MULTI-INNO TECHNOLOGY CO., LTD.

LCD MODULE SPECIFICATION

Model : MI12832F-G

Revision	1.0
Engineering	
Date	
Our Reference	

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		

GENERAL DESCRIPTION

Display mode : 128 x 32 Dots, Graphic COG LCD module

Interface : 8 bit Parallel or Serial

Driving method : 1/33 duty, 1/9 bias

Controller IC : Sitronix ST7565P or equivalent
For the detailed information, please refer to the IC specifications.

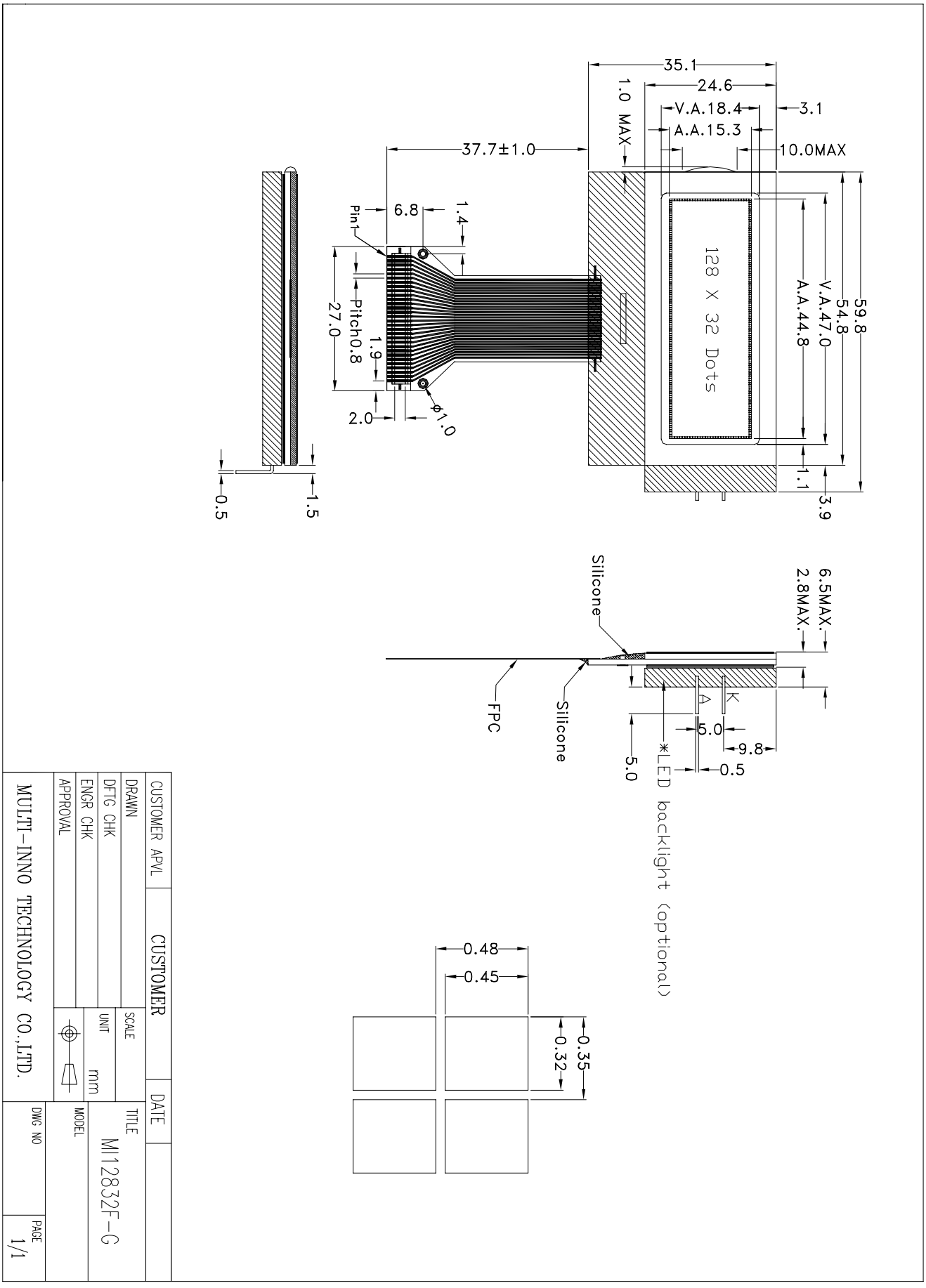
MECHANICAL DIMENSIONS

Item	Dimension	Unit	Item	Dimension	Unit
Outline Dimension	59.8(L)x35.1(W)x2.8/6.5(MAX) (H)	mm	Dot Pitch	0.35(L)x0.48(W)	mm
Viewing Area	47.0(L)x18.4(W)	mm	Dot Size	0.32(L)x0.45(W)	mm

