CLOVER DISPLAY LTD.

LCD MODULE SPECIFICATION

Model : CG240160D - _ _ - _ _ - _ _ - _

Revision	00
Engineering	Jackson Fung
Date	19 June 2015
Our Reference	X9058

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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:

CG240160D - 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
*(4)---Display mode
        T – TN
        V – TN (Negative)
        S – STN Yellow green
        G – STN Grey
        B – STN Blue (Negative)
        F – FSTN
        N – FSTN (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

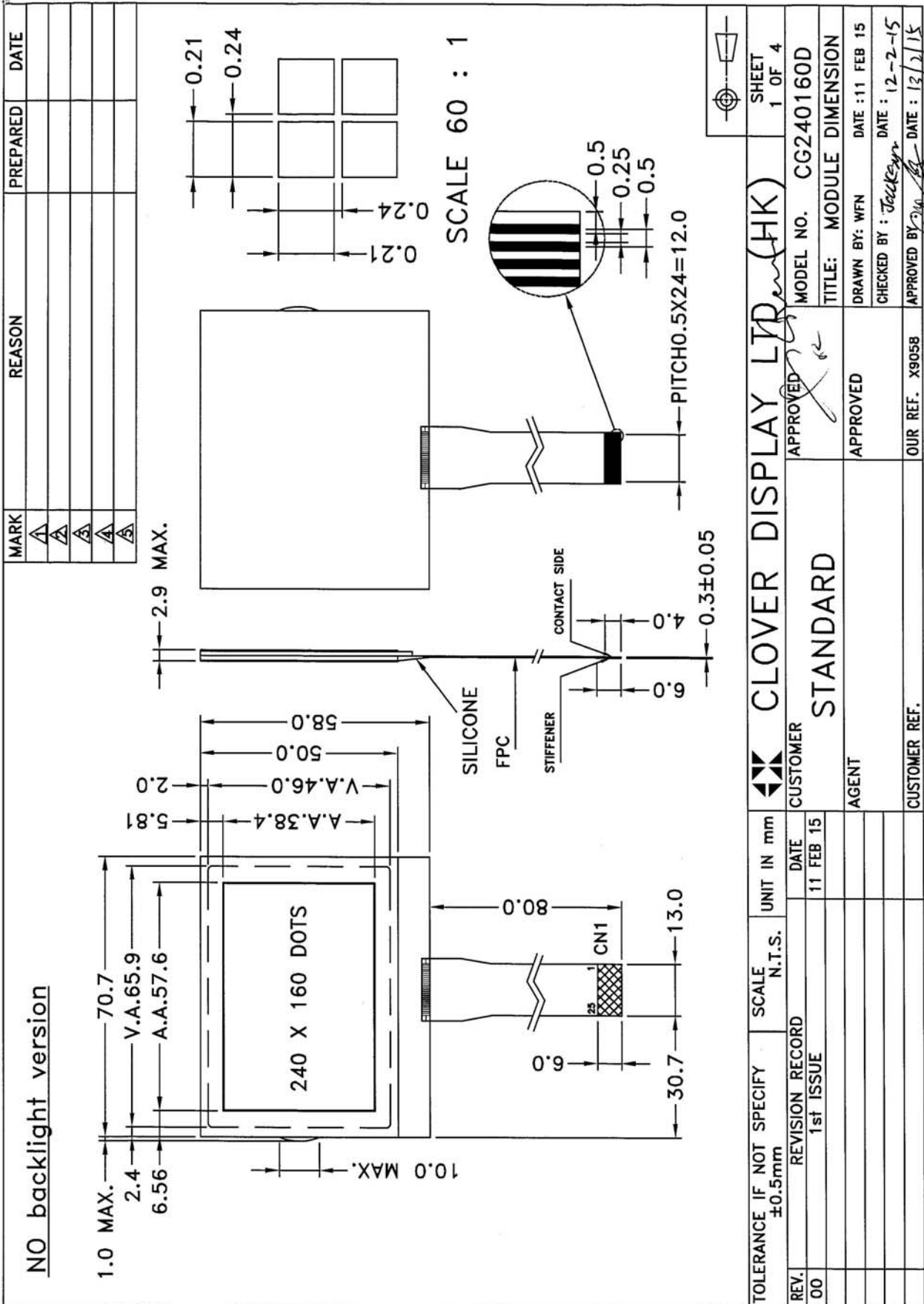|		
Display mode	:	240 X 160 dots graphic COG LCD module
Interface	:	8-bit parallel / 4-line serial
Driving method	:	1/160 duty, 1/14 bias
Controller IC	:	Sitronix ST75256 or equivalent
		For the detailed information, please refer to the IC specifications.

MECHANICAL DIMENSIONS

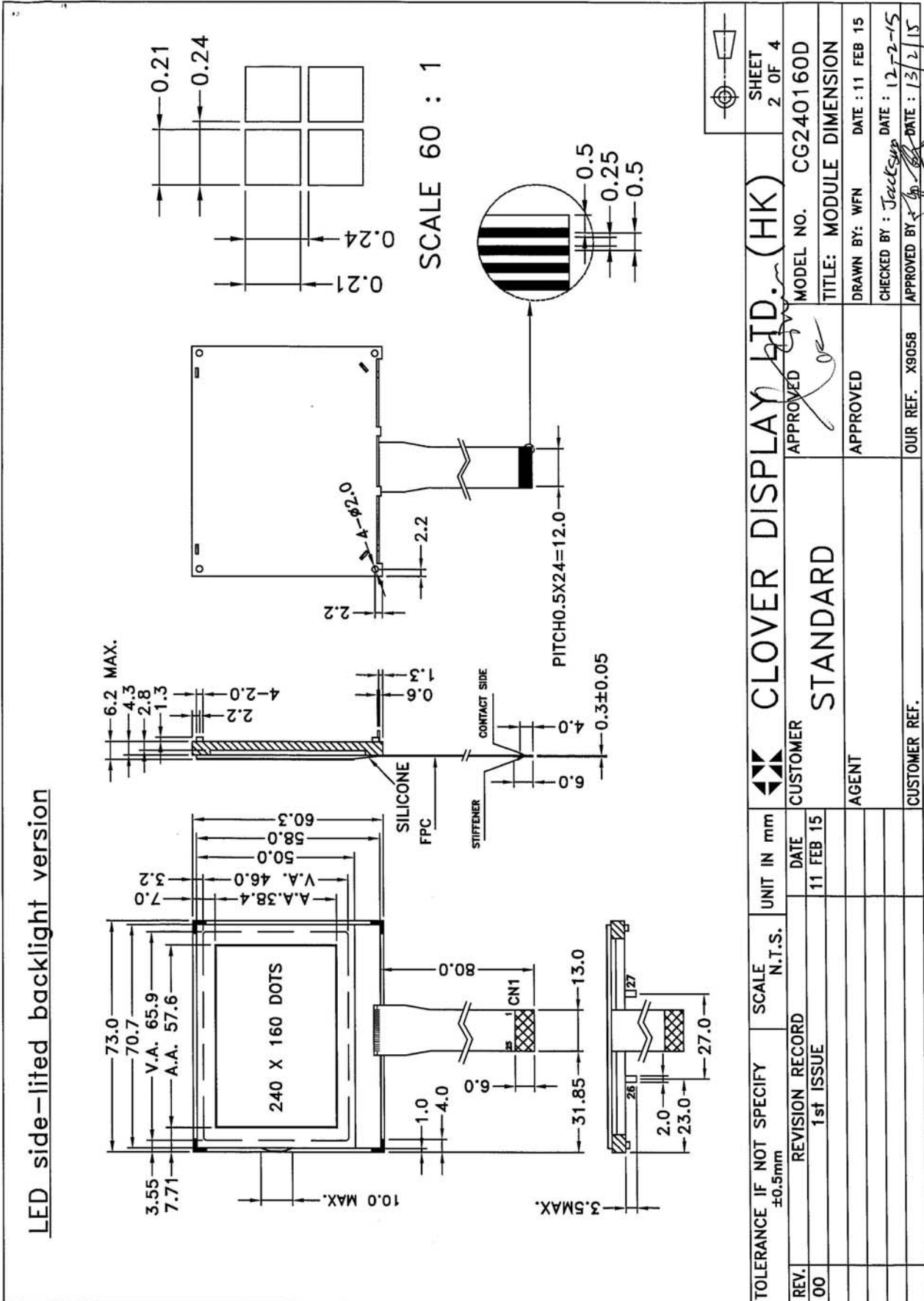| Item	Dimension	Unit	Item	Dimension	Unit
Outline Dimension		mm	Dot Pitch	0.24(L)x0.24(W)	mm
No Backlight	70.7(L)x58.0(W)x2.9MAX.(H)	mm	Dot Size	0.21(L)x0.21(W)	mm
LED side-lited backlight	73.0(L)x60.3(W)x6.2MAX.(H)	mm	Viewing Area	65.9(L)x46.0(W)	mm

