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TFT | OLED | CHARACTER | GRAPHIC | UWVD | SEGMENT | CUSTOM

Character Display Module

Part Number
C162F-FTW-YW63

Overview:

- 16x2 Character LCD
- FSTN Positive
- 65.5x36.7mm Module
- 4-bit or 8-bit MPU Interface(s)
- White LED Backlight
- Transflective
- Wide Temp Range
- 3.3V
- LCD IC: ST7066U-0A
- RoHS Compliant

Character LCD Features

Characters: 16x2

Interface(s): 4-bit or 8-bit MPU

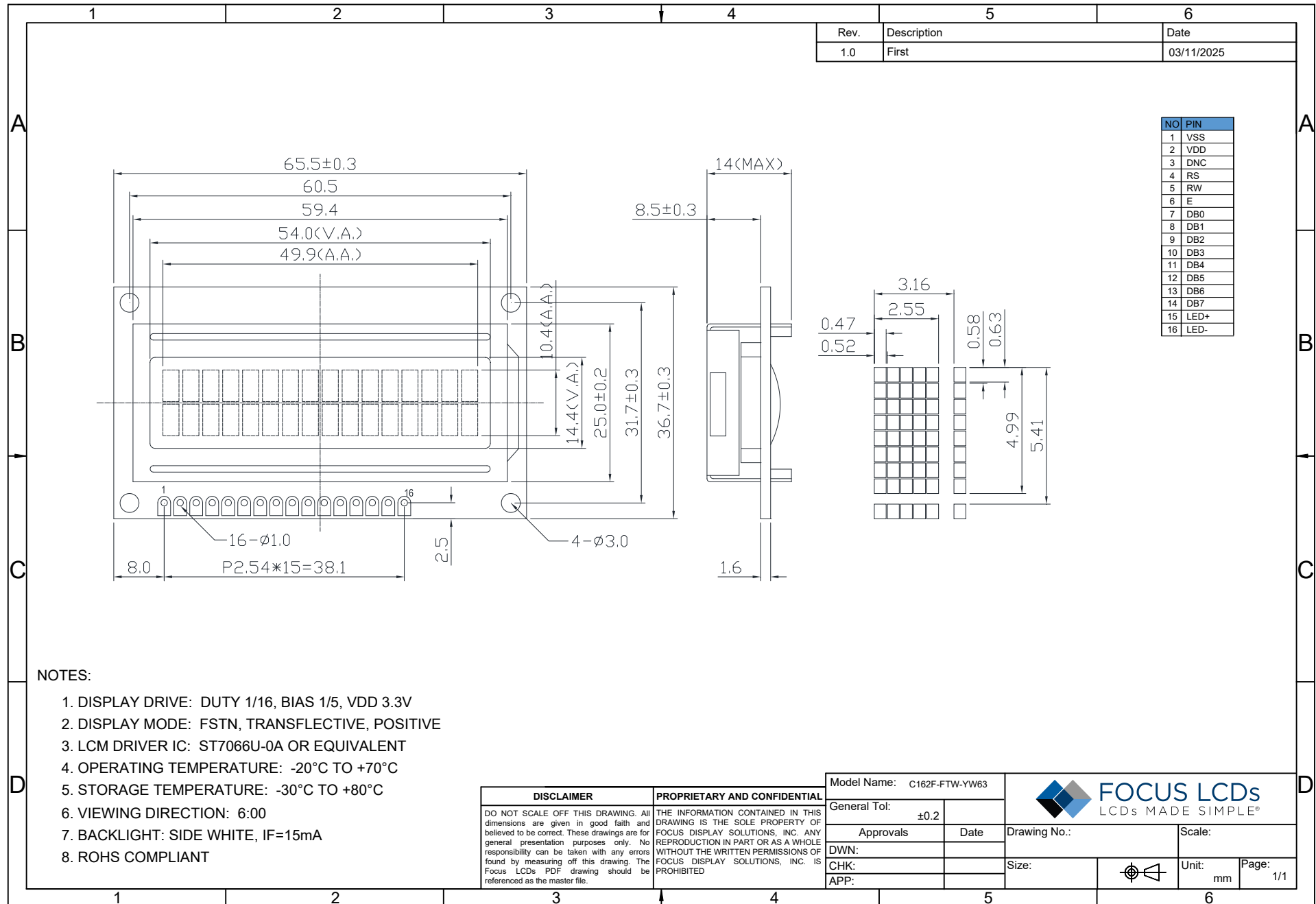
RoHS Compliant

General Information Items	Specification	Unit	Note
	Main Panel		
Viewing Area (VA)	54.0 (H) x 14.4 (V)	mm	--
LCD Type	FSTN Positive	--	--
Viewing Angle	6:00	O'Clock	--
Polarizer	Transflective	--	--
Backlight Type	LED	--	--
Backlight Color	White	--	--
LCD IC	ST7066U-0A	--	--
Character Height	4.99	mm	--
Operating Temperature	-20 to +70	°C	--
Storage Temperature	-30 to +80	°C	--

Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	--	65.5	--	mm	--
	Vertical (V)	--	36.7	--	mm	--
	Depth (D)	--	14.0	--	mm	--
Weight		--	TBD	--	g	--

1. Outline Dimensions



2. Input Terminal Pin Assignment

NO.	Symbol	Description	I/O
1	VSS	Negative power supply, ground.	S
2	VDD	Positive power supply.	S
3	DNC	Do not connect (contrast voltage is internally controlled).	--
4	RS	Register select signal.	MPU
5	RW	Read/write select signal.	MPU
6	E	Operation (data read/write) enable signal.	MPU
7-10	DB0~DB3	Four low order bi-directional three-state data bus lines. Used for data transfer between the MPU and the LCM. These four are not used during 4-bit operation.	MPU
11-14	DB4~7	Four high order bi-directional three-state data bus lines. Used for data transfer between the MPU.	MPU
