CLOVER DISPLAY LTD.

SPECIFICATION

FOR

LCD MODULE

MODEL NO. : M9127

SPEC. REVISION NO. : 00

SAMPLE NO. : 01

CUSTOMER APPROVAL

Please kindly find & approve the samples & specification and return one copy of this page with authorized signature & company stamp.

DEPARTMENT	NAME	SIGNATURE	EFFECTIVE DATE
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SPECIFICATION REVISION RECORD

Revision No.	**Description**	**Date**(DD/MM/YY)
00	1st Issue	14/10/03

SAMPLE REVISION RECORD

Sample No.	**Description**	**Date**(DD/MM/YY)
00	Prototype Sample	25/09/03
01	1st Issue	15/10/03

GENERAL DESCRIPTION

Display mode	:	128 x 64 dots Graphic COG LCD module STN / Transflective / Grey
Interface	:	8 bit parallel (6800 mode)
Driving method	:	1/65 duty, 1/9 bias
Viewing direction	:	6 O'clock
Backlight	:	EL/ Blue
Controller IC	:	Samsung S6B0724 For the detailed information, please refer to the IC specifications.

MECHANICAL DIMENSIONS

Item	Dimension	Unit	Item	Dimension	Unit
Outline Dimension	34.4(L)x31.6(W)x2.6(Max)(H)	mm	Dot Pitch	0.22(L)x0.30 (W)	mm
Viewing Area	30.4(L)x20.9 (W)	mm	Dot Size	0.195(L)x0.275(W)	mm

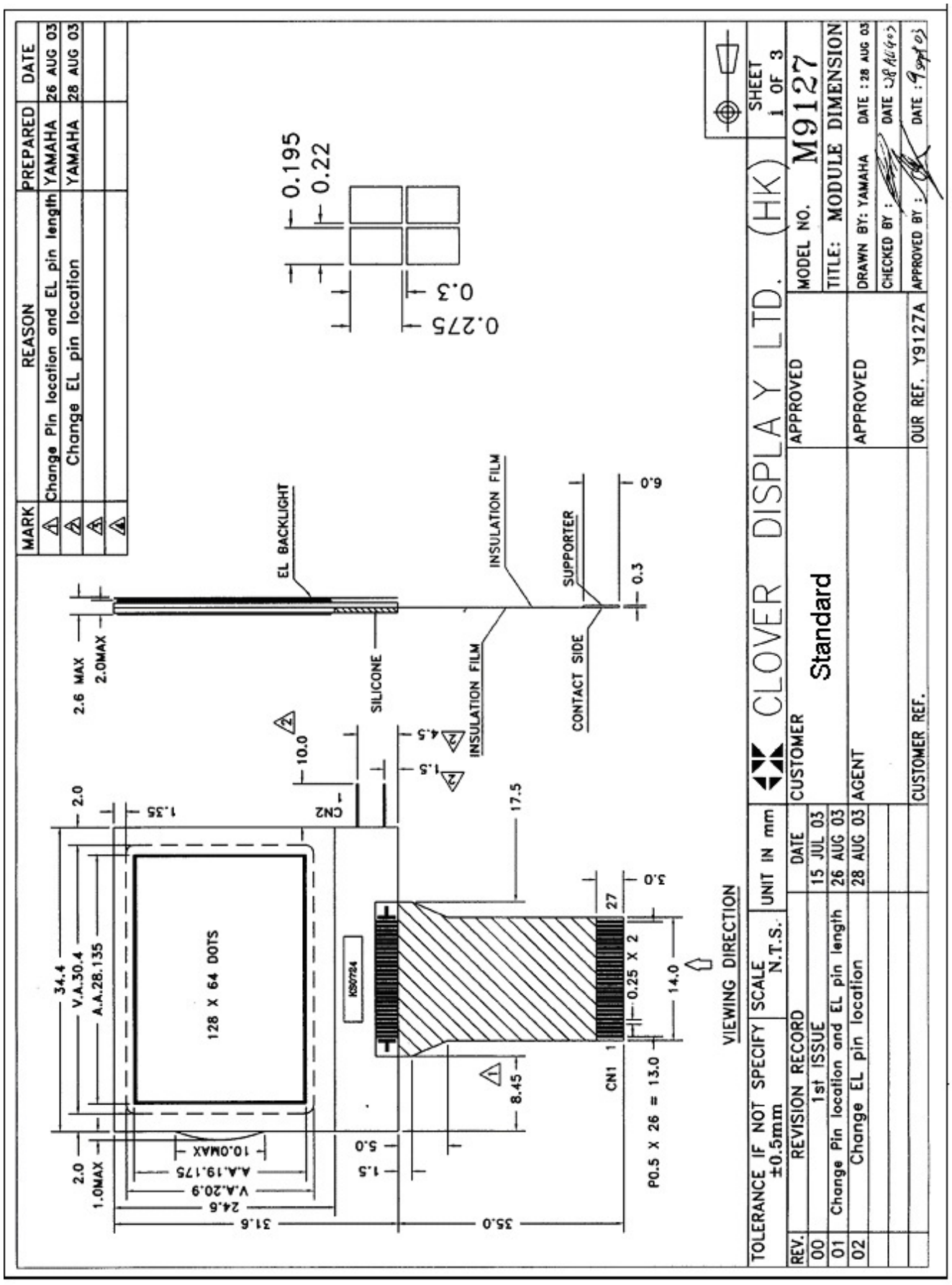
CONNECTOR PIN ASSIGNMENT (CN1)

