Display Elektronik GmbH

DATA SHEET

LCD MODULE

DEM 128128C FGH
(FPCF, refl.)

Product Specification **Ver.: 0**

15/Jan./2014

DOCUMENT REVISION HISTORY

Version	DATE	DESCRIPTION	CHANGED BY
00	15.01.2014	First issue	MHO

CONTENTS

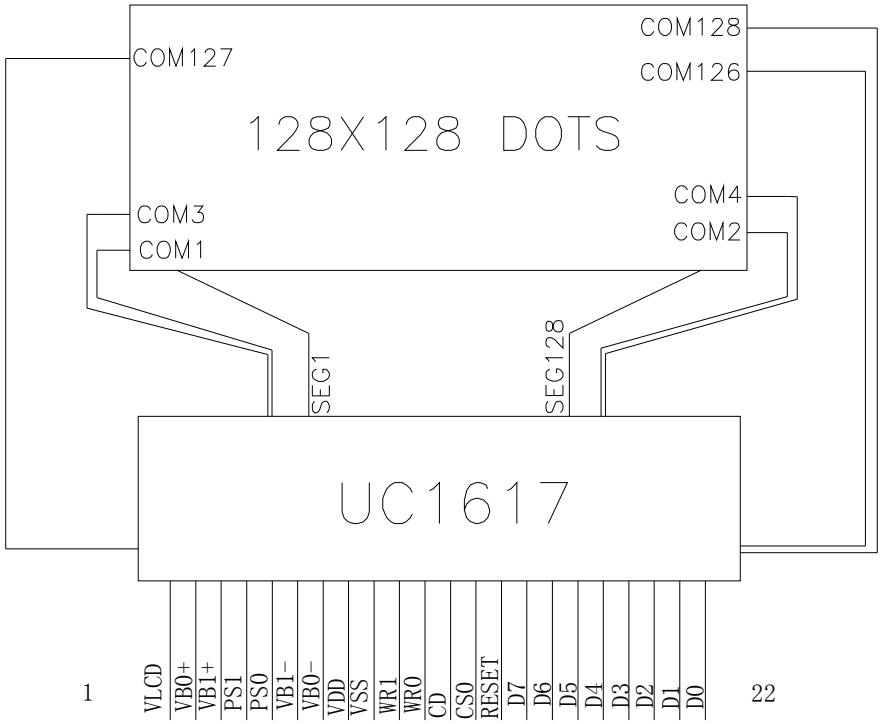
1. FUNCTIONS & FEATURES

Format	: 128 x 128 dots
LCD mode	: FSTN/Positive/Reflective
Viewing direction	: 6 o'clock
Driving scheme	: 1/128 Duty, 1/10 Bias
Power supply voltage (V_{DD})	: 3.3 Volt (typ.)
LCD driving voltage	: 11.5 Volt (typ.)
Operation temp	: -20 to 70°C
Storage temp	: -30 to 80°C
Interface	: 8-BIT-MCU; SPI; I^2C
RoHS	: Compliant