15	LED+	Power supply for BKL.	--
16	LED-	Power supply for BKL.	--

I: Input, O: Output, S: Supply

3. LCD Optical Characteristics

Item		Symbol	Condition	Min	Typ.	Max	Unit
Contrast Ratio		CR		--	5	--	
Response Time	On	T_{on}		--	150	200	ms
	Off	T_{off}		--	200	250	ms
Viewing Angle CR≥2, 25°C	Hor.	Θ_L	$\Phi=270^\circ$, 9H	--	60	--	degree
		Θ_R	$\Phi=90^\circ$, 3H	--	60	--	
	Ver.	Θ_T	$\Phi=180^\circ$, 12H	--	40	--	
		Θ_B	$\Phi=0^\circ$, 6H	--	60	--	

4. Electrical Characteristics

4.1 Absolute Maximum Rating

Characteristics	Symbol	Min	Max	Unit
Supply Voltage	VDD-VSS	-0.3	7.0	V
	VIN/VOUT	-0.3	VDD+0.5	V
LCD Driver Supply Voltage	VLCD	-0.3	4.5	V
Operating Temperature	TOP	-20	+70	°C
Storage Temperature	TST	-30	+80	°C

NOTE: If the absolute maximum rating of the above parameters is exceeded, even momentarily, the quality of the product may be degraded. Absolute maximum ratings specify the values which the product may be physically damaged if exceeded. Be sure to use the product within the range of the absolute maximum ratings.

4.2 DC Electrical Characteristics

Characteristics		Symbol	Condition	Min	Typ.	Max	Unit
Supply Voltage for Logic		VDD-VSS		3.0	3.3	3.5	V
Supply Voltage for LCD		VLCD-VSS	Ta=25°C	--	--	--	V
Input Voltage	H Level	VIH		0.7*VDD	--	3.5	V
	L Level	VIL		-0.3	--	0.6	V
Output Voltage	H Level	VOH		0.75*VDD	--	--	V
	L Level	VOL		--	--	0.2*VDD	V
Supply Current		IDD	VDD=3.3V	--	0.75	1.5	mA
Supply Voltage of Backlight		VLED	Forward current=15mA	2.8	3.0	3.2	V
Supply Current of Backlight		ILED	VLED=3.0V	10.0	15.0	20.0	mA

Condition:

1. VDD = 3.3V
2. 1/16 Duty, 1/5 Bias

4.3 DDRAM Address

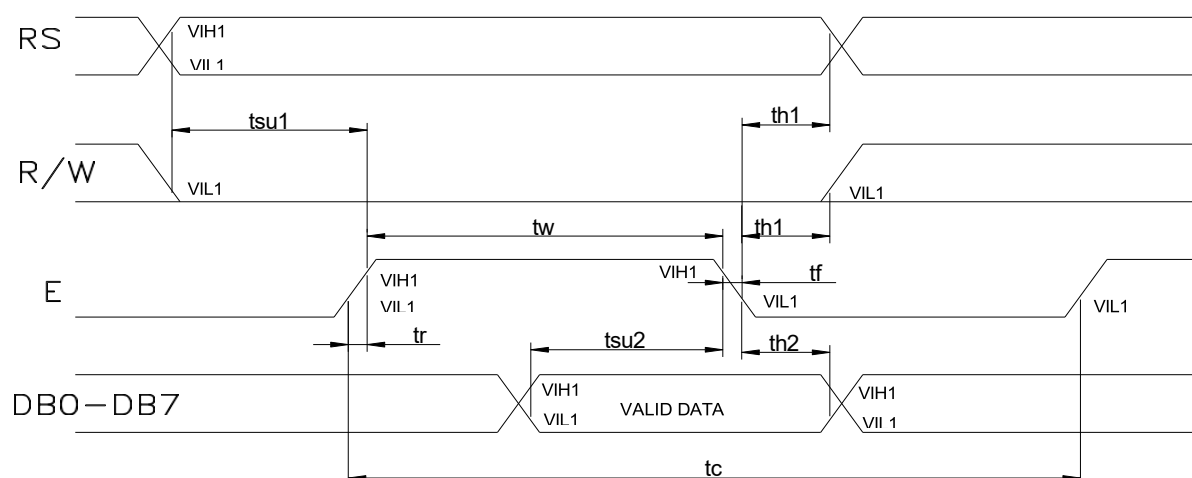
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F

5. Timing Characteristics

Write cycle ($T_a=25^\circ\text{C}$, $V_{DD}=3.3\text{V}$)

Parameter	Symbol	Test Pin	Min.	Typ.	Max.	Unit
Enable cycle time	tc	E	1000	-	-	ns
Enable pulse width	tw		450	-	-	
Enable rise/fall time	tr, tf		-	-	25	
RS; R/W setup time	tsu1	RS;R/W RS;R/W	60	-	-	
RS; R/W address hold time	th1		20	-	-	
Read data output delay	tsu2	DB0~DB7	195	-	-	
Read data hold time	th2		10	-	-	

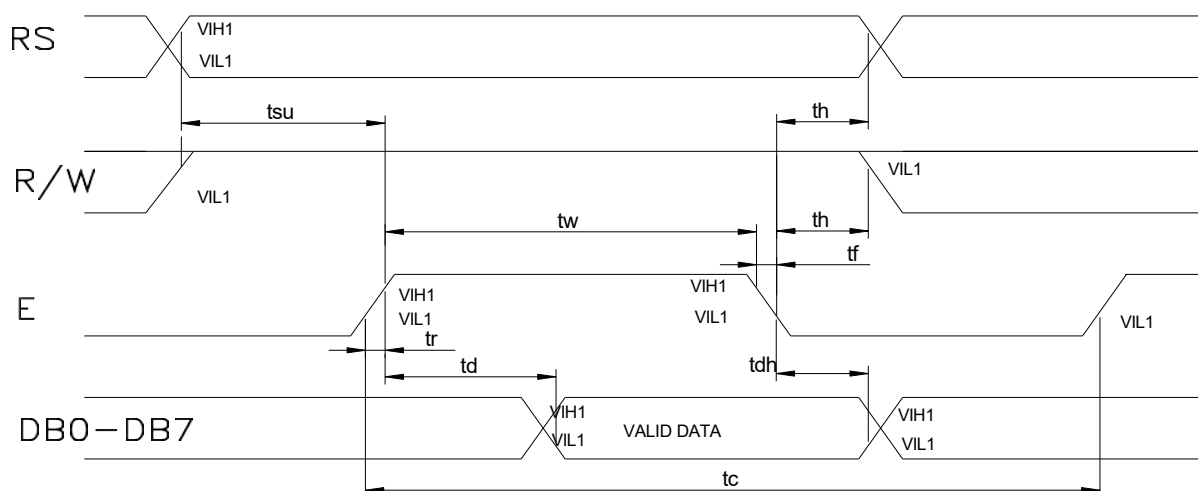
Write mode timing diagram



Read cycle ($T_a=25^\circ\text{C}$, $V_{DD}=3.3\text{V}$)