CONNECTOR PIN ASSIGNMENT（CN1）

Pin No.	Symbol	Function	Pin No.	Symbol	Function
1	GND	Connect to ground	15	IF0	Interface operation mode select
2	D7	Data bus	16	IF1	
3	D6		17	VD1S	Digital power source select
4	D5		18	VSS	Ground
5	D4		19	VDD	Supply voltage for logic
6	D3		20	CA1N	DC/DC voltage converter
7	D2		21	CA1P	
8	D1		22	XV0	Negative operating voltage of COM-drivers
9	D0		23	V0	Positive operating voltage of COM-drivers
10	RSTB	Reset	24	VG	Power of SEG-drivers
11	RWR	Read/write execution control	25	GND	Connect to ground
12	ERD		* 26	A	Supply voltage for backlight (+)
13	A0	Data/command display control	* 27	K	Supply voltage for backlight (-)
14	CSB	Chip select			

Note (*) : Pin 26, 27 are used for backlight version

COUNTER DRAWING OF MODULE DIMENSION (No backlight version)

NO backlight version

240 X 160 DOTS

1.0 MAX.
2.4
6.56
70.7
V.A.65.9
A.A.57.6
58.0
50.0
V.A.46.0
A.A.38.4
2.0
5.81
10.0 MAX.
80.0
13.0
30.7
6.0
CN1
1
25

2.9 MAX.
0.21
0.24
0.21
0.24

SCALE 60 : 1

0.5
0.25
0.5
PITCH0.5X24=12.0

SILICONE
FPC
STIFENER
CONTACT SIDE
4.0
6.0
0.3±0.05

MARK	REASON	PREPARED	DATE
1			
2			
3			
4			
5			

CLOVER DISPLAY LTD.(HK)

APPROVED	MODEL NO. CG240160D
APPROVED	TITLE: MODULE DIMENSION
	DRAWN BY: WFN DATE :11 FEB 15
	CHECKED BY : DATE : 12-2-15
	APPROVED BY DATE : 12/2/15
OUR REF. X9058	

CUSTOMER   STANDARD

AGENT

CUSTOMER REF.

UNIT IN mm
SCALE N.T.S.
DATE   11 FEB 15

TOLERANCE IF NOT SPECIFY
±0.5mm

REV.	REVISION RECORD
00	1st ISSUE

SHEET
1 OF 4

COUNTER DRAWING OF MODULE DIMENSION (LED site-lited backlight version)

SCALE 60 : 1

LED side-lited backlight version

240 X 160 DOTS

SILICONE
FPC
STIFFENER
CONTACT SIDE

PITCH0.5X24=12.0

CLOVER DISPLAY LTD. (HK)		
UNIT IN mm	MODEL NO.	CG240160D
	TITLE:	MODULE DIMENSION
SCALE N.T.S.	DRAWN BY: WFN	DATE : 11 FEB 15
CUSTOMER	CHECKED BY : Jacksun	DATE : 12-2-15
STANDARD	APPROVED	DATE : 13/2/15
AGENT	APPROVED	
CUSTOMER REF.	OUR REF. X9058	

		SHEET 2 OF 4

TOLERANCE IF NOT SPECIFY ±0.5mm

REV.	REVISION RECORD	DATE
00	1st ISSUE	11 FEB 15

COUNTER DRAWING OF PIN OUT & BLOCK DIAGRAM

CN1

PIN NO.	SYMBOL	FUNCTION
1	GND	Connect to ground
2	D7	
3	D6	
4	D5	
5	D4	Data bus
6	D3	
7	D2	
8	D1	
9	D0	
10	RSTB	Reset
11	RWR	Read/write execution control
12	ERD	Data/Command display control
13	A0	Chip select
14	CSB	
15	IF0	Interface operation mode select
16	IF1	
17	VD1S	Digital power source select
18	VSS	Ground
19	VDD	Supply voltage for logic
20	CA1N	DC/DC voltage converter
21	CA1P	
22	XV0	Negative operating voltage of COM-drivers
23	V0	Positive operating voltage of COM-drivers
24	VG	Power of SEG-drivers
25	GND	Connect to ground
*26	A	Supply voltage for backlight(+)
*27	K	Supply voltage for backlight(−)

240X160 DOTS LCD PANEL

COM2 to COM160 (EVEN NO.) 80

COM1 to COM159 (ODD NO.) 80

SEG1 to SEG240 240

ST75256 OR EQUIVALENCE

LED side lited backlight

Note: (*) For the module with backlight

CN1
(1)GND
(2)D7
(3)D6
(4)D5
(5)D4
(6)D3
(7)D2
(8)D1
(9)D0
(10)RSTB
(11)RWR
(12)ERD
(13)A0
(14)CSB
(15)IF0
(16)IF1
(17)VD1S
(18)VSS
(19)VDD
(20)CA1N
(21)CA1P
(22)XV0
(23)V0
(24)VG
(25)GND

*(26)A
*(27)K

CLOVER DISPLAY LTD. (HK)

CUSTOMER	STANDARD	APPROVED	MODEL NO.	CG240160D
		APPROVED	TITLE: PIN OUT & BLOCK DIAGRAM	
AGENT			DRAWN BY: WFN	DATE :11 FEB 15
			CHECKED BY : Jealkson	DATE : 12-2-15
CUSTOMER REF.			APPROVED BY :	DATE : 13/2/15
		OUR REF. X905B		

TOLERANCE IF NOT SPECIFY ±0.5mm		SCALE N.T.S.	UNIT IN mm		SHEET 3 OF 4
REV.	REVISION RECORD		DATE		
00	1st ISSUE		11 FEB 15		

ELECTRICAL CHARACTERISTICS

Conditions: VSS=0V, Ta=25℃

Item	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage for Logic	VDD	3.05	3.3	3.55	V
Supply Current for Logic	IDD	–	1.5	–	mA
Operating Voltage for LCD (*)	VLCD	15.7	16.5	17.3	V
'High' Level Input Voltage	VIH	0.7VDD	–	–	V
'Low' Level Input Voltage	VIL	–	–	0.3VDD	V

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

Side/Array BL:

Constant voltage driving:

Item	Symbol	MIN.	TYP.	MAX.	Unit	Condition
White backlight current	I_{BL}	–	35	45	mA	V_{BL} =3.3V
Blue backlight current	I_{BL}	–	35	45	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 4	-0.3 to 4	V
Input Voltage	V_T	-0.3 to V_{DD} +0.3	-0.3 to V_{DD} +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

C0: 1μF/25V   C1: 1μF/16V   C2: 1μF/16V
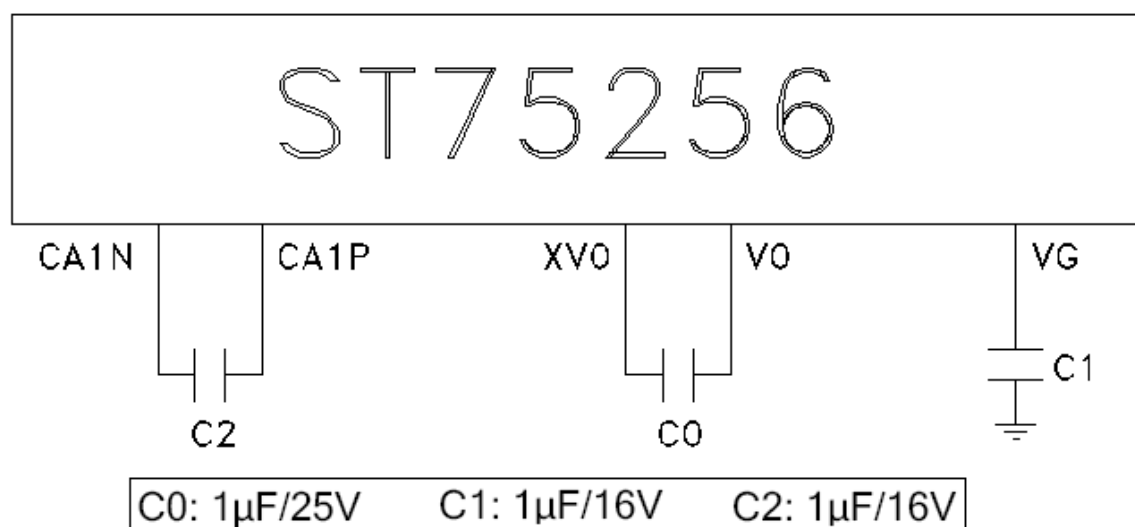
INSTRUCTIONS TABLE