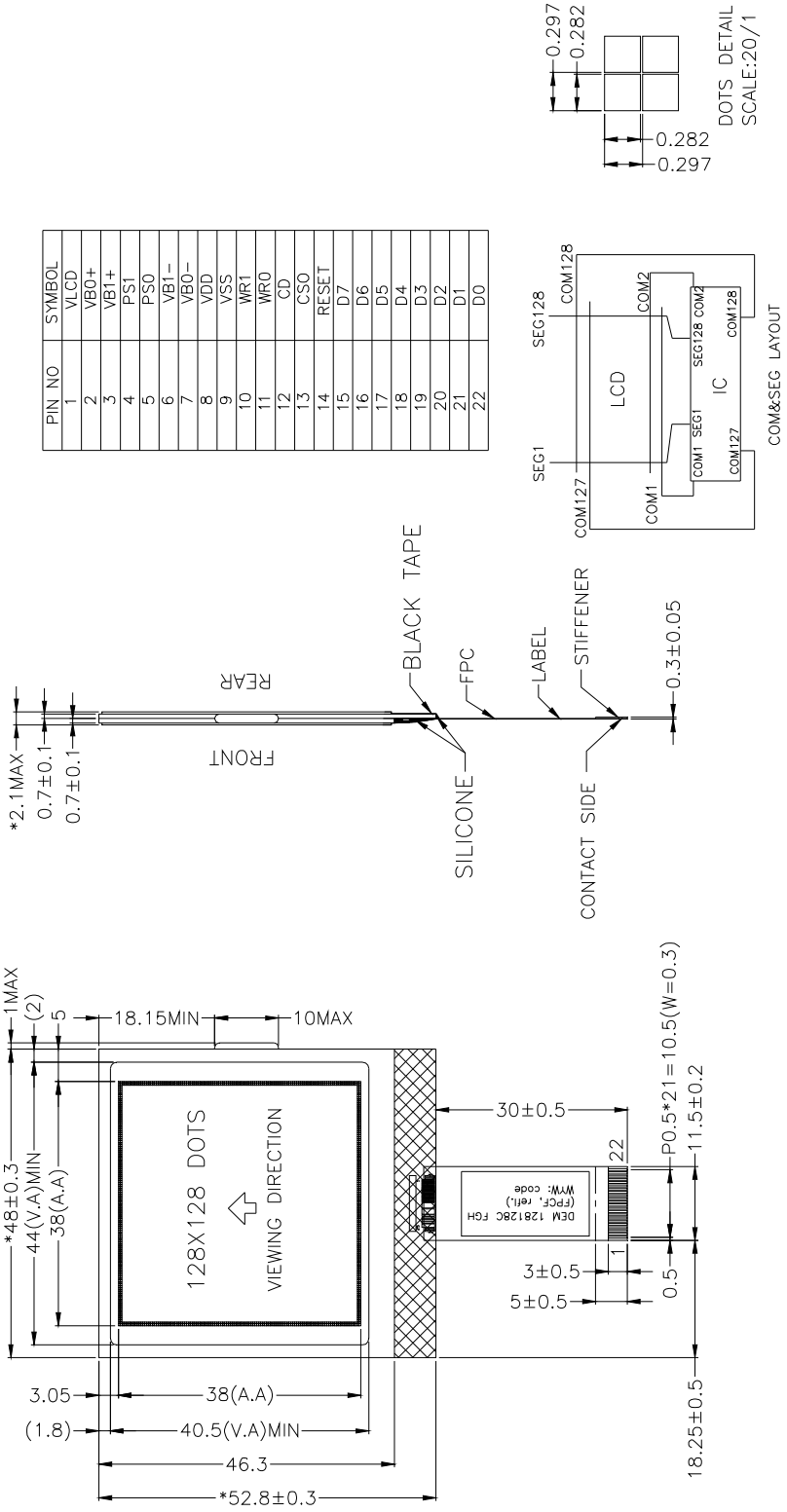
2. MECHANICAL SPECIFICATIONS

Module size	: 48.00 x 52.80 x 2.10 mm (without FPC)
Viewing area	: 44.00 x 40.50 mm
Dot pitch	: 0.297 x 0.297 mm
Dot size	: 0.282 x 0.282 mm
Dot Gap	: 0.015 mm

3. BLOCK DIAGRAM



4. DIMENSIONAL OUTLINE



5. PIN DESCRIPTION

No.	Symbol	Function
1	VLCD	High voltage LCD power supply.
2,3,6,7	VB0+,VB1+, VB1-,VB0-	LCD bias voltages, there are the voltage sources to provide the SEG driving currents, these voltages are generated internally. Connect capacitors of CBX value between VBX- and VBX+.
4	PS1	Bus mode: The interface bus mode is determined by BM[1:0] and D[7:6].
5	PS0	
8	VDD	LCM power supply(3.3V).
9	VSS	Power ground.
10	WR1	WR[1:0] controls the read/write operation of the host interface.
11	WR0	
12	CD	Set control data or display data for read/write operation. in IIC mode, CD pin is not used and connect to VSS. “L”: Control data; “H”: Display data.
13	CS0	Chip is selected when CS0= “L”.
14	RESET	Reset signal input, active “L”.
15-22	D7-D0	Data Bus.