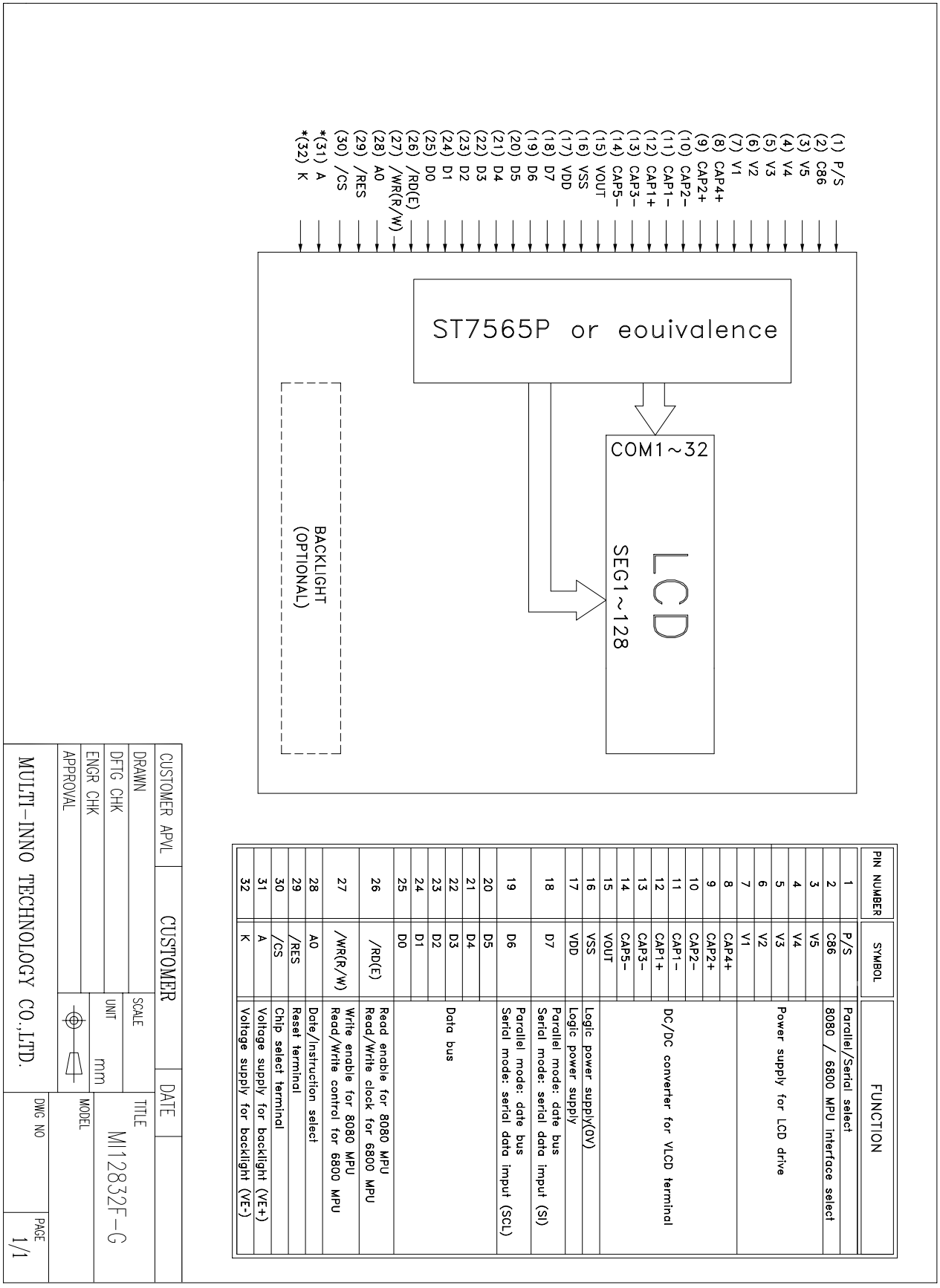
CONNECTOR PIN ASSIGNMENT

Pin No.	Symbol	Function	Pin No.	Symbol	Function
1	P/S	Parallel /Serial select	16	VSS	Logic power supply(0V)
2	C86	8080 / 6800 MPU interface select	17	VDD	Logic power supply
3	V5	Power supply for LCD drive	18	D7	Parallel mode : Data bus Serial mode : Serial data input(SI)
4	V4		19	D6	Parallel mode : Data bus Serial mode : Serial clock input(SCL)
5	V3		20	D5	Data bus
6	V2		21	D4	
7	V1		22	D3	
8	CAP4+	DC/DC converter for VLCD terminal	23	D2	
9	CAP2+		24	D1	
10	CAP2-		25	D0	
11	CAP1-		26	/RD(E)	Read enable for 8080 MPU Read /Write clock for 6800 MPU
12	CAP1+		27	/WR(R/W)	Write enable for 8080 MPU Read / Write control for 6800 MPU
13	CAP3-		28	A0	Data / Instruction select
14	CAP5-		29	/RES	Reset terminal
15	VOUT		30	/CS	Chip select terminal

COUNTER DRAWING OF MODUAL DIMENSION



COUNTER DRAWING OF PIN OUT & BLOCK DIAGRAM



PIN NUMBER	SYMBOL	FUNCTION
1	P/S	Parallel/Serial select
2	C86	8080 / 6800 MPU interface select
3	V5	Power supply for LCD drive
4	V4	
5	V3	
6	V2	
7	V1	
8	CAP4+	DC/DC converter for VLCD terminal
9	CAP2+	
10	CAP2-	
11	CAP1-	
12	CAP1+	
13	CAP3-	
14	CAP5-	
15	VOUT	Logic power supply(0V)
16	VSS	Logic power supply
17	VDD	
18	D7	Parallel mode: date bus Serial mode: serial data imput (SI)
19	D6	Parallel mode: date bus Serial mode: serial data imput (SCL)
20	D5	Data bus
21	D4	
22	D3	
23	D2	
24	D1	
25	D0	
26	/RD(E)	Read enable for 8080 MPU Read/Write clock for 6800 MPU
27	/WR(R/W)	Write enable for 8080 MPU Read/Write control for 6800 MPU
28	A0	Date/Instruction select
29	/RES	Reset terminal
30	/CS	Chip select terminal
31	A	Voltage supply for backlight (VE+)
32	K	Voltage supply for backlight (VE-)

CUSTOMER APVL	CUSTOMER	DATE	
DRAWN		SCALE	TITLE MI12832F-G
DFTG CHK		UNIT mm	
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	VDD	3.1	3.3	3.5	V	"H"Level Input Voltage	VIH	0.8VDD	—	VDD	V
Supply Current	IDD	—	250	450	μA	"L"Level Input Voltage	VIL	VSS	—	0.2VDD	V
Operating Voltage for LCD	VLCD	7.8	8.0(*)	8.2	V	—	—	—	—	—	—
EL Backlight Voltage (VEL)						**Backlight Current**					
EL (@ Frequency 400Hz)	—		—	—	—	—	—	—	—	—	—
Side-lited LED Backlight Forward Voltage (VF)						**Side-lited LED Backlight Forward Current (IF)**					
White	VBL	3.2	3.3	3.4	V	White	IBL	—	40	—	mA
Blue	VBL	—	—	—	V	Blue	IBL	—	—	—	mA
Yellow Green	VBL	—	—	—	V	YellowGreen	IBL	—	—	—	mA

Note : (*) Please refer to REFERENCE CIRCUIT EXAMPLE (4X Boosting Circuit).