Pin No.	Symbol	Function	Pin No.	Symbol	Function
1	V0	LCD Operation Voltage	15	DB7	Data Bus Line
2	V4		16	DB6	
3	V3		17	DB5	
4	V2		18	DB4	
5	V1		19	DB3	
6	C2-	Voltage Converter	20	DB2	
7	C2+		21	DB1	
8	C1+		22	DB0	
9	C1-		23	E_RDB	Enable Pin
10	C3+		24	RW_WRB	Read/Write
11	VOUT	Voltage Converter input/output	25	RS	Register Selection Pin
12	VSS	Power Supply (0V)	26	RESETB	Reset pin
13	VCI	Reference voltage for the voltage converter	27	CS2	Chip selection
14	VDD	Power Supply for Logic	–	–	–

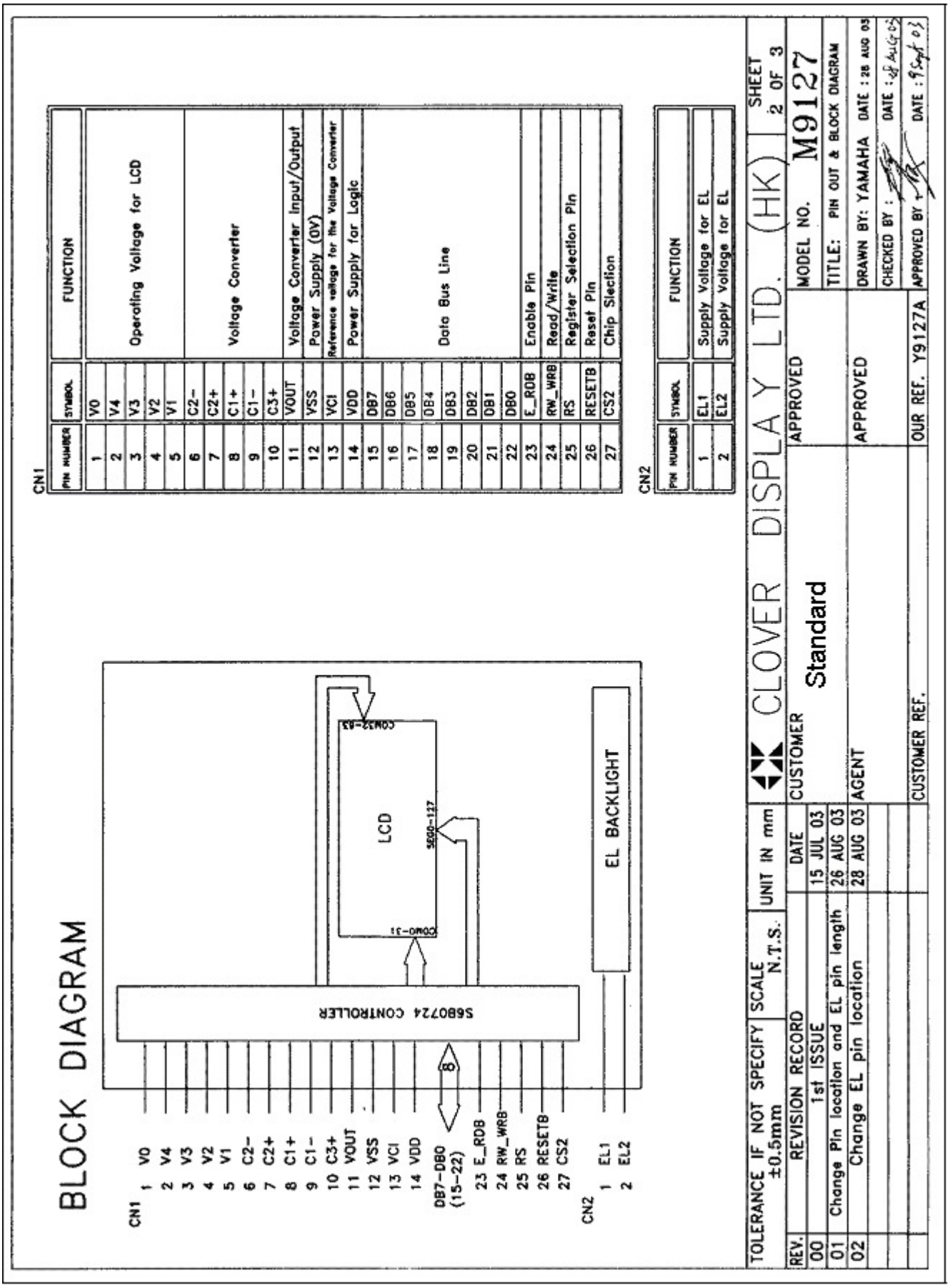
CONNECTOR PIN ASSIGNMENT (CN2)

