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1. Scope

This specification defines general provisions as well as inspection standards for LCD module supplied by Dalian Dongfu Color Display Co., Ltd.

If the event of unforeseen problem or unspecified items may occur, please contact the nearest supplier or our company.

2. Warranty

Module products manufactured to this specification shall be capable of meeting all characteristics for a minimum period of 12 months from the date of shipping from Dalian Dongfu Color Display Co., Ltd. when stored or used as specified under normal conditions within the contents of these sheets.

3. Features

3-1 . Features

Display Mode:	{ Transflective or Reflective, Positive type STN LCD
Display Color:	
Display Format:	128(w) × 64(h) dots matrix
Input Data:	8-bit parallel data interfaced from a MPU
Multiplexing Ratio:	1/64 Duty
Viewing Angle :	6 o'clock
Back Light :	EL, Yellow green
Display RAM Capacity:	65 × 132 bits
Internal temperature compensation	
Controller:	KS0713 (TCP)

3-2. Mechanical Specifications

Item	Specifications	Unit
Dimensional Outline	100.0(W) × 58.5(H) × 15.0 Max.(T)	mm
Number of Dots	128(W) × 64(H) Dots	—
Viewing Area	54.0(W) × 31.0(H)	mm
Active Area	47.33(W) × 26.21(H)	mm
Dot Pitch	0.37(W) × 0.41(H)	mm
Dot Size	0.34(W) × 0.38(H)	mm
Weight	Approx. 80	g

3-3. Absolute Maximum Ratings

Item		Symbol	Min.	Max.	Unit	Note
Supply Voltage	Logic	Vdd	0	5.5	V	
	LCD drive	—	—	—	V	Internal
Input Voltage		Vi	0	Vdd	V	
Operating Temperature		Top	-20	70		
Storage Temperature		Tstg	-40	80		
Humidity		—	—	90	%RH	

3-4. Electrical Characteristics

3-4-1. Electrical Characteristics

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Note: <1> Duty =1/64 <2> All dots on static state

Item		Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply Voltage	Logic	Vdd		2.4	3.3	5.5	V
	LCD drive	V0		—	9.6	—	
Input Voltage	"H" Level	Vih		0.8Vdd	—	Vdd	
	"L" Level	Vil		0	—	0.2Vdd	
Frame Frequency		Fflm	Vdd=3V	—	75	—	Hz
Current Consumption	Logic	Idd	Vdd=3V	—	8.5	—	mA
	LCD drive			—	—	—	
LCD Driving Voltage (Recommended Voltage)		V0	Ta= -20 =0 ° , =0 °	—	—	—	V
			Ta= 25 =0 ° , =0 °	—	9.6	—	
			Ta= 60 =0 ° , =0 °	—	—	—	

3-4-2. Specification for E/L Back Light

Note<1>: Half value of initial brightness at 20 60%RH

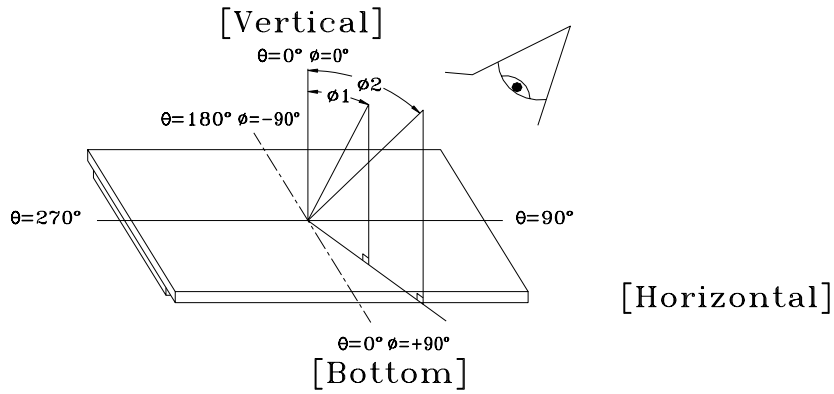
Item	Unit	Standard Values			Conditions
		Min.	Typ.	Max.	
Supply Voltage	V	—	100	125	—
Supply Frequency	Hz	—	400	400	—
Initial Brightness	cd/m ² (nit)	45	55	—	AC100 Vrms, 400Hz, Dark room
Current	mA/cm ²	—	0.08	0.12	AC100 Vrms, 400Hz, Dark room
Life time	Hrs	10000			Note <1>
Luminous Color	—	White			AC100 Vrms, 400Hz, Dark room
Operating Temp.		-20 ~ 70			—
Storage Temp.		-40 ~ 80			—

3-5. Electro-optical Characteristics

Item		Symbol	Temp.	Conditions	Min.	Typ.	Max.	Unit	Note
LCD Driving Voltage (Recommended voltage)		Vop	-10	=0 ° , =0 °	—	—	—	V	1,2,5
			25		—	9.6	—		
			50		—	—	—		
Response Time	Rise Time	tr	-10	=0 ° , =0 °	—	1500	2000	mS	1,3,5
			25		—	150	200		
	Decay Time	td	-10		—	3000	3500		
			25		—	200	250		
Viewing Angle			25	Vertical	-35	—	35	deg.	1,4,5
				Horizontal	-30	—	30		
Contrast Ratio		K	25	=0 ° , =0 °	2.0	5.0	—	—	1,5,6

Note: <1> Definition of and

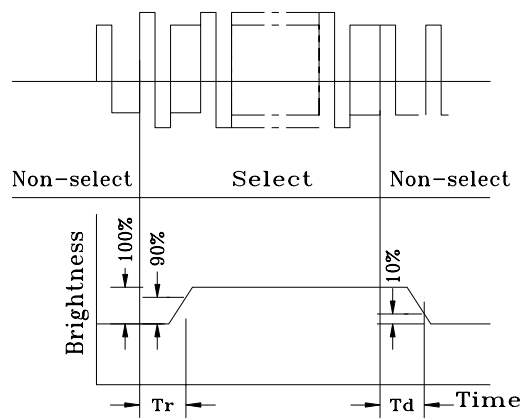
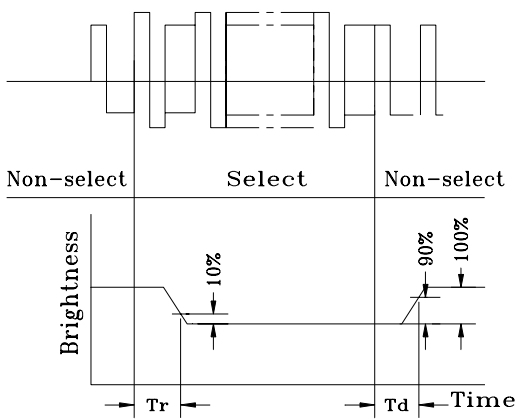
<2> Contrast ratio higher than 2 (k 2) can be obtained in this voltage range.



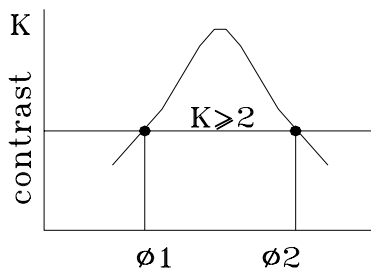
Note: <3>Definition of response time wave form

Positive Display

Negative Display

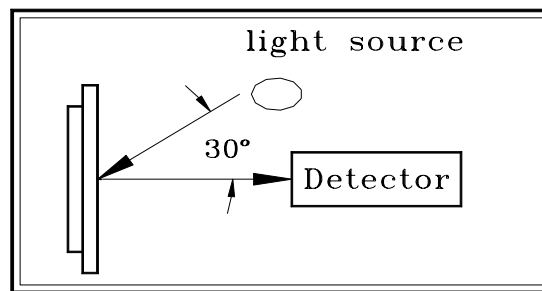


Note: <4>Definition of viewing angle
() = | 1- 2 |



Viewing angle

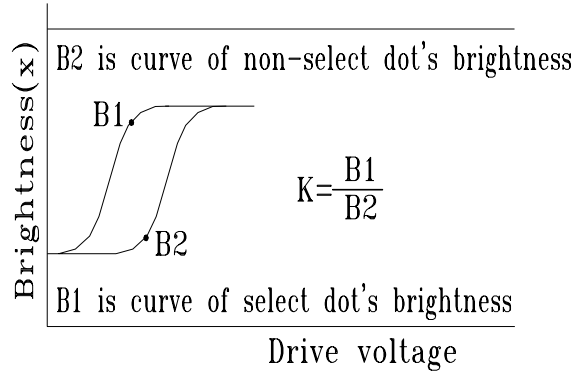
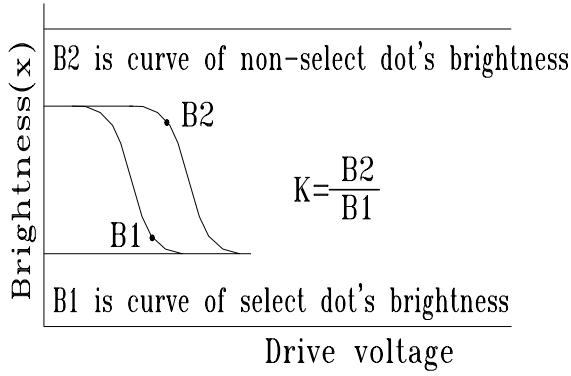
Note: <5> Optical measuring system
temperature regulated chamber



