Tailorpixels

A Professional Manufacturer of Display

Manufacturer Certificated

9001 CERT. No.: 282Q19070712006

14001 CERT. No.: 282E19070712007

Product Specification

Model: TTW240128A2-A0

240X128 SMT Module

This module uses RoHS material

Tailor Pixels Technology Co., Ltd.
www.tailorpixels.com
tailor@tailorpixels.com
Ph: 86-755-8821 2653

Specification Revision History

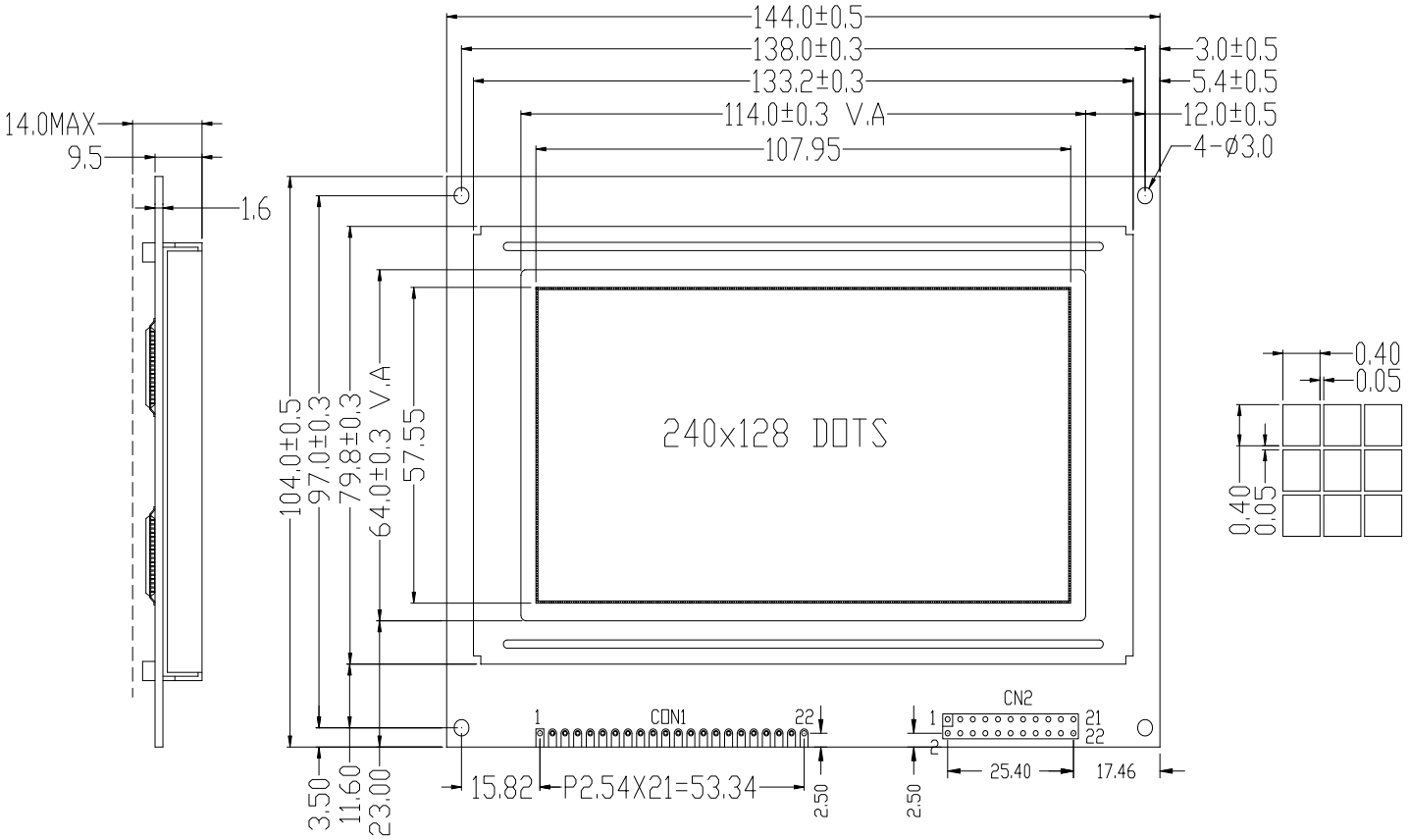
Version	Content	Date
A0	First Issue	28-Sep-10