INSTRUCTION	A0	R/W	COMMAND BYTE								DESCRIPTION
			D7	D6	D5	D4	D3	D2	D1	D0	
1.Extension Command	0	0	0	0	1	1	EXT1	0	0	EXT0	Set extension instruction
Ext[1:0]=0,0 (Extension Command 1)											
2.Display ON/OFF	0	0	1	0	1	0	1	1	1	DSP	Set LCD display DSP=0: Display off DSP=1: Display on
3.Inverse Display	0	0	1	0	1	0	0	1	1	INV	Set inverse display INV=0: Normal display INV=1: Inverse display
4.All Pixel ON/OFF	0	0	0	0	1	0	0	0	1	AP	Set all pixel on mode AP=0: All pixel off mode AP=1: All pixel on mode
5.Display Control	0	0	1	1	0	0	1	0	1	0	Set display control CLD :Set CL dividing ratio LF[4:0] : Set N-line inversion counter DT[7:0] : Set the number of duty FI : Set the inversion type of frame at the end of common scan cycle
	1	0	0	0	0	0	0	CLD	0	0	
	1	0	DT7	DT6	DT5	DT4	DT3	DT2	DT1	DT0	
	1	0	0	0	LF4	FI	LF3	LF2	LF1	LF0	
6.Power Save	0	0	1	0	0	1	0	1	0	SLP	Set power save mode SLP=0: Sleep out mode SLP=1: Sleep in mode
7.Set Page Address	0	0	0	1	1	1	0	1	0	1	Set Page Address Starting Page address: 00h≦YS≦28h Ending Page address: YS≦YE≦28h
	1	0	YS7	YS6	YS5	YS4	YS3	YS2	YS1	YS0	
	1	0	YE7	YE6	YE5	YE4	YE3	YE2	YE1	YE0	
8.Set Column Address	0	0	0	0	0	1	0	1	0	1	Set Column Address Starting Column address: 00h≦XS≦FFh Ending Column address: XS≦XE≦FFh
	1	0	XS7	XS6	XS5	XS4	XS3	XS2	XS1	XS0	
	1	0	XE7	XE6	XE5	XE4	XE3	XE2	XE1	XE0	
9.Data Scan Direction	0	0	1	0	1	1	1	1	0	0	Set normal/ inverse display of address and address scan direction
	1	0	0	0	0	0	0	C/L	MX	MY	
10.Write Data	0	0	0	1	0	1	1	1	0	0	Write data to DDRAM
	1	0	D7	D6	D5	D4	D3	D2	D1	D0	
11.Read Data	0	0	0	1	0	1	1	1	0	1	Read data from DDRAM
	1	1	D7	D6	D5	D4	D3	D2	D1	D0	
12.Partial In	0	0	1	0	1	0	1	0	0	0	Set partial area Starting partial display address: 00h≦PTS≦A1h Ending partial display address: 00h≦PTE≦A1h
	1	0	PTS7	PTS6	PTS5	PTS4	PTS3	PTS2	PTS1	PTS0	
	1	0	PTE7	PTE6	PTE5	PTE4	PTE3	PTE2	PTE1	PTE0	

INSTRUCTION	A0	R/W	COMMAND BYTE D7	D6	D5	D4	D3	D2	D1	D0	DESCRIPTION
13.Partial Out	0	0	1	0	1	0	1	0	0	1	Exit the partial mode
14.Read/Modify/Write In	0	0	1	1	1	0	0	0	0	0	Enable read modify write
15.Read/Modify/Write Out	0	0	1	1	1	0	1	1	1	0	Disable read modify write
16.Scroll Area	0	0	1	0	1	0	1	0	1	0	Set scroll area
	1	0	TL7	TL6	TL5	TL4	TL3	TL2	TL1	TL0	
	1	0	BL7	BL6	BL5	BL4	BL3	BL2	BL1	BL0	
	1	0	NSL7	NSL6	NSL5	NSL4	NSL3	NSL2	NSL1	NSL0	
	1	0	0	0	0	0	0	0	SCM1	SCM0	
17.Set Start Line	0	0	1	0	1	0	1	0	1	1	Set scroll start address 00h$\leq$SL$\leq$A1h
	1	0	SL7	SL6	SL5	SL4	SL3	SL2	SL1	SL0	
18.OSC ON	0	0	1	1	0	1	0	0	0	1	Turn on the internal oscillator
19.OSC OFF	0	0	1	1	0	1	0	0	1	0	Turn off the internal oscillator
20.Power Control	0	0	0	0	1	0	0	0	0	0	Power circuit operation VB=0: OFF, VB=1: ON VF=0: OFF, VF=1: ON VR=0: OFF, VR=1: ON
	1	0	0	0	0	0	VB	0	VF	VR	
21.Set Vop	0	0	1	0	0	0	0	0	0	1	Set Vop
	1	0	0	0	Vop5	Vop4	Vop3	Vop2	Vop1	Vop0	
	1	0	0	0	0	0	0	Vop8	Vop7	Vop6	
22.Vop Control	0	0	1	1	0	1	0	1	1	VOL	Control Vop VOL=0: Vop increase one step VOL=1: Vop decrease one step
23.Read Register Mode	0	0	0	1	1	1	1	1	0	REG	Set read register mode REG=0: read the register value of VPR[5:0] REG=1: read the register value of VPR[8:6]
24.Nop	0	0	0	0	1	0	0	1	0	1	No operation
25.Read Status	0	1	D7	D6	D5	D4	D3	D2	D1	D0	Read status byte
26.Data Format Select	0	0	0	0	0	0	1	DO	0	0	DO=0; LSB on bottom (Default) DO=1; LSB on top
27. Display Mode	0	0	1	1	1	1	0	0	0	0	Set display mode DM=0 :Mono(Default) DM=1 :4Gray Scale Mode
	1	0	0	0	0	1	0	0	0	DM	
28.ICON Control	0	0	0	1	1	1	0	1	1	ICON	Enable/Disable ICON ICON=1 ; Enable ICON=0 ; Disable

INSTRUCTION	A0	R/W	COMMAND BYTE								DESCRIPTION
			D7	D6	D5	D4	D3	D2	D1	D0	
Ext[1:0]=0,1 (Extension Command 2)											
29.Analog Circuit Set	0	0	0	0	1	1	0	0	1	0	Set analog set BE[1:0]: Booster efficiency set BS[2:0]: Set bias ratio
	1	0	0	0	0	0	0	0	0	0	
	1	0	0	0	0	0	0	0	BE1	BE0	
	1	0	0	0	0	0	0	BS2	BS1	BS0	
30.Booster Level	0	0	0	1	0	1	0	0	0	1	Set booster level
	1	0	1	1	1	1	1	0	1	BST	
31. Driving Select	0	0	0	1	0	0	0	0	0	DS	Power type DS=0: Internal (Default) DS=1 :External
32.High Power Mode	0	0	0	1	0	0	1	0	0	HPM	Set high power mode HPM=0 ; Normal Mode HPM =1 ; High Power Mode
33.Auto Read Control	0	0	1	1	0	1	0	1	1	1	Set auto-read instruction XARD=0: Enable auto read XARD=1: Disable auto read
	1	0	1	0	0	XARD	1	1	1	1	
34.OTP WR/RD Control	0	0	1	1	1	0	0	0	0	0	OTP WR/RD control WR/RD=0: Enable OTP read WR/RD=1: Enable OTP write
	1	0	0	0	WR/RD	0	0	0	0	0	
35.OTP Control Out	0	0	1	1	1	0	0	0	0	1	OTP control out
36.OTP Write	0	0	1	1	1	0	0	0	1	0	OTP write
37.OTP Read	0	0	1	1	1	0	0	0	1	1	OTP read
38.OTP Selection Control	0	0	1	1	1	0	0	1	0	0	OTP selection control Ctrl=1: Disable OTP Ctrl=0: Enable OTP
	1	0	1	Ctrl	0	1	1	0	0	1	
39.OTP Programming Setting	0	0	1	1	1	0	0	1	0	1	OTP programming setting
	1	0	0	0	0	0	1	1	1	1	
40.Frame Rate	0	0	1	1	1	1	0	0	0	0	Frame rate setting in different temperature range
	1	0	0	0	0	FRA4	FRA3	FRA2	FRA1	FRA0	
	1	0	0	0	0	FRB4	FRB3	FRB2	FRB1	FRB0	
	1	0	0	0	0	FRC4	FRC3	FRC2	FRC1	FRC0	
	1	0	0	0	0	FRD4	FRD3	FRD2	FRD1	FRD0	
41.Temperature Range	0	0	1	1	1	1	0	0	1	0	Temperature range setting
	1	0	0	TA6	TA5	TA4	TA3	TA2	TA1	TA0	
	1	0	0	TB6	TB5	TB4	TB3	TB2	TB1	TB0	
	1	0	0	TC6	TC5	TC4	TC3	TC2	TC1	TC0	