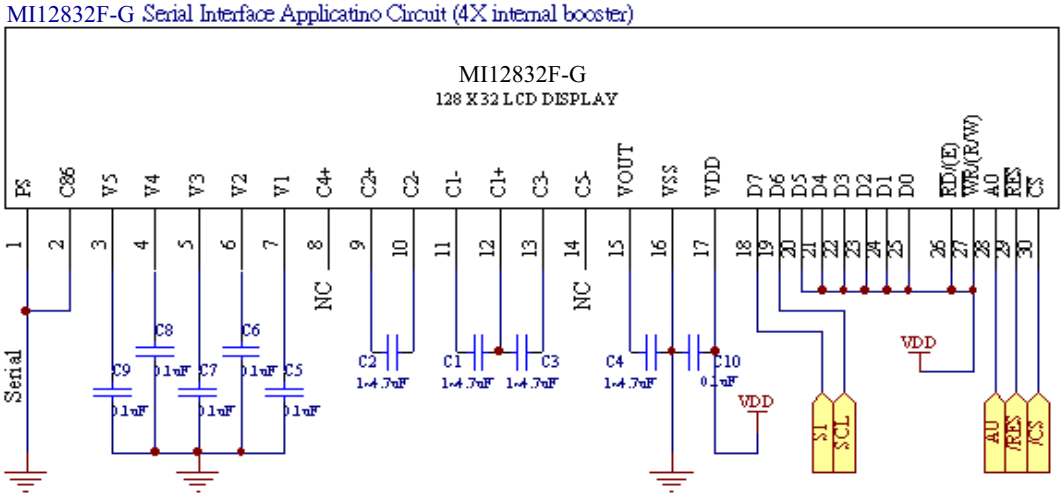
ABSOLUTE MAXIMUM RATINGS

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

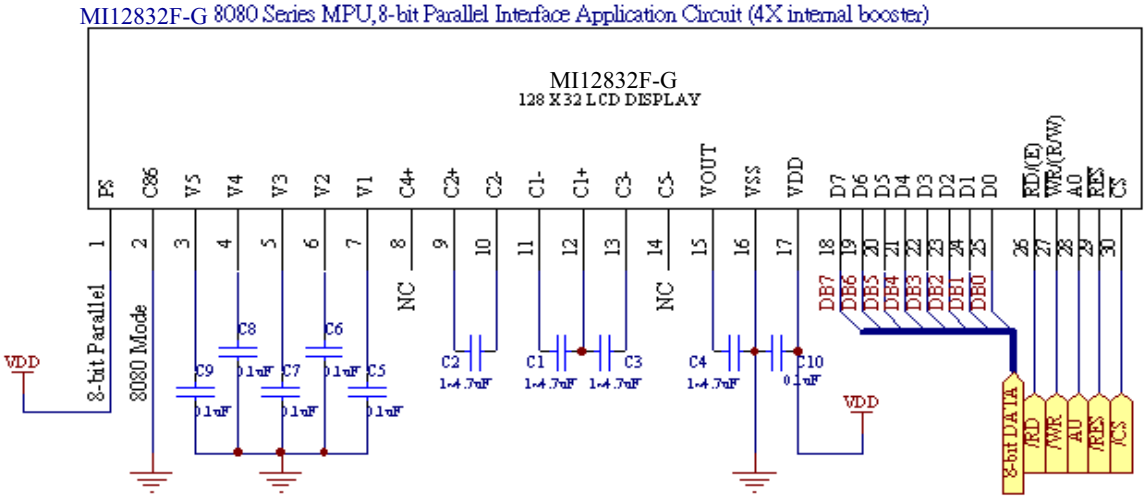
Item	Symbol	Rating (for normal temperature)	Rating (for wide temperature)	Unit
Supply Voltage	VDD	0.3 to 4.0	0.3 to 4.0	V
Operating Temperature	Topr	0 to 50	-20 to 70	℃
Storage Temperature	Tstg	-10 to 60	-30 to 80	℃

REFERENCE CIRCUIT EXAMPLE

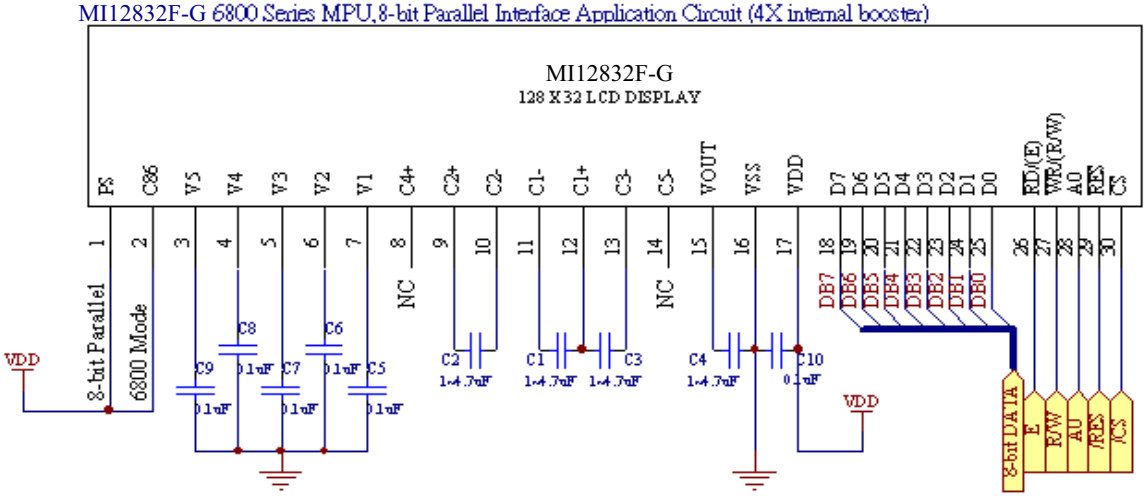
MI12832F-G Serial Interface Applicatino Circuit (4X internal booster)