CONTENTS

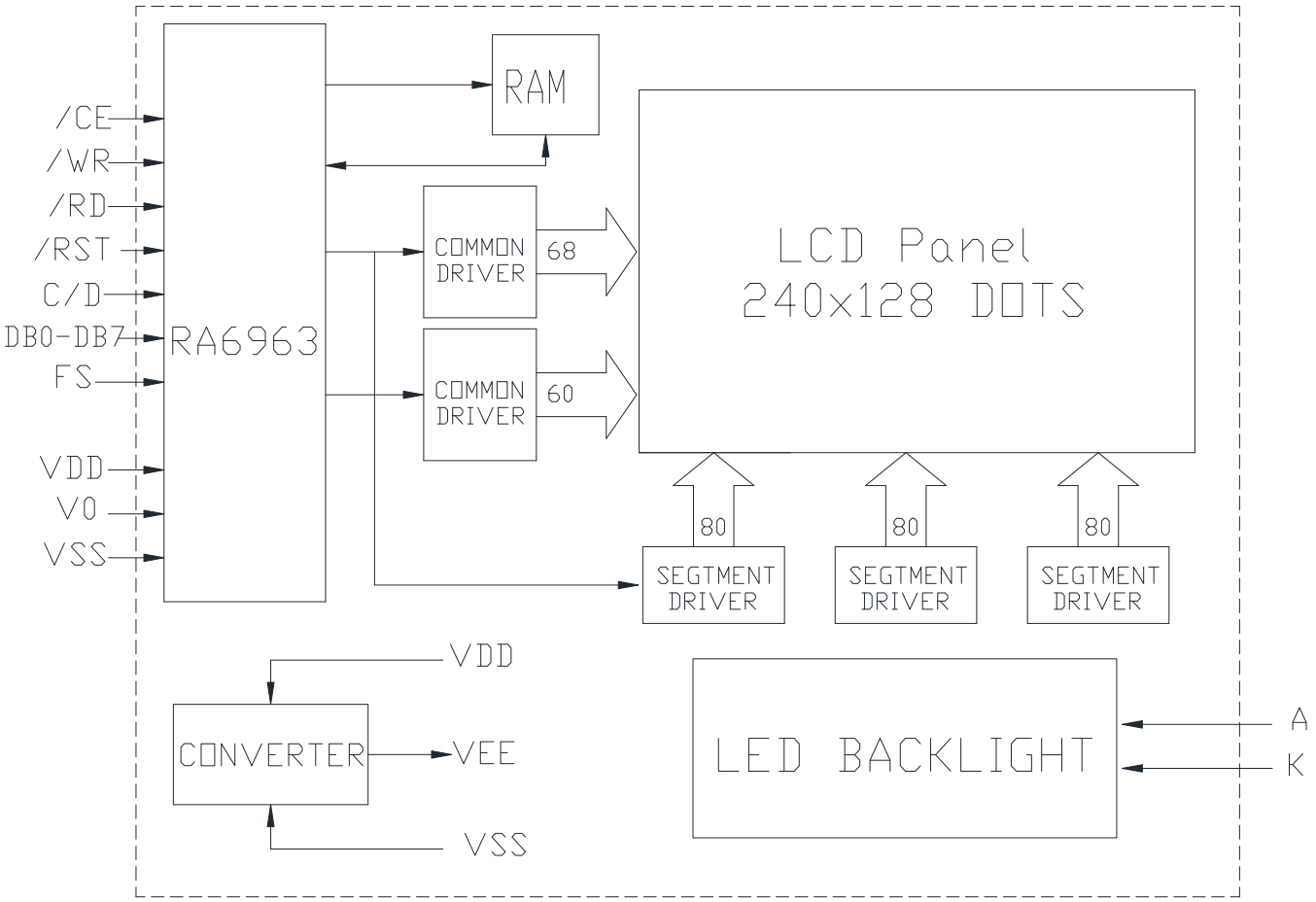
■ PHYSICAL DATA

ITEM	STANDARD VALUE	UNIT
NUMBER OF GRAPHIC	240×128	mm
MODULE DIMENSION	144.0×104.0×14.0(MAX)	mm
EFFECTIVE DISPLAY AREA	114.0×64.0	mm
DOT SIZE	0.40×0.40	mm
DOT PITCH	0.45×0.45	mm
LCD TYPE	STN/TRANSFLFCTIVE/POSITIVE	
DUTY	1/128 duty 1/12 BIAS	
VIEWING DIRECTION	6	o'clock
BACK LIGHT TYPE	SIDE LIT LED	
BACK LIGHT COLOR	YELLOW-GREEN	
APPROX. WEIGHT	TBD	g

■ MECHANICAL DIMENSIONS



■ BLOCK DIAGRAM



■ INTERFACE PIN CONNECTIONS

CON1：

NO	SYMBOL	LEVEL	FUNCTION
1	FG		Frame Ground
2	VSS	0V	Ground
3	VDD	+5.0V	Supply voltage for logic
4	V0	---	Input voltage for LCD
5	/RW	H/L	Write signal
6	/RD	H/L	Read signal
7	/CE	L	Chip enable signal
8	/CD	H/L	H : Instruction Code, L : Data
9	NC		No connection
10	/RST	L	Reset signal
11	DB0	H/L	Data bit 7
12	DB1	H/L	Data bit 6
13	DB2	H/L	Data bit 5
14	DB3	H/L	Data bit 4
15	DB4	H/L	Data bit 3
16	DB5	H/L	Data bit 2
17	DB6	H/L	Data bit 1
18	DB7	H/L	Data bit 0
19	FS	H/L	Font select signal (H : 6 x 8 dots, L : 8 x 8 dots)
20	VOUT	-19.6V	DC-DC Output voltage for LCD
21	A	+5.0V	Back light anode VDD=5..0
22	K	0	Back light cathode

CON2：

NO	SYMBOL	LEVEL	FUNCTION
1	FG		Frame Ground
2	VSS	0V	Ground
3	VDD	+5.0V	Supply voltage for logic
4	V0	---	Input voltage for LCD
5	/RW	H/L	Write signal
6	/RD	H/L	Read signal
7	/CE	L	Chip enable signal
8	/CD	H/L	H : Instruction Code, L : Data
9	NC		No connection
10	/RST	L	Reset signal
11	DB0	H/L	Data bit 7
12	DB1	H/L	Data bit 6
13	DB2	H/L	Data bit 5
14	DB3	H/L	Data bit 4
15	DB4	H/L	Data bit 3
16	DB5	H/L	Data bit 2
17	DB6	H/L	Data bit 1
18	DB7	H/L	Data bit 0
19	FS	H/L	Font select signal (H : 6 x 8 dots, L : 8 x 8 dots)
20	VOUT	-19.6V	DC-DC Output voltage for LCD
21	K	0	Back light cathode
22	A	+5.0V	Back light anode VDD=5..0

■ ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	MIN	MAX	UNIT
Supply voltage for logic	VDD	-0.3	6.4	V
Supply voltage for LCD	V0	VDD-19.0	VDD+0.3	V
Input voltage	VI	-0.3	VDD+0.3	V
Operating temperature	TOP	-20	+70	°C
Storage temperature	TST	-30	+80	°C