| INSTRUCTION | A0 | R/W | COMMAND BYTE | | | | | | | | DESCRIPTION |
			D7	D6	D5	D4	D3	D2	D1	D0	
42.Temperature Gradient Compensation	0	0	1	1	1	1	0	1	0	0	Set temperature gradient compensation coefficient
	1	0	MT13	MT12	MT11	MT10	MT03	MT02	MT01	MT00	
	1	0	MT33	MT32	MT31	MT30	MT23	MT22	MT21	MT20	
	1	0	MT53	MT52	MT51	MT50	MT43	MT42	MT41	MT40	
	1	0	MT73	MT72	MT71	MT70	MT63	MT62	MT61	MT60	
	1	0	MT93	MT92	MT91	MT90	MT83	MT82	MT81	MT80	
	1	0	MTB3	MTB2	MTB1	MTB0	MTA3	MTA2	MTA1	MTA0	
	1	0	MTD3	MTD2	MTD1	MTD0	MTC3	MTC2	MTC1	MTC0	
	1	0	MTF3	MTF2	MTF1	MTF0	MTE3	MTE2	MTE1	MTE0	
Ext[1:0]=1,0(Extension Command 3)											
43.Set ID	0	0	1	1	0	1	0	1	0	1	Set ID
	1	0	ID7	ID6	ID5	ID4	ID3	ID2	ID1	ID0	
44 Read ID	0	0	0	1	1	1	1	1	1	RID	Read ID RID=1 ; Enable RID=0 ; Disable
	0	1	D7	D6	D5	D4	D3	D2	D1	D0	

DISPLAY DATA RAM

4-Level Gray Scale Mode

Display Data RAM → Liquid Crystal Display
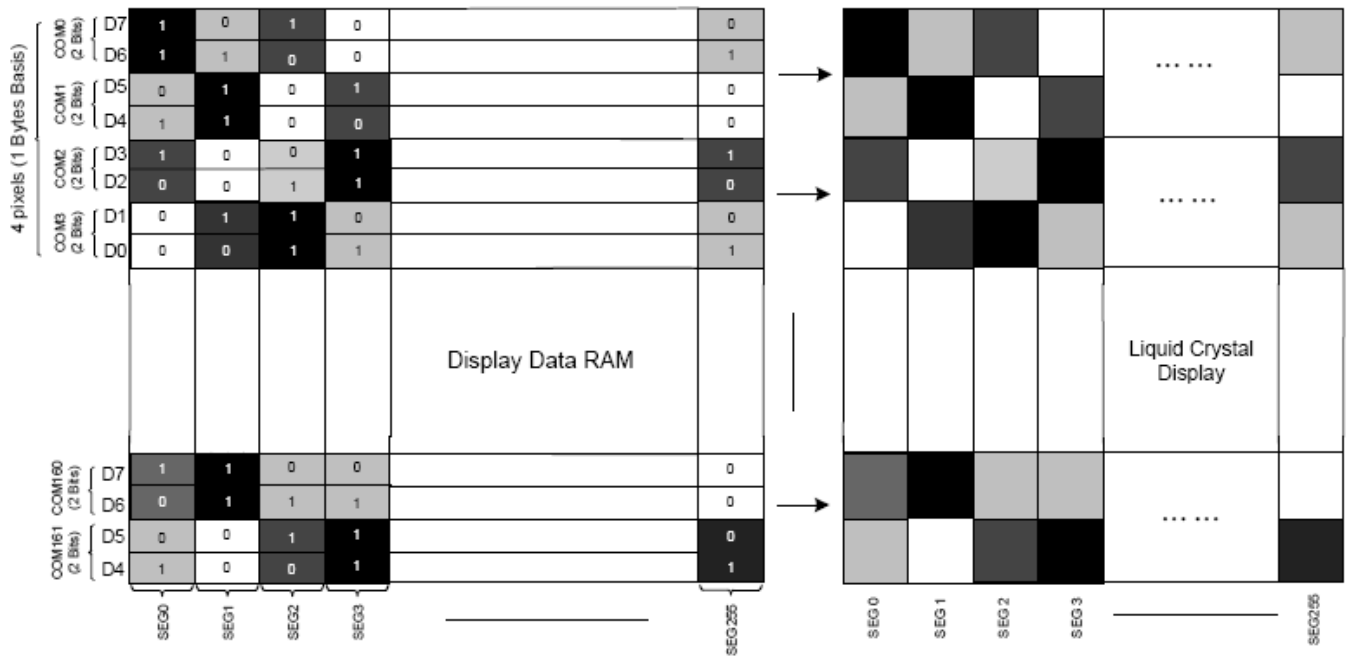
2 Bits Data N=0~3		DDRAM		LCD
D2N+1	D2N			
1	1	1	1	■ (black)
0	0	0	0	□ (white)
1	0	1	0	▨ (dark gray)
0	1	0	1	▨ (light gray)

Monochrome Mode

		SEG			...	
COM0 (1 Bit)	D7	0	1	1	1	...	0
COM1 (1 Bit)	D6	1	0	0	0	...	0
COM2 (1 Bit)	D5	0	0	0	0	...	1
COM3 (1 Bit)	D4	0	1	1	1	...	0
COM4 (1 Bit)	D3	1	0	0	0	...	0
COM5 (1 Bit)	D2	0	1	0	1	...	1
COM6 (1 Bit)	D1	0	0	0	1	...	0
COM7 (1 Bit)	D0	1	0	1	0	...	0

8 pixels (1 Bytes Basis)

Display Data RAM → Liquid Crystal Display
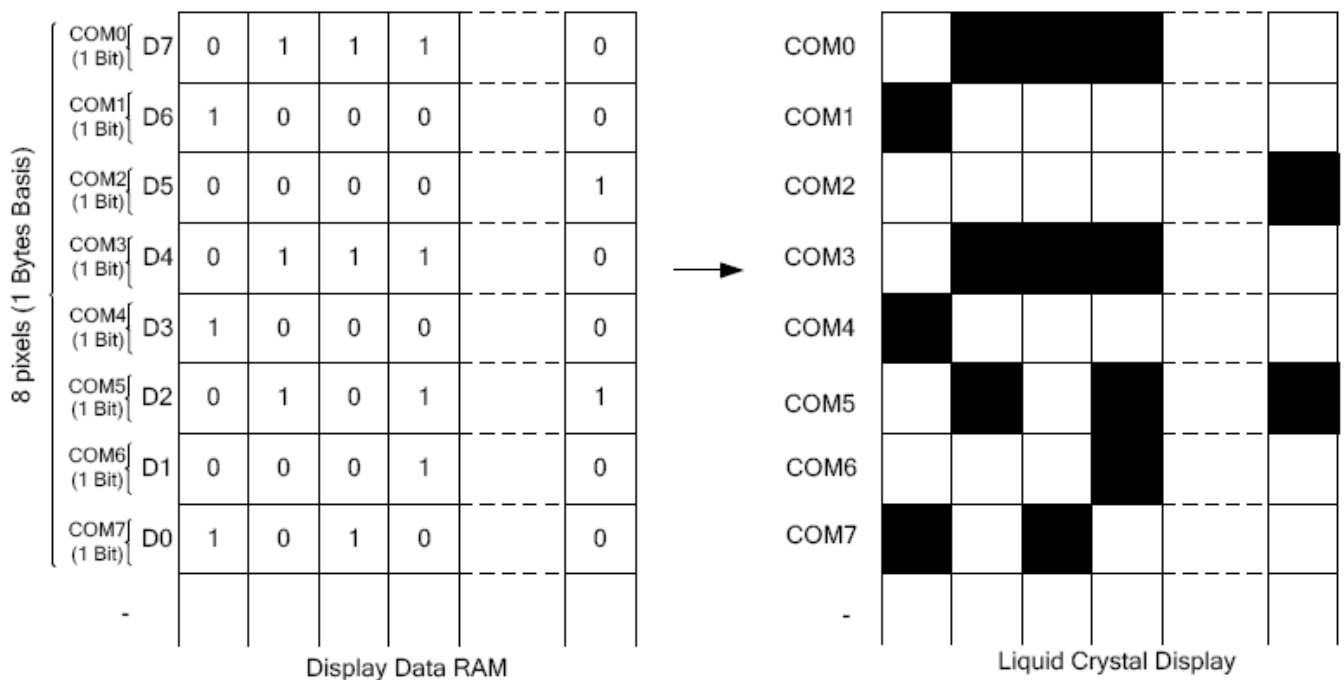
SERIAL INTERFACE TIMING DIAGRAM