Measuring equipment: DMS
(Made in AUTRONIC)

Note: <6> Definition of Contrast Ratio (K)
Positive Display

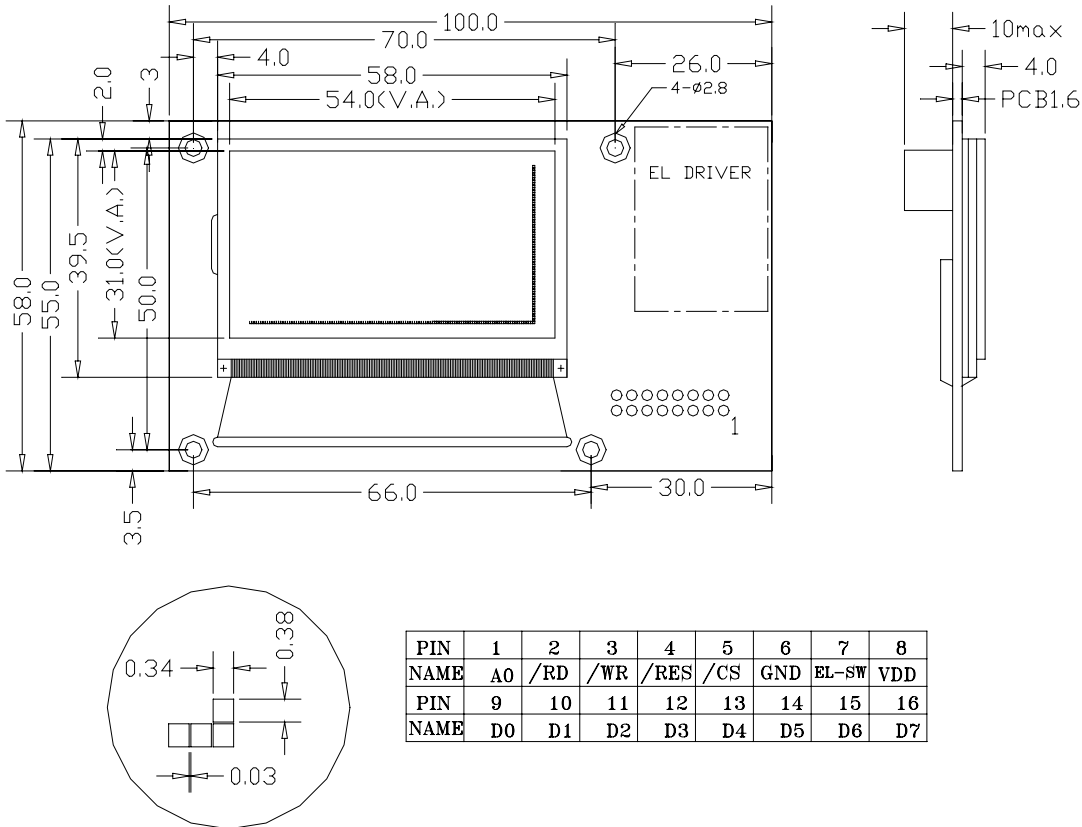
Negative Display



Contrast Ratio (K) = $\frac{\text{Brightness of non-selected dot (B2)}}{\text{Brightness of selected dot (B1)}}$
(Positive type)

Contrast Ratio (K) = $\frac{\text{Brightness of non-selected dot (B1)}}{\text{Brightness of selected dot (B2)}}$
(Negative type)

4. Dimensional Outline



PIN	1	2	3	4	5	6	7	8
NAME	A0	/RD	/WR	/RES	/CS	GND	EL-SW	VDD
PIN	9	10	11	12	13	14	15	16
NAME	D0	D1	D2	D3	D4	D5	D6	D7

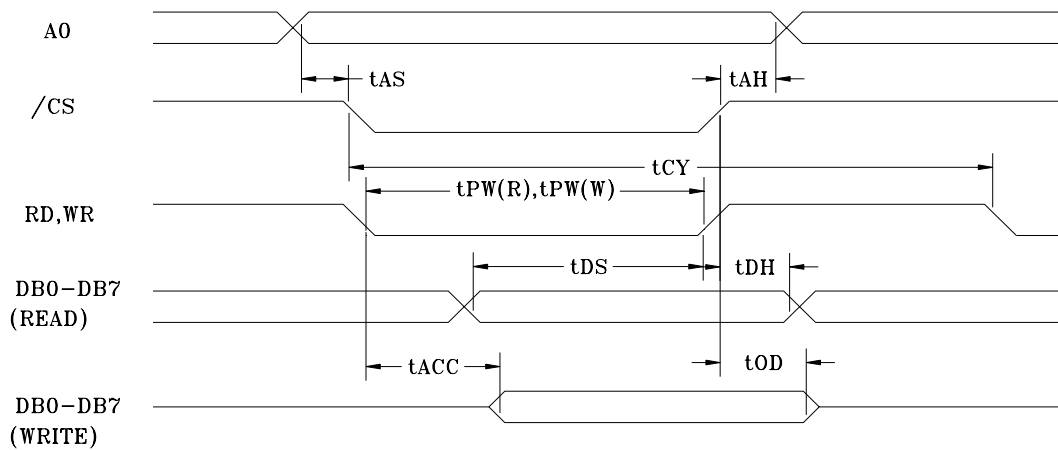
5. I/O Terminal

5-1. I/O Terminal

- A0: Selects data or instructions.
When A0="H", data on D0 to D7 are display data.
When A0="L", data on D0 to D7 are control instructions.
- /RD: When /RD is in "L" level, read connected to MPU
- /WR: When /WR is in "L" level, write connected to MPU
- /RES: Reset. Initialize system when low
- /CS: Chip Select. valid in "L" level
- GND: Ground
- EL_SW: EL Backlight enable. valid in "H" level
- VDD: power supply (anode)

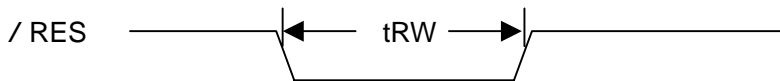
- D0 to D7: Data buses

5-2 . Timing and timing diagram



AC Characteristics

Item	MIN	TYP	MAX	UNIT
TAS	13	-	-	ns
TAH	17	-	-	ns
TCY	400	-	-	ns
TPW(W)	55	-	-	ns
TPW(R)	125	-	-	ns
TDS	35	-	-	ns
TDH	13	-	-	ns
TACC	-	-	125	ns
TOD	10	-	90	ns



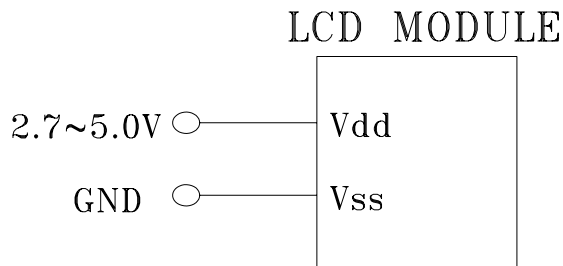
Item	MIN	TYP	MAX	UNIT
TRW	900	-	-	ns

DC Characteristics

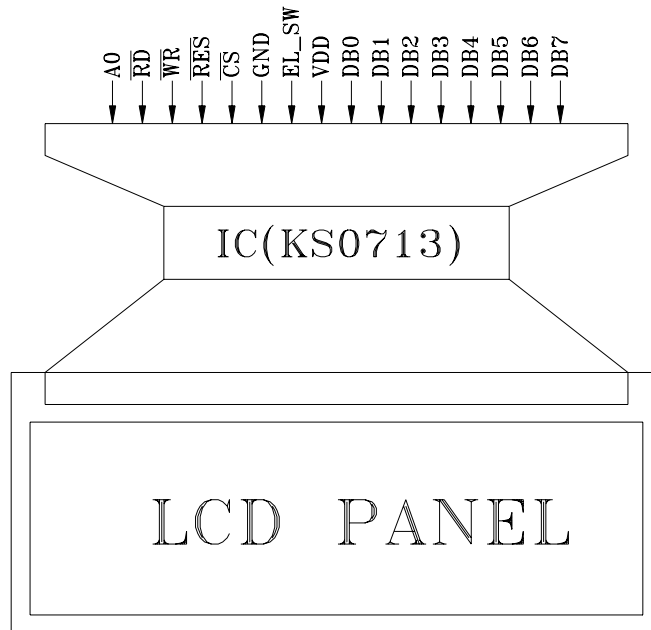
VSS=0V, VDD=2.4-5.5V

ITEM	SYM	MIN	TYP	MAX	UNIT
Input Voltage High	VIH	0.8VDD	-	VDD	V
Input Voltage Low	VIL	VSS	-	0.2VDD	V
Output Voltage High	VOH	0.8VDD	-	VDD	V
Output Voltage Low	VOL	VSS	-	0.2VDD	V

5-3. Power Supply Circuit



5-4. Circuit diagram



Block diagram

Note: When the signal lines are directly connected to C-MOS circuit which has no pull-up or pull-down resistor, it is necessary to isolate external disturbance to protect those signal lines.