■ ELECTRICAL CHARACTERISTICS

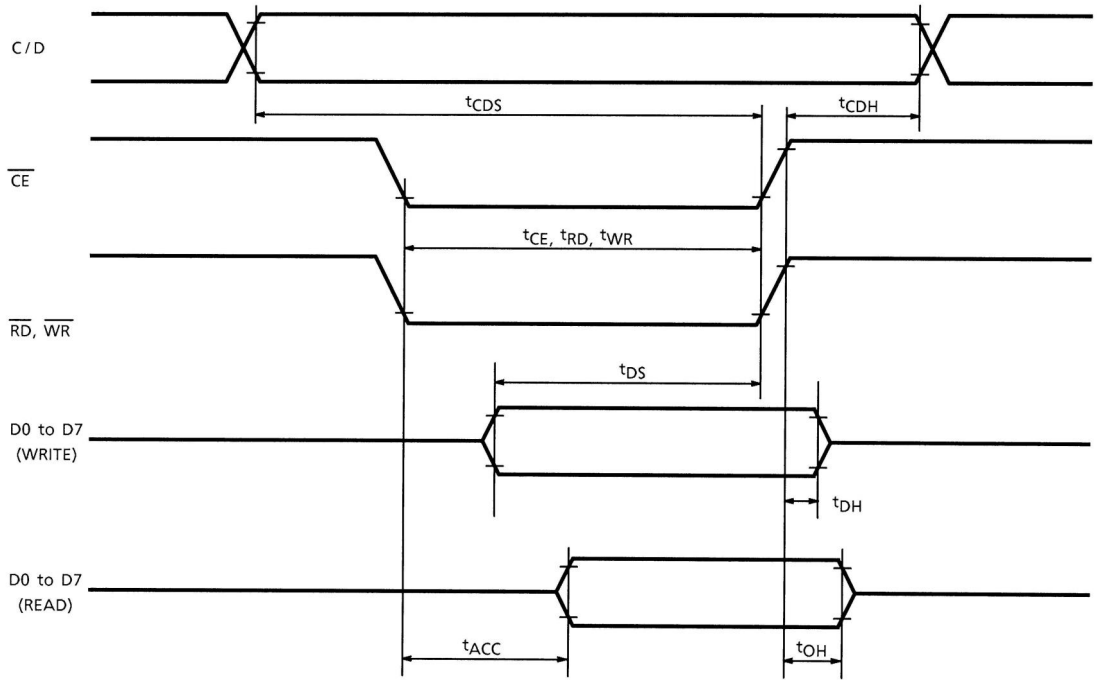
▼ DC Characteristics

Condition: VDD=+5.0V±10%, VSS=0V, VDD-V0=8 to 17V, Ta=-30 to +85℃

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Supply voltage for logic	VDD	----	4.5	5.0	5.5	V
Supply current for logic	IDD	----		16.0	35.0	mA
Operating voltage for LCD	VDD-V0	+25℃	17.5	17.8	18.1	V
Input voltage ' H ' level	V_{IH}	----	2.0	----	VDD	V
Input voltage ' L ' level	V_{IL}	----	0	----	0.8	V
output voltage ' H ' level	V_{OH}	I_{OH}=-200μA	2.4	----	----	V
output voltage ' L ' level	V_{OL}	I_{OL}=1.6mA	----	----	0.4	V

▼ AC Characteristics

Parameter	Symbol	Min	Max	Unit
C/D set up time	tCDS	100	---	ns
C/D hold time	tCDH	10	---	ns
CE, RD, WR pulse width	tCE, tRD, tWR	80	---	ns
Data set up time	tDS	80	---	ns
Data hold time	tDH	40	---	ns
Access time	tACC	---	150	ns
Output hold time	tOH	10	50	ns



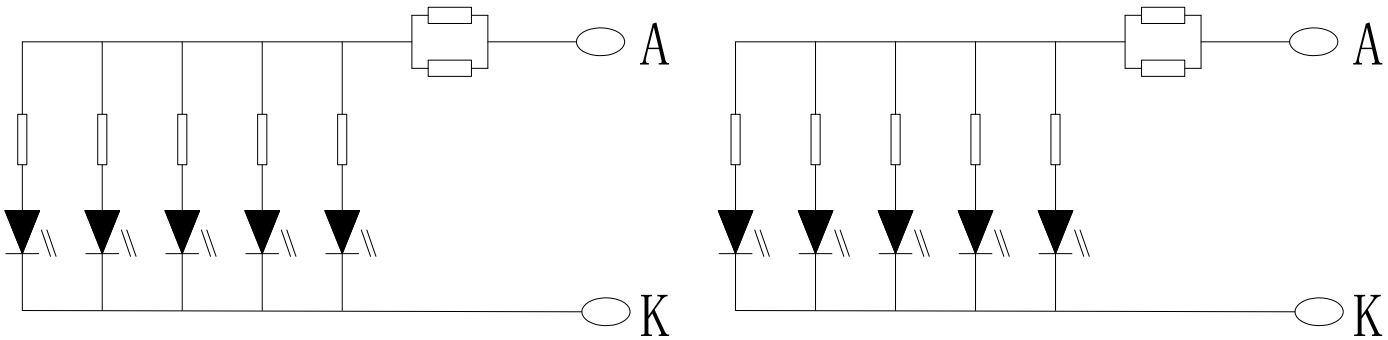
■ BACKLIGHT

▼ Backlight Type

Backlight Type: LED (YELLOW-GREEN)

▼ Power Supply For Backlight

(LED Chip 2*5=10 dies)