Pin No.	Symbol	Function
1	EL1	Supply voltage for EL
2	EL2	

COUNTER DRAWING OF MODULE DIMENSION



COUNTER DRAWING OF PIN OUT & BLOCK DIAGRAM



ELECTRICAL CHARACTERISTICS

Condition: VSS=0V, Ta=25℃

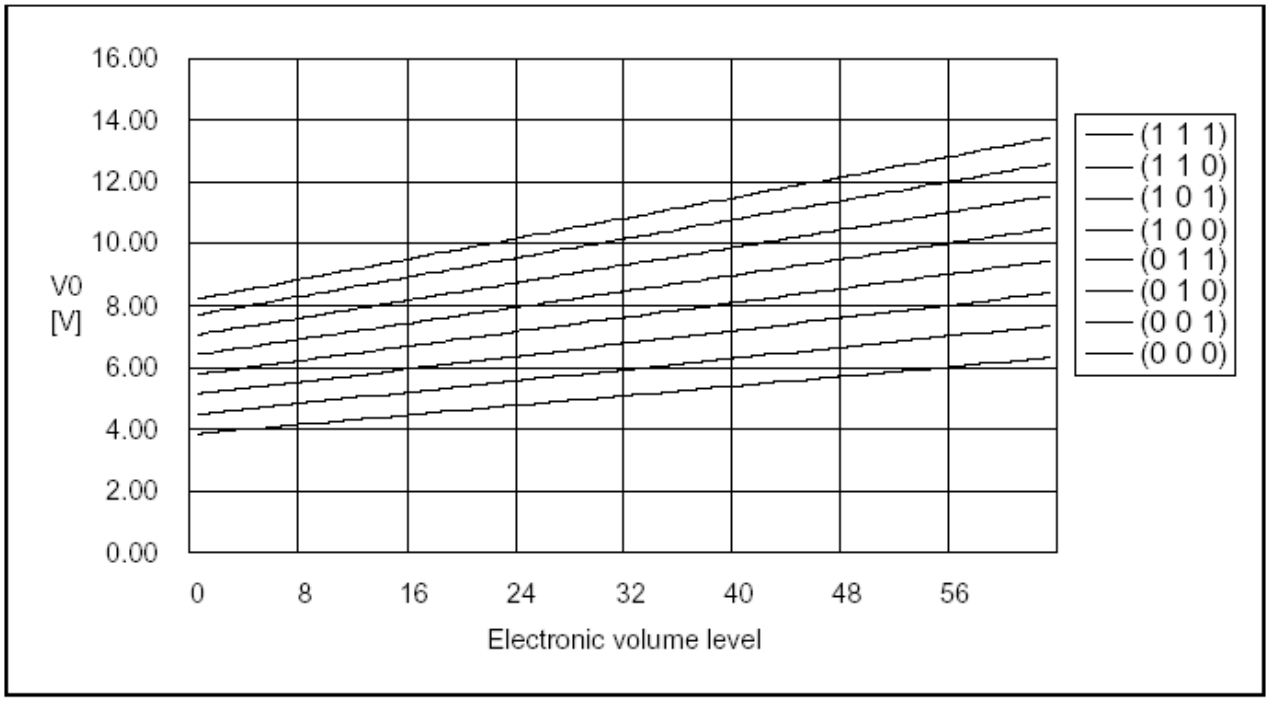
Item	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage	VDD	2.4	3.3	3.6	V
Supply Current	IDD	—	150	200	uA
Operating Voltage for LCD	VO	7.8	8.0	8.2	V
"High"Level Input Voltage	VIH	0.8VDD	—	VDD	V
"Low"Level Input Voltage	VIL	0	—	0.2VDD	V
Backlight Voltage	VEL	—	110	—	Vrms
Backlight Frequency	FEL	—	400	—	Hz

Regulator resistor select register: (R2, R1, R0) = (1,0,0)
Reference voltage register set = 18H (Heximals) for typical VLCD 8.0V

Internal Rb / Ra Ratio depending on 3-bit Data (R2 R1 R0)

	3-bit data settings (R2 R1 R0)							
	000	001	010	011	100	101	110	111
1+(Rb / Ra)	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.4

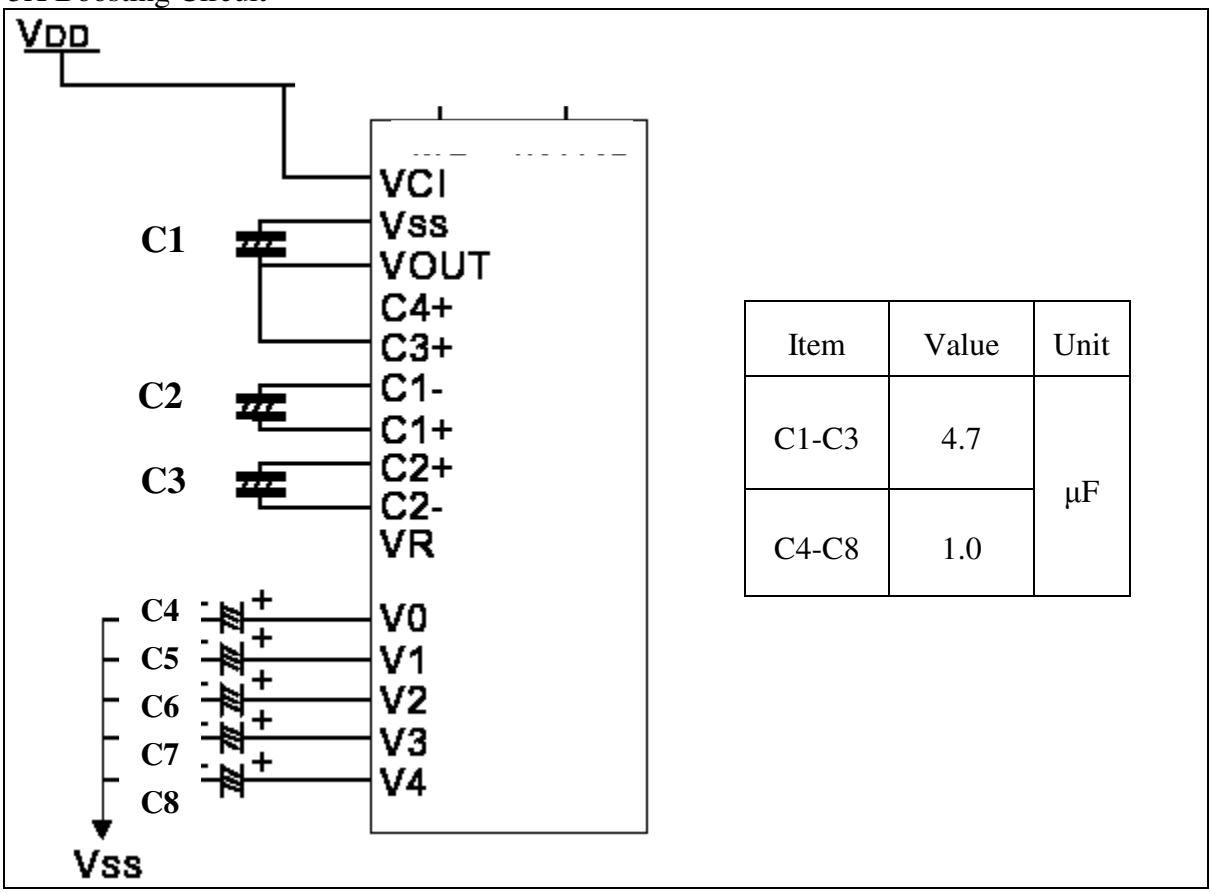
The following figure shows V0 voltage measured by adjusting internal regulator resistor ratio (Rb / Ra) and 6-bit electronic volume registers for each temperature coefficient at Ta = 25 °C.