5-5 . Notes for hardware and software

1 . LCD Bias Set

LCD Bias should be set 1/9. Specify by LCD BIAS SET instruction.

D7	D6	D5	D4	D3	D2	D1	D0
1	0	1	0	0	0	1	0
							1

When D0=0, 1/7 Bias; D0=1, 1/9 Bias.

2 . ADC Select

Normally, ADC bit is set 1. DDRAM corresponds to displayed columns reversedly.

3 . Select scanning direction of COM

Set by instruction "COMMON OUTPUT MODE SELECT".

D7	D6	D5	D4	D3	D2	D1	D0
1	1	0	0	0	*	*	*
				1			

D3=1, Reverse Direction, D3=0, Normal Direction (Normal Direction always).

4 . Page address X array

Corresponding to display screen from the top down, page addresses are as follows:

X=0 , 1 , 2 , 3 , 4 , 5 , 6 , 7

Change by PAGE ADDRESS SET instruction

5 . Column address Y array

When ADC=1, column addresses Y corresponding to display screen from the 1st line to the 128th line are from 04H to 83H

Change by COLUMN ADDRESS SET instruction

6 . LCD voltage set

Specify the LCD driving voltage in accordance with the following sequence:

- POWER CONTROL sets VC=1 (by internal voltage converter), VR=1 (by internal voltage regulator) and VF=1 (by internal voltage follower).
- REGULATOR RESISTOR SELECT sets R2, R1 and R0 1, 1 and 0 respectively.

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- SET REFERENCE VOLTAGE MODE
- SET REFERENCE VOLTAGE REGISTER sets 30H. Set LCD voltage about 10V (本指令取值 00H~3FH, LCD voltage variable)

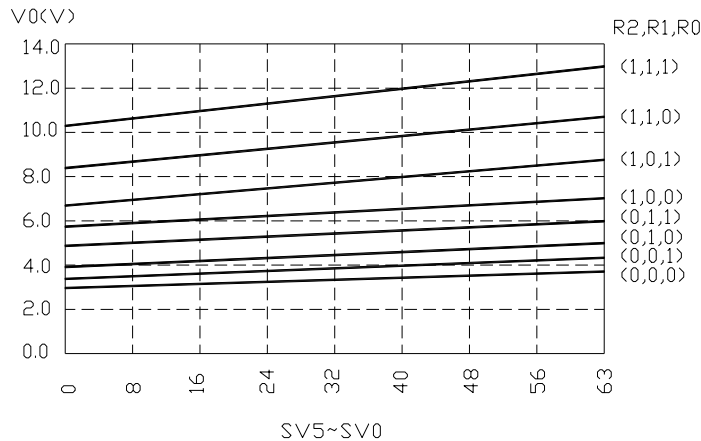
*Formula for V0 (Driving voltage):

$$V0 = (1 + Rb/Ra) \times VEV [V]$$

$$VEV = [1 - (63 -) / 300] \times 2.0 [V]$$

The parameter is the value determined by SV5-SV0 in instruction "Set Reference Voltage Register" within the range 0 to 63. The value of (1+Rb/Ra) is specified by R2-R0 in instruction "Regulator Resistor Select".

R2,R1,R0	000	001	010	011	100	101	110	111
1+(Rb/Ra)	1.90	2.19	2.55	3.02	3.61	4.35	5.29	6.48



Instruction Table

Instruction	A0	RW	D7	D6	D5	D4	D3	D2	D1	D0	Function
Read Display Data	1	1	Read data								Read data from DDRAM
Write Display Data	1	0	Write data								Write data from DDRAM
Read Status	0	1	BUSY	A D C	O N/ O F F	R E S E T B	0	0	0	0	Read the internal status
Display ON/OFF	0	0	1	0	1	0	1	1	1	DON	Turn ON/OFF LCD panel When DON=0,display is OFF When DON=1,display is ON
Initial Display line	0	0	0	1	S T 5	S T 4	S T 3	ST2	ST1	ST0	Specify DDRAM line for COM1
Set Reference Voltage Mode	0	0	1	0	0	0	0	0	0	1	Set reference voltage mode
Set Reference Voltage Register	0	0	X	X	S V 5	S V 4	S V 3	SV2	SV1	SV0	Set reference voltage register
Set Page Address	0	0	1	0	1	1	P 3	P2	P1	P0	Set page address
Set Column Address MSB	0	0	0	0	0	1	Y 7	Y6	Y5	Y4	Set column address MSB
Set Column Address LSB	0	0	0	0	0	0	Y 3	Y2	Y1	Y0	Set column address LSB
ADC Select	0	0	1	0	1	0	0	0	0	ADC	Select SEG output direction When ADC=0 normal (SEG1-SEG132) When ADC=1 reverse (SEG132-SEG1)
Reverse Display ON/OFF	0	0	1	0	1	0	0	1	1	REV	Select normal/reverse display When REV=0 normal When REV=1 reverse
Entire Display ON/OFF	0	0	1	0	1	0	0	1	0	EON	Select normal display/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	B	Select LCD bias

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										I AS	
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 internal functions
SHL Select	0	0	1	1	0	0	S H L	X	X	X	Select Com output direction When SHL=0 normal (COM1-COM64) When SHL=1 reverse (COM64-COM1)
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 resistance ratio of the regulator resistor
Set Static Indicator Mode	0	0	1	0	1	0	1	1	0	SM	Set static indicator mode
Set Static Indicator Register			X	X	X	X	X	X	S1	S0	Set static register
Power Save	-	-	-	-	-	-	-	-	-	-	Compound instruction of display OFF and entire display ON
Test Instruction	0	0	1	1	1	1	X	X	X	X	Don't use this instruction

- **Read Display Data**
8-bit data from display data RAM specified by the column address and page address can be read by this instruction. The column address is incremented by 1 automatically after each this instruction. A dummy read is required after loading an address into the column address register.
- **Write Display Data**
8-bit data of display data can be written to the RAM location specified by the column address and page address. The column address is incremented by 1 automatically.
- **Read Status**
Indicates the internal status conditions.

Flag	Description
BUSY	The device is busy when internal operation or reset. Any instruction is rejected until BUSY goes low. 0: Chip is active, 1: Chip is being busy.
ADC	Indicates the relationship between RAM column address and segment driver. 0: Reverse direction, 1: Normal direction
ON/OFF	Indicates display ON/OFF status. 0: Display ON, 1: Display OFF
RESETB	Indicates the initialization is in progress by RESETB signal. 0: Chip is active, 1: Chip is being reset.

- **Display ON/OFF**
DON=1: Display ON
DON=0: Display OFF
- **Initial Display Line**
Set the line address of display RAM to determine the initial display line. The values of bits ST5 to ST0 are within the range 0 to 63.
- **Reference Voltage Select**
Consists of two bytes instruction. The first byte sets reference voltage mode, the second one update the contents of reference voltage register. The values of bits ST5 to ST0 are within the range 0 to 63. After second instruction reference voltage mode is released.
- **Set Page Address**
Sets the page address of display data RAM. Along with the column address, the page address defines the address of the display RAM to write or read. The values of bits P3 to P0 are within the range 0 to 8.
- **Set Column Address**

Sets the column address of display RAM. Along with the page address, the column address defines the address of the display RAM to write or read display data. It is made up with the high and the low bytes. (The high byte: MSB, the low byte: LSB) The values of bits Y7 to Y0 are within the range 0 to 131.