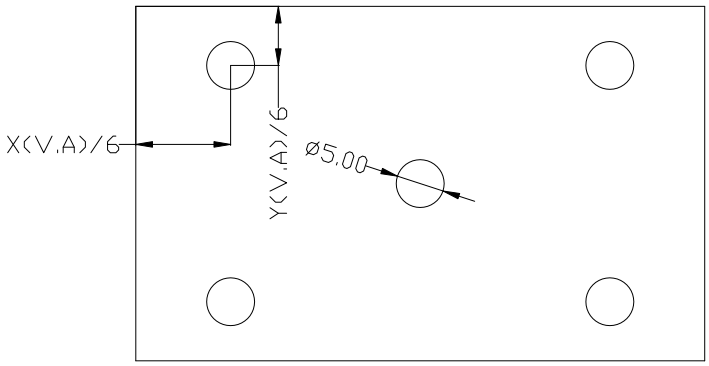
▼ Absolute Maximum Rating

PARAMETER	SYMBOL	CONDITION	MAX	UNIT
Absolute maximum forward current	Ifm		300	mA
Peak forward current	Ifp	1 MSEC plus 10% Duty Cycle	500	mA
Reverse voltage	VR		7.0	V
Life	Hour	If(forward current) =150mA	80000	H

Electrical-Optical Characteristics

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Forward voltage	Vf (LED(+)-LED(-))		4.8	5.0	5.2	V
Forward current	If		----	135	160	mA
Reverse current	Ir	VR=7.0V	----	----	200	μA
Chromaticity		If(forward current) = 150mA	x=0.28 y=0.27	x=0.30 y=0.29	x=0.32 y=0.31	
Luminance	Lv	If(forward current) = 135mA	200	260	360	cd/㎡

Note:The Master Screen's luminance is the average value of 5 points,and The Lvmin./Lvmax. is not less than 70%. The measurement instrument is BM-7 luminance Colorimeter. The aperture is Φ5 mm.