Electronic Volume Level

REFERENCE CIRCUIT EXAMPLES

3X Boosting Circuit



Item	Value	Unit
C1-C3	4.7	μF
C4-C8	1.0	

ABSOLUTE MAXIMUM RATINGS

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

Item	Symbol	Rating	Unit
Supply Voltage	V_{DD}	-0.3 to 7.0	V
Input Voltage	V_T	-0.3 to V_{DD} +0.3	V
Operating Temperature	T_{opr}	0 to 50	℃
Storage Temperature	T_{stg}	-10 to 60	℃

COMMAND TABLE

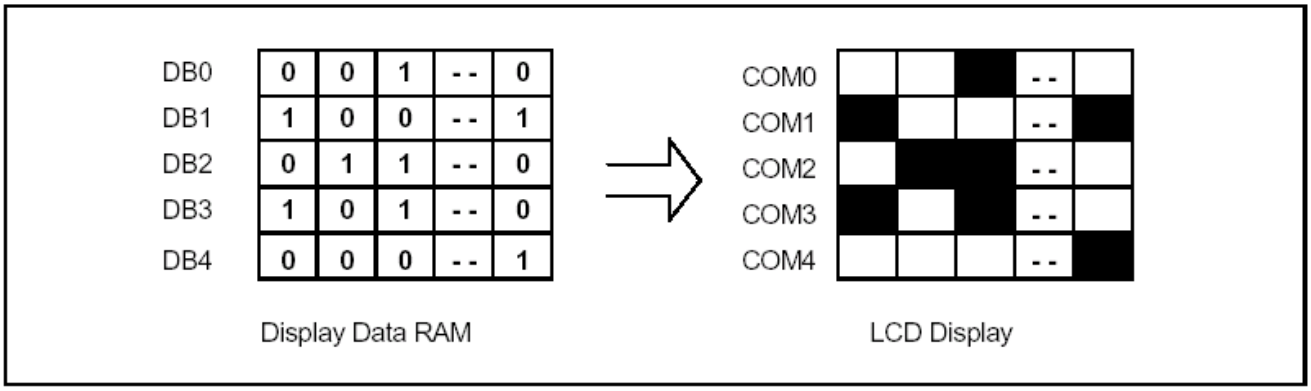
×: Don't care

Instruction	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description
Display ON / OFF	0	0	1	0	1	0	1	1	1	DON	Turn on/off LCD panel When DON = 0: display OFF When DON = 1: display ON
Initial display line	0	0	0	1	ST5	ST4	ST3	ST2	ST1	ST0	Specify DDRAM line for COM0
Set page address	0	0	1	0	1	1	P3	P2	P1	P0	Set page address
Set column address MSB	0	0	0	0	0	1	Y7	Y6	Y5	Y4	Set column address MSB
Set column address LSB	0	0	0	0	0	0	Y3	Y2	Y1	Y0	Set column address LSB
Read status	0	1	BUSY	ADC	ONOFF	RESETB	0	0	0	0	Read the internal status
Write display data	1	0	Write data								Write data into DDRAM
Read display data	1	1	Read data								Read data from DDRAM
ADC select	0	0	1	0	1	0	0	0	0	ADC	Select SEG output direction When ADC = 0: normal direction (SEG0→SEG131) When ADC = 1: reverse direction (SEG131→SEG0)
Reverse display ON / OFF	0	0	1	0	1	0	0	1	1	REV	Select normal / reverse display When REV = 0: normal display When REV = 1: reverse display
Entire display ON / OFF	0	0	1	0	1	0	0	1	0	EON	Select normal/entire display ON When EON = 0: normal display. When EON = 1: entire display ON
LCD bias select	0	0	1	0	1	0	0	0	1	BIAS	Select LCD bias
Set modify-read	0	0	1	1	1	0	0	0	0	0	Set modify-read mode
Reset modify-read	0	0	1	1	1	0	1	1	1	0	release modify-read mode
Reset	0	0	1	1	1	0	0	0	1	0	Initialize the internal functions
SHL select	0	0	1	1	0	0	SHL	×	×	×	Select COM output direction When SHL = 0: normal direction (COM0→COM63) When SHL = 1: reverse direction (COM63→COM0)
Power control	0	0	0	0	1	0	1	VC	VR	VF	Control power circuit operation
Regulator resistor select	0	0	0	0	1	0	0	R2	R1	R0	Select internal resistance ratio of the regulator resistor
Set reference voltage mode	0	0	1	0	0	0	0	0	0	1	Set reference voltage mode
Set reference voltage register	0	0	×	×	SV5	SV4	SV3	SV2	SV1	SV0	Set reference voltage register
Set static indicator mode	0	0	1	0	1	0	1	1	0	SM	Set static indicator mode
Set static indicator register	0	0	×	×	×	×	×	×	S1	S0	Set static indicator register
Power save	-	-	-	-	-	-	-	-	-	-	Compound Instruction of display OFF and entire display ON