- **ADC Select**
Changes the relationship between RAM column address and segment driver.
0: Normal Direction, 1: Reverse direction.
- **Reverse Display**
When REV=1, reverses the display status on LCD panel without rewriting the contents of the display data RAM. That is to say, when RAM bit data="1", LCD pixel is not illuminated. When RAM bit data="0", LCD pixel is illuminated.
- **Entire Display ON/OFF**
When EON=1, forces the whole LCD points to be turned on regardless of the contents of the display data RAM. This instruction has priority over the Reverse Display ON/OFF instruction.
- **LCD Bias Select**
Selects LCD bias ratio of the voltage required for driving the LCD.
BIAS=0 , 1/7 duty; BIAS=1, 1/9 duty.
- **Set Modify-read**
This instruction stops the automatic increment of the column address by Read Display Data instruction.
- **Reset Modify-read**
Cancels the Modify Read Mode.
- **Reset**
This instruction resets initial display line, column address, page address, and common output status select to their initial status, but does not affect the contents of display data RAM.
- **SHL Select**
COM output scanning direction is selected by this instruction which determines the LCD driver output status.
SHL=0: Normal Direction (COM1-COM64)
SHL=1: Reverse Direction (COM64-COM1)
- **Power Control**
Selects LCD power circuit.
VC: indicates whether voltage converter turns on or not.
VR: indicates whether voltage regulator turns on or not.
VF: indicates whether voltage follower turns on or not.
- **Regulator Resistor Select**
Selects resistance ratio of the resistor used in Voltage Regulator. The values of R2 to R0 are within the range 0 to 7.
- **Set Static Indicator state**
Consists of two bytes instruction. The first byte instruction (Set Static Indicator Mode) enables the second byte instruction (Set Static Indicator Register) to be valid. The second byte updates the contents of static indicator register without issuing any other instruction and this static indicator state is released after setting the data of indicator register.
 - Set Static Indicator Mode

SM=0, Static Indicator OFF

SM=1, Static indicator ON

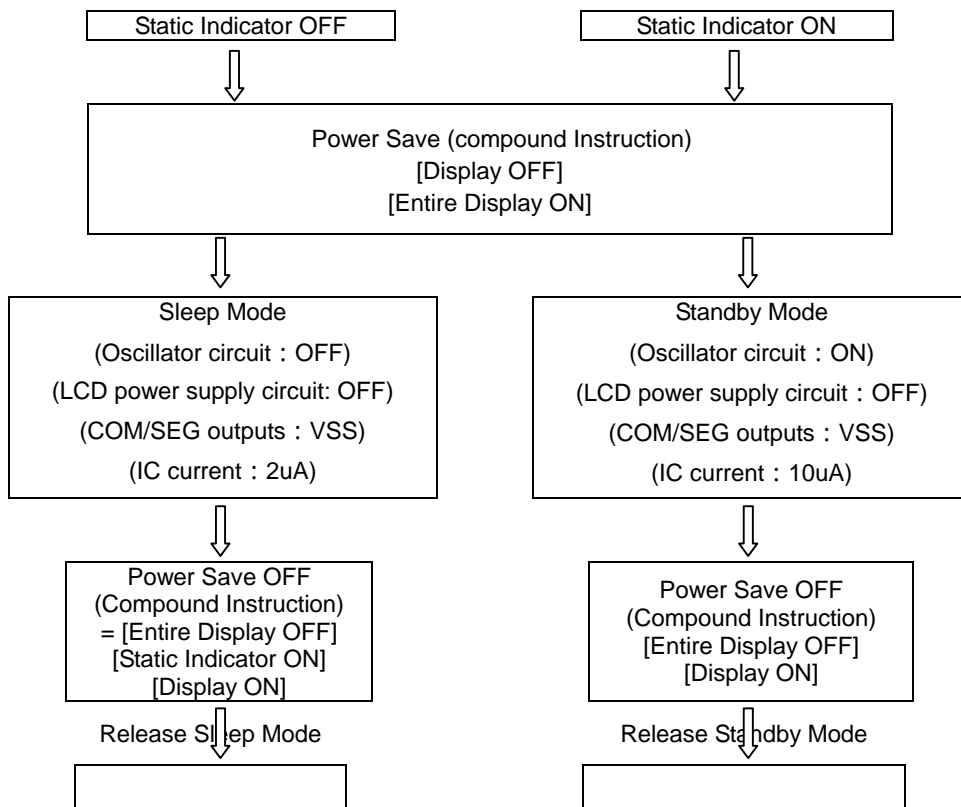
- Set Static Indicator Register
- Set Static Indicator Register

S1	S0	Status of Static Indicator Output
0	0	OFF
0	1	ON (About 1 Second Blinking)
1	0	ON (About 0.5 Second Blinking)
1	1	ON

*EDM1288 has no Static Indicator.

● Power Save (compound instruction)

If the Entire Display ON/OFF is issued during the display OFF state, driving IC enters the save status to reduce the power consumption.



The following figure is the correspondence of display and DDRAM.

Page Address				DATA	Column Address												Line Address			
0	0	0	0	D0	0	0	1	0	0									00		
				D1	0	1	0	1	0										01	
				D2	1	0	0	0	1											02
				D3	1	0	0	0	1									PAGE 0		03
				D4	1	1	1	1	1											04
				D5	1	0	0	0	1											05
				D6	1	0	0	0	1											06
				D7	0	0	0	0	0											07
0	0	0	1	D0														08		
				D1															09	
				D2																0A
				D3														PAGE 1		0B
				D4																0C
				D5																0D
				D6																0E
				D7																0F
0	0	1	0	D0												PAGE2	10			
				↓													↓			
				D7																
0	0	1	1	D0													PAGE3	18		
				↓																
				D7														1F		
0	1	0	0	D0													PAGE4	20		
				↓																
				D7														27		
0	1	0	1	D0													PAGE5	28		
				↓																
				D7														2F		
0	1	1	0	D0													PAGE6	30		
				↓																
				D7														37		
0	1	1	1	D0													PAGE7	38		
				↓																
				D7														3F		
1	0	0	0	D0													PAGE8			
Column Address				HEX	00	01	02	03	04	05	06	07	08	09	0A	0B	→	83	ADC=1	
Column Address				HEX	83	82	81	80	7F	7E	7D	7C	7B	7A	79	78	→	00	ADC=0	

RESET STATE

- Set /RES in "low" , the initialization is as follows :
 - Display ON/OFF: OFF
 - Entire Display ON/OFF: OFF (Normal)
 - ADC select: OFF (normal)
 - Reverse Display ON/OFF: OFF (Normal)
 - Power Control register (VC,VR,VF)=(0,0,0)

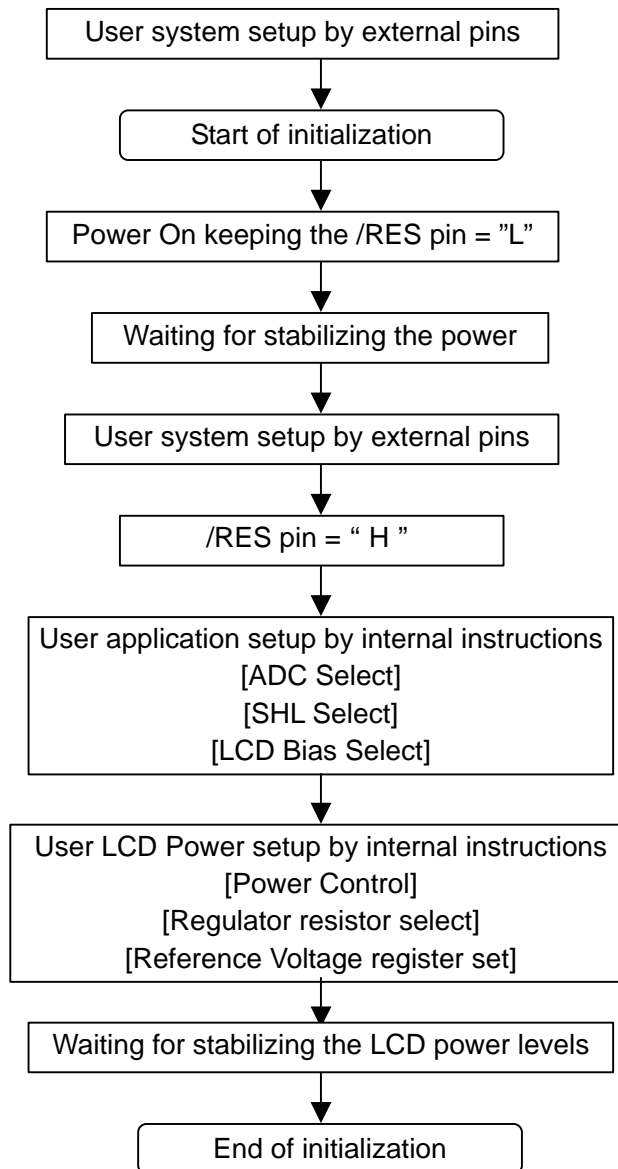
 - LCD bias ratio: 1/7
 - Read-modify-write: OFF
 - SHL select: 0
 - Static indicator mode: OFF
 - Static indicator register: (S1,S0)=(0,0)
 - Display start line: 0(First)
 - Column address: 0
 - Page address: 0
 - Regulator resistor select register: (R2,R1,R0)=(0,0,0)