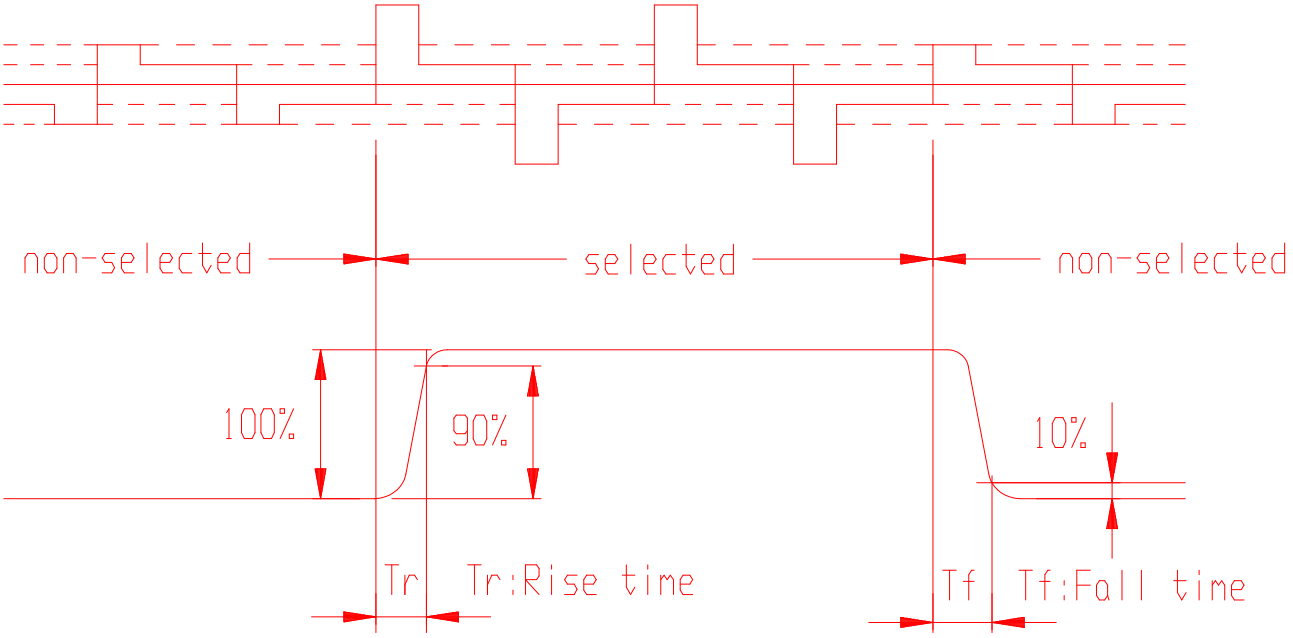
■ OPTICAL CHARACTERISTICS

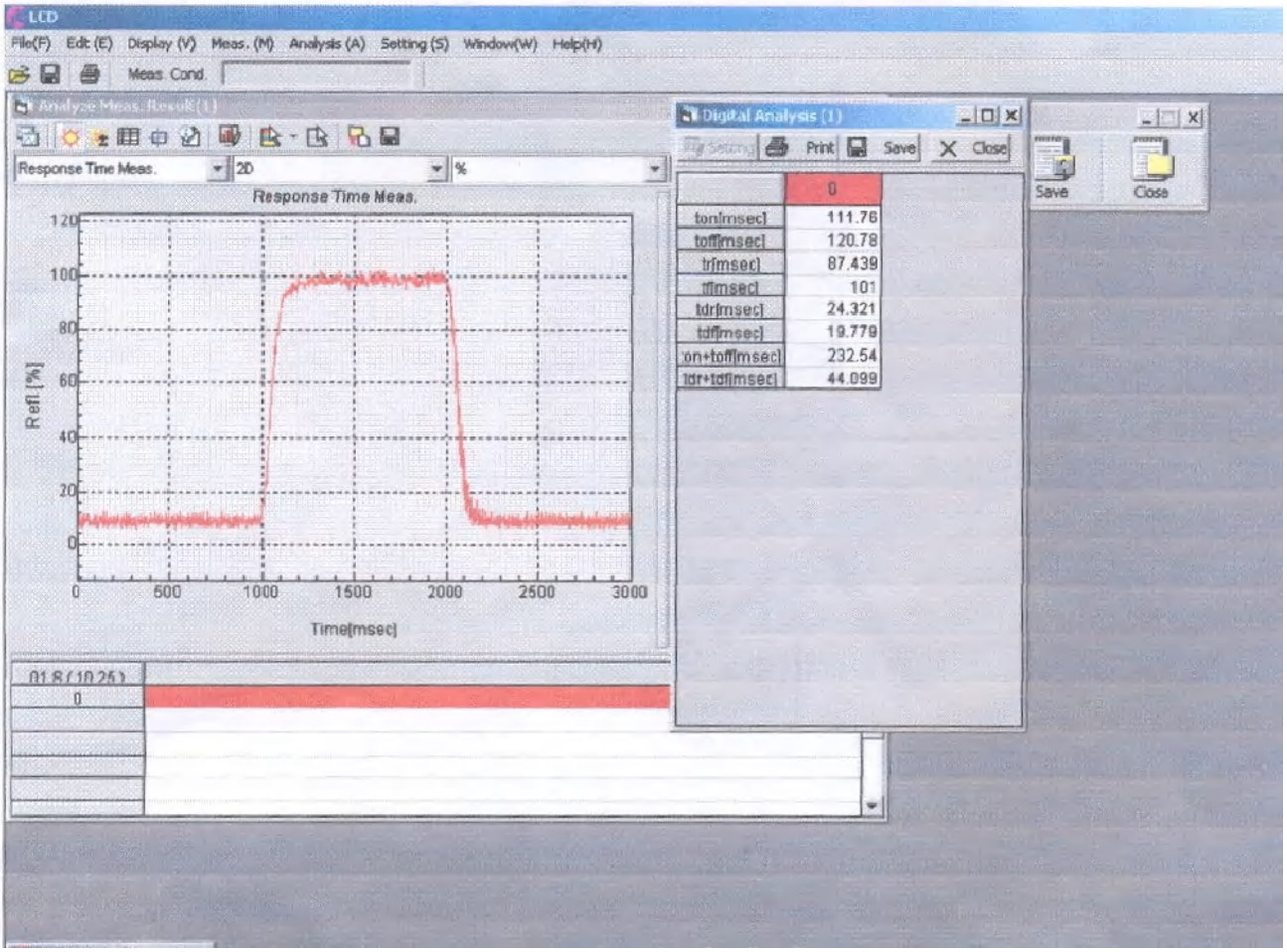
Test instrument is LCD-5000,made in Japan

Item	Symbol	Condition	Min	Typ	Max	Unit	Remarks	Note
Operating voltage	Vop	25℃	16.9	17.2	17.5	V	---	---
Response time	Tr	----	----	87.439	130	ms	---	1
	Td	----	----	101	200	ms	---	1
Contrast ratio	Cr	----	----	24	----	---	---	2
Viewing angle range	θ	Cr≥6	----	60	----	deg	Ø=0°	3
			----	28	----	deg	Ø=180°	3

▼ Definition Of Viewing Angle

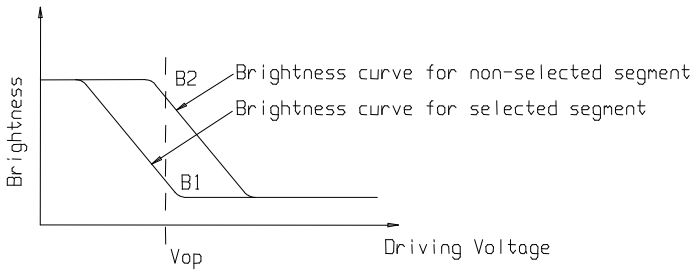
Note1: Definition of response time



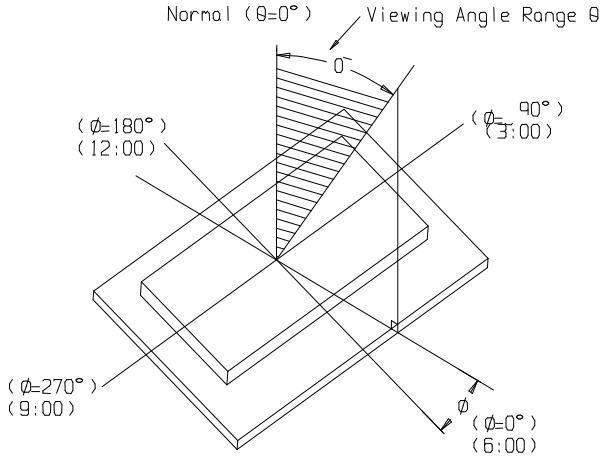


Note2: Definition of contrast ratio ‘Cr’

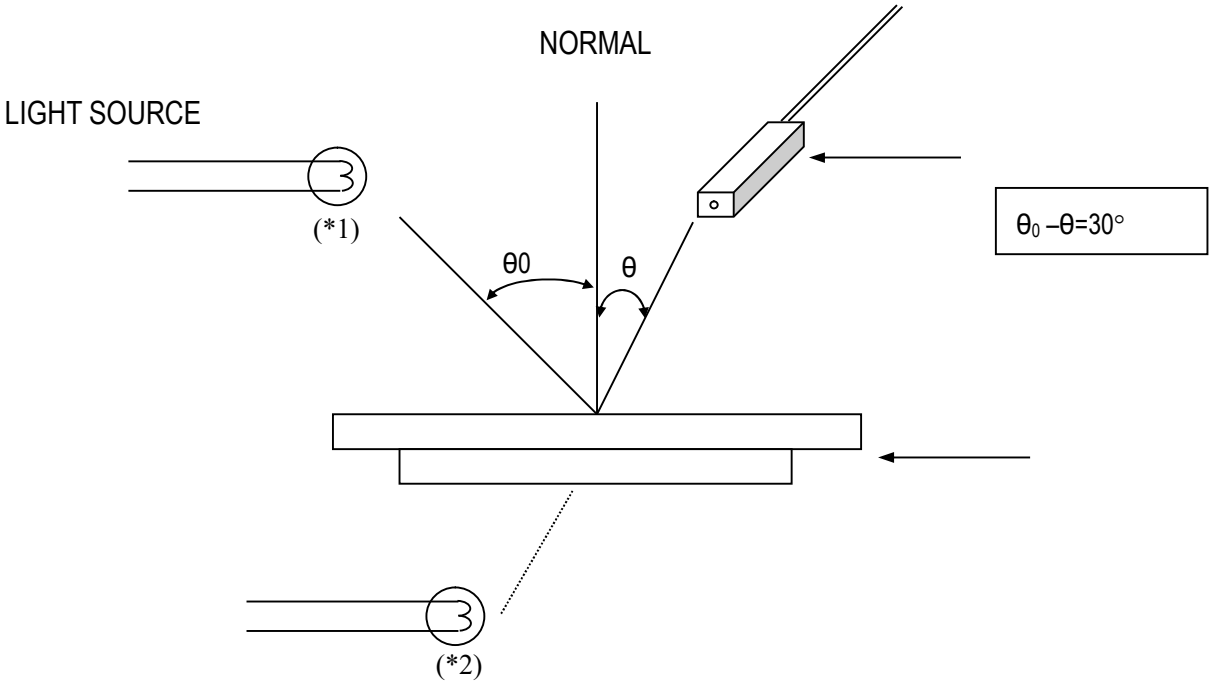
$$Cr = \frac{\text{Brightness of non-selected segment(B2)}}{\text{Brightness of selected segment(B1)}}$$



