SEG343→SEG0
N-Line Inversion	0	0	0	0	1	1	0	1	1	0	Set N-Line inversion
	1	0	0	0	0	NL4	NL3	NL2	NL1	NL0	
N-Line Inversion ON/OFF	0	0	1	1	1	0	0	1	0	NL	Set N-Line inversion mode NL=0: N-Line inversion off NL=1: N-Line inversion on
Enable DDRAM	0	0	0	1	1	0	1	1	0	1	Enable DDRAM 1/88 Duty: ED[7:0]=15h 　　　　　ED[15:8]=0Ch 1/72 Duty: ED[7:0]=11h 　　　　　ED[15:8]=0Eh 1/64 Duty: ED[7:0]=0Fh 　　　　　ED[15:8]=0Fh
	1	0	ED[7:0]								
	1	0	ED[15:8]								
Read Modify Write	0	0	1	1	1	0	0	0	0	0	Enable Read Modify Write mode
Read Modify Write End	0	0	1	1	1	0	1	1	1	0	Disable Read Modify Write mode
Built-in Oscillator Circuit ON/OFF	0	0	1	0	1	0	1	0	1	OSC	Set built-in oscillator mode OSC=0: built-in oscillator off OSC=1: built-in oscillator on

INSTRUCTION	A0	R/W	D7	D6	D5	D4	D3	D2	D1	D0	DESCRIPTION
Operation Clock Frequency	0	0	0	1	0	1	1	1	1	1	Set frame rate in different temperature range
	1	0	FRB3	FRB2	FRB1	FRB0	FRA3	FRA2	FRA1	FRA0	
	1	0	FRD3	FRD2	FRD1	FRD0	FRC3	FRC2	FRC1	FRC0	
Power Control	0	0	0	0	1	0	0	1	0	1	Set built-in power circuits on/off
	1	0	-	-	VAD	V3	VPF	VMV3	VNAD	VNF	
Booster Level	0	0	0	0	1	0	1	0	1	1	Set the level of built-in booster circuit
	1	0	-	-	-	-	-	-	0	BL	
BIAS	0	0	1	0	1	0	0	0	1	0	Set the bias ratio of liquid crystal driving voltage
	1	0	0	0	0	0	0	BS2	BS1	BS0	
Electronic Volume	0	0	1	0	0	0	0	0	0	1	Set the V3 level for liquid crystal driving voltage
	1	0	EV7	EV6	EV5	EV4	EV3	EV2	EV1	EV0	
	1	0	0	0	0	0	0	0	0	0	
Power Discharge	0	0	1	1	1	0	1	0	1	0	Set power circuits discharge
	1	0	-	-	-	-	DV3	DVPF	DVNF	DVMV3	
Power Save	0	0	1	0	1	0	1	0	0	PD	Set power save mode PD=0 : normal mode PD=1 : standby mode
Temperature Gradient Compensation	0	0	0	1	0	0	1	1	1	0	Set temperature gradient compensation coefficient
	1	0	MT1[3:0]				MT0[3:0]				
	1	0	MT3[3:0]				MT2[3:0]				
	1	0	MT5[3:0]				MT4[3:0]				
	1	0	MT7[3:0]				MT6[3:0]				
	1	0	MT9[3:0]				MT8[3:0]				
	1	0	MTB[3:0]				MTA[3:0]				
	1	0	MTD[3:0]				MTC[3:0]				
	1	0	MTF[3:0]				MTE[3:0]				
Temperature Gradient Compensation Flag	0	0	0	0	1	1	1	0	0	1	Set the slope of temperature gradient is positive or negative
	1	0	FMT7	FMT6	FMT5	FMT4	FMT3	FMT2	FMT1	FMT0	
	1	0	FMTF	FMTE	FMTD	FMTC	FMTB	FMTA	FMT9	FMT8	
Read Status	0	0	1	0	0	0	1	1	1	0	Read IC status
	1	1	D	OSC	AVD	V3	VPF	VMV3	VNAD	VNF	
	1	1	DISV	-	MY	PD	TD	NLFR	-	-	
Temperature Detection	0	0	0	1	1	0	1	0	0	TD	Set temperature detection mode TD=0: disable mode TD=1: enable mode
LCD Driving Method	0	0	1	1	1	0	0	1	1	1	Set LCD driving method
	1	0	-	-	-	NLFR	1	-	-	1	
NOP	0	0	1	1	1	0	0	0	1	1	No operation
Frequency Compensation Temperature Range	0	0	1	1	1	0	1	1	0	0	Set temperature range for frequency compensation
	1	0	-	TA6	TA5	TA4	TA3	TA2	TA1	TA0	
	1	0	-	TB6	TB5	TB4	TB3	TB2	TB1	TB0	
	1	0	-	TC6	TC5	TC4	TC3	TC2	TC1	TC0	

