CLOVER DISPLAY LTD.

SPECIFICATION

FOR

LCD MODULE

MODEL NO. : M9109

SPEC. REVISION NO. : 01
SAMPLE NO. : 02

CUSTOMER APPROVAL
Admatec Gmbh

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

DEPARTMENT	NAME	SIGNATURE	EFFECTIVE DATE
PREPARED BY	JACKSON FUNG	Jackson	14 June 2002
APPROVED BY	WY TSANG		14 June 2002

ADDRESS : ROOM 1006, 10/F WESTIN CENTRE, 26 HUNG TO ROAD, KWUN TONG, KOWLOON, HONG KONG.
TEL : (852) 2341 3238 (SALES OFFICE) (852) 2342 8228 (GENERAL OFFICE)
FAX : (852) 2357 4237 (SALES OFFICE) (852) 2341 8785 (GENERAL OFFICE)
E-MAIL : cdl@cloverlcd.com
URL : http://www.cloverlcd.com

SPECIFICATION REVISION RECORD

Revision No.	Description	Date(DD/MM/YY)
00	1st Issue	06/02/02
01	Counter drawing changed from revision 04 to 06 for backlight remove and pin out modify	22/05/02

SAMPLE REVISION RECORD

Sample No.	Description	Date(DD/MM/YY)
00	1st Issue	06/02/02
01	New sample with modification	22/05/02
02	Improve Contrast	14/06/02

GENERAL DESCRIPTION

Display mode	:	128 x 64 dots, Graphic COG LCD module, FSTN/ Positive/ Transflective
Interface	:	8-bit Parallel or Serial
Driving method	:	1/65 duty, 1/9 bias
Viewing direction	:	6 O'clock
IC Driver	:	Samsung – KS0724