6. MAXIMUM ABSOLUTE LIMIT

Item	Symbol	MIN	MAX	Unit
Supply Voltage for Logic	V_{DD}	-0.3	4.0	V
Supply Voltage for LCD	VLCD	-0.3	19.8	V
Input Voltage	Vin	-0.4	V_{DD}+0.5	V
Operating Temperature	Top	-20	70	°C
Storage Temperature	Tst	-30	80	°C

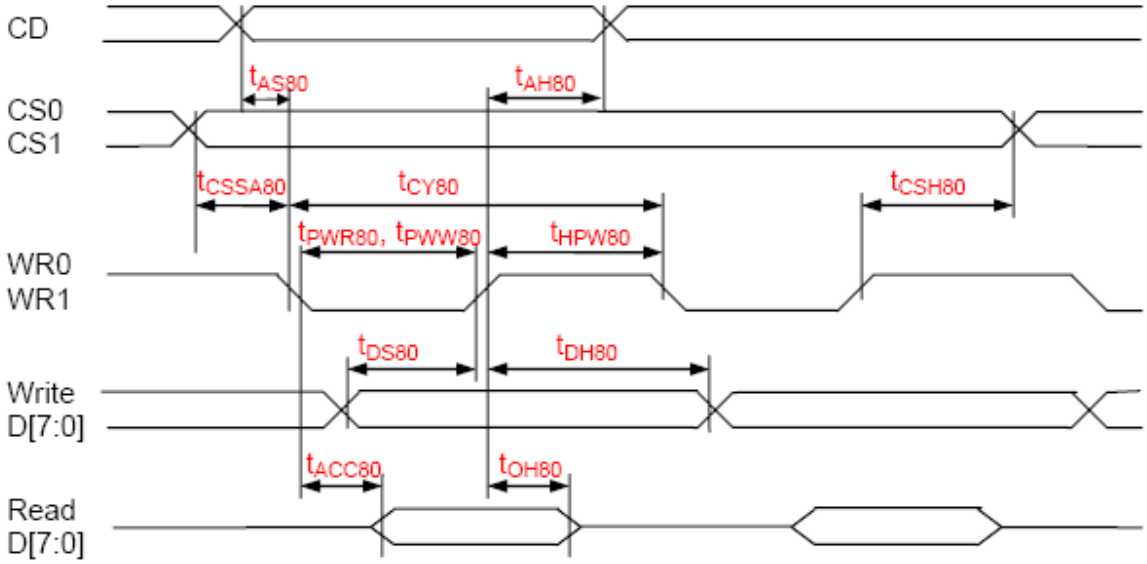
7. ELECTRICAL CHARACTERISTICS

7.1 DC characteristics (VDD=3.3V,TA=25°C)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{DD}	Supply for digital circuit		1.65		3.465	V
$V_{DD2/3}$	Supply for bias & pump		2.6		3.465	V
V_{LCD}	Charge pump output	$V_{DD2/3} \geq$ 2.6V, 25°C		14	15	V
V_D	LCD data voltage	$V_{DD2/3} \geq$ 2.6V, 25°C	0.89		1.78	V
V_{IL}	Input logic LOW				$0.2V_{DD}$	V
V_{IH}	Input logic HIGH		$0.8V_{DD}$			V
V_{OL}	Output logic LOW				$0.2V_{DD}$	V
V_{OH}	Output logic HIGH		$0.8V_{DD}$			V
I_{IL}	Input leakage current				1.5	µA
I_{SB}	Standby current	$V_{DD} = V_{DD2/3}$ = 3.3V, Temp = 85 °C			50	µA
C_{IN}	Input capacitance			5	10	pF
C_{OUT}	Output capacitance			5	10	pF
$R_{ON(SEG)}$	SEG output impedance	V_{LCD} = 15V		1.6	2.1	kΩ
$R_{ON(COM)}$	Upward COM output impedance	V_{LCD} = 15V		1.6	2.1	kΩ
$R_{ONS(COM)}$	Downward COM output impedance			1.85	2.5	kΩ
f_{LINE}	Average Line rate	LC[4:3] = 10b	-10%	21.1	+10%	kHz