 - Reference voltage set: OFF

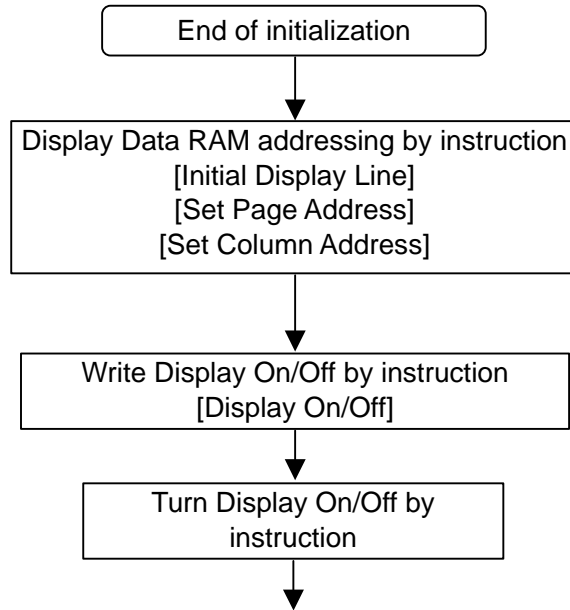
- Reference voltage control register:
(SV5,SV4,SV3,SV2,SV1,SV0)=(1,0,0,0,0,0)
- Use RESET instruction , and the initialization is as follows :
 - Read-modify-write: OFF
 - Static indicator mode: OFF
 - Static indicator register: (S1,S0)=(0,0)
 - SHL select: 0
 - Display start line: 0(First)
 - Column address: 0
 - Page address: 0
 - Regulator resistor select register: (R2,R1,R0)=(0,0,0)
 - Reference voltage set: OFF
 - Reference voltage control register:
(SV5,SV4,SV3,SV2,SV1,SV0)=(1,0,0,0,0,0)

Referential flow-charts

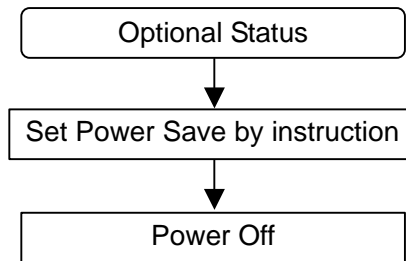
Referential Instruction Setup flow



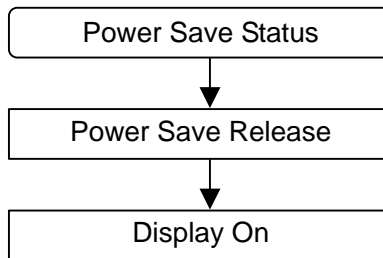
Referential Instruction Setup flow: Data displaying



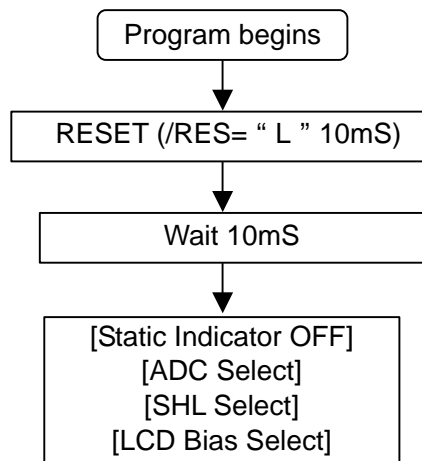
Referential Instruction Setup flow: Power off

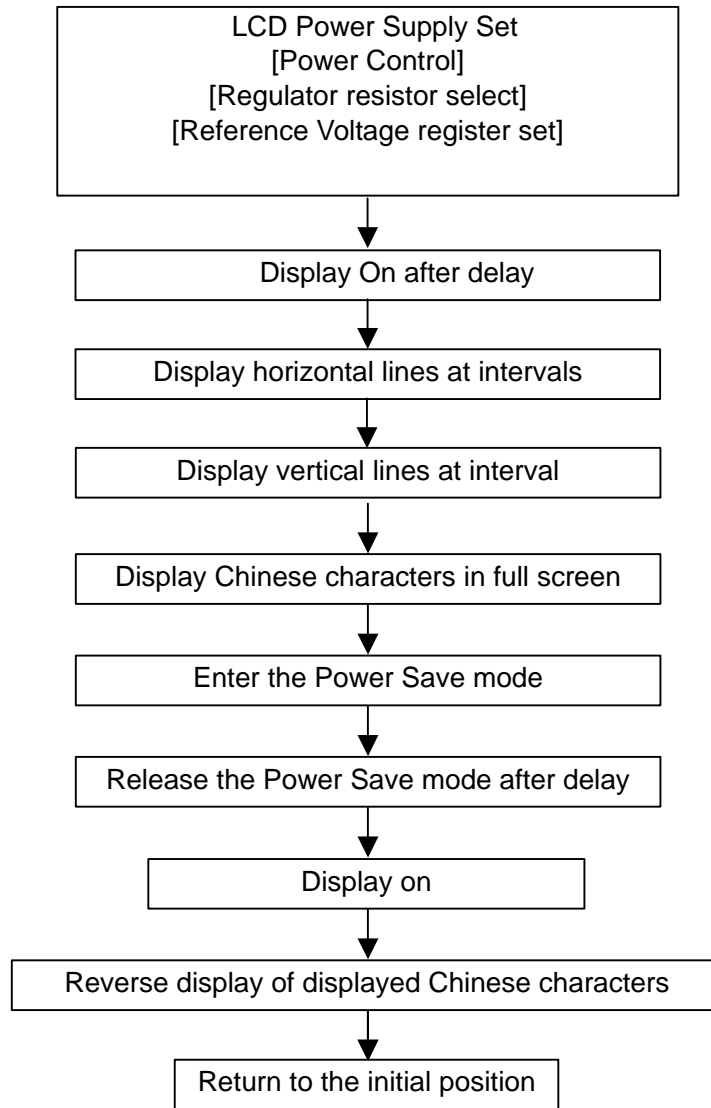


Referential recovery flow: power off



Program Example





The following is the example of programming 8031 to display common lines, segment lines and Chinese characters.

```

; Crystal:12MHz
; /CS connected with GND
; /RES connected with P1.5
; A0 connected with P1.3
; /RD, /WR connected with 8031/RD , /WR
  
```

```

RRST      BIT  P1.5 ; /RES
D_I       BIT  P1.3 ; A0

          ORG 0000H
START:NOP
CLR RRST
LCALL DELAY1
NOP
SETB RRST
LCALL DELAY1

          LCALL BF
          CLR D_I
          MOV A,#0ACH ;STATIC  INDICATOR
          OFF
          MOVX @R0,A
          MOV A,#000H ;OFF
          MOVX @R0,A

          LCALL BF
          CLR D_I
  
```

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```

MOV A,#0A1H ;ADC
MOVX @R0,A
LCALL BF
CLR D_I
MOV A,#0C0H ;SHL
MOVX @R0,A
LCALL BF
CLR D_I
MOV A,#0A3H ;BIAS 1/9
MOVX @R0,A
LCALL BF
CLR D_I
MOV A,#02FH ;POWER
MOVX @R0,A
LCALL BF
CLR D_I
MOV A,#026H ;POWER-RRS
MOVX @R0,A
LCALL BF
CLR D_I
MOV A,#081H ;POWER
MOVX @R0,A
LCALL BF
CLR D_I
MOV A,#030H ;POWER-SRVR
MOVX @R0,A
LCALL DELAY1

LCALL BF
CLR D_I
MOV A,#0AFH ;DISP ON
MOVX @R0,A

MOV R7,#80H
MOV R1,#55H
LCALL BF
CLR D_I
MOV A,#0B0H ;X=0
MOVX @R0,A
LCALL Y0
LCALL WR0
LCALL BF
CLR D_I
MOV A,#0B1H ;X=1
MOVX @R0,A
LCALL Y0
LCALL WR0
LCALL BF
CLR D_I
MOV A,#0B2H ;X=2
MOVX @R0,A
LCALL Y0
LCALL WR0
LCALL BF
CLR D_I
MOV A,#0B3H ;X=3
MOVX @R0,A
LCALL Y0

LCALL WR0
LCALL BF
CLR D_I
MOV A,#0B4H ;X=4
MOVX @R0,A
LCALL Y0
LCALL WR0
LCALL BF
CLR D_I
MOV A,#0B5H ;X=5
MOVX @R0,A
LCALL Y0
LCALL WR0
LCALL BF
CLR D_I
MOV A,#0B6H ;X=6
MOVX @R0,A
LCALL Y0
LCALL WR0
LCALL BF
CLR D_I
MOV A,#0B7H ;X=7
MOVX @R0,A
LCALL Y0
LCALL WR0
LCALL DELAY3