Instruction	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description
NOP	0	0	1	1	1	0	0	0	1	1	*Non-Operation command*
Test Instruction_1	0	0	1	1	1	1	×	×	×	×	*Don't use this instruction*
Test Instruction_2	0	0	1	0	0	1	×	×	×	×	*Don't use this instruction*

DISPLAY DATA RAM

The Display Data RAM stores pixel data for the LCD. It is 65-row by 132-column addressable array. Each pixel can be selected when the page and column addresses are specified. The 65 rows are divided into 8 pages of 8 lines and the 9th page with a single line (DB0 only). Data is read from or written to the 8 lines of each page directly through DB0 to DB7. The display data of DB0 to DB7 from the microprocessor correspond to the LCD common lines as shown in figure 6. The microprocessor can read from and write to RAM through the I/O buffer. Since the LCD controller operates independently, data can be written into RAM at the same time as data is being displayed without causing the LCD flicker.



RAM-to-LCD Data Transfer

Page Address Circuit

This circuit is for providing a Page Address to DISPLAY-DATA-RAM shown in figure 8. It incorporates 4-bit Page Address register changed by only the "Set Page" instruction. Page Address 8 (DB3 is "H", but DB2, DB1 and DB0 are "L") is a special RAM area for the icons and display data DB0 is only valid. When Page Address is above 8, it is impossible to access to on-chip RAM.

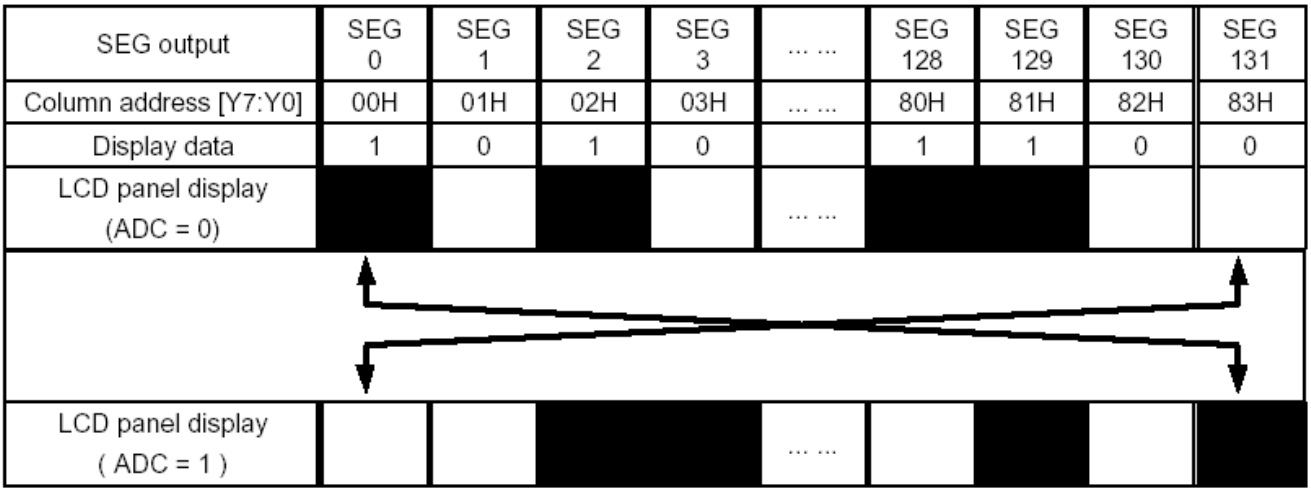
Line Address Circuit

This circuit assigns DDRAM a Line Address corresponding to the first line (COM0) of the display. Therefore, by setting line address repeatedly, it is possible to realize the screen scrolling and page switching without changing the contents of on-chip RAM as shown in figure 8. It incorporates 6-bit line address register changed by only the initial display line instruction and 6-bit counter circuit. At the beginning of each LCD frame, the contents of register are copied to the line counter which is increased by CL signal and generates the Line Address for transferring the 132-bit RAM data to the display data latch circuit. However, display data of icons are not scrolled because the MPU can not access Line Address of icons.

Column Address Circuit

Column Address circuit has an 8-bit preset counter that provides column address to the Display Data RAM as shown in figure 8. When set Column Address MSB / LSB instruction is issued, 8-bit [Y7:Y0] is updated. And, since this address is increased by 1 each a read or write data instruction, microprocessor can access the display data continuously. However, the counter is not increased and locked if a non-existing address above 84H. It is unlocked if a column address is set again by set Column Address MSB / LSB instruction. And the Column Address counter is independent of page address register.

ADC select instruction makes it possible to invert the relationship between the Column Address and the segment outputs. It is necessary to rewrite the display data on built-in RAM after issuing ADC Select instruction. Refer to the following figure 7.