7.2 AC characteristics(VDD=3.3V,TA=25°C)

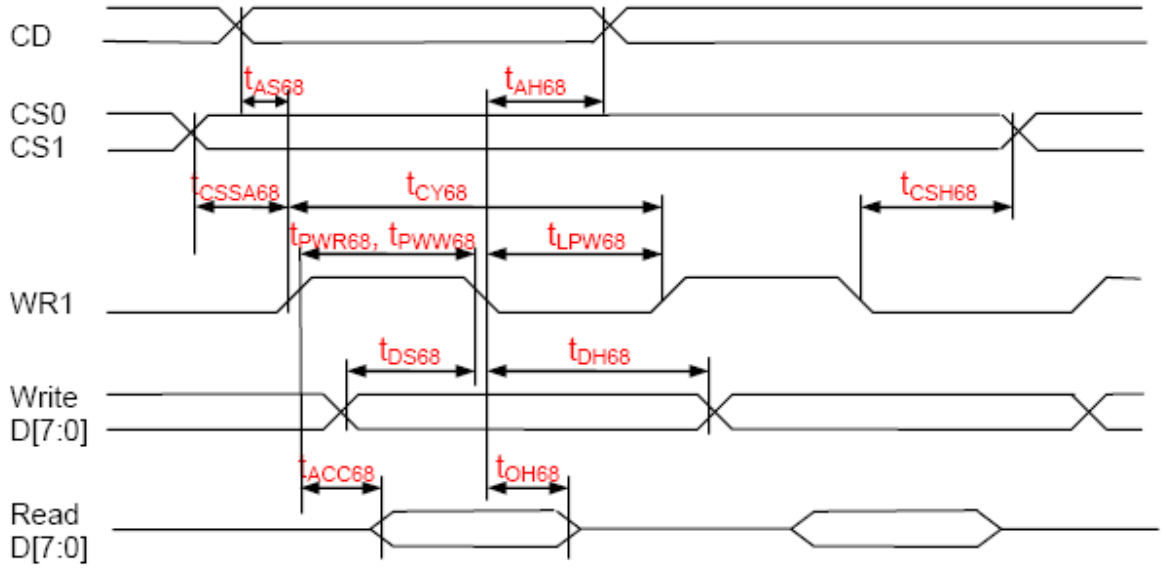
Parallel bus timing characteristics (for 8080 MCU)



Symbol	Signal	Description	Condition	Min.	Max.	Unit
(2.5V ≤ V_{DD} < 3.465V, Ta= –30 to +85°C)				(Read / Write)		
tAS80 tAH80	CD	Address setup time Address hold time		0 0	–	nS
tCSSA80 tCSH80	CS1/CS0	Chip select setup time Chip select hold time		5 5	–	nS
tCY80 tPWR80 / tPWW80 tHPW80	WR0, WR1	System cycle time Pulse width High pulse width		200 / 160 85 / 65 85 / 65	–	nS
tDS80 tDH80	D7~D0 (Write)	Data setup time Data hold time		– / 30 – / 0	–	nS
tACC80 tOH80	D7~D0 (Read)	Read access time Output disable time	C_L = 100pF	– / – – / –	65 / – 30 / –	nS

Note: The rising time (tr) and the falling time (tf) are stipulated to be equal to or less than 15nS each.

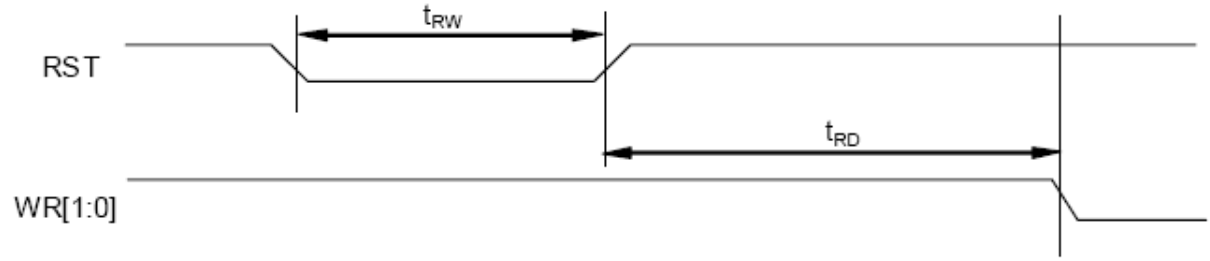
Parallel bus timing characteristics (for 6800 MCU)