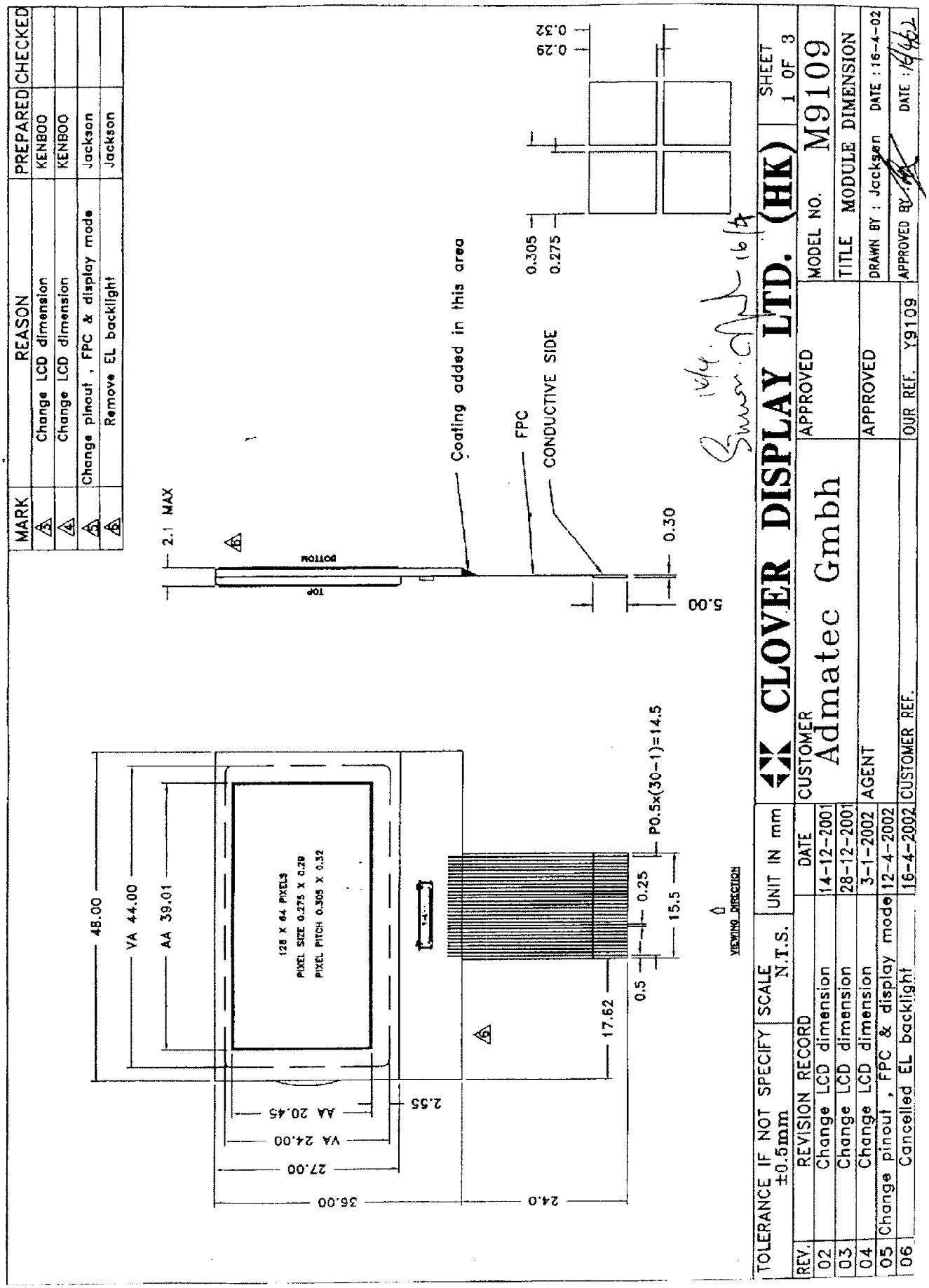
MECHANICAL DIMENSIONS

Item	Dimension	Unit	Item	Dimension	Unit
Outline Dimension	48.0(L)x36.0(W)x2.1(Max)(H)	mm	Dot Pitch	0.305(L)x0.32(W)	mm
Viewing Area	44.0(L)x24.0(W)	mm	Dot Size	0.275(L)x0.29(W)	mm