MI12832F-G 8080 Series MPU,8-bit Parallel Interface Application Circuit (4X internal booster)



MI12832F-G 6800 Series MPU,8-bit Parallel Interface Application Circuit (4X internal booster)



INSTRUCTIONS

(Note) *: disabled data

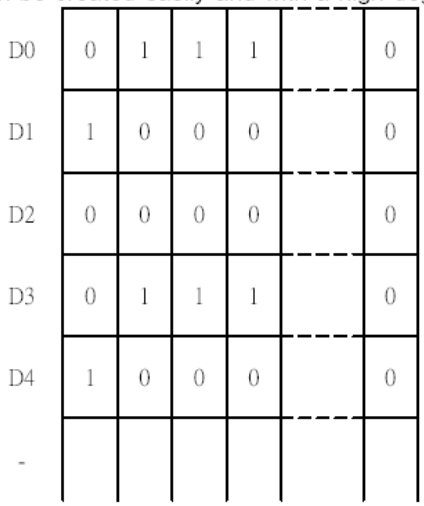
Command	Command Code										Function
	A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	
(1) Display ON/OFF	0	1	0	1	0	1	0	1	1	1	0 1	LCD display ON/OFF 0: OFF, 1: ON
(2) Display start line set	0	1	0	0	1	Display start address						Sets the display RAM display start line address
(3) Page address set	0	1	0	1	0	1	1	Page address				Sets the display RAM page address
(4) Column address set upper bit Column address set lower bit	0 0	1 1	0 0	0 0	0 0	0 0	1 0	Most significant column address Least significant column address				Sets the most significant 4 bits of the display RAM 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 1	Sets the display RAM address SEG output correspondence 0: normal, 1: reverse
(9) Display normal/ reverse	0	1	0	1	0	1	0	0	1	1	0 1	Sets the LCD display normal/ reverse 0: normal, 1: reverse
(10) Display all points ON/OFF	0	1	0	1	0	1	0	0	1	0	0 1	Display all points 0: normal display 1: all points ON
(11) LCD bias set	0	1	0	1	0	1	0	0	0	1	0 1	Sets the LCD drive voltage bias ratio 0: 1/9 bias, 1: 1/7 bias (ST7565P)
(12) Read/modify/write	0	1	0	1	1	1	0	0	0	0	0	Column address increment At write: +1 At read: 0
(13) End	0	1	0	1	1	1	0	1	1	1	0	Clear read/modify/write
(14) Reset	0	1	0	1	1	1	0	0	0	1	0	Internal reset
(15) Common output mode select	0	1	0	1	1	0	0	0 1	*	*	*	Select COM output scan direction 0: normal direction 1: reverse direction
(16) Power control set	0	1	0	0	0	1	0	1	Operating mode			Select internal power supply operating mode
(17) Vo voltage regulator internal resistor ratio set	0	1	0	0	0	1	0	0	Resistor ratio			Select internal resistor ratio(Rb/Ra) mode
(18) Electronic volume mode set Electronic volume register set	0	1	0	1 0	0 0	0 Electronic volume value	0	0	0	0	1	Set the Vo output voltage electronic volume register
(19) Static indicator ON/OFF Static indicator register set	0	1	0	1 0	0 0	1 0	0 0	1 0	1 0	0 0	0 1 Mode	0: OFF, 1: ON Set the flashing mode
(20) Booster ratio set	0	1	0	1 0	1 0	1 0	1 0	1 0	0 0	0 step-up value	0	select booster ratio 00: 2x,3x,4x 01: 5x 11: 6x
(21) Power saver												Display OFF and display all points ON compound command
(22) NOP	0	1	0	1	1	1	0	0	0	1	1	Command for non-operation
(23) Test	0	1	0	1	1	1	1	*	*	*	*	Command for IC test. Do not use this command

RECOMMENDED INITIAL SETTINGS

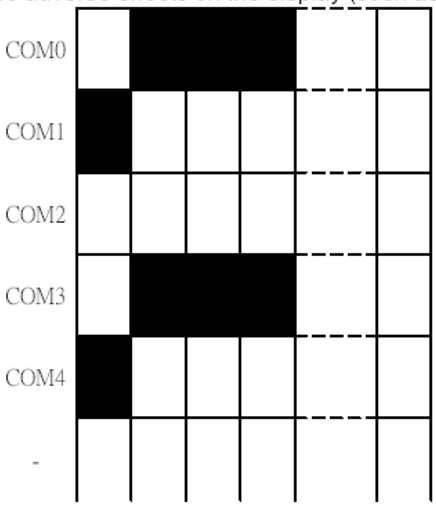
Display Start Line Set : 40H
ADC Select : A0H
LCD Bias Set : A2H
Common Output Mode Select : C0H
Power Control Set: 2FH
V0 Voltage Regulator Internal Resistor Ratio Set : 24H
Electronic Volume Register Set : 18H
Booster Ratio Set : 00H

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 Figure 3, 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).