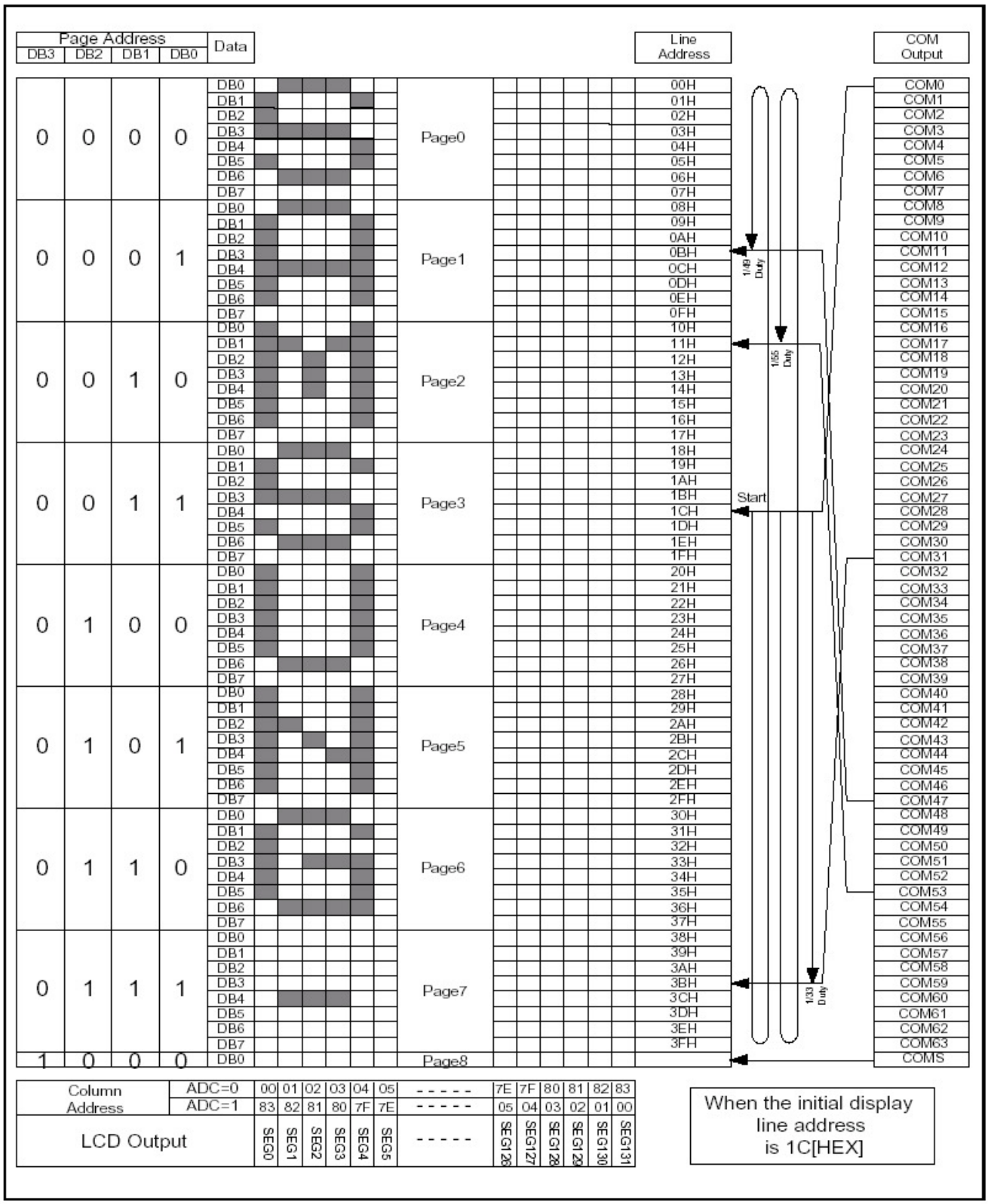


The Relationship between the Column Address and the Segment Outputs

Segment Control Circuit

This circuit controls the display data by the display ON / OFF, reverse display ON / OFF and entire display ON / OFF instructions without changing the data in the display data RAM.

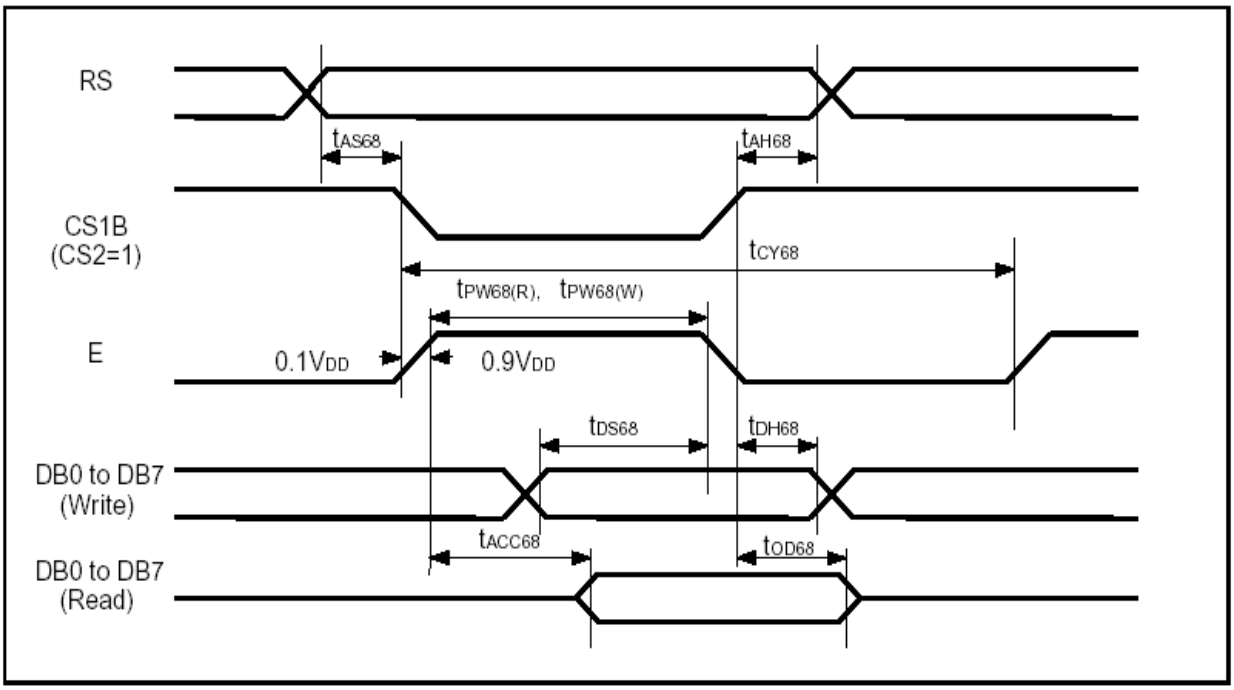
DISPLAY DATA RAM MAP



Display Data RAM Map

AC CHARACTERISTICS

Read / Write Characteristics (6800-series Microprocessor)