Symbol	Signal	Description	Condition	Min.	Max.	Unit
(2.5V ⩽ V_{DD} < 3.465V, Ta= –30 to +85°C)				(Read / Write)		
tAS68 tAH68	CD	Address setup time Address hold time		0 0	–	nS
tCSSA68 tCSH68	CS1/CS0	Chip select setup time Chip select hold time		5 5	–	nS
tCY68 tPWR68 / tPWW68 tLPW68	WR1	System cycle time Pulse width Low pulse width		200 / 160 85 / 65 85 / 65	–	nS
tDS68 tDH68	D7~D0 (Write)	Data setup time Data hold time		– / 30 – / 0	–	nS
tACC68 tOH68	D7~D0 (Read)	Read access time Output disable time	C_L = 100pF	– / – – / –	70 / – 30 / –	nS

Note: The rising time (tr) and the falling time (tf) are stipulated to be equal to or less than 15nS each.

Reset characteristics



(1.65V ⩽ V_{DD} < 3.465V, Ta= –30 to +85°C)

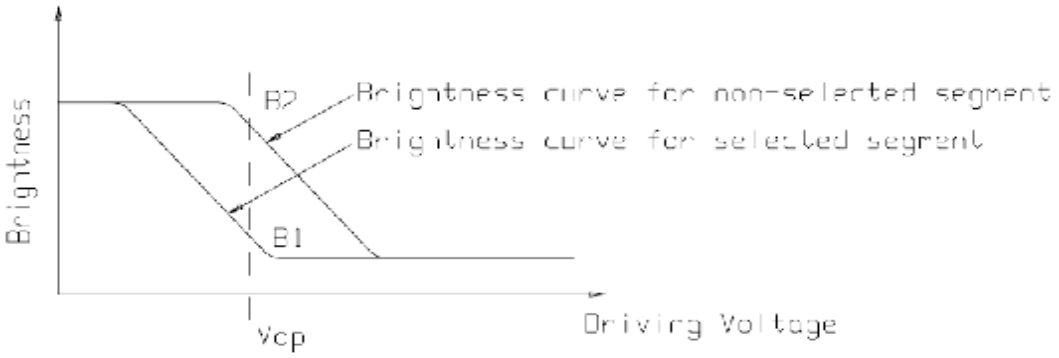
Symbol	Signal	Description	Condition	Min.	Max.	Unit
tRW	RST	Reset low pulse width		3	–	µS
tRD	RST, WR	Reset to WR pulse delay		10	–	mS

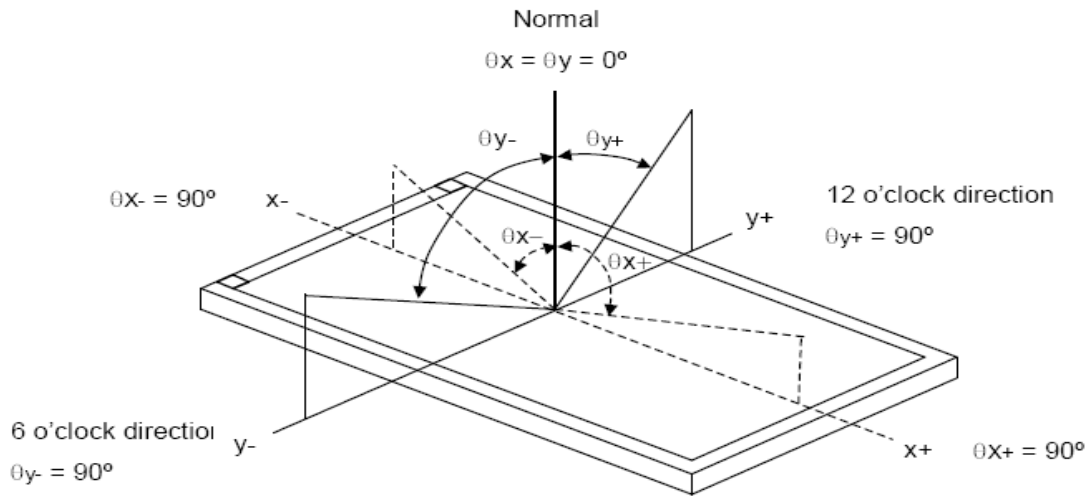
8. ELECTRO-OPTICAL CHARACTERISTICS

(Ta = 25°C)