System Bus Timing for 4-Line SPI MCU Interface
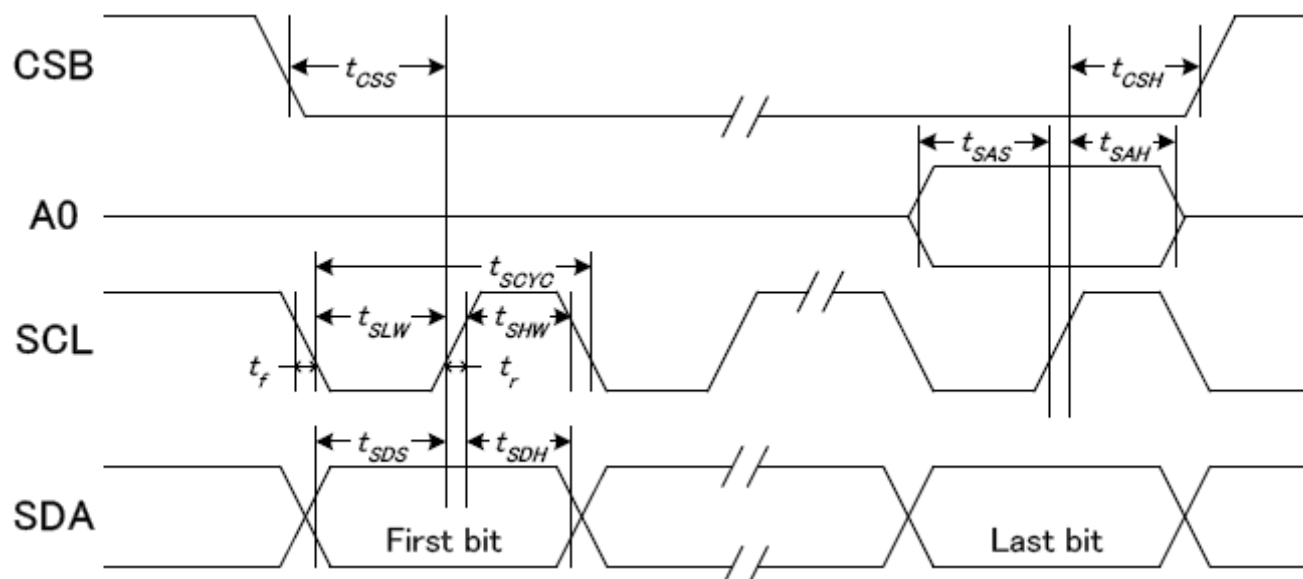
VDD1 = 1.8~3.3V, Ta = 25°C

Item	Signal	Symbol	Condition	Min.	Max.	Unit
Serial clock period		tSCYC		60	—	
SCLK "H" pulse width	SCLK	tSHW		30	—	
SCLK "L" pulse width		tSLW		30	—	
Address setup time	A0	tSAS		20	—	
Address hold time		tSAH		20	—	
Data setup time	SDA	tSDS		20	—	ns
Data hold time		tSDH		20	—	
CSB-SCLK time		tCSS		20	—	
CSB-SCLK time	CSB	tCSH		20	—	
CS "H" pulse width		tCHW		0	-	

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.

System Bus Timing for 8080 MCU Interface
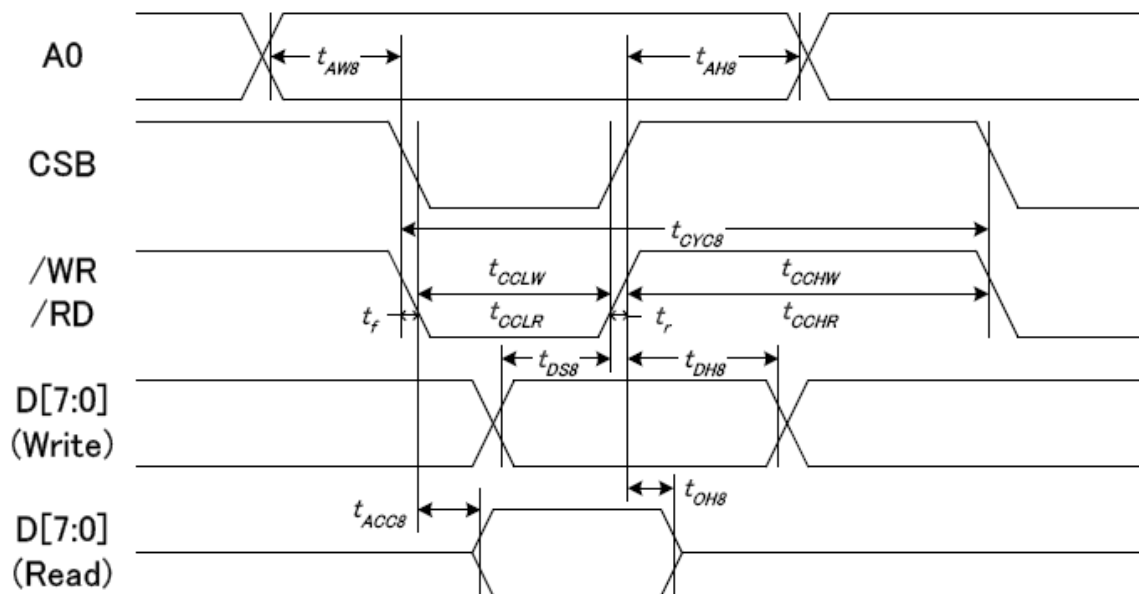
VDD1 = 1.8~3.3V, Ta = 25°C

Item	Signal	Symbol	Condition	Min.	Max.	Unit
Address setup time	A0	tAW8		20	—	
Address hold time		tAH8		0	—	
System cycle time (WRITE)	/WR	tCYC8		160	—	
/WR L pulse width (WRITE)		tCCLW		70	—	
/WR H pulse width (WRITE)		tCCHW		70	—	
System cycle time (READ)	RD	tCYC8		400	—	ns
/RD L pulse width (READ)		tCCLR		180		
/RD H pulse width (READ)		tCCHR		180		
WRITE Data setup time	D[7:0]	tDS8		15	—	
WRITE Data hold time		tDH8		15	—	
READ access time		tACC8	CL = 30 pF	—	100	
READ Output disable time		tOH8	CL = 30 pF	10	110	

Note:

1. The input signal rise time and fall time (tr, tf) is specified at 15 ns or less. When the system cycle time is extremely fast, (tr + tf) $\leqq$ (tCYC8 – tCCLW – tCCHW) for (tr + tf) $\leqq$ (tCYC8 – tCCLR – tCCHR) are specified.