| INSTRUCTION | A0 | R/W | COMMAND BYTE | | | | | | | | DESCRIPTION |
			D7	D6	D5	D4	D3	D2	D1	D0	
Temperature Hysteresis Value	0	0	1	1	1	0	1	1	0	1	Set temperature hysteresis value
	1	0	-	-	0	0	THV3	THV2	THV1	THV0	
	1	0	-	-	-	-	THF3	THF2	THF1	THD0	
Current Temperature	0	0	1	1	1	0	1	1	1	1	Monitor current temperature
	1	1	T7	T6	T5	T4	T3	T2	T1	T0	
Test	0	0	1	1	1	1	1	1	TE	T	Set test command mode TE=0 : normal command mode TE=1 : test command mode T : select test command mode

RECOMMENDED INITIAL SETTINGS

Set Display Inverse : A6H
Set Page Address : B1H,00H, 0AH,
Set Column Address : 13H,00H,D8H
Set Com Scan Direction : C4H,02H
Set Bias : A2H,03H
Set Electronic Volume:81H,6FH,00H
Set Booster:2BH,01H
Set Enable DDRAM:6DH,0FH,0CH
Set N-Line Inversion:36H,05H
Set N-Line Inversion Off :E4H,ABH
Set Operation Clock Frequency:5FH,00H,00H
Set LCD Drive Method:E7H,19H
Set Power Control1 : 25H,08H
Set Power Control2 : 25H,0EH
Set Power Control3 : 25F,0FH
Set Power Control4 : 25H,20H
Set Power Control5 : 25H,26H
Set Power Control6 : 25H,36H
Set Power Control7 : 25H,3EH
Set Power Control8 : 25H,3FH
Set Display On : AFH

DDRAM MAP TO LCD DRIVER OUTPUT

Page	Page Address			
	D3	D2	D1	D0
Page 0	0	0	0	0
Page 1	0	0	0	1
Page 2	0	0	1	0
Page 3	0	0	1	1
Page 4	0	1	0	0
Page 5	0	1	0	1
Page 6	0	1	1	0
Page 7	0	1	1	1
Page 8	1	0	0	0
Page 9	1	0	0	1
Page 10	1	0	1	0

Column Address

MX=0

MX=1

MY=0

MY=1

COM PAD: COM0 – COM87

SEG PAD: SEG0 ... SEG343

4-LINE SPI INTERFACE TIMING
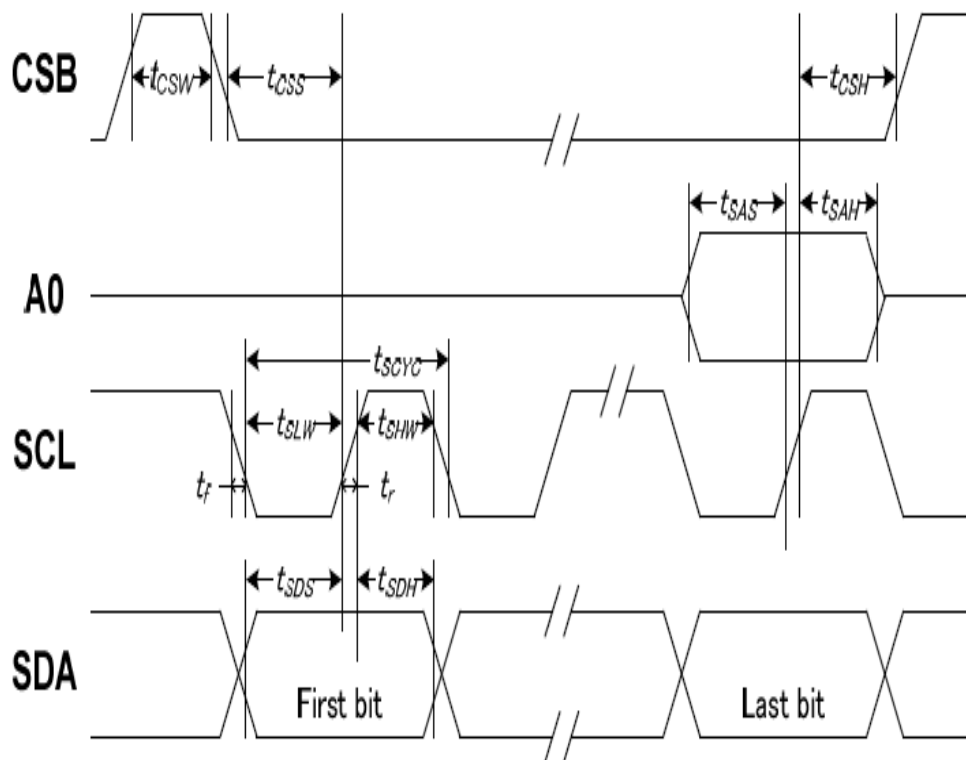
VDD1 = 3.3V~5.0V , Ta = 25℃