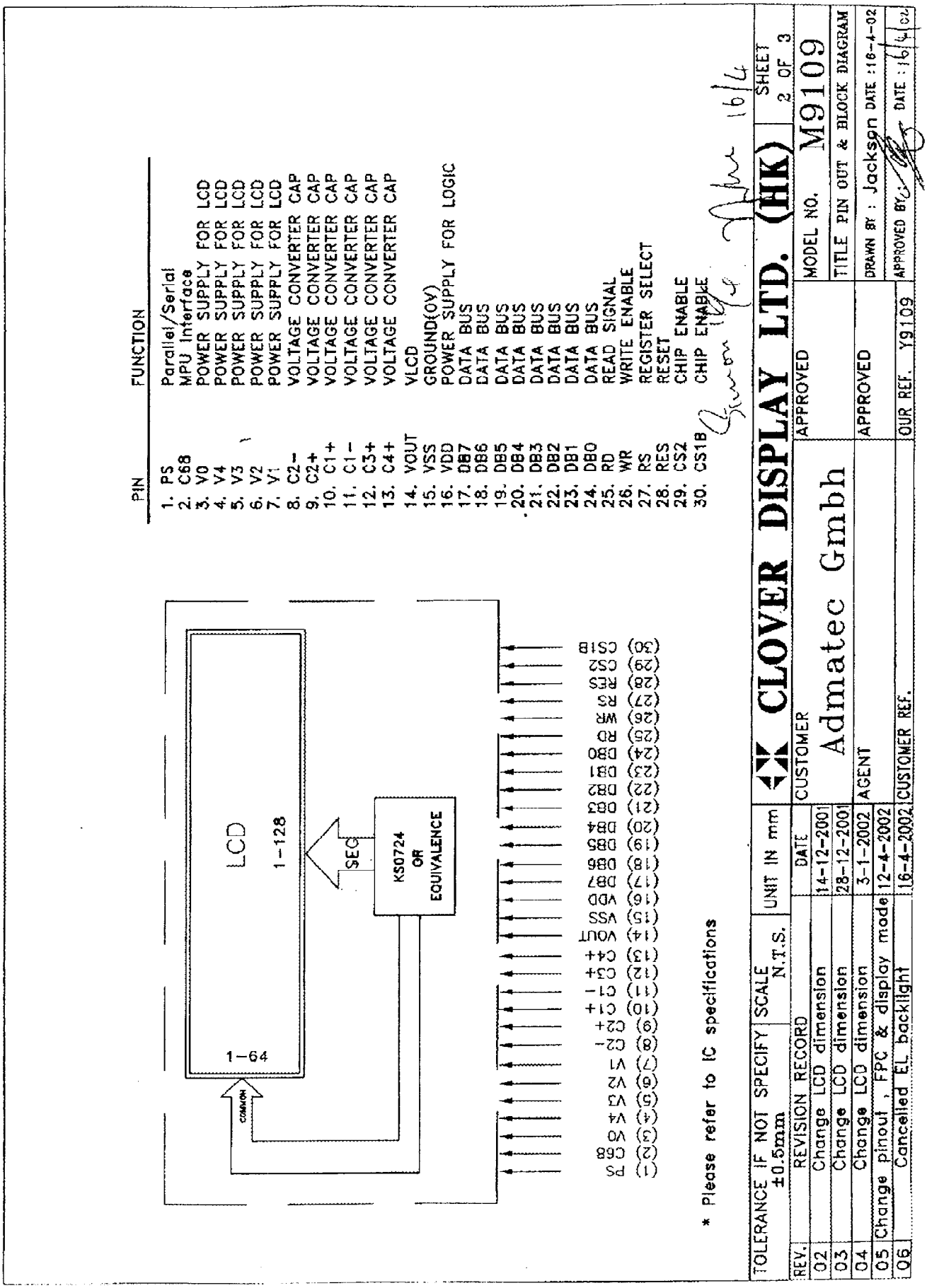
CONNECTOR PIN ASSIGNMENT

Pin No.	Symbol	Function	Pin No.	Symbol	Function
1	PS	Parallel/Serial	16	VDD	Power Supply for Logic
2	C68	MPU interface	17	DB7	Data Bus
3	V0	Power Supply for LCD	18	DB6	Data Bus
4	V4	Power Supply for LCD	19	DB5	Data Bus
5	V3	Power Supply for LCD	20	DB4	Data Bus
6	V2	Power Supply for LCD	21	DB3	Data Bus
7	V1	Power Supply for LCD	22	DB2	Data Bus
8	C2-	Voltage Converter Cap	23	DB1	Data Bus
9	C2+	Voltage Converter Cap	24	DB0	Data Bus
10	C1+	Voltage Converter Cap	25	RD	Read Signal
11	C1-	Voltage Converter Cap	26	RW	Write Enable
12	C3+	Voltage Converter Cap	27	RS	Register Select
13	C4+	Voltage Converter Cap	28	RES	Reset
14	Vout	VLCD	29	CS2	Chip Enable
15	VSS	Ground (0V)	30	CS1B	Chip Enable

COUNTER DRAWING OF MODULE DIMENSION



COUNTER DRAWING OF PIN OUT & BLOCK DIAGRAM



ELECTRICAL CHARACTERISTICS

Item	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage	VDD	2.75	3.0	3.25	V
Supply Current	IDD	–	200	–	μA
Supply Voltage for LCD	VLCD-VSS	–	10.0	–	V
"H"Level Input Voltage	VIH	0.8 VDD	–	VDD	V
"L"Level Input Voltage	VIL	0	–	0.2 VDD	V

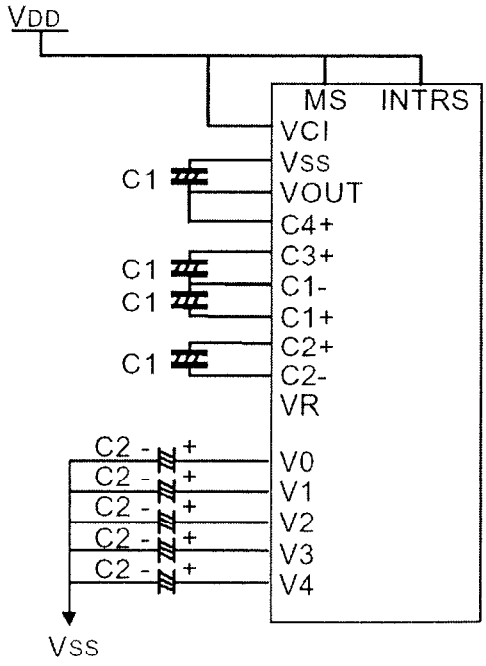
ABSOLUTE MAXIMUM RATINGS

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

Item	Symbol	Rating	Unit
Supply Voltage	VDD	-0.3 to 7.0	V
Input Voltage	VIN	-0.3 to VDD +0.3	V
Operating Temperature	Topr	-20 to 50	℃
Storage Temperature	Tstg	-20 to 60	℃

RECOMMENDED TO USE 4X BOOSTER

When using internal regulator resistors



Value of external Capacitance

Item	Value	Unit
C1	1.0 to 4.7	μF
C2	0.47 to 1.0	

INSTRUCTION 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
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 (DDRAM)

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.