Note3: Definition of viewing angle range ‘θ’



Note4:Measuring Instruments For Electro-optical Characteristics



*1.Light source position for measuring the reflective type of LCD panel
*2.Light source position for measuring the transflective / transmissive types of LCD panel

■ OPERATING PRINCIPLES & METHODS

▼ Flowchart of Communications with MPU

● Status Read

Before sending data (Read/Write) command, it is necessary to check the status.

Status check

Status of T6963C can be read from data lines.

RD	L
WR	H
CE	L
C/D	H
D0-D7	Status word

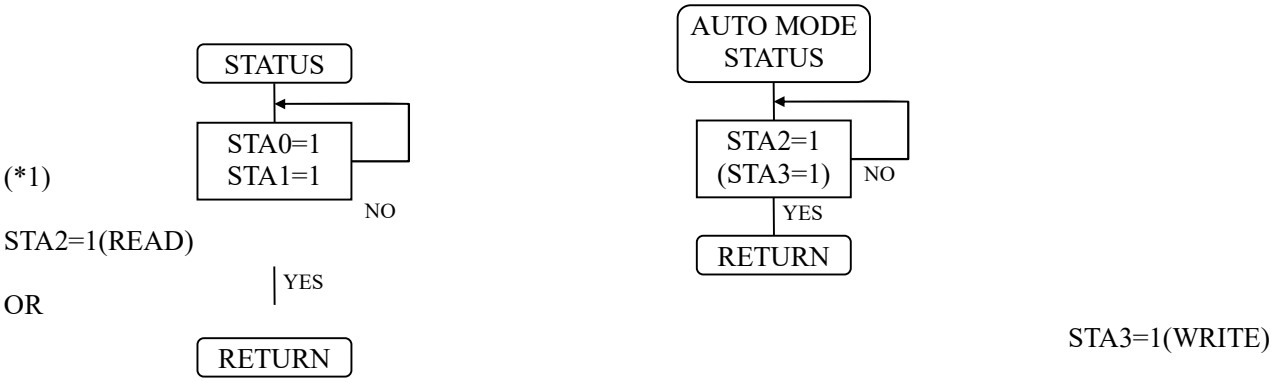
T6963C status word format is following.

MSB							LSB
STA7 D7	STA6 D6	STA5 D5	STA4 D4	STA3 D3	STA2 D2	STA1 D1	STA0 D0

STA0	Check capability of command execution	0 : Disable 1 : Enable
STA1	Check capability of data read/write	0 : Disable 1 : Enable
STA2	Check capability of auto mode data read	0 : Disable 1 : Enable
STA3	Check capability of auto mode data write	0 : Disable 1 : Enable
STA4	Not use	
STA5	Check capability of controller operation	0 : Disable 1 : Enable
STA6	Error flag. Using screen peek/copy command	0 : No error 1 : Error
STA7	Check the condition blink	0 : Display off 1 : Normal display

Note 1 : It is necessary to check STA0 and STA1 at the same time. The error is happened by sending data at executing command.
Note 2 : The status check will be enough to check STA0/STA1.
Note 3 : STA2/STA3 are valid in auto mode STA0/STA1 are invalid.

Status checking flow



Note 4 : It is impossible to save status check in the case of command of MSB0. To have the delay time cannot be save status check.

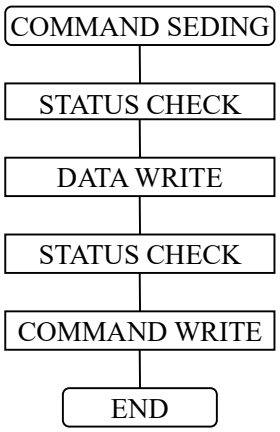
The interrupt of hardware is happened at the end of lines. If command of MSB0 is sent in this period, the command executing is waited. The state of waiting doesn't be known without to check status. The sending next command or data is disregarded or rewrites data of waiting command.

● Data Set

when using the T6963C, first set the data, then set the command

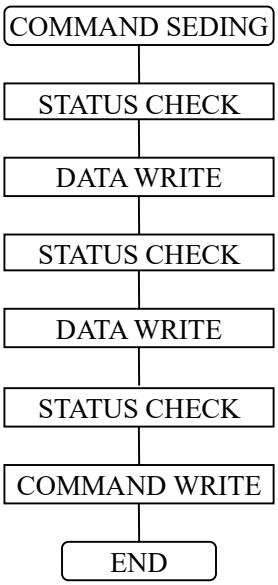
The order of procedure of command sending

1. The case of 1 data



STA0, 1

2. The case of 2 data



STA0,

Note : In case of over 2 data sending, the last data (or last 2 data) is valid.