Item	Signal	Symbol	Condition	Min.	Max.	Unit
Serial clock period	SCL	tSCYC		250	—	ns
SCL "H" pulse width		tSHW		100	—	
SCL "L" pulse width		tSLW		100	—	
Address setup time	A0	tSAS		150	—	
Address hold time		tSAH		150	—	
Data setup time	SDA	tSDS		100	—	
Data hold time		tSDH		100	—	
CSB-SCL time	CSB	tCSS		150	—	
CSB-SCL time		tCSH		150	—	
CSB "H" pulse width		tCSW		25	—	

Note:

1. The input signal rise and fall time (tr, tf) are specified at 15 ns or less.

2. All timing is specified using 20% and 80% of VDD1 as the standard.

3-LINE SPI INTERFACE TIMING
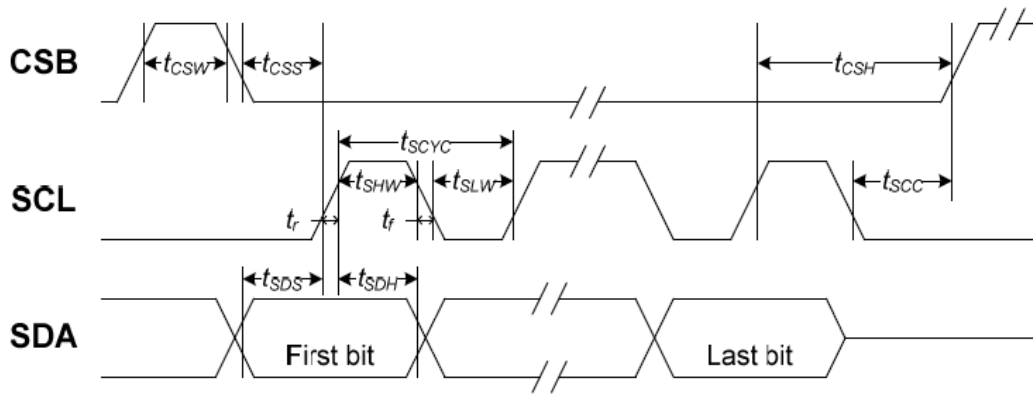
VDD1 = 3.3V~5.0V, Ta = 25℃

Item	Signal	Symbol	Condition	Rating		Unit
				Min.	Max.	
Serial Clock Period	SCL	tSCYC		250	—	ns
SCL "H" pulse width		tSHW		100	—	
SCL "L" pulse width		tSLW		100	—	
SCL wait time		tSCC		100	—	
Data setup time	SDA	tSDS		100	—	
Data hold time		tSDH		100	—	
CSB-SCL time	CSB	tCSS		150	—	
CSB-SCL time		tCSH		150	—	
CSB "H" pulse width		tCSW		10	—	

Note:

1. The input signal rise and fall time (tr, tf) are specified at 15 ns or less.
2. All timing is specified using 20% and 80% of VDD1 as the standard.

RESET TIMING
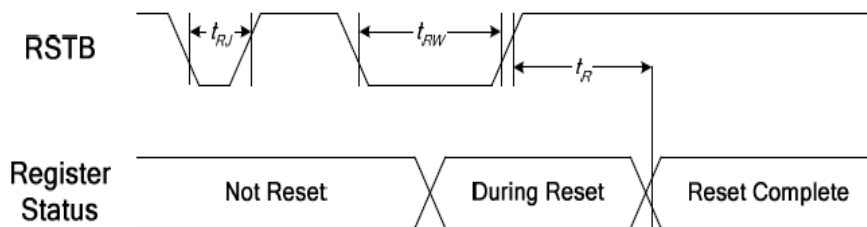
VDD1 = 3.3V~5.0V , Ta = 25℃

Item	Signal	Symbol	Condition	Rating		Unit
				Min.	Max.	
Reset time	RSTB	tR		—	5 *1	us
Reset "L" pulse width		tRW		15	—	
Reset rejection		tRJ		—	5	
Reset rejection (for noise spike)		tRJS		—	10	ns

ELECTRO-OPTICAL CHARACTERISTICS

MEASURING CONDITION: POWER SUPPLY = V_{OP} / 64 Hz

TEMPERATURE = 23 ± 5 °C

RELATIVE HUMIDITY = 60 ± 20 %

ITEM	SYMBOL	UNIT	TYP. STN
RESPONSE TIME	Ton	ms	220
	Toff	ms	280
CONTRAST RATIO	Cr	-	12
VIEWING ANGLE (6 O'clock) Cr ≥ 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