Parameter	Symbol	Test Pin	Min.	Typ.	Max.	Unit
Enable cycle time	tc	E	1000	-	-	ns
Enable pulse width	tw		450	-	-	
Enable rise/fall time	tr, tf		-	-	25	
RS; R/W setup time	tsu	RS; R/W RS; R/W	60	-	-	
RS; R/W address hold time	th		20	-	-	
Read data output delay	td	DB0~DB7	-	-	360	
Read data hold time	tdh		5	-	-	

Read mode timing diagram



6. Instructions

Instruction	Instruction Code										Description	Execution time (fosc= 270 KHZ)
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRA and set DDRAM address to "00H" from AC	1.53ms
Return Home	0	0	0	0	0	0	0	0	1	-	Set DDRAM address to "00H" From AC and return cursor to Its original position if shifted. The contents of DDRAM are not changed.	1.53ms
Entry mode Set	0	0	0	0	0	0	0	1	I/D	SH	Assign cursor moving direction And blinking of entire display	39us
Display ON/ OFF control	0	0	0	0	0	0	1	D	C	B	Set display (D), cursor (C), and Blinking of cursor (B) on/off Control bit.	37us
Cursor or Display shift	0	0	0	0	0	1	S/C	R/L	-	-	Set cursor moving and display Shift control bit, and the Direction, without changing of DDRAM data.	39us
Function set	0	0	0	0	1	DL	N	F	-	-	Set interface data length (DL: 8- Bit/4-bit), numbers of display Line (N: =2-line/1-line) and, Display font type (F: 5x11/5x8)	39us
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address Counter.	39us
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address Counter.	39us
Read busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal Operation or not can be known By reading BF. The contents of Address counter can also be read.	0us
Write data to Address	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	43us
Read data From RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM).	43us

Note:

Be sure the ST7066U is not in the busy state (BF = 0) before sending an instruction from the MPU to the ST7066U. If an instruction is sent without checking the busy flag, the time between the first instruction and next instruction will take much longer than the instruction time itself. Refer to Instruction Table for the list of each

6.1 Instruction Description

1) Clear display

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	0	0	1

Clear all the display data by writing "20H" (space code) to all DDRAM address and set DDRAM address to "00H" into AC (address counter).

Return the cursor to the original status, namely, bring the cursor to the left edge on the first line of the display. Make the entry mode increment (I/D="High").

2) Return home

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	0	1	-

Return home is cursor return home instruction.

Set DDRAM address to "00H" into the address counter.

Return cursor to its original site and return display to its original status, if shifted. Contents of DDRAM do not change.

3) Entry mode set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	1	I/D	SH

Set the moving direction of cursor and display.

I/D: increment / decrement of DDRAM address (cursor or blink)

When I/D="high", cursor/blink moves to right and DDRAM address is increased by 1.

When I/D="Low", cursor/blink moves to left and DDRAM address is increased by 1.

*CGRAM operates the same way as DDRAM, when reading from or writing to CGRAM.

SH: shift of entire display

When DDRAM read (CGRAM read/write) operation or SH="Low", shifting of entire display is not performed. If SH="High" and DDRAM write operation, shift of entire display is performed according to I/D value. (I/D="high". shift left, I/D="Low". Shift right).

4) Display ON/OFF control

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	1	D	C	B

Control display/cursor/blink ON/OFF 1 bit register.

D: Display ON/OFF control bit

When D="High", entire display is turned on.

When D="Low", display is turned off, but display data remains in DDRAM.

C: cursor ON/OFF control bit

When D="High", cursor is turned on.

When D="Low", cursor is disappeared in current display, but I/D register preserves its data.

B: Cursor blink ON/OFF control bit

When B="High", cursor blink is on, which performs alternately between all the "High" data and display characters at the cursor position.

When B="Low", blink is off.

5) Cursor or display shift

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	1	S/C	R/L	-	-

Shifting of right/left cursor position or display without writing or reading of display data. This instruction is used to correct or search display data.

During 2-line mode display, cursor moves to the 2nd line after the 40th digit of the 1st line. Note that display shift is performed simultaneously in all the lines.

When display data is shifted repeatedly, each line is shifted individually.