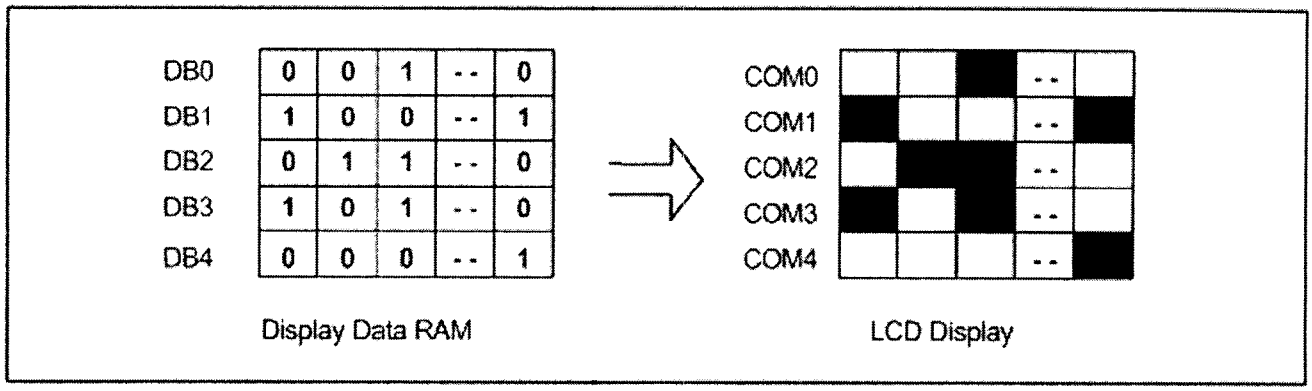


Figure 6. RAM-to-LCD Data Transfer

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.

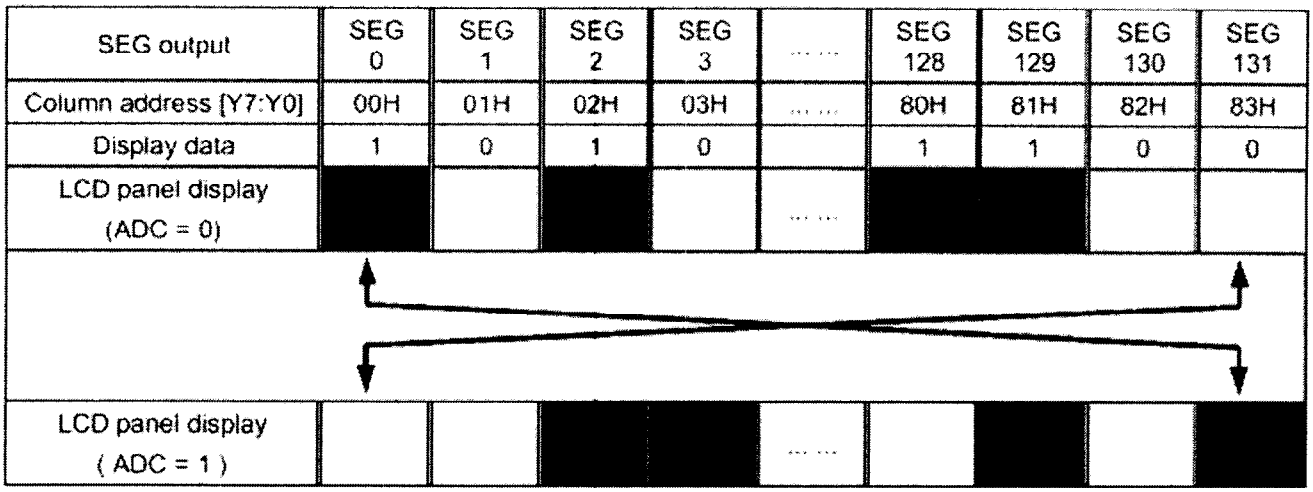
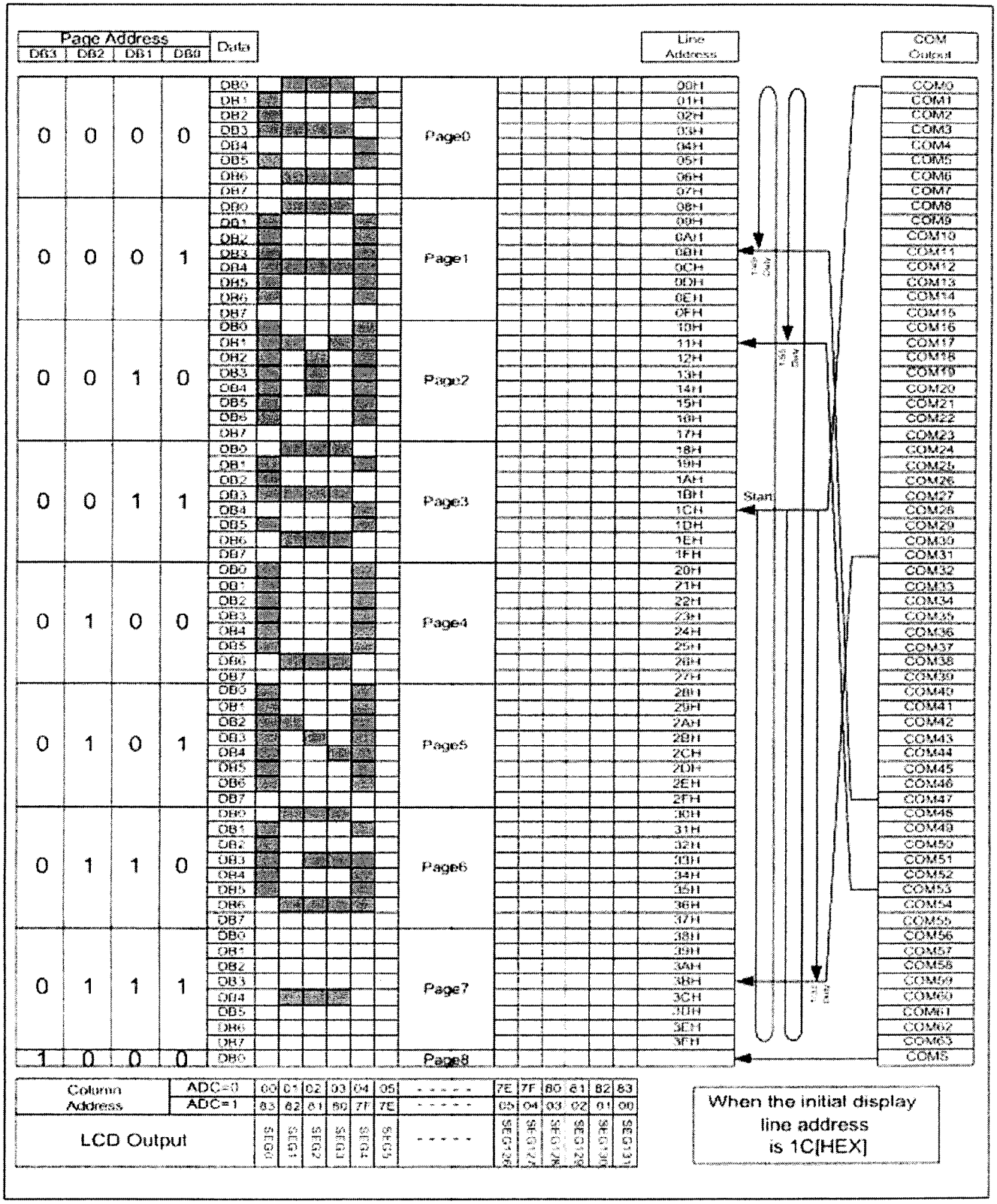