MOV R7,#80H
MOV R1,#0FFH
LCALL BF
CLR D_I
MOV A,#0B0H ;X=0
MOVX @R0,A
LCALL Y0
LCALL WR1
LCALL BF

CLR D_I
MOV A,#0B1H ;X=1
MOVX @R0,A
LCALL Y0
LCALL WR1
LCALL BF
CLR D_I
MOV A,#0B2H ;X=2
MOVX @R0,A
LCALL Y0
LCALL WR1
LCALL BF
CLR D_I
MOV A,#0B3H ;X=3
MOVX @R0,A
LCALL Y0
LCALL WR1
LCALL BF
CLR D_I
MOV A,#0B4H ;X=4
MOVX @R0,A

```


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```
LCALL Y0
LCALL WR1
LCALL BF
CLR D_I
MOV A,#0B5H ;X=5
MOVX @R0,A
LCALL Y0
LCALL WR1
LCALL BF
CLR D_I
MOV A,#0B6H ;X=6
MOVX @R0,A
LCALL Y0
LCALL WR1
LCALL BF
CLR D_I
MOV A,#0B7H ;X=7
MOVX @R0,A
LCALL Y0
LCALL WR1
LCALL DELAY3

MOV DPTR,#0900H
MOV R3,#0B0H
MOV R4,#010H
LCALL ZK
MOV R3,#0B0H
MOV R4,#11H
LCALL ZK
MOV R3,#0B0H
MOV R4,#12H
LCALL ZK
MOV R3,#0B0H
MOV R4,#13H
LCALL ZK
MOV R3,#0B0H
MOV R4,#014H
LCALL ZK
MOV R3,#0B0H
MOV R4,#15H
LCALL ZK
MOV R3,#0B0H
MOV R4,#16H
LCALL ZK
MOV R3,#0B0H
MOV R4,#17H
LCALL ZK
MOV R3,#0B2H
MOV R4,#010H
LCALL ZK
MOV R3,#0B2H
MOV R4,#11H
LCALL ZK
MOV R3,#0B2H
MOV R4,#12H
LCALL ZK
MOV R3,#0B2H
MOV R4,#13H

LCALL ZK
MOV R3,#0B2H
MOV R4,#014H
LCALL ZK
MOV R3,#0B2H
MOV R4,#15H
LCALL ZK
MOV R3,#0B2H
MOV R4,#16H
```

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```

LCALL ZK
MOV R3,#0B6H
MOV R4,#17H
LCALL ZK
LCALL DELAY3

;POWER SAVE
LCALL BF
CLR D_I
MOV A,#0AEH ;DISPLAY OFF
MOVX @R0,A
LCALL BF
CLR D_I
MOV A,#0A5H ;ENTIRE DISPLAY ON
MOVX @R0,A

LCALL DELAY3

;POWER SAVE RELEASE
LCALL BF
CLR D_I
MOV A,#0A4H ;ENTIRE DISPLAY OFF
MOVX @R0,A
LCALL BF
CLR D_I
MOV A,#0ADH ;STATIC INDICATOR ON
MOVX @R0,A
LCALL BF
CLR D_I
MOV A,#0AFH ;DISP ON
MOVX @R0,A

LCALL BF
CLR D_I
MOV A,#0AFH ;DISP ON
MOVX @R0,A

LCALL BF
CLR D_I
MOV A,#0A7H ;REVERSE DISPLAY ON
MOVX @R0,A
LCALL DELAY3
LCALL DELAY3

LJMP START

WR0:LCALL BF
SETB D_I
LCALL BF
CLR D_I
MOV A,R4
MOVX @R0,A ;Y=R4
LCALL BF
CLR D_I
MOV A,#04
MOVX @R0,A
MOV R2,#10H
TT: LCALL BF

MOV A,R1
MOVX @R0,A
MOV R1,A
DJNZ R7,WR0
MOV R7,#80H
RET

WR1:LCALL BF
SETB D_I
MOV A,R1
MOVX @R0,A
CPL A
MOV R1,A
DJNZ R7,WR1
MOV R7,#80H
RET

Y0: LCALL BF
CLR D_I
MOV A,#10H
MOVX @R0,A ;Y=0
LCALL BF
CLR D_I
MOV A,#04H
MOVX @R0,A ;Y=0
RET

BF: NOP
CLR D_I
MOVX A,@R0
JB ACC.7,BF
JB ACC.4,BF
RET

DELAY1: NOP
MOV R4,#00AH
MOV R3,#0FFH

LOOP2: DJNZ R3,LOOP2
DJNZ R4,LOOP2
RET

DELAY3: MOV R5,#08H
MOV R4,#0FFH
MOV R3,#0FFH

LOOP1:DJNZ R3,LOOP1
DJNZ R4,LOOP1
DJNZ R5,LOOP1
RET

ZK: LCALL BF
CLR D_I
MOV A,R3 ;X=R3
MOVX @R0,A

MOV A,#00H
MOVC A,@A+DPTR
SETB D_I
MOVX @R0,A
INC DPTR
DJNZ R2,TT
LCALL BF
CLR D_I
INC R3
MOV A,R3 ;X=1

```

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```

MOVX @R0,A
LCALL BF
CLR D_I
MOV A,R4
MOVX @R0,A
LCALL BF
CLR D_I
MOV A,#04H
MOVX @R0,A