When display shift is performed, the contents of the address counter are not changed.

Shift patterns according to S/C and R/L bits

S/C	R/L	Operation
0	0	Shift cursor to the left, AC is decreased by 1
0	1	Shift cursor to the right, AC is increased by 1
1	0	Shift all the display to the left, cursor moves according to the display
1	1	Shift all the display to the right, cursor moves according to the display

6) Function set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	DL	N	F	-	-

DL: Interface data length control bit

When DL="High", it means 8-bit bus mode with MPU.

When DL="Low", it means 4-bit bus mode with MPU. Hence, DL is a signal to select 8-bit or 4-bit bus mode. When 4-bit bus mode, it needs to transfer 4-bit data twice.

N: Display line number control bit

When N="Low", 1-line display mode is set.

When N="High", 2-line display mode is set.

F: Display line number control bit

When F="Low", 5x8 dots format display mode is set.

When F="High", 5x11 dots format display mode.

7) Set CGRAM address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0

Set CGRAM address to AC.

The instruction makes CGRAM data available from MPU.

8) Set DDRAM address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0

Set DDRAM address to AC.

This instruction makes DDRAM data available from MPU.

When 1-line display mode (N=LOW), DDRAM address is form "00H" to "4FH". In 2-line display mode (N=High), DDRAM address in the 1st line form "00H" to "27H", and DDRAM address in the 2nd line is from "40H" to "67H".

9) Read busy flag & address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0

This instruction shows whether KS0066U is in internal operation or not.

If the resultant BF is “High”, internal operation is in progress and should wait BF is to be LOW, which by then the next instruction can be performed. In these instructions, you can also read the value of the address counter.

10) Write data to RAM

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	0	D7	D6	D5	D4	D3	D2	D1	D0

Write binary 8-bit data to DDRAM/CGRAM.

The selection of RAM from DDRAM, and CGRAM, is set by the previous address set instruction (DDRAM address set, CGRAM address set).

RAM set instruction can also determine the AC direction to RAM.

After write operation. The address is automatically increased/decreased by 1, according to the entry mode.

11) Read data from RAM

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	1	D7	D6	D5	D4	D3	D2	D1	D0

Read binary 8-bit data from DDRAM/CGRAM.

The selection of RAM is set by the previous address set instruction. If the address set instruction of RAM is not performed before this instruction, the data that has been read first is invalid, as the direction of AC is not yet determined. If RAM data is read several times without RAM address instructions set before, read operation, the correct RAM data can be obtained from the second. But the first data would be incorrect, as there is no time margin to transfer RAM data.

In case of DDRAM read operation, cursor shift instruction plays the same role as DDRAM address set instruction, it also transfers RAM data to output data register.

After read operation, address counter is automatically increased/decreased by 1 according to the entry mode.

After CGRAM read operation, display shift may not be executed correctly.

NOTE: In case of RAM write operation, AC is increased/decreased by 1 as in read operation.

At this time, AC indicates the next address position, but only the previous data can be read by the read instruction.

Reset Function

Initializing by Internal Reset Circuit

An internal reset circuit automatically initializes the ST7066U when the power is turned on. The following instructions are executed during the initialization. The busy flag (BF) is kept in the busy state until the initialization ends (BF = 1). The busy state lasts for 40 ms after VCC rises to 4.5 V.

1. Display clear
2. Function set:
 - DL = 1; 8-bit interface data
 - N = 0; 1-line display
 - F = 0; 5x8 dot character font
3. Display on/off control:
 - D = 0; Display off
 - C = 0; Cursor off
 - B = 0; Blinking off
4. Entry mode set:
 - I/D = 1; Increment by 1
 - S = 0; No shift

Note:

If the electrical characteristics conditions listed in the table Power Supply Conditions (Page 31) are not met, the internal reset circuit will not operate normally and will fail to initialize the ST7066U. For such a case, initialization must be performed by the MPU as explain by the following figures.

7. Cautions and Handling

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, ethyl alcohol or trichlorotrifluoroethane. 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 make any modification on the PCB without consulting.
5. When mounting the 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 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: $280^{\circ}\text{C} \pm 10^{\circ}\text{C}$
4. Soldering time: 3 to 4 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 V_o .
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. For long-term storage under 40°C is required and the relative humidity should be kept below 60%.