Display data RAM



Liquid crystal display

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 respective both the page address and the column address.

Furthermore, as is shown in Table 4, 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.

Table 4

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

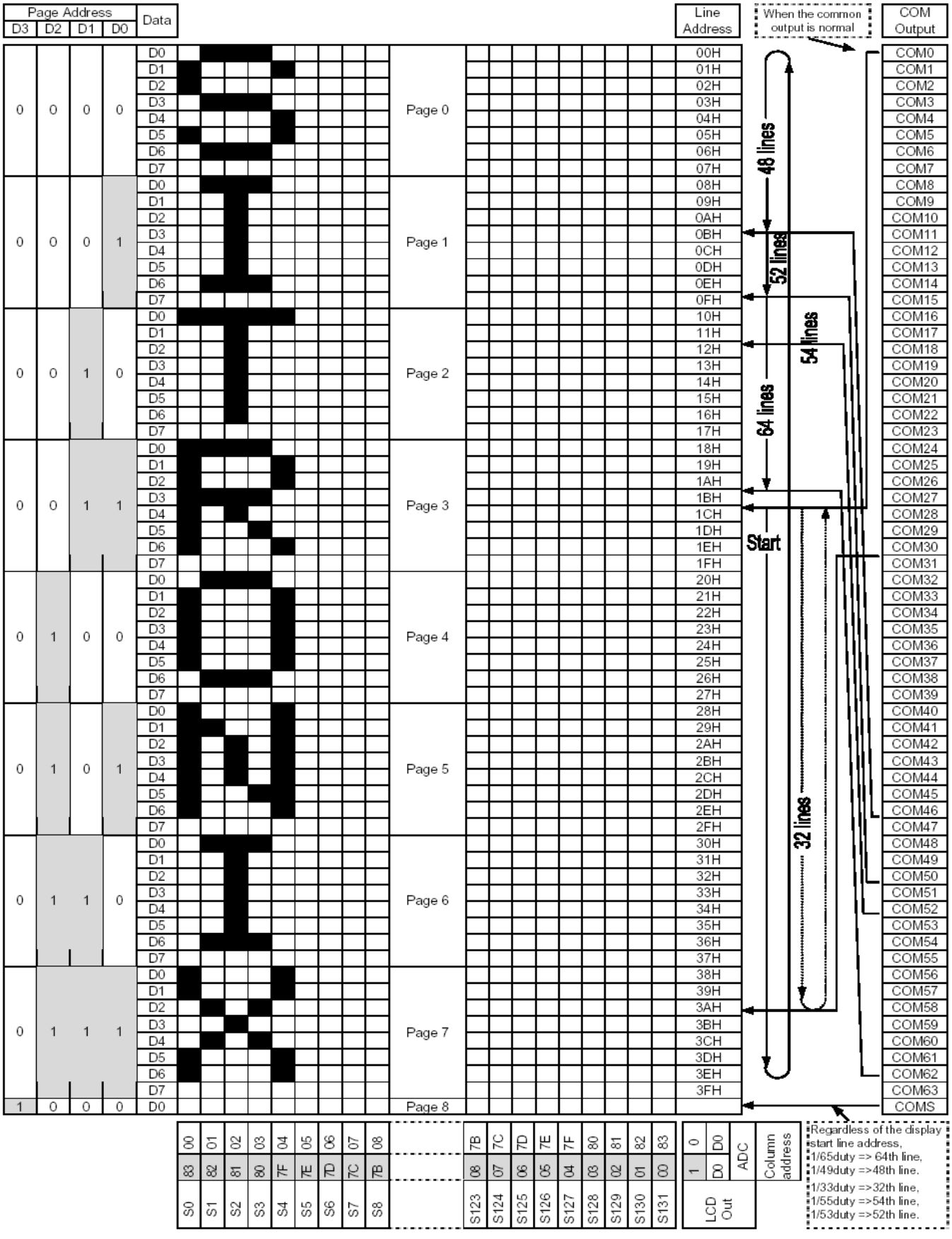
The line address circuit, as shown in Table 4, specifies the line address relating to the COM output when the contents of the display data RAM are displayed. Using the display start line address set command, what is normally the top line of the display can be specified (this is the COM0 output when the 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.