▼ Description of Command

● Register Set

Code	Hex	Function	D1	D2
00100001	21H	Cursor Pointer Set	X ADRS	Y ADRS
00100010	22H	Offset Register Set	Data	00H
00100100	24H	Address Pointer Set	Low ADRS	High ADRS

(1) Cursor Pointer Set

The position of cursor is specified by X ADRS, Y ADRS. The cursor position is moved only by this command. The cursor pointer doesn't have the function of increment and decrement. The shift of cursor are set by this command. X ADRS, Y ADRS are specified following.

X ADRS 00H~4FH (Lower 7bits are valid)
Y ADRS 00H~1FH (Lower 5bits are valid)

1 screen drive
X ADRS 00~4FH

Y ADRS 00H~0FH

2 screens drive
X ADRS 00~4FH

Y ADRS 00H~0FH Upper screen
Y ADRS 10H~1FH Lower screen

(2) Offset Register Set

The offset register is used to determine external character generator RAM area.

T6963C has 16 bit address lines as follow.

MSB															LSB
ad15	ad14	ad13	ad12	ad11	ad10	ad9	ad8	ad7	ad6	ad5	ad4	ad3	ad2	ad1	ad0

The upper 5 bit (ad15~ad11) are determined by offset register. The middle 8 bit (ad10~ad3) are determined by character code. The lower 3 bit (ad2~ad0) are determined by vertical counter. The lower 5 bit of D1 (data) are valid. The data format of external character generator RAM.

The ralationship of display RAM address and offset register

Data of offset register	CG RAM HEX address(start-end)
00000	0000-07FFH
00001	0800-0FFFH
00010	1000-17FFH
11100	E000-E7FFH
11101	E800-EFFFH
11110	F000-F7FFH
11111	F800-FFFFH

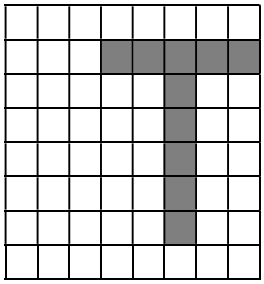
(Example 1)

Offset register 02H

Character code 80H

Character generator RAM start address 0001 0100 0000 0000

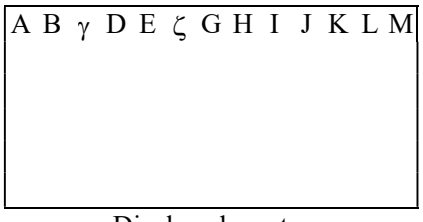
1 4 0 0 H



(Address)	(Data)
1400H	00H
1401H	1FH
1402H	04H
1403H	04H
1404H	04H
1405H	04H
1406H	04H
1407H	00H

(Example 2)

The relationship of display RAM data and display character



Display character

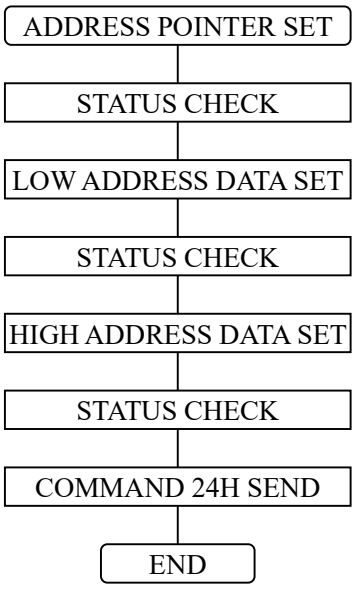
(RAM Data)	(Character)
21H	A
22H	B
83H	γ
24H	D
25H	E
86H	ζ

Note : γ and ζ are displated by character generator RAM.

(3) Address Pointer Set

The address pointer set command is used to indicate the start address for writing (or reading) to external RAM.

The flow chart address pointer set command



Address pointer set command send

● Control Word Set

Code	Hex	Function	D1	D2
01000000	40H	Text home address set	Low address	High address
01000001	41H	Text area set	Columns	00H
01000010	42H	Graphic home address set	Low address	High address
01000011	43H	Graphic area set	Columns	00H

The home address and column size are defined by this command.

(1) Text Home Address Set

The starting address of external display RAM for Text display is defined by this command. The text home address shows the left end and most upper position.

The relationship of external display RAM address and display position

TH		TH+CL
TH+TA		TH+TA+CL
(TH+TA)+TA		TH+2TA+CL
(TH+2TA)+TA		TH+3TA+CL
TH+(n-1)TA		TH+(n-1)TA+CL

TH : Text home address
TA : Text area number (columns)
CL : Columns are fixed by hardware. (pin-programmable)

(Example)

Text home address : 0000H
Text area : 0020H
MD2=H, MD3=H : 32 columns
DUAL=H, MDS=L, MD0=L, MD1=L : 16 lines

0000H	0001H	……	001EH	001FH
0020H	0021H	……	003EH	003FH

0040H	0041H	……	005EH	005FH
0060H	0061H	……	007EH	007FH
0080H	0081H	……	009EH	009FH
00A0H	00A1H	……	00BEH	00BFH
00C0H	00C1H	……	00DEH	00DFH
00E0H	00E1H	……	00FEH	00FFH
0100H	0101H	……	011EH	011FH
0120H	0121H	……	013EH	013FH
0140H	0141H	……	015EH	015FH
0160H	0161H	……	017EH	017FH
0180H	0181H	……	019EH	019FH
01A0H	01A1H	……	01BEH	01BFH
01C0H	01C1H	……	01DEH	01DFH
01E0H	01E1H	……	01FEH	01FFH

(2) Graphic Home Address Set

The starting address of external display RAM for Graphic display is defined by this command. The graphic home address shows the left end most upper line.