```

```

MOV R2,#010H
TT1:LCALL BF
MOV A,#00H
MOVC A,@A+DPTR
SETB D_I
MOVX @R0,A
INC DPTR
DJNZ R2,TT1
RET

```

```

ORG 0900H
DB 000H,040H,060H,0F0H,0F0H,000H,000H,000H ;1
DB 000H,040H,060H,0F0H,0F0H,000H,000H,000H ;1
DB 000H,010H,010H,01FH,01FH,010H,010H,000H
DB 000H,010H,010H,01FH,01FH,010H,010H,000H

DB 040H,042H,0CCH,000H,004H,044H,064H,05CH
DB 047H,0F4H,044H,044H,046H,004H,000H,000H
DB 040H,020H,01FH,020H,044H,044H,044H,044H
DB 044H,07FH,044H,044H,046H,044H,040H,000H

DB 008H,008H,008H,088H,068H,018H,00FH,0E8H
DB 008H,008H,008H,088H,008H,00CH,008H,000H
DB 000H,040H,021H,011H,00DH,041H,081H,07FH
DB 001H,005H,009H,031H,061H,000H,000H,000H

DB 010H,010H,010H,010H,010H,0F1H,092H,096H
DB 090H,090H,090H,0D0H,090H,018H,010H,000H
DB 000H,080H,040H,020H,018H,007H,000H,000H
DB 040H,080H,040H,03FH,000H,000H,000H,000H

DB 000H,000H,000H,0FEH,092H,092H,092H,092H
DB 092H,092H,092H,0FFH,002H,000H,000H,000H
DB 040H,042H,044H,04DH,040H,07FH,040H,040H
DB 040H,07FH,040H,049H,044H,066H,040H,000H

DB 040H,040H,042H,042H,042H,042H,042H,0C2H
DB 042H,042H,042H,043H,042H,060H,040H,000H
DB 010H,008H,004H,006H,000H,040H,080H,07FH
DB 000H,000H,002H,004H,008H,018H,000H,000H

DB 080H,080H,09FH,091H,091H,091H,09FH,0E0H
DB 09FH,091H,0B1H,0D1H,09FH,080H,080H,000H
DB 008H,008H,0FCH,08CH,08AH,08AH,0F9H,000H
DB 0F9H,08AH,08AH,08CH,0FCH,008H,008H,000H

DB 010H,010H,010H,0D0H,0FFH,090H,010H,000H

DB 080H,082H,082H,0FEH,082H,082H,082H,0FEH
DB 082H,0A2H,010H,008H,086H,060H,000H,000H
DB 000H,040H,030H,00FH,000H,000H,000H,0FFH
DB 000H,084H,042H,021H,010H,008H,006H,000H

DB 020H,030H,010H,010H,010H,0F0H,0E0H,000H ;3
DB 020H,030H,010H,010H,010H,0F0H,0E0H,000H ;3
DB 008H,018H,011H,011H,011H,01FH,00EH,000H
DB 008H,018H,011H,011H,011H,01FH,00EH,000H

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```

DB 010H,090H,010H,0FFH,010H,010H,010H,000H
DB 008H,004H,003H,000H,0FFH,000H,011H,008H
DB 006H,041H,080H,07FH,000H,000H,000H,000H

DB 020H,030H,010H,010H,090H,0F0H,060H,000H ;2
DB 020H,030H,010H,010H,090H,0F0H,060H,000H ;2
DB 018H,01CH,016H,013H,011H,018H,018H,000H
DB 018H,01CH,016H,013H,011H,018H,018H,000H

DB 000H,0FEH,002H,022H,0DAH,006H,000H,0FEH
DB 092H,092H,092H,092H,0FFH,002H,000H,000H
DB 000H,0FFH,008H,010H,008H,007H,000H,0FFH
DB 042H,024H,008H,014H,022H,061H,020H,000H

DB 000H,000H,080H,040H,030H,00CH,000H,0C0H
DB 007H,01AH,020H,040H,080H,080H,080H,000H
DB 001H,001H,020H,070H,028H,024H,023H,020H
DB 020H,028H,030H,060H,000H,001H,000H,000H

DB 010H,010H,092H,092H,092H,092H,092H,092H
DB 0D2H,09AH,012H,002H,0FFH,002H,000H,000H
DB 000H,000H,03FH,010H,010H,010H,010H,010H
DB 03FH,000H,040H,080H,07FH,000H,000H,000H

DB 010H,022H,064H,00CH,080H,004H,074H,084H
DB 004H,004H,004H,0C4H,03EH,004H,000H,000H
DB 000H,008H,0F8H,006H,081H,040H,020H,011H
DB 00AH,004H,00BH,010H,060H,0C0H,040H,000H

DB 000H,010H,00CH,024H,024H,024H,025H,026H
DB 0A4H,074H,024H,004H,014H,00CH,000H,000H
DB 002H,002H,002H,002H,002H,042H,082H,07FH
DB 002H,002H,002H,002H,002H,003H,002H,000H

DB 000H,0FEH,002H,022H,012H,01EH,0AAH,04AH
DB 0AAH,01AH,00AH,002H,002H,0FFH,002H,000H
DB 000H,0FFH,042H,042H,041H,049H,048H,052H
DB 054H,041H,041H,042H,042H,0FFH,000H,000H
DB 004H,004H,004H,0F4H,094H,094H,095H,096H
DB 094H,094H,094H,0F4H,004H,006H,004H,000H
DB 000H,0FEH,002H,002H,07AH,04AH,04AH,04AH
DB 04AH,04AH,07AH,002H,082H,0FEH,000H,000H

DB 024H,024H,024H,0A4H,0FEH,0A3H,022H,000H
DB 024H,048H,000H,0FFH,000H,000H,000H,000H
DB 010H,008H,006H,001H,0FFH,000H,001H,002H
DB 002H,002H,002H,0FFH,001H,001H,001H,000H

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DB 010H,010H,010H,0FFH,010H,010H,088H,088H
DB 088H,0FFH,088H,088H,08CH,008H,000H,000H
DB 004H,044H,082H,07FH,001H,080H,081H,046H
DB 028H,010H,028H,026H,041H,0C0H,040H,000H

DB 000H,0F8H,00CH,00BH,008H,008H,0F8H,040H
DB 030H,08FH,008H,008H,008H,0FCH,008H,000H
DB 000H,07FH,021H,021H,021H,021H,07FH,000H
DB 000H,000H,043H,080H,040H,03FH,000H,000H

DB 000H,030H,028H,0A4H,063H,010H,008H,048H
DB 048H,048H,07FH,048H,048H,04CH,008H,000H
DB 000H,022H,063H,022H,012H,012H,000H,0FEH
DB 042H,042H,042H,042H,042H,0FEH,000H,000H

DB 000H,000H,000H,000H,07FH,049H,049H,049H
DB 049H,049H,07FH,000H,000H,080H,000H,000H
DB 000H,0FFH,049H,049H,049H,049H,0FFH,000H
DB 0FFH,049H,049H,049H,049H,0FFH,001H,000H

DB 000H,040H,0C0H,080H,080H,0C0H,040H,000H
DB 000H,000H,000H,000H,000H,000H,000H,000H
DB 001H,005H,007H,003H,003H,007H,005H,001H
DB 000H,000H,000H,000H,000H,000H,000H,000H

DB 000H,080H,0C0H,060H,0F0H,0F0H,000H,000H ;4
DB 000H,080H,0C0H,060H,0F0H,0F0H,000H,000H ;4
DB 003H,003H,002H,012H,01FH,01FH,012H,000H
DB 003H,003H,002H,012H,01FH,01FH,012H,000H

DB 040H,044H,054H,065H,0C6H,064H,054H,044H
DB 000H,0FCH,044H,044H,0C2H,042H,040H,000H

END

DB 020H,011H,049H,081H,07FH,001H,005H,049H
DB 030H,00FH,000H,000H,0FFH,000H,000H,000H

DB 000H,0FCH,084H,084H,084H,0FEH,014H,010H
DB 090H,010H,010H,010H,0FFH,010H,010H,000H
DB 000H,03FH,010H,010H,010H,03FH,000H,000H
DB 000H,023H,040H,080H,07FH,000H,000H,000H

DB 080H,040H,020H,0F8H,047H,040H,040H,040H
DB 07FH,0A0H,022H,02CH,020H,030H,020H,000H
DB 000H,000H,000H,0FFH,000H,000H,000H,000H
DB 000H,003H,00CH,030H,040H,080H,0F0H,000H

DB 000H,0F8H,00CH,00BH,008H,008H,0F8H,040H
DB 030H,08FH,008H,008H,008H,0FCH,008H,000H
DB 000H,07FH,021H,021H,021H,021H,07FH,000H
DB 000H,000H,043H,080H,040H,03FH,000H,000H

DB 000H,008H,0C8H,088H,098H,0E8H,089H,08EH
DB 088H,0C8H,0A8H,098H,08CH,088H,000H,000H
DB 080H,060H,01FH,000H,000H,000H,000H,000H
DB 000H,000H,000H,000H,000H,000H,000H,000H

DB 000H,010H,060H,080H,000H,0FFH,000H,000H
DB 000H,0FFH,000H,000H,0C0H,030H,000H,000H
DB 040H,040H,040H,047H,040H,07FH,040H,040H
DB 040H,07FH,044H,043H,040H,060H,040H,000H

DB 000H,040H,0C0H,080H,080H,0C0H,040H,000H
DB 000H,000H,000H,000H,000H,000H,000H,000H
DB 001H,005H,007H,003H,003H,007H,005H,001H
DB 000H,000H,000H,000H,000H,000H,000H,000H

6. Quality Level

6-1 Inspection conditions

6-1-1 The environmental conditions for inspection shall be as follows:

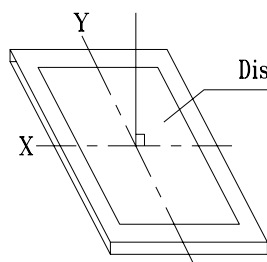
Room temperature: 20 ± 3

Humidity: $65 \pm 20\%$ RH

6-1-2 The external visual inspection:

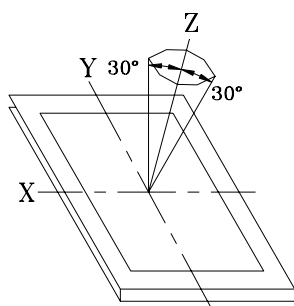
The inspection shall be performed by using a 20W fluorescent lamp for illumination and the distance between LCD and the eyes of the inspector should be at least 30cm.

6-1-3 (1) Light method



Fluorescent lamp set the perpendicular to the display surface

(2) Inspection distance and angle



Inspection should be performed within ϕ ($\phi=30^\circ$) from Z axis to each X and Y axis.

Inspection distance of any direction within ϕ must be kept 30 ± 50 cm to the display surface.

6-2 Sampling procedures for each item's acceptance level table

Defect type	Sampling procedure	AQL
Major defect	MIL-STD-105D Inspection Level I Normal inspection Single sample inspection	Q/ED-01-98(II)
Minor defect	MIL-STD-105D Inspection Level I Normal inspection Single sample inspection	Q/ED-01-98(II)

6-3 Classification of defects

6-3-1 Major defect

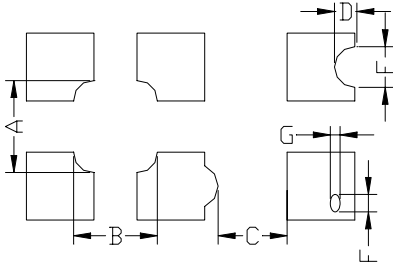
A major defect refers to a defect that may substantially degrade usability for product applications.

6-3-2 Minor defect

A minor defect refers to a defect that deviates from existing standards almost unrelated to the effective use of the product or its operation.

6-4 Inspection standards

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Item	Criterion for defects	Defect type																					
1) Display on inspection	(1) Non display (2) Vertical line is deficient (3) Horizontal line is deficient (4) Cross line is deficient	Major																					
2) Black / White spot	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Size (mm)</th> <th>Acceptable number</th> </tr> </thead> <tbody> <tr> <td>0.3</td> <td>Ignore (note)</td> </tr> <tr> <td>0.3< 0.45</td> <td>3</td> </tr> <tr> <td>0.45< 0.6</td> <td>1</td> </tr> <tr> <td>0.6< 0.3</td> <td>0</td> </tr> </tbody> </table> <p style="text-align: center;">(Note) Not allowed if four more spots crowd together</p>	Size (mm)	Acceptable number	0.3	Ignore (note)	0.3< 0.45	3	0.45< 0.6	1	0.6< 0.3	0	Minor											
Size (mm)	Acceptable number																						
0.3	Ignore (note)																						
0.3< 0.45	3																						
0.45< 0.6	1																						
0.6< 0.3	0																						
3) Black / White line	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Length (mm)</th> <th>Width (mm)</th> <th>Acceptable number</th> </tr> </thead> <tbody> <tr> <td>L 10</td> <td>W 0.03</td> <td>Ignore</td> </tr> <tr> <td>5.0 L 10</td> <td>0.03<W 0.04</td> <td>3</td> </tr> <tr> <td>5.0 L 10</td> <td>0.04<W 0.05</td> <td>2</td> </tr> <tr> <td>1.0 L 10</td> <td>0.05<W 0.06</td> <td>2</td> </tr> <tr> <td>1.0 L 10</td> <td>0.06<W 0.08</td> <td>1</td> </tr> <tr> <td>L 10</td> <td>0.08<W</td> <td>follows 2) point defect</td> </tr> </tbody> </table> <p style="text-align: center;">Defects separate with each other at an interval of more than 20mm.</p>	Length (mm)	Width (mm)	Acceptable number	L 10	W 0.03	Ignore	5.0 L 10	0.03<W 0.04	3	5.0 L 10	0.04<W 0.05	2	1.0 L 10	0.05<W 0.06	2	1.0 L 10	0.06<W 0.08	1	L 10	0.08<W	follows 2) point defect	Minor