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

3. tCCLW and tCCLR are specified as the overlap between CSB being "L" and WR and RD being at the "L" level.
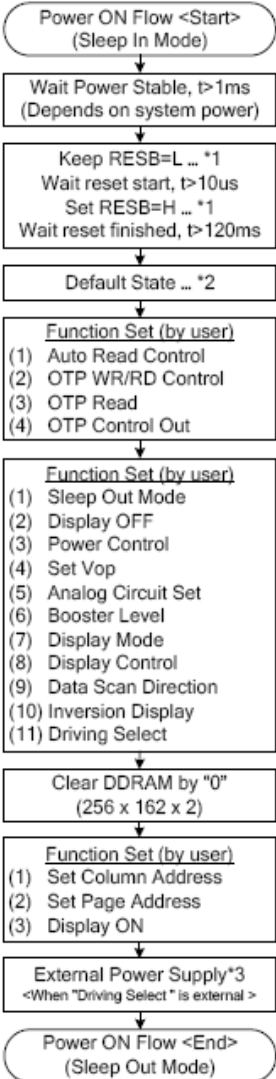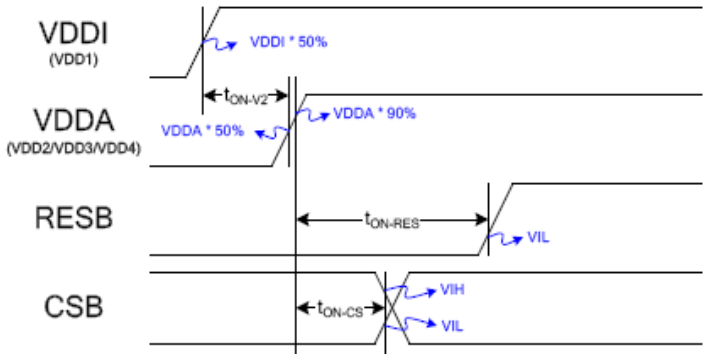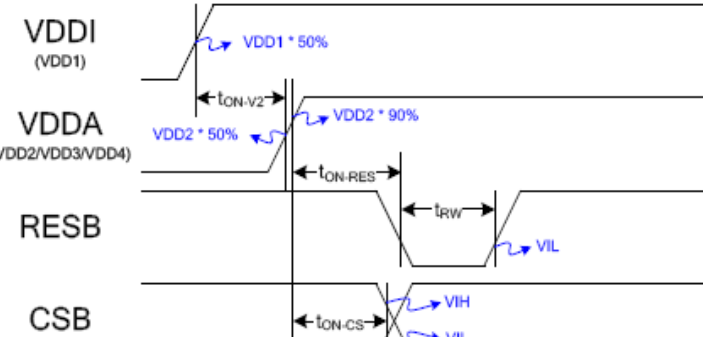
System Bus Timing for 6800 MCU Interface
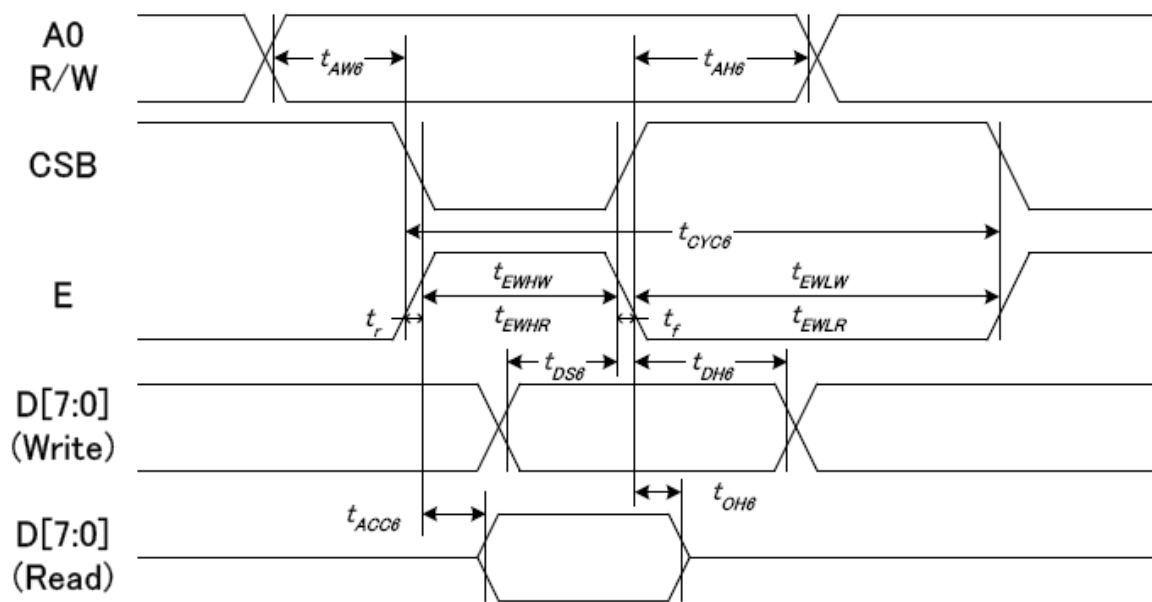
VDD1 = 1.8~3.3V, Ta = 25°C

Item	Signal	Symbol	Condition	Min.	Max.	Unit
Address setup time	A0	tAW6		20	—	ns
Address hold time		tAH6		0	—	
System cycle time (WRITE)	E	tCYC6		160	—	
Enable L pulse width (WRITE)		tEWLW		70	—	
Enable H pulse width (WRITE)		tEWHW		70	—	
System cycle time (READ)		tCYC6		400		
Enable L pulse width (READ)		tEWLR		180	—	
Enable H pulse width (READ)		tEWHR		180		
Write data setup time	D[7:0]	tDS6		15	—	
Write data hold time		tDH6		15	—	
Read data access time		tACC6	CL = 30 pF	—	100	
Read data output disable time		tOH6	CL = 30 pF	10	110	

Note:

1. The input signal rise time and fall time (tr, tf) is specified at 15 ns or less. When the system cycle time is extremely fast, (tr + tf) $\leqq$ (tCYC6 – tEWLW – tEWHW) for (tr + tf) $\leqq$ (tCYC6 – tEWLR – tEWHR) are specified.

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

3. tEWLW and tEWLR are specified as the overlap between CSB being "L" and E.
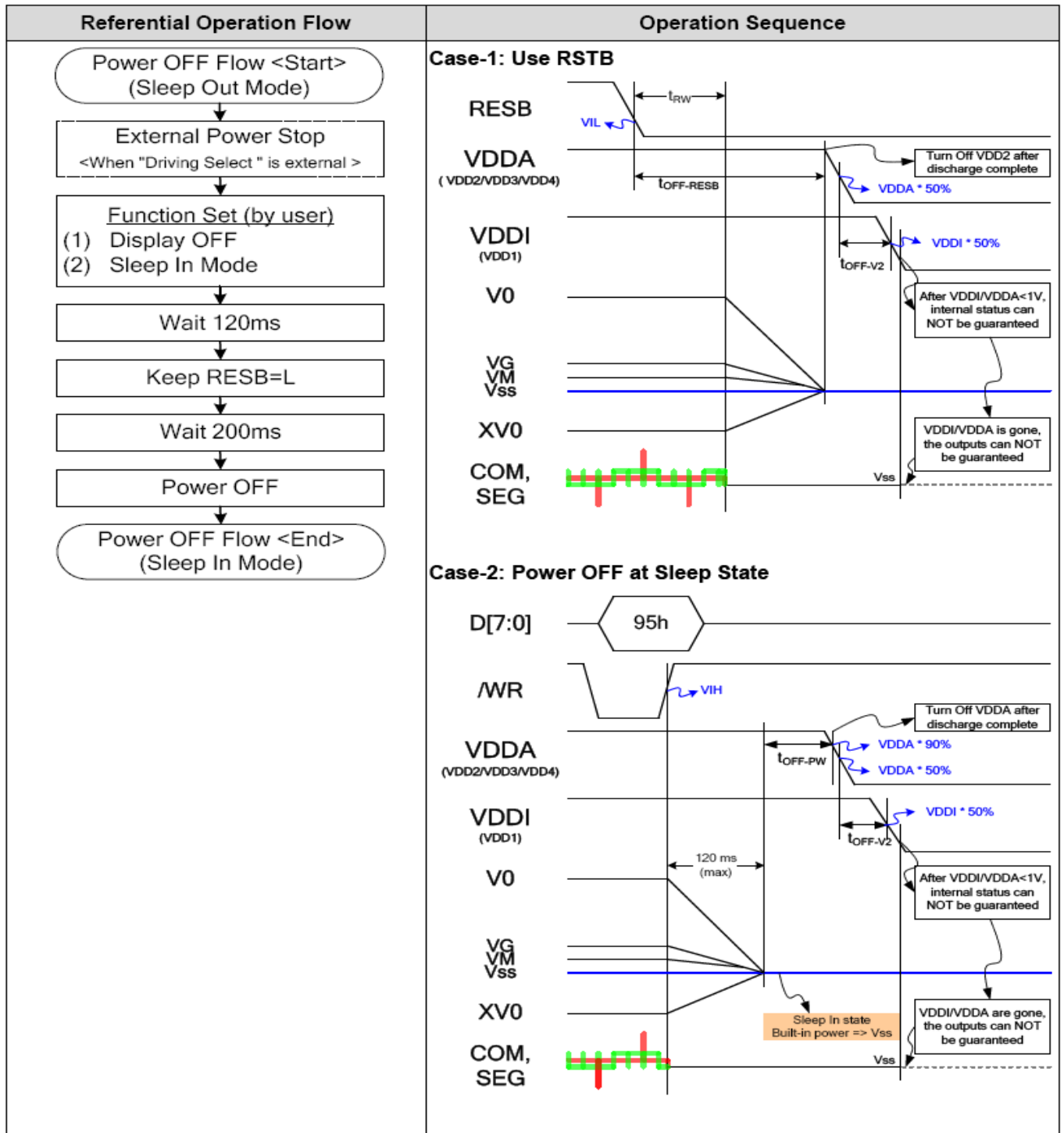
POWER ON