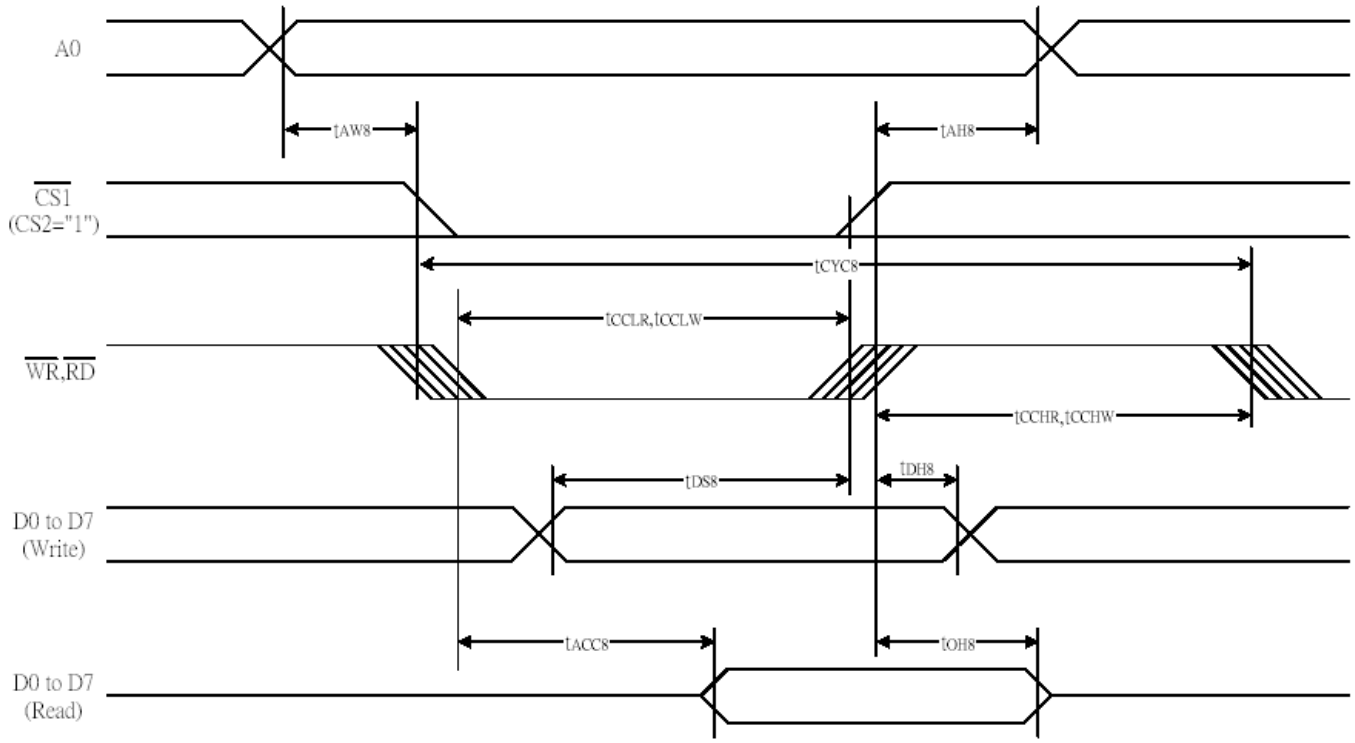
PAGE ADDRESS CIRCUIT

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.



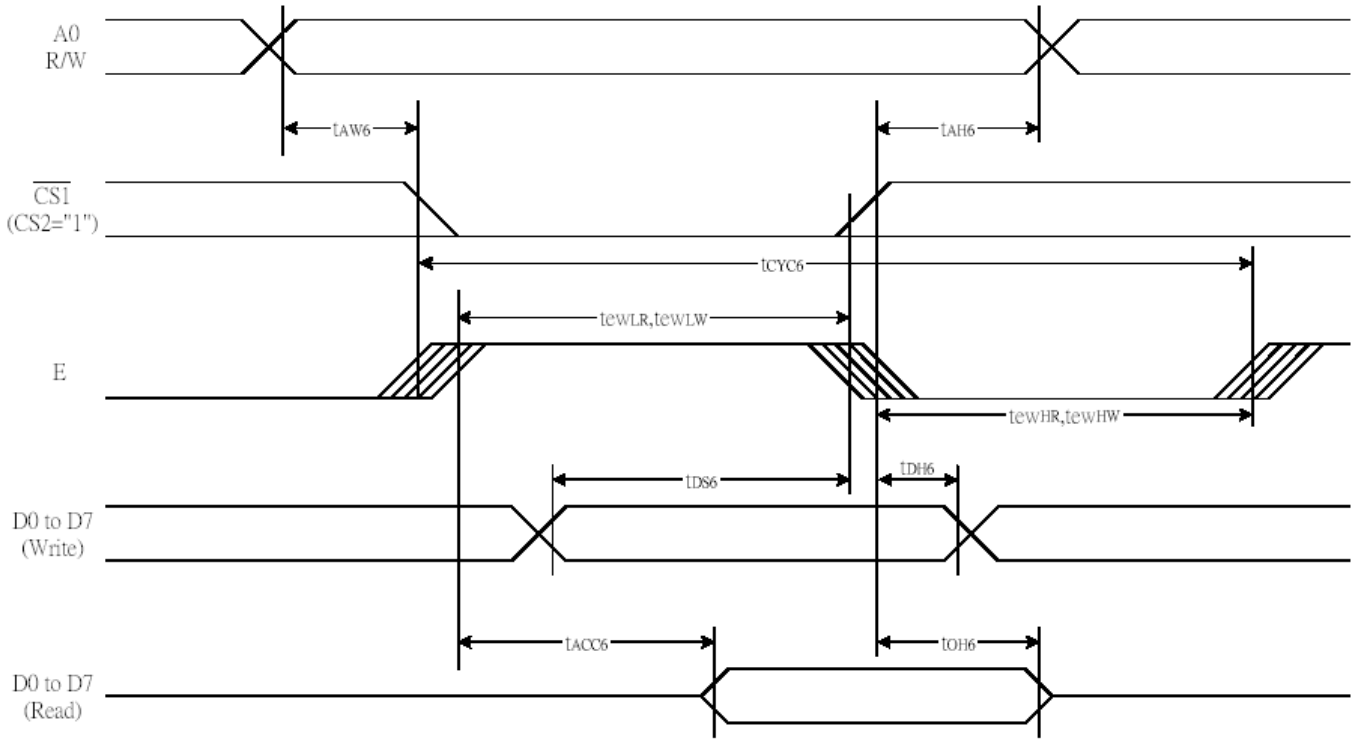
TIMING CHARACTERISTICS(FOR PARALLEL INTERFACE 8080 MODE)



(VDD = 3.3V , Ta =25°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	t_{AH8}		0	—	Ns
Address setup time		t_{AW8}		0	—	
System cycle time		t_{CYC8}		240	—	
Enable L pulse width (WRITE)	WR	t_{CCLW}		80	—	
Enable H pulse width (WRITE)		t_{CCHW}		80	—	
Enable L pulse width (READ)	RD	t_{CCLR}		140	—	
Enable H pulse width (READ)		t_{CCHR}		80		
WRITE Data setup time	D0 to D7	t_{DS8}		40	—	
WRITE Address hold time		t_{DH8}		0	—	
READ access time		t_{ACC8}	C_L = 100 pF	—	70	
READ Output disable time		t_{OH8}	C_L = 100 pF	5	50	