Figure 7. The Relationship between the Column Address and the Segment Outputs

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.

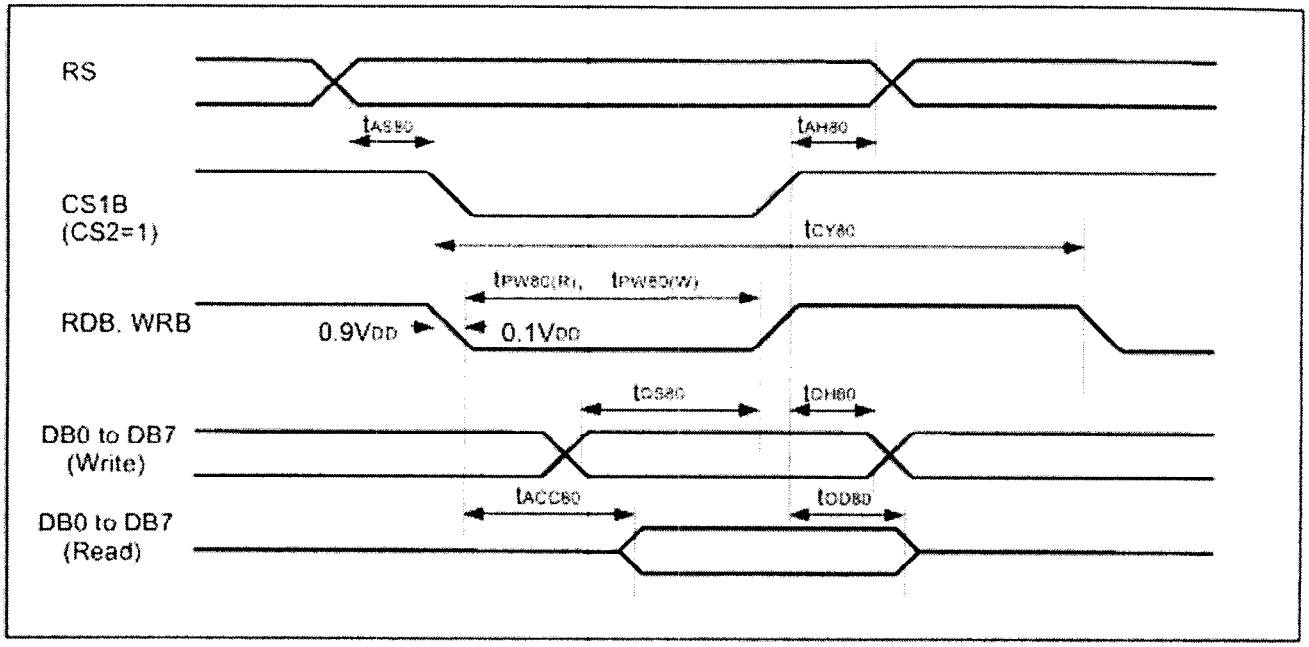
DATA RAM MAP



Display Data RAM Map

AC CHARACTERISTICS (8080- series)