Referential Operation Flow	Operation Sequence

Referential Operation Flow

Power ON Flow <Start>
(Sleep In Mode)
↓
Wait Power Stable, t>1ms
(Depends on system power)
↓
Keep RESB=L ... *1
Wait reset start, t>10us
Set RESB=H ... *1
Wait reset finished, t>120ms
↓
Default State ... *2
↓
Function Set (by user)
(1) Auto Read Control
(2) OTP WR/RD Control
(3) OTP Read
(4) OTP Control Out
↓
Function Set (by user)
(1) Sleep Out Mode
(2) Display OFF
(3) Power Control
(4) Set Vop
(5) Analog Circuit Set
(6) Booster Level
(7) Display Mode
(8) Display Control
(9) Data Scan Direction
(10) Inversion Display
(11) Driving Select
↓
Clear DDRAM by "0"
(256 x 162 x 2)
↓
Function Set (by user)
(1) Set Column Address
(2) Set Page Address
(3) Display ON
↓
External Power Supply*3
<When "Driving Select " is external >
↓
Power ON Flow <End>
(Sleep Out Mode)

Operation Sequence

Case-1: RSTB=L while Power ON

VDDI (VDD1)
VDDI * 50%
t_{ON-V2}
VDDA (VDD2/VDD3/VDD4)
VDDA * 50%
VDDA * 90%
RESB
t_{ON-RES}
VIL
CSB
t_{ON-CS}
VIH
VIL

Case-2: RSTB=H while Power ON

VDDI (VDD1)
VDD1 * 50%
t_{ON-V2}
VDDA (VDD2/VDD3/VDD4)
VDD2 * 50%
VDD2 * 90%
t_{ON-RES}
RESB
t_{RW}
VIL
CSB
t_{ON-CS}
VIH
VIL

Note

1. Please refer to the specification of tRW and tR.

2. Refer to the section of Reset circuit.

3. The detail instruction functionality is described in section of INSTRUCTION DESCRIPTION.

4. The power stable is defined as the time that the later power (VDDI or VDDA) reaches 90% of its rated voltage.

5. VDDA include VDD2, VDD3, VDD4

Item	Symbol	Requirement	Description
VDD2 power ON delay	t_{ON-V2}	No Limitation	• VDDI and VDDA can be applied in any order. IC will NOT be damaged when one of VDD1 and VDD2 is ON but another is OFF. • Power stable is defined as the time that the later power (VDDI or VDDA) reaches 90% of its rated voltage. • Recommend Setting: $-50\text{ms} \leq t_{ON-V2} \leq$ No Limitation.
RESB input time	t_{ON-RES}	Case-1 $t_{RW} \leq t_{ON-RES}$ Case-2 No Limitation	• RESB=L can be input at any time after power is stable. • t_{RW} & t_R should match the timing specification of RESB. • RESB has priority over CSB. • Recommend Setting: $0 \leq t_{ON-RES} \leq 50$ ms.
CSB input time	t_{ON-CS}	No Limitation	• CSB can be input at any time after power is stable.

Note:

1. If the contents of internal registers are the same as default, the related commands can be ignored.

2. If RESB is held high or unstable during power ON, a successful hardware reset by RSTB is required after VDDI and VDDA are both stable (as illustrated in Case-2). Otherwise, correct functionality can NOT be guaranteed.
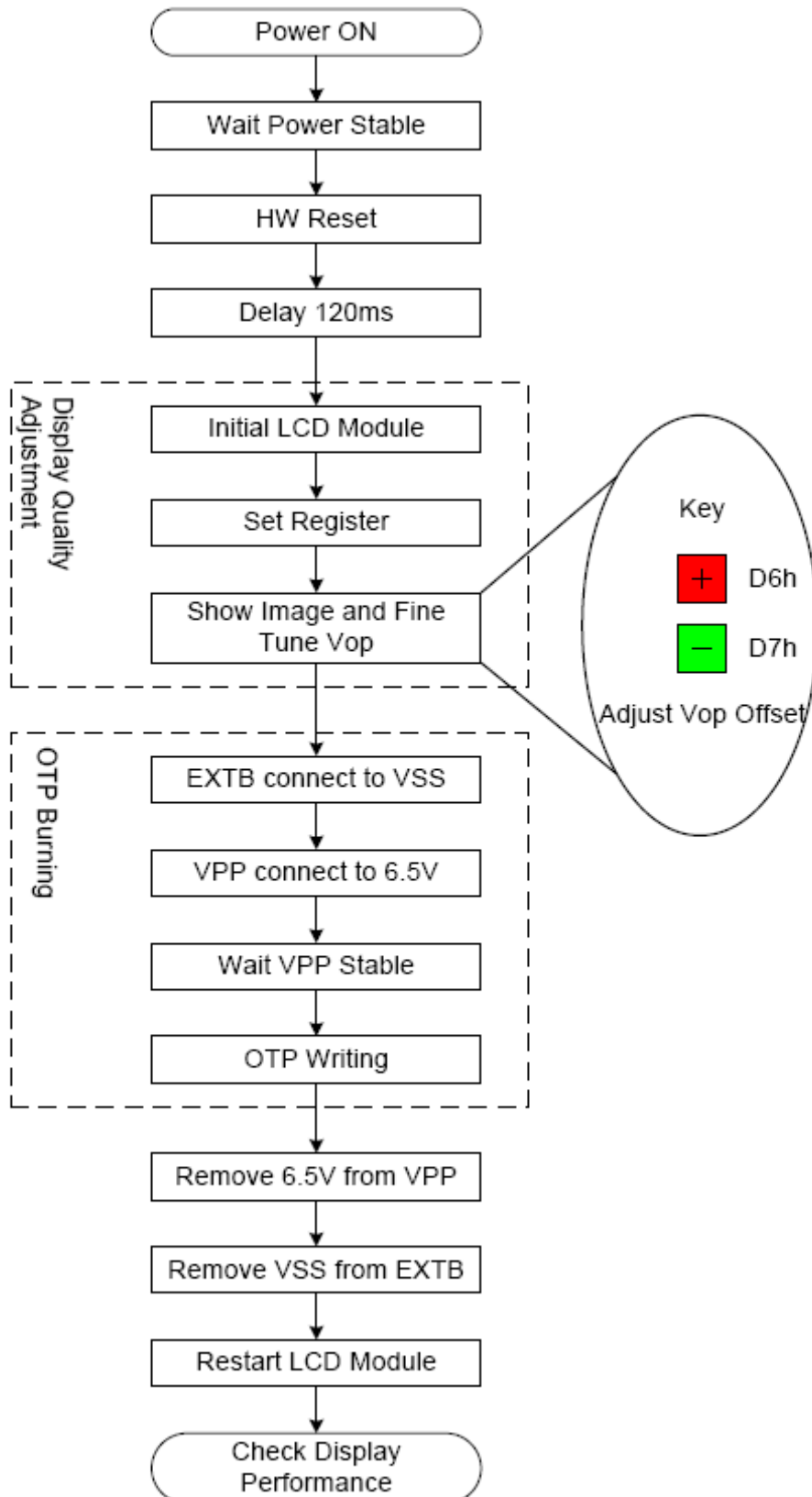
POWER OFF