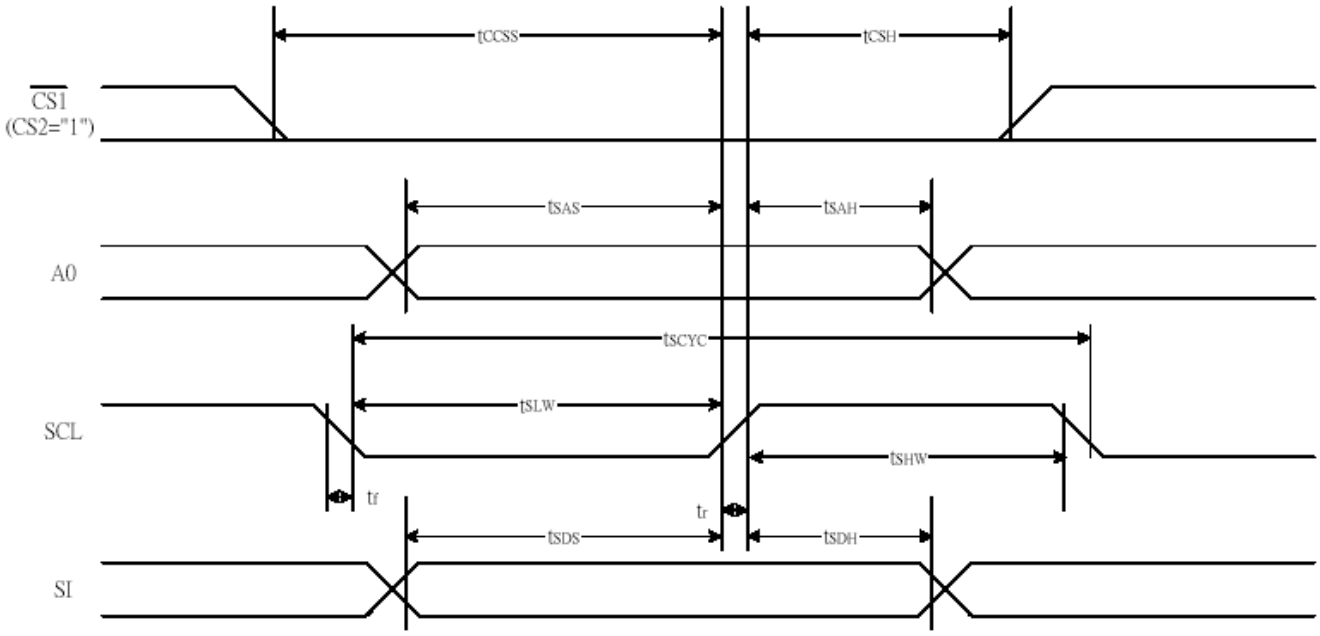
TIMING CHARACTERISTICS(FOR PARALLEL INTERFACE 6800 MODE)



(V_{DD} = 3.3 V , Ta = 25°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	t_{AH6}		0	—	ns
Address setup time		t_{AW6}		0	—	
System cycle time		t_{CYC6}		240	—	
Enable L pulse width (WRITE)	WR	t_{EWLW}		80	—	
Enable H pulse width (WRITE)		t_{EWHW}		80	—	
Enable L pulse width (READ)	RD	t_{EWLR}		80	—	
Enable H pulse width (READ)		t_{EWHR}		140		
WRITE Data setup time	D0 to D7	t_{DS6}		40	—	
WRITE Address hold time		t_{DH6}		0	—	
READ access time		t_{ACC6}	C_L = 100 pF	—	70	
READ Output disable time		t_{OH6}	C_L = 100 pF	5	50	

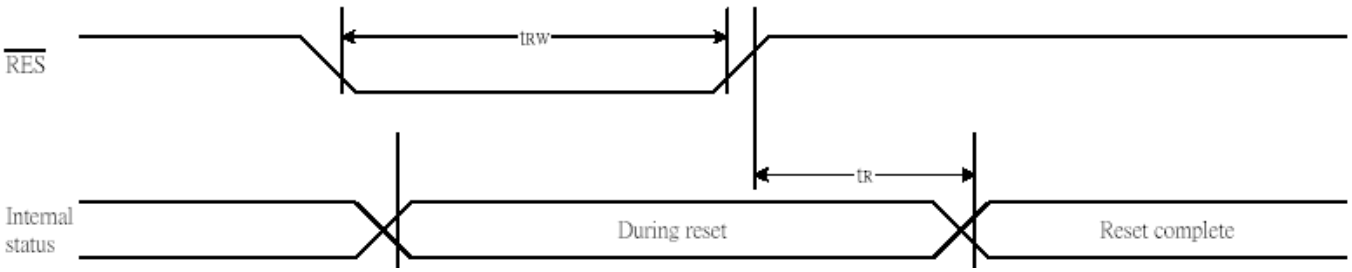
TIMING CHARACTERISTICS(FOR SERIAL INTERFACE)



(VDD = 3.3V, Ta =25°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Serial Clock Period	SCL	Tscyc		100	—	ns
SCL "H" pulse width		Tshw		50	—	
SCL "L" pulse width		TSLW		50	—	
Address setup time	A0	TSAS		20	—	
Address hold time		Tsah		10	—	
Data setup time	SI	Tsds		20	—	
Data hold time		TSDH		10	—	
CS-SCL time	CS	Tcss		20	—	
CS-SCL time		Tcsh		40	—	