Item	Symbol	Condition	Min	Typ	Max	Unit
Operating Voltage	Vop	Ta = -20°C	11.6	11.9	12.2	V
		Ta = 25°C	11.2	11.5	11.8	
		Ta = 70°C	10.8	11.1	11.4	
Response time	Tr	Ta = 25°C	---	180	216	ms
	Tf		---	120	144	ms
Contrast	Cr	Ta = 25°C θx=θy=0	---	4.5	---	---
Viewing angle range	θx-	Cr≥2	30	35	---	deg
	θx+		30	35	---	deg
	θy-		35	40	---	deg
	θy+		35	40	---	deg

$$Cr = \frac{\text{Brightness of non-selected segment(B2)}}{\text{Brightness of selected segment(B1)}}$$





9. CONTROL AND DISPLAY INSTRUCTION

	Command	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0	Action	Default
1.	Write Data Byte	1	0	#	#	#	#	#	#	#	#	Write 1 byte	N/A
2.	Read Data Byte	1	1	#	#	#	#	#	#	#	#	Read 1 byte	N/A
3.	Get Status	0	1	-	MX	MY	WA	DE	WS	MD	MS	Get {Status, Ver, PMO, Prod, PID}	N/A
				Ver[1:0]		PMO[5:0]							
				Prod[3:0]				0	PID	0	0		
4.	Set Page_C Address	0	0	0	0	0	#	#	#	#	#	Set CA[4:0]	00H
5.	Set Temp. Compensation	0	0	0	0	1	0	0	1	#	#	Set TC[1:0]	00b
6.	Set Panel Loading	0	0	0	0	1	0	1	0	#	#	Set PC[1:0]	10b
7.	Set Pump Control	0	0	0	0	1	0	1	1	#	#	Set PC[3:2]	11b
8.	Set Adv. Program Control	0	0	0	0	1	1	0	0	R	R	Set R, R = 0~2	N/A
	(double-byte command)	0	0	#	#	#	#	#	#	#	#	Set APC[R][7:0]	
9.	Set Scroll Line LSB	0	0	0	1	0	0	#	#	#	#	Set SL[3:0]	0H
	Set Scroll Line MSB	0	0	0	1	0	1	-	#	#	#	Set SL[6:4]	0H
10.	Set Row Address LSB	0	0	0	1	1	0	#	#	#	#	Set RA[3:0]	0H
	Set Row Address MSB	0	0	0	1	1	1	-	#	#	#	Set RA[6:4]	0H
11.	Set V_{BIAS} Potentiometer	0	0	1	0	0	0	0	0	0	1	Set PM[7:0]	4EH
	(double-byte command)	0	0	#	#	#	#	#	#	#	#		
12.	Set Partial Display Control	0	0	1	0	0	0	0	1	#	#	Set LC[10:9]	00b: Disable
13.	Set RAM Address Control	0	0	1	0	0	0	1	#	#	#	Set AC[2:0]	001b
14.	Set Fixed Lines	0	0	1	0	0	1	0	0	0	0	Set {FLT, FLB}	00H
		0	0	#	#	#	#	#	#	#	#		
15.	Set Line Rate	0	0	1	0	1	0	0	0	#	#	Set LC[4:3]	00b
16.	Set All-Pixel-ON	0	0	1	0	1	0	0	1	0	#	Set DC[1]	0b
17.	Set Inverse Display	0	0	1	0	1	0	0	1	1	#	Set DC[0]	0b
18.	Set Display Enable	0	0	1	0	1	0	1	1	#	#	Set DC[3:2]	10b
19.	Set LCD Mapping Control	0	0	1	1	0	0	0	#	#	#	Set LC[2:0]	000b
20.	Set N-Line Inversion	0	0	1	1	0	0	1	0	0	0	Set NIV[3:0]	6H
		0	0	-	-	-	-	#	#	#	#		
21.	Set LCD Gray Shade 1	0	0	1	1	0	1	0	0	#	#	Set LC[6:5]	01b
22.	Set LCD Gray Shade 2	0	0	1	1	0	1	0	1	#	#	Set LC[8:7]	10b
23.	System Reset	0	0	1	1	1	0	0	0	1	0	System Reset	N/A
24.	NOP	0	0	1	1	1	0	0	0	1	1	No operation	N/A
25.	Set Test Control	0	0	1	1	1	0	0	1	TT		For testing only. Do not use.	N/A
	(double-byte command)	0	0	#	#	#	#	#	#	#	#		
26.	Set LCD Bias Ratio	0	0	1	1	1	0	1	0	#	#	Set BR[1:0]	11b: 11
27.	Set COM End	0	0	1	1	1	1	0	0	0	1	Set CEN[6:0]	127
		0	0	-	#	#	#	#	#	#	#		
28.	Set Partial Display Start	0	0	1	1	1	1	0	0	1	0	Set DST[6:0]	0
		0	0	-	#	#	#	#	#	#	#		
29.	Set Partial Display End	0	0	1	1	1	1	0	0	1	1	Set DEN[6:0]	127
		0	0	-	#	#	#	#	#	#	#		