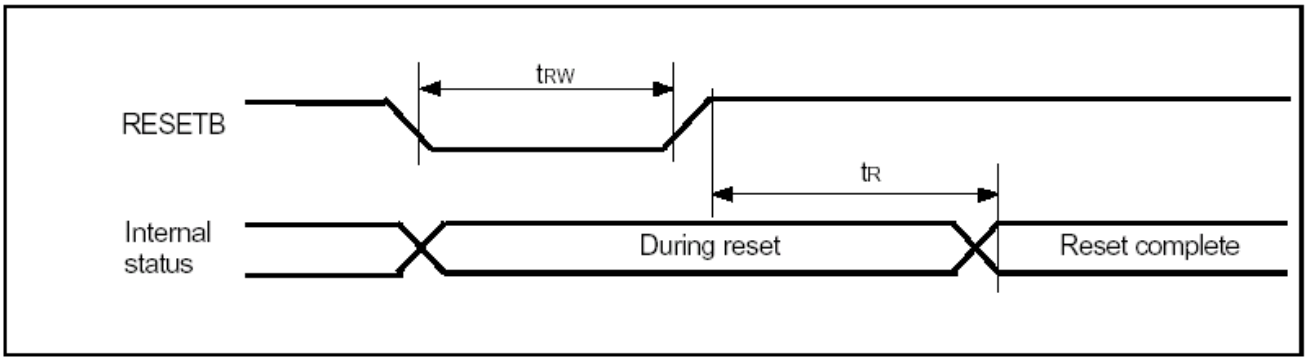


Read / Write Characteristics (6800-series Microprocessor)

(V_{DD} = 2.4 to 3.6V, Ta = -40 to +85°C)

Item		Signal	Symbol	Min.	Typ.	Max.	Unit	Remark
Address setup time Address hold time		RS	t_{AS68} t_{AH68}	0 0	-	-	ns	
System cycle time		RS	t_{CY68}	300	-	-	ns	
Data setup time Data hold time		DB7 to DB0	t_{DS68} t_{DH68}	40 15	-	-	ns	
Access time Output disable time			t_{ACC68} t_{OD68}	- 10	-	140 100	ns	C_L = 100 pF
Enable pulse width	Read Write	E_RDB	$t_{PW68(R)}$ $t_{PW68(W)}$	120 60	-	-	-	