Referential Operation Flow	Operation Sequence

Referential Operation Flow:

Power OFF Flow \<Start\>
(Sleep Out Mode)

↓

External Power Stop
\<When "Driving Select " is external \>

↓

Function Set (by user)
(1) Display OFF
(2) Sleep In Mode

↓

Wait 120ms

↓

Keep RESB=L

↓

Wait 200ms

↓

Power OFF

↓

Power OFF Flow \<End\>
(Sleep In Mode)

Operation Sequence:

Case-1: Use RSTB

RESB — t_{RW} — VIL

VDDA (VDD2/VDD3/VDD4) — $t_{OFF-RESB}$ — Turn Off VDD2 after discharge complete — VDDA * 50%

VDDI (VDD1) — t_{OFF-V2} — VDDI * 50%

V0

VG VM Vss

After VDDI/VDDA<1V, internal status can NOT be guaranteed

XV0 — Vss — VDDI/VDDA is gone, the outputs can NOT be guaranteed

COM, SEG

Case-2: Power OFF at Sleep State

D[7:0] — 95h

/WR — VIH

VDDA (VDD2/VDD3/VDD4) — t_{OFF-PW} — Turn Off VDDA after discharge complete — VDDA * 90% — VDDA * 50%

VDDI (VDD1) — t_{OFF-V2} — VDDI * 50%

V0 — 120 ms (max)

VG VM Vss

After VDDI/VDDA<1V, internal status can NOT be guaranteed

XV0 — Sleep In state Built-in power => Vss — VDDI/VDDA are gone, the outputs can NOT be guaranteed

COM, SEG — Vss

Item		Symbol	Requirement	Description
Power OFF Time	Case-1	$t_{OFF-RESB}$	200ms ≤ $t_{OFF-RESB}$	● Power can be turned OFF after built-in power becomes VSS.
	Case-2	t_{OFF-PW}	0 ≤ t_{OFF-PW}	
VDD2 power ON delay		t_{OFF-V2}	No Limitation	● VDD1 and VDD2 can be powered down in any order. IC will NOT be damaged when one of VDD1 and VDD2 is ON but another is OFF. ● Recommend Setting: -50ms ≤ t_{OFF-V2} ≤ No Limitation.

Note: In Case-2, RSTB can fall to VSS at the same time as VDDI.

Referential OTP Burning Flow

```
          ┌─────────────────┐
          │    Power ON      │
          └────────┬─────────┘
                   │
          ┌────────▼─────────┐
          │ Wait Power Stable│
          └────────┬─────────┘
                   │
          ┌────────▼─────────┐
          │     HW Reset     │
          └────────┬─────────┘
                   │
          ┌────────▼─────────┐
          │   Delay 120ms    │
          └────────┬─────────┘
                   │
┌ Display Quality Adjustment ─ ─ ─ ─ ┐
│         ┌────────▼─────────┐       │
│         │ Initial LCD Module│      │
│         └────────┬─────────┘       │
│                  │                 │
│         ┌────────▼─────────┐       │
│         │   Set Register    │      │
│         └────────┬─────────┘       │
│                  │                 │
│         ┌────────▼─────────┐       │
│         │ Show Image and Fine│     │
│         │    Tune Vop       │      │
│         └────────┬─────────┘       │
└ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘
                   │
┌ OTP Burning ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┐
│         ┌────────▼─────────┐       │
│         │ EXTB connect to VSS│     │
│         └────────┬─────────┘       │
│                  │                 │
│         ┌────────▼─────────┐       │
│         │ VPP connect to 6.5V│     │
│         └────────┬─────────┘       │
│                  │                 │
│         ┌────────▼─────────┐       │
│         │  Wait VPP Stable  │      │
│         └────────┬─────────┘       │
│                  │                 │
│         ┌────────▼─────────┐       │
│         │   OTP Writing     │      │
│         └────────┬─────────┘       │
└ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘
                   │
          ┌────────▼─────────┐
          │ Remove 6.5V from VPP│
          └────────┬─────────┘
                   │
          ┌────────▼─────────┐
          │ Remove VSS from EXTB│
          └────────┬─────────┘
                   │
          ┌────────▼─────────┐
          │ Restart LCD Module│
          └────────┬─────────┘
                   │
          ┌────────▼─────────┐
          │  Check Display    │
          │   Performance     │
          └──────────────────┘
```

Key

| + | D6h |
| − | D7h |

Adjust Vop Offset

Note:

● In this section "+" and "-" key button, please execute command D6h to increase one step at Vop and execute command D7h to decrease one step at Vop.

ELECTRO-OPTICAL CHARACTERISTICS

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

TEMPERATURE = 22 ± 5 °C

RELATIVE HUMIDITY = 60 ± 15 %

ITEM	SYMBOL	UNIT	TYP. STN
RESPONSE TIME	T_{on}	ms	320
	T_{off}	ms	430
CONTRAST RATIO	Cr	-	8
VIEWING ANGLE (Cr ≥ 2)	$V_{3:00}$	°	40
	$V_{6:00}$	°	55
	$V_{9:00}$	°	40
	$V_{12:00}$	°	35

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
	$0.3<d\leq0.4$	QTY≤1		
	$0.4<d$	QTY=0		
LINE SCRATCHES	$x\geq0.7$ $y\geq0.05$	QTY=0	MINOR	3
BLACK LINE	$x\geq0.7$ $y\geq0.05$	QTY=0	MINOR	3

*d = MAX (d_1,d_2) ** N. A . = NOT APPLICABLE   DEFECT TABLE : B
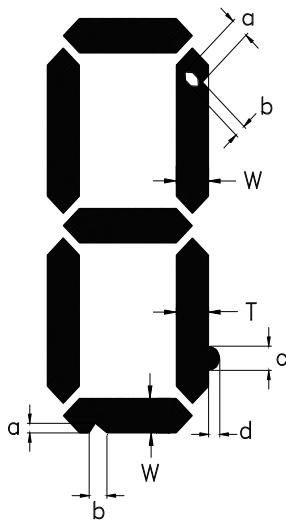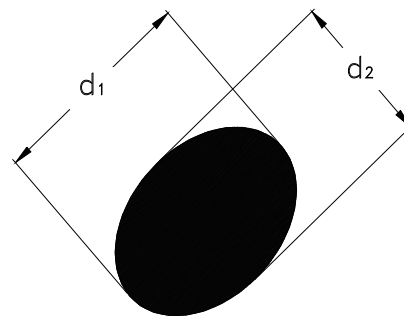
POLARIZER BUBBLES / SPOTS
fig . 2

fig . 1
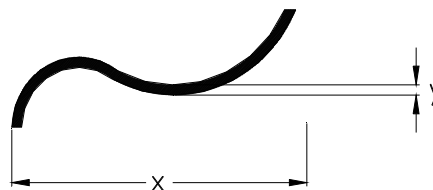
LINE SCRATCHES / BLACK LINE
fig . 3

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
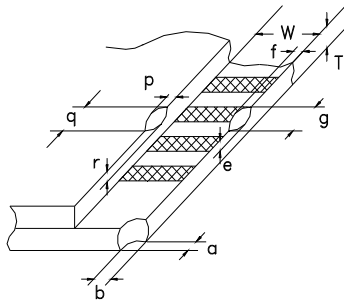
fig . 4
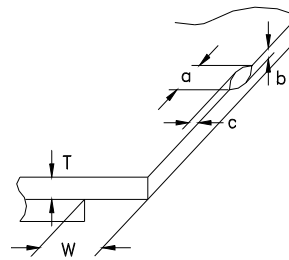
fig . 5
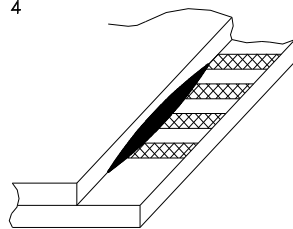
fig . 6
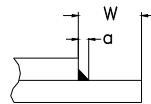
HANDLING PRECAUTIONS

(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, 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.