	Command	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0	Action		Default
30.	Set Window Program Starting Page_C Address	0 0	0 0	1 -	1 -	1 -	1 #	0 #	1 #	0 #	0 #	Note (3)	Set WPC0	0
31.	Set Window Programming Starting Row Address	0 0	0 0	1 -	1 #	1 #	1 #	0 #	1 #	0 #	1 #		Set WPP0	0
32.	Set Window Programming Ending Page_C Address	0 0	0 0	1 -	1 -	1 -	1 #	0 #	1 #	1 #	0 #		Set WPC1	31
33.	Set Window Programming Ending Row Address	0 0	0 0	1 -	1 #	1 #	1 #	0 #	1 #	1 #	1 #		Set WPP1	127
34.	Enable window program	0	0	1	1	1	1	1	0	0	#	Set AC[3]		0: Disable
35.	Set MTP Operation control	0 0	0 0	1 -	0 -	1 #	1 #	1 #	0 #	0 #	0 #	Set MTPC[5:0]		10H
36.	Set MTP Write Mask	0 0	0 0	1 -	0 -	1 #	1 #	1 #	0 #	0 #	1 #	Set MTPM[5:0]		0
37.	Set V_{MTP1} Potentiometer	0 0	0 0	1 #	1 #	1 #	1 #	0 #	1 #	0 #	0 #	Note (3)	Set MTP1	N/A
38.	Set V_{MTP2} Potentiometer	0 0	0 0	1 #	1 #	1 #	1 #	0 #	1 #	0 #	1 #		Set MTP2	
39.	Set MTP Write Timer	0 0	0 0	1 #	1 #	1 #	1 #	0 #	1 #	1 #	0 #		Set MTP3	
40.	Set MTP Read Timer	0 0	0 0	1 #	1 #	1 #	1 #	0 #	1 #	1 #	1 #		Set MTP4	
SERIAL READ COMMAND (ENABLED ONLY IN S8/S9 MODE)														
41.	Get Status	0	0	1	1	1	1	1	1	1	0	Get status until chip disabled		N/A
		0	1	-	MX	MY	WA	DE	WS	MD	MS			
		0	1	Ver[1:0]		PMO[5:0]								
		0	1	Prod[3:0]				0	PID	0	0			

Notes:

(1) Any bit patterns other than the commands listed above may result in undefined behavior.

(2) The interpretation of commands (36)~(40) depends on register MTPC[3].

(3) Commands (37)~(40) are shared with commands (30)~(33) and have exactly the same code.
When MTPC[3]=0, commands (37)~(40) are interpreted as `Window Programming` commands.
When MTPC[3]=1, they are the `MTP Control` commands.