Length (mm)	Width (mm)	Acceptable number																					
L 10	W 0.03	Ignore																					
5.0 L 10	0.03<W 0.04	3																					
5.0 L 10	0.04<W 0.05	2																					
1.0 L 10	0.05<W 0.06	2																					
1.0 L 10	0.06<W 0.08	1																					
L 10	0.08<W	follows 2) point defect																					
4) Display pattern	 <table border="1" style="margin-left: auto; margin-right: auto; text-align: center;"> <thead> <tr> <th colspan="6">[Unit: mm]</th> </tr> </thead> <tbody> <tr> <td>A+B</td> <td>0.45</td> <td>0<C</td> <td>D+E</td> <td>0.35</td> <td>F+G</td> </tr> <tr> <td>2</td> <td></td> <td></td> <td>2</td> <td></td> <td>2</td> </tr> </tbody> </table> <p>Note: 1) Up to 3 damages acceptable 2) Not allowed if there are two or more pinholes every 3 of fourths inch.</p>	[Unit: mm]						A+B	0.45	0<C	D+E	0.35	F+G	2			2		2	Minor			
[Unit: mm]																							
A+B	0.45	0<C	D+E	0.35	F+G																		
2			2		2																		
5) Spot-like contrast irregularity	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Size (mm)</th> <th>Acceptable Number</th> </tr> </thead> <tbody> <tr> <td>0.7</td> <td>Ignore (note)</td> </tr> <tr> <td>0.7< 1.0</td> <td>3</td> </tr> <tr> <td>1.0< 1.5</td> <td>1</td> </tr> <tr> <td>1.5<</td> <td>0</td> </tr> </tbody> </table> <p>Note: 1) Conformed to limit samples. 2) Intervals of defects are more than 30mm.</p>	Size (mm)	Acceptable Number	0.7	Ignore (note)	0.7< 1.0	3	1.0< 1.5	1	1.5<	0	Minor											
Size (mm)	Acceptable Number																						
0.7	Ignore (note)																						
0.7< 1.0	3																						
1.0< 1.5	1																						
1.5<	0																						
6) Bubbles in polarizer	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Size (mm)</th> <th>Acceptable Number</th> </tr> </thead> <tbody> <tr> <td>0.4</td> <td>Ignore (note)</td> </tr> <tr> <td>0.4< 0.65</td> <td>2</td> </tr> <tr> <td>0.65< 1.2</td> <td>1</td> </tr> <tr> <td>1.2<</td> <td>0</td> </tr> </tbody> </table>	Size (mm)	Acceptable Number	0.4	Ignore (note)	0.4< 0.65	2	0.65< 1.2	1	1.2<	0	Minor											
Size (mm)	Acceptable Number																						
0.4	Ignore (note)																						
0.4< 0.65	2																						
0.65< 1.2	1																						
1.2<	0																						
7) Scratches and dent on the polarizer	Scratches and dent on the polarizer shall be in the accordance with "2) Black/white spot", and "3) Black/White line".	Minor																					
8) Stains on the surface of LCD panel	Stains which cannot be removed even when wiped lightly with a soft cloth or similar cleaning.	Minor																					
9) Rainbow color	No rainbow color is allowed in the optimum contrast on state within the active area.	Minor																					

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10) Viewing area encroachment	Polarizer edge or line is visible in the opening viewing area due to polarizer shortness or sealing line.	Minor
11) Bezel appearance	Rust and deep damages that are visible in the bezel are rejected.	Minor
12) Defect of land surface contact	Evident crevices that are visible are rejected.	Minor
13) Parts mounting	(1) Failure to mount parts (2) Parts not in the specifications are mounted (3) For example: Polarity is reversed, HSC or TCP falls off.	Major
14) Part alignment	(1) LSI, IC lead width is more than 50% beyond pad outline. (2) More than 50% of LSI, IC leads is off the pad outline.	Minor
15) Conductive foreign matter (solder ball, solder hips)	(1) $0.45 < \phi, N \geq 1$	Major
	(2) $0.3 < \phi < 0.45, N \geq 1$ ϕ : Average diameter of solder ball (unit: mm)	Minor
	(3) $0.5 < L, N \geq 1$ L: Average length of solder chip (unit: mm)	Minor
16) PCB pattern damage	(1) Deep damage is found on copper foil and the pattern is nearly broken.	Major
	(2) Damage on copper foil other than 1) above	Minor
17) Faulty PCB correction	(1) Due to PCB copper foil pattern burnout, the pattern is connected, using a jumper wire for repair; 2 or more places are corrected per PCB. (2) Short-circuited part is cut, and no resist coating has been performed.	Minor
18) Bezel flaw	Bezel claw missing or not bent	Minor
19) Indication on name plate (sampling indication label)	(1) Failure to stamp or label error, or not legible. (all acceptable if legible) (2) The separation is more than 1/3 for indication discoloration, in which the characters can be checked.	Minor

7. Reliability

7-1 Lifetime

50,000 hours (25 in the room without ray of sun)

7-2 Items of reliability

Item	Condition	Criterion
1) High Temperature Operating	60 96hrs	No cosmetic failure is allowable. Contrast ratio should be between initial value $\pm 10\%$. Total current consumption should be below double of initial value.
2) Low Temperature Operation	-20 96hrs	
3) Humidity	40 , 90%RH, 96hrs	No cosmetic failure is allowable. Contrast ratio should be between initial value $\pm 20\%$. Total current consumption should be below double of initial value.
4) High Temperature	70 96hrs	
5) Low Temperature	-30 96hrs	
6) Thermal shock	25 30 25 70 5(min) 30(min) 5(min) 30(min) 5 cycle, 55~60%RH	

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7) Vibration	10~55~10hz amplitude: 1.5mm 2hrs for each direction (X,Y,Z)	No defects in cosmetic and operational function are allowable. Total current consumption should be below double of initial value.
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8. Handling precautions

8-1 Mounting method

A panel of LCD module made by Dalian Dongfu Color Display Co., Ltd. consists of two thin glass plates with polarizers that easily get damaged.

And since the module is so constructed as to be fixed by utilizing fitting holes in the printed circuit board (PCB).

Extreme care should be used when handling the LCD modules.

8-2 Cautions of LCD handling and cleaning

When cleaning the display surface, use soft cloth with solvent (recommended below) and wipe lightly.

Isopropyl alcohol

Do not wipe the display surface with dry or hard materials that will damage the polarizer surface.

Do not use the following solvent:

Water

Ethyl alcohol

Ketene

Aromatics

8-3 Caution against static charge

The LCD module uses C-MOS LSI drivers. So we recommend you:

Connect any unused input terminal 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.

8-4 Packaging

- Module employs LCD elements, and must be treated as such.

Avoid intense shock and falls from a height.

- To prevent modules from degradation, do not operate or store them exposed direct to sunshine or high temperature/humidity.

8-5 Caution for operation

- It is an indispensable condition to drive LCD module within the limits of the specified voltage since the higher voltage over the limits may cause the shorter life of LCD module.

An electrochemical reaction due to DC (direct current) causes LCD undesirable deterioration so that the uses of DC (direct current) drive should be avoided.

- Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD module may show dark color in them. However those phenomena do not mean malfunction or out of order of LCD module, which will come back in the specified operating temperature.

8-6 Storage

In the case of storing for a long period of time, the following ways are recommended:

- Storage in polyethylene bag with the opening sealed so as not to enter fresh air outside in it. And with not desiccant.

- Placing in a dark place where neither exposure to direct sunlight nor light is. Keeping the storage temperature range.

- Storing with no touch on polarizer surface by any thing else.

8-7 Safety

- It is recommendable to crash damaged or unnecessary LCD into pieces and to wash off liquid crystal by either of solvents such as acetone and ethanol, which should be burned up later.
- When any liquid leaked out of a damaged glass cell comes in contact with your hands, please wash it off well at once with soap and water.

9. Precaution for use

- 9-1 Both parties should provide a limit sample on an occasion when both parties agree its necessity. The judgement by a limit sample shall take effect after the limit sample has been established and confirmed by both parties
- 9-2 On the following occasions, the handling of problem should be decided through discussion and agreement between responsible of the both parties.
- When a question is arisen in this manual.
 - When a new problem is arisen which is not specified in this manual.
 - Some problem is arisen due to the change of inspection and operating conditions in users.
 - When a new problem is arisen at the customer's operating set for sample evaluation in the customer site.