Read / Write Characteristics (8080-series MPU)



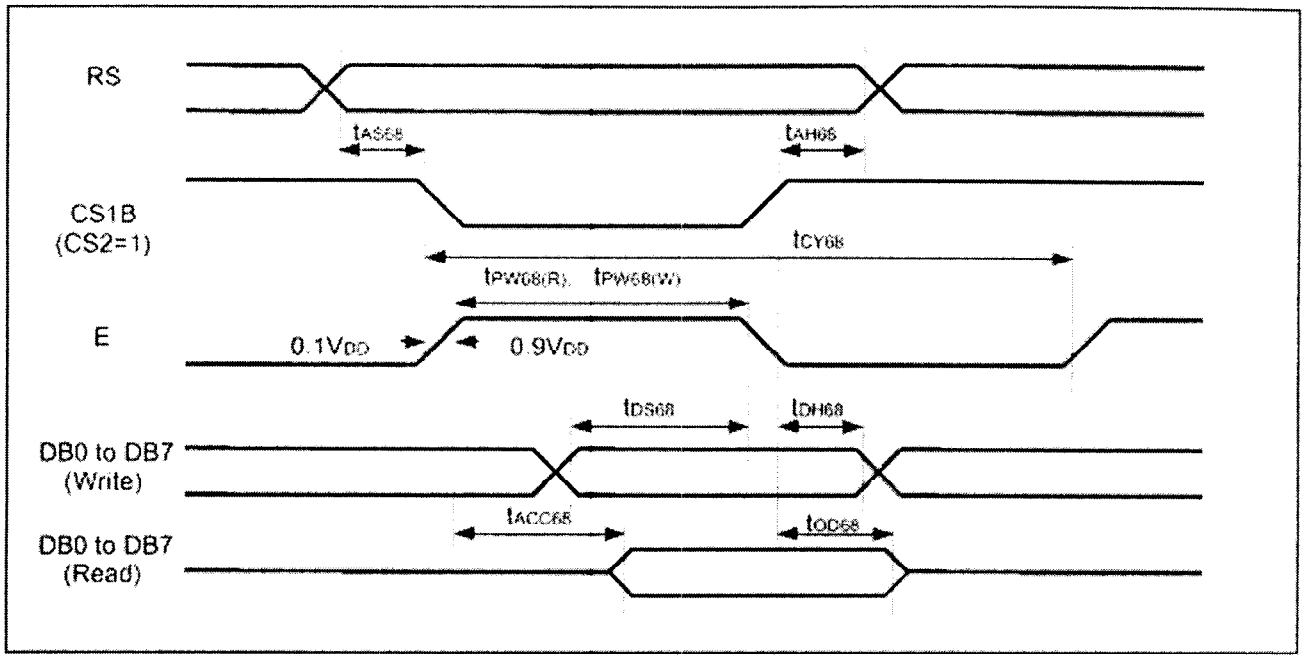
Read / Write Characteristics (8080-series MPU)

(VDD = 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	tAS80 tAH80	0 0	-	-	ns	
System cycle time	RS	tCY80	300	-	-	ns	
Pulse width (WRB)	RW_WRB	tPW80(W)	60	-	-	ns	
Pulse width (RDB)	E_RDB	tPW80(R)	60	-	-	ns	
Data setup time Data hold time	DB7 to DB0	tDS80 tDH80	40 15	-	-	ns	
Read access time Output disable time		tACC80 tOD80	- 10	-	140 100	ns	CL = 100 pF

AC CHARACTERISTICS (6800-series)

Read / Write Characteristics (6800-series Microprocessor)