NO.	Item	TEST CONDITION FOR NORMAL TEMPERATURE	TEST CONDITION FOR WIDE TEMPERATURE	TIME
1	High temperature operating	50°C	70°C	240 hours
2	Low temperature operating	0°C	-20°C	240 hours
3	High temperature storage	60°C	80°C	240 hours
4	Low temperature storage	-10°C	-30°C	240 hours
5	Temperature-humidity storage	40°C 90% R.H.	60°C 90% R.H.	96 hours
6	Temperature cycling	-10°C to 60°C 30 Min Dwell	-30°C to 80°C 30 Min Dwell	5 cycle
7	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	—

Inspection condition:

No. 1 ~ 6:

The samples should be placed in room temperature for 2 hours before inspection.

Acceptance criteria:

No non-conformance found in functional and cosmetic.

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
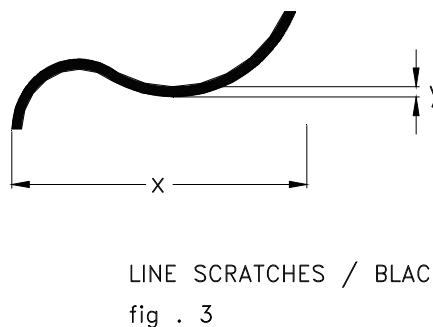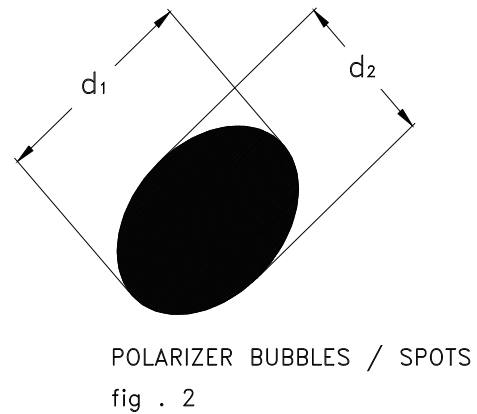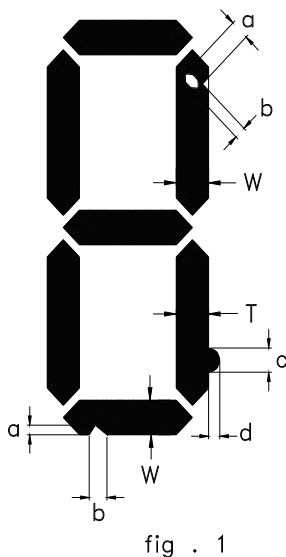
QUALITY STANDARD (CONT .)

DEFECT		CRITERIA	TYPE	FIGURE
CHIPS	CONTACT EDGE	$e \leq 1/2T$ $f \leq 1/3W$ $g \leq 3.5$	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
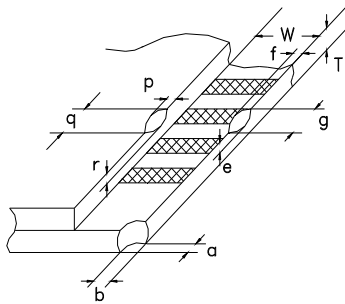
fig . 4
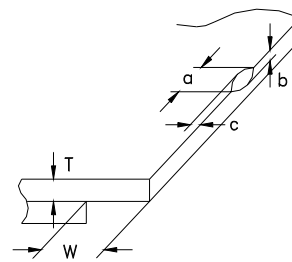
fig . 5
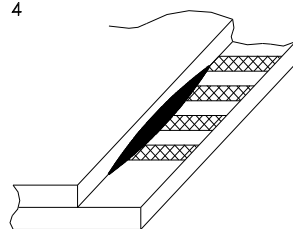
fig . 6

QUALITY STANDARD OF LCD MODULE

1.0	**Sampling Method**		
	Sampling Plan : MIL STD 105 E Class of AQL : Level II/Single Sampling Critical : 0.25% Major 0.65% Minor 1.5%		
2.0	**Defect Group**	**Failure Category**	**Failure Reasons**
	Critical Defect 0.25%(AQL)	Malfunction	Open Short Burnt or dead component Missing part/improper part P.C.B. Broken
	Major Defect 0.65%(AQL)	Poor Insulation	Potential short High current Component damage or scratched or Lying too close improper coating
		Poor Conduction	Damage joint Wrong polarity Wrong spec. part Uneven/intermittent contact Loose part Copper peeling Rust or corrosion or dirt's
	Minor Defect 1.5%(AQL)	Cosmetic Defect	Minor scratch Flux residue Thin solder Poor plating Poor marking Crack solder Poor bending Poor packing Wrong size

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

CLOVER 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 Clover is limited to repair and/or replacement. Clover will not be responsible for any subsequent or consequential event.