(4) MTPM and PM are actually the same register. Only one of the commands (36 or 11) is valid at any time, and it is determined by MTPC[3].

(5) After MTP-ERASE or MTP-PROGRAM operation, before resuming normal operation, please always
a) Remove TST4 power source.
b) Do a full V_{DD} ON-OFF-ON cycle.

10. PRECAUTION FOR USING LCD/LCM

LCD/LCM is assembled and adjusted with a high degree of precision. Do not attempt to make any alteration or modification. The followings should be noted.

General Precautions:

1. LCD panel is made of glass. Avoid excessive mechanical shock or applying strong pressure onto the surface of display area.
2. The polarizer used on the display surface is easily scratched and damaged. Extreme care should be taken when handling. To clean dust or dirt off the display surface, wipe gently with cotton, or other soft material soaked with isopropyl alcohol or ethyl alcohol, do not use water, ketone or aromatics and never scrub hard.
3. Do not tamper in any way with the tabs on the metal frame.
4. Do not made any modification on the PCB without consulting DISPLAY.
5. When mounting a LCM, make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
6. Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels and also cause rainbow on the display.
7. Be careful not to touch or swallow liquid crystal that might leak from a damaged cell. Any liquid crystal adheres to skin or clothes, wash it off immediately with soap and water.

Static Electricity Precautions:

1. CMOS-LSI is used for the module circuit; therefore operators should be grounded whenever he/she comes into contact with the module.
2. Do not touch any of the conductive parts such as the LSI pads; the copper leads on the PCB and the interface terminals with any parts of the human body.
3. Do not touch the connection terminals of the display with bare hand; it will cause disconnection or defective insulation of terminals.
4. The modules should be kept in anti-static bags or other containers resistant to static for storage.
5. Only properly grounded soldering irons should be used.
6. If an electric screwdriver is used, it should be grounded and shielded to prevent sparks.
7. The normal static prevention measures should be observed for work clothes and working benches.
8. Since dry air is inductive to static, a relative humidity of 50-60% is recommended.

Soldering Precautions:

1. Soldering should be performed only on the I/O terminals.
2. Use soldering irons with proper grounding and no leakage.
3. Soldering temperature: 300±5°C
4. Soldering time: 2 to 3 second.
5. Use eutectic solder with resin flux filling.
6. If flux is used, the LCD surface should be protected to avoid spattering flux.
7. Flux residue should be removed.

Operation Precautions:

1. The viewing angle can be adjusted by varying the LCD driving voltage Vo.
2. Since applied DC voltage causes electro-chemical reactions, which deteriorate the display, the applied pulse waveform should be a symmetric waveform such that no DC component remains. Be sure to use the specified operating voltage.
3. Driving voltage should be kept within specified range; excess voltage will shorten display life.
4. Response time increases with decrease in temperature.
5. Display color may be affected at temperatures above its operational range.
6. Keep the temperature within the specified range usage and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel-off or generate bubbles.
7. When storing the LCD modules,avoid exposure to direct sunlight or to the light of fluorescent lamps.For long-term storage,the temperature should be 0°C~40°C,and the relative humidity should be kept 40%~60%.

Limited Warranty:

DISPLAY LCDs and modules are not consumer products, but may be incorporated by DISPLAY's customers into consumer products or components thereof, DISPLAY does not warrant that its LCDs and components are fit for any such particular purpose.

1. The liability of DISPLAY is limited to repair or replacement on the terms set forth below. DISPLAY will not be responsible for any subsequent or consequential events or injury or damage to any personnel or user including third party personnel and/or user. Unless otherwise agreed in writing between DISPLAY and the customer, DISPLAY will only replace or repair any of its LCD which is found defective electrically or visually when inspected in accordance with DISPLAY general LCD inspection standard . (Copies available on request)
2. No warranty can be granted if any of the precautions state in handling liquid crystal display above has been disregarded. Broken glass, scratches on polarizer mechanical damages as well as defects that are caused accelerated environment tests are excluded from warranty.
3. In returning the LCD/LCM, they must be properly packaged; there should be detailed description of the failures or defect.