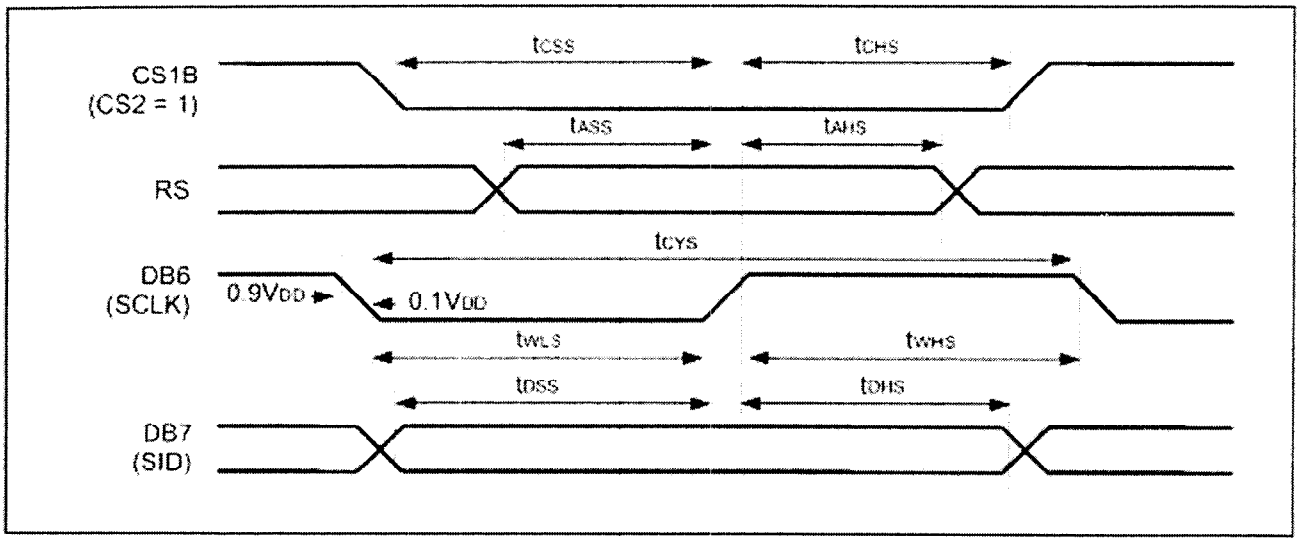
Read / Write Characteristics (6800-series Microprocessor)

(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	tAS68 tAH68	0 0	-	-	ns	
System cycle time		RS	tCY68	300	-	-	ns	
Data setup time Data hold time		DB7 to DB0	tDS68 tDH68	40 15	-	-	ns	
Access time Output disable time			tACC68 tOD68	- 10	-	140 100	ns	C_L = 100 pF
Enable pulse width	Read Write	E_RDB	tPW68(R) tPW68(W)	120 60	-	-	-	

AC CHARACTERISTICS (Serial Interface)

Serial Interface Characteristics

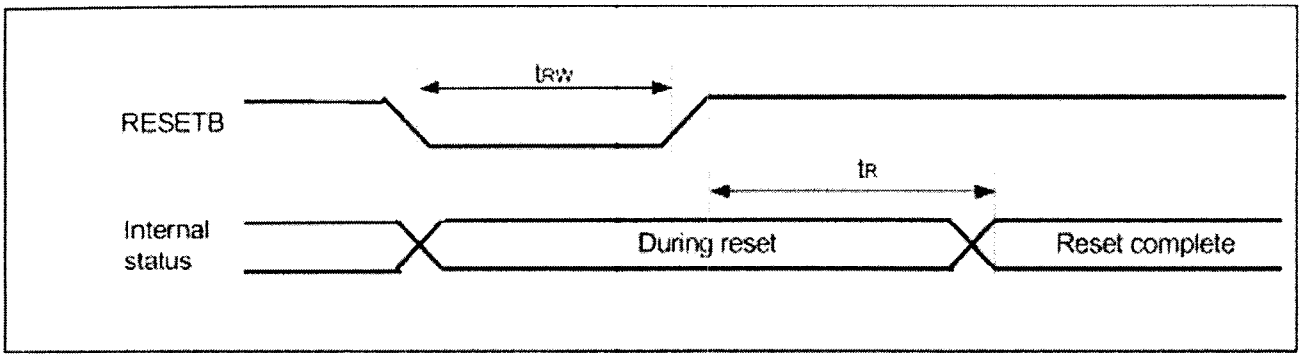


Serial Interface Characteristics

(VDD = 2.4 to 3.6V, Ta = -40 to +85°C)

Item	Signal	Symbol	Min.	Typ.	Max.	Unit	Remark
Serial clock cycle SCLK high pulse width SCLK low pulse width	DB6 (SCLK)	tCYS tWHS tWLS	250 100 100	- - -	- - -	ns	
Address setup time Address hold time	RS	tASS tAHS	150 150	- -	- -	ns	
Data setup time Data hold time	DB7 (SID)	tDSS tDHS	100 100	- -	- -	ns	
CS1B setup time CS1B hold time	CS1B	tCSS tCHS	150 150	- -	- -	ns	