RESET TIMING

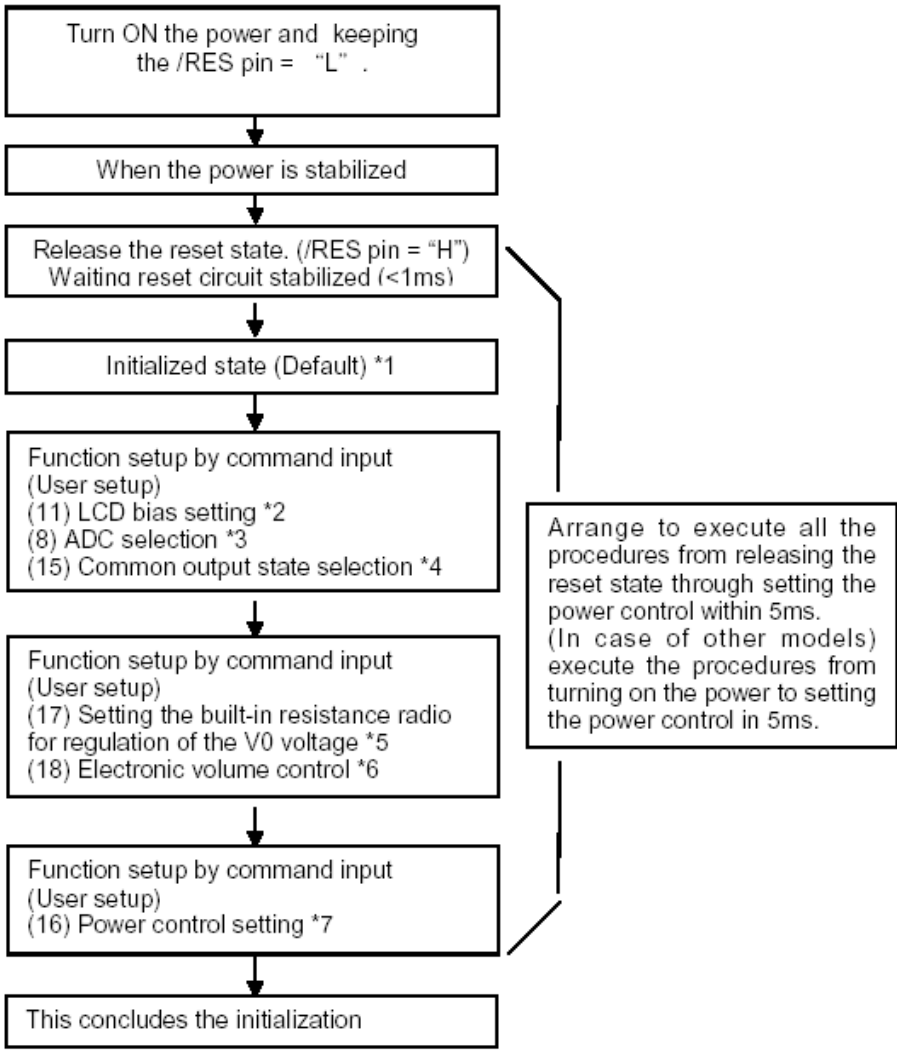


(VDD = 3.3V , Ta = –40 to 85°C)

Item	Signal	Symbol	Condition	Rating			Units
				Min.	Typ.	Max.	
Reset time		tR		—	—	1.0	us
Reset "L" pulse width	/RES	tRW		1.0	—	—	us

INITIALIZATION METHOD

1. When the built-in power is being used immediately after turning on the power:



* 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 radio 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 = VOP / 64 Hz
TEMPERATURE = 22 ± 5 °C
RELATIVE HUMIDITY = 60 ± 15 %

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

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) ≤ 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

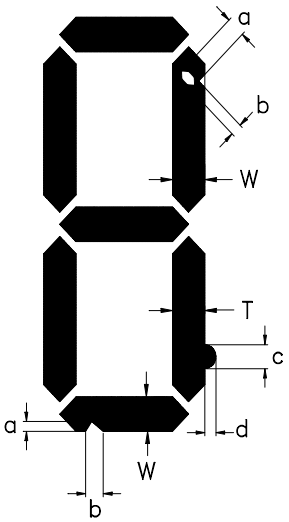
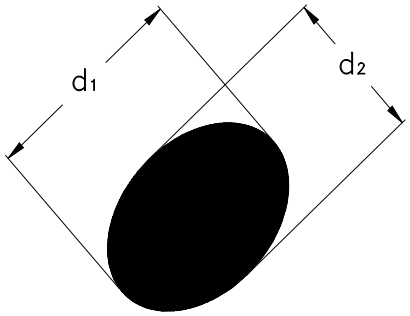
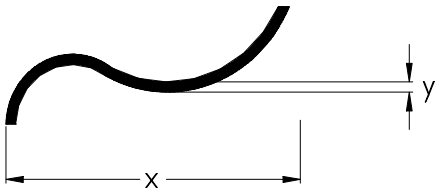


fig . 1



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

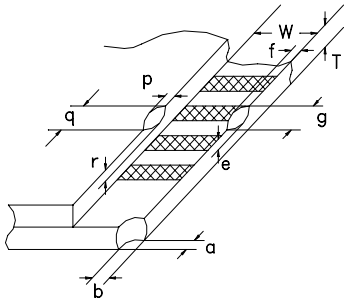


fig . 4

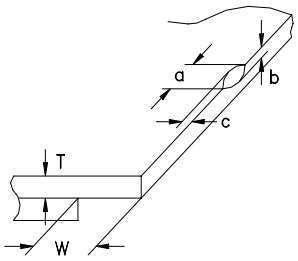


fig . 5

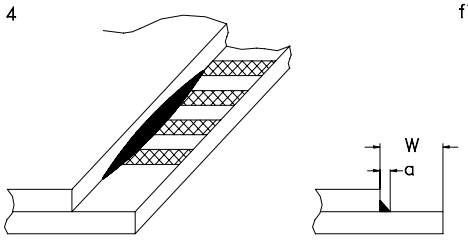


fig . 6

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

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