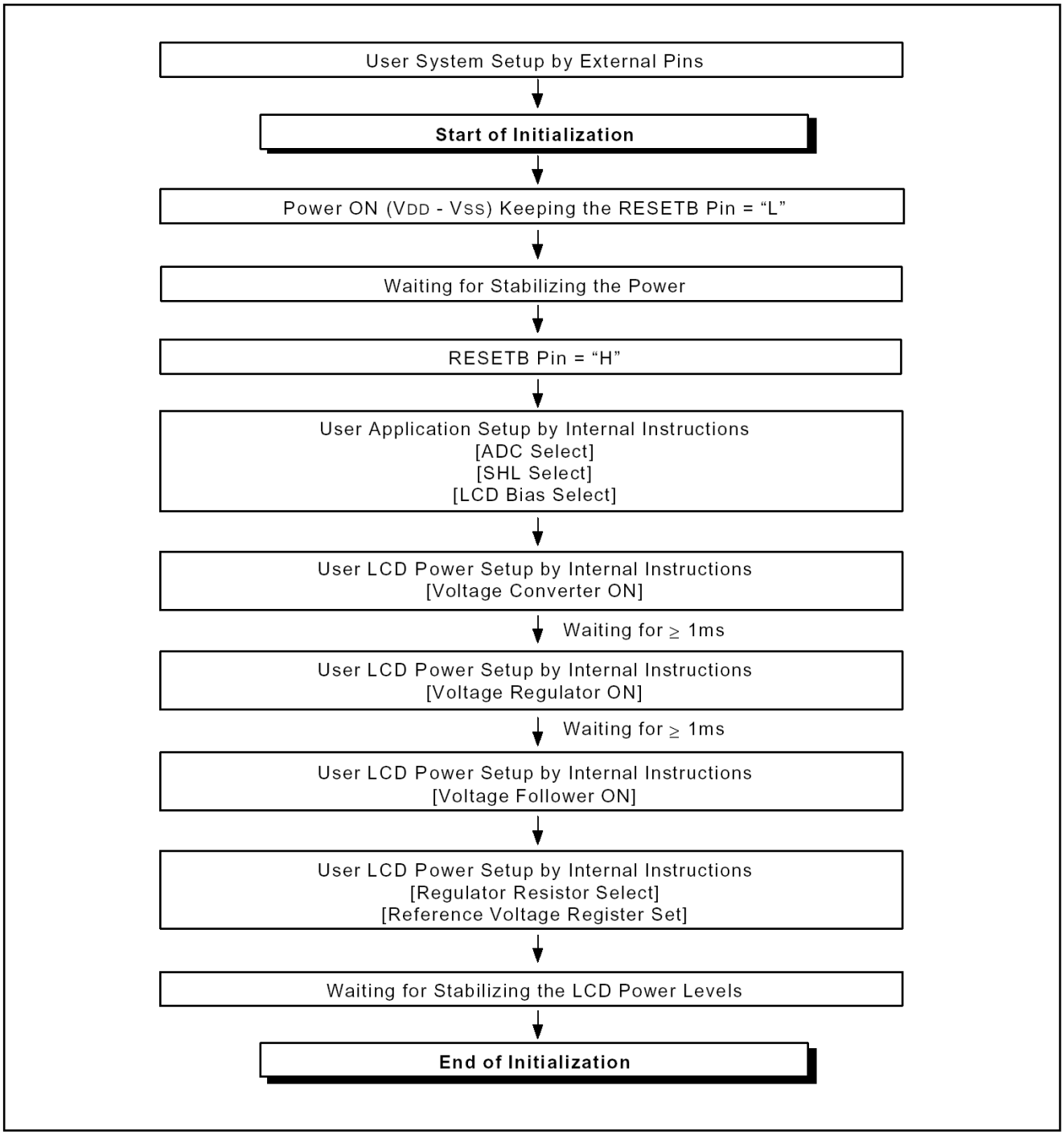
RESET INPUT TIMING



(V_{DD} = 2.4 to 3.6V, Ta = -40 to +85°C)

Item	Signal	Symbol	Min.	Typ.	Max.	Unit	Remark
Reset low pulse width	RESETB	t_{RW}	1.0	-	-	ns	
Reset time	-	t_R	-	-	1.0	ns	

INITIALIZATION



Initializing with the Built-in Power Supply Circuits

ELECTRO-OPTICAL CHARACTERISTICS

MEASURING CONDITION: POWER SUPPLY = V_{OP} / 64 Hz
TEMPERATURE = 22 ± 5 ℃
RELATIVE HUMIDITY = 60 ± 15 %

ITEM	SYMBOL	UNIT	TYP.
RESPONSE TIME	Ton	ms	220
	Toff	ms	280
CONTRAST RATIO	Cr	-	12
VIEWING ANGLE (6 O'clock) (Cr ≥ 2)	$V_{3:00}$	°	40
	$V_{6:00}$	°	70
	$V_{9:00}$	°	40
	$V_{12:00}$	°	50

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

RELIABILITY OF LCD MODULE

ITEM	TEST CONDITION	TIME
High temperature operating	50°C	240 hours
Low temperature operating	0°C	240 hours
High temperature storage	60°C	240 hours
Low temperature storage	-10°C	240 hours
Temperature-humidity storage	40°C 90% R.H.	96 hours
Temperature cycling	-10°C to 60°C 30 Min Dwell	5 cycles
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	—

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) ≤ 1 / 4 W	MINOR	1
EXCESS SEGMENT	MAX(c,d) ≤ 1 / 4 T	MINOR	1
BUBBLES	d* ≥ 0.2 QTY=0	MINOR	2
BLACKS SPOTS	d ≤ 0.3 N.A.** 0.3<d≤0.4 QTY≤1 0.4<d QTY=0	MINOR	2
LINE SCRATCHES	x≥0.7 y≥0.05 QTY=0	MINOR	3
BLACK LINE	x≥0.7 y≥0.05 QTY=0	MINOR	3

*d = MAX (d_1,d_2) ** N. A . = NOT APPLICABLE DEFECT TABLE : B

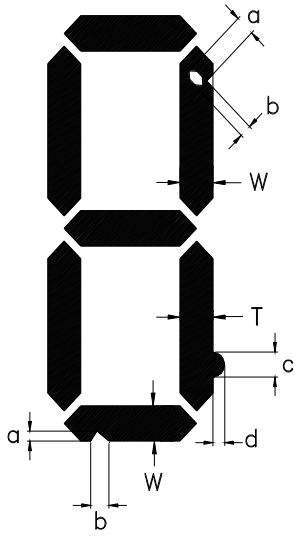
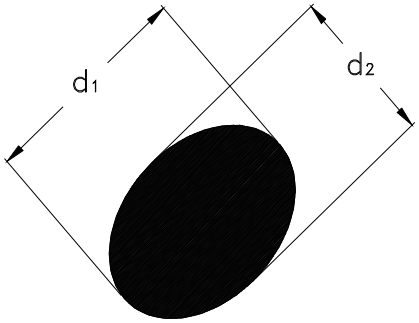
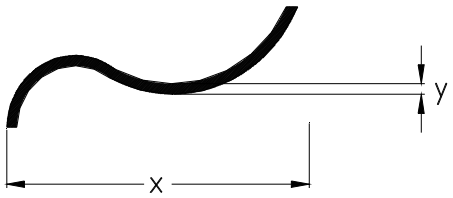


fig . 1



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

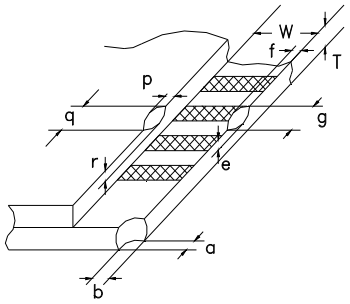


fig . 4

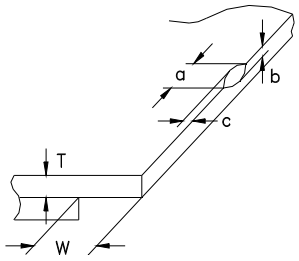


fig . 5

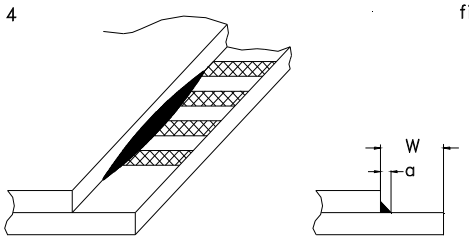


fig . 6

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

CLOVER will replace or repair any of her LCD modules 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.