RESET INPUT TIMING

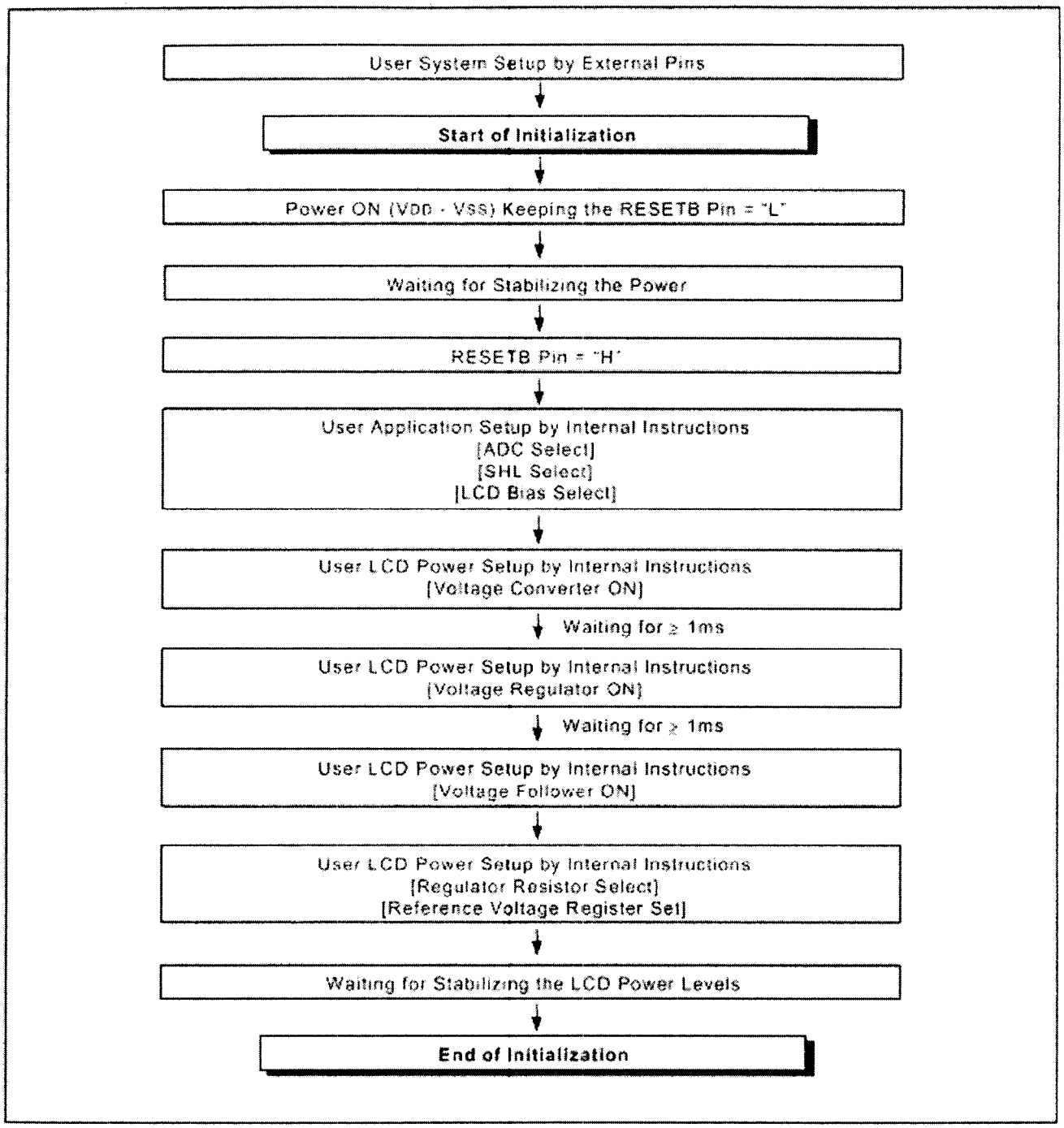


Reset Input Timing

(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	

INITIALIZING



Initializing with the Built-in Power Supply Circuits

ELECTRO-OPTICAL CHARACTERISTICS

MEASURING CONDITION: POWER SUPPLY = VOP / 64 Hz
TEMPERATURE = 22 ± 5℃
RELATIVE HUMIDITY = 60 ± 15 %

ITEM	SYMBOL	UNIT	TYP.
RESPONSE TIME	Ton	ms	200
	Toff	ms	200
CONTRAST RATIO	Cr	-	10
VIEWING ANGLE (6 O'clock) (Cr ≥ 2)	V3:00	°	20
	V6:00	°	40
	V9:00	°	20
	V12:00	°	30

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

RELIABILITY OF LCD MODULE

Item	Test Condition	Time
High temperature operating	50℃	240 hours
Low temperature operating	-20℃	240 hours
High temperature storage	60℃	240 hours
Low temperature storage	-20℃	240 hours
Temperature-humidity storage	60℃90% R.H.	96 hours
Temperature cycling	-20℃ to 60℃ 30 Min Dwell	5 cycles

QUALITY STANDARD OF LCD MODULE

1.0	**Sampling Method**		
	Sampling Plan : MIL STD 105 D 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 of 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.

(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) 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.