The relationship of external display RAM address and display position

GH		GH+CL
GH+GA		GH+GA+CL
(GH+GA)+GA		GH+2GA+CL
(GH+2GA)+GA		GH+3GA+CL
GH+(n-1)GA		GH+(n-1)GA+CL

GH : Graphic home address
GA : Graphic area number (colums)
CL : Columns are fixed by hardware. (pin-programmable)

(Example)

Graphic home address : 0000H
Graphic area : 0020H
MD2=H, MD3=H : 32 columns
DUAL=H, MDS=L, MD0=L, MD1=L : 16 lines

0000H	0001H	……	001EH	001FH
0020H	0021H	……	003EH	003FH
0040H	0041H	……	005EH	005FH
0060H	0061H	……	007EH	007FH
⋮	⋮	⋮	⋮	⋮
0F80H	0F81H	……	0F9EH	0F9FH
0FA0H	0FA1H	……	0FBEH	0FBFH
0FC0H	0FC1H	……	0FDEH	0FDFH
0FE0H	0FE1H	……	0FFEH	0FFFH

(3) Text Area Set

The columns of display are defined by the hardware setting. This command can be used to adjust columns of display.

(Example)
Text home address : 0000H
Text area : 001EH
MD2=H, MD3=H : 32 columns
DUAL=H, MDS=L, MD0=L, MD1=L : 16 lines

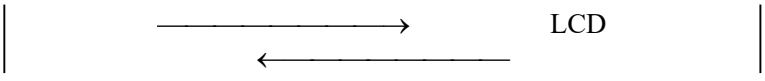
0000H	0001H	……	001DH	001EH	001FH
001EH	001FH	……	003BH	003CH	003DH
003CH	003DH	……	0059H	005AH	005BH
005AH	005BH	……	0077H	0078H	0079H
0078H	0079H	……	0095H	0096H	0097H
0096H	0097H	……	00B3H	00B4H	00B5H
00B4H	00B5H	……	00D1H	00D2H	00D3H
00D2H	00D3H	……	00EFH	00F0H	00F1H
00F0H	00F1H	……	010DH	010EH	010FH
010EH	010FH	……	012BH	012CH	012DH
012CH	012DH	……	0149H	014AH	014BH
014AH	014BH	……	0167H	0168H	0169H
0168H	0169H	……	0185H	0186H	0187H
0186H	0187H	……	01A3H	01A4H	01A5H
01A4H	01A5H	……	01C1H	01C2H	01C3H
01C2H	01C3H	……	01DFH	01E0H	01E1H

(4) Graphic Area Set

The columns of display are defined by the hardware setting. This command can be used to adjust columns of graphic display.

(Example)
Text home address : 0000H
Text area : 001EH
MD2=H, MD3=H : 32 columns
DUAL=H, MDS=L, MD0=L, MD1=L : 16 lines

0000H	0001H	……	001DH	001EH	001FH
001EH	001FH	……	003BH	003CH	003DH
003CH	003DH	……	0059H	005AH	005BH
005AH	005BH	……	0077H	0078H	0079H
0E88H	0E89H	……	0EA5H	0EA6H	0EA7H
0EA6H	0FA7H	……	0EC3H	0EC4H	0EC5H
0EC4H	0FC5H	……	0EE1H	0EE2H	0EE3H
0EE2H	0FE3H	……	0EFFH	0F00H	0F01H



The address in graphic area can be continuous and RAM area can be used without ineffective area, if graphic area is defined the same number as the actual column number of LCD display.

● Mode Set

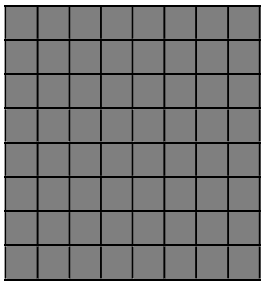
Code	Function	Operand
1000x000	"OR" Mode	---
1000x001	"EXOR" Mode	---
1000x011	"AND" Mode	---
1000x100	"TEXT ATTRIBUTE" Mode	---
10000xxx	Internal Character Generator Mode	---
10001xxx	External Character Generator Mode	---

x : Don't care

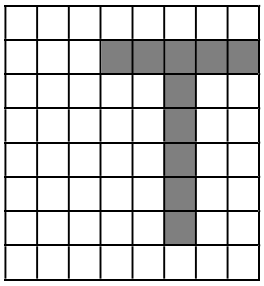
The display mode is defined by this command. The display mode don't have changed until to send next this command. Logically "OR" , "EXOR", "AND" of text and graphic dispaly can be displayed.

When internal character generator mode is selected, character code 00H~7FH are selected from built-in character generator ROM. The character code 80H~FFH are automatically selected external character generator RAM.

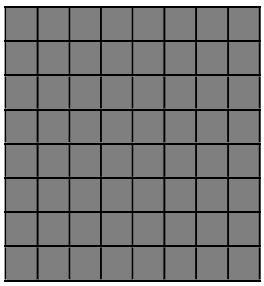
(Example)



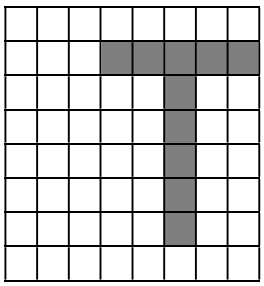
Graphic



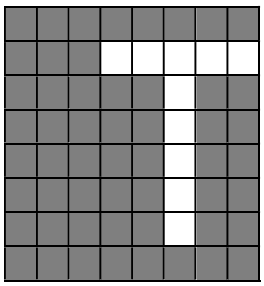
Text



"OR"



"AND"



"EXOR"

Note : Only text display is attributed, because attribute data is located in graphic RAM area.

Attribute function

"Reverse display", "Character blink" and "Inhibit" are called "Attribute". The attribute data is written in the graphic area defined by control word set command. The mode set command selects text display only and graphic display cannot be displayed.

The attribute data of the lst character in text area is written at the lst byte in graphic area, and attribute data of n-th character is written at the n-th byte in graphic area. Attribute function is defined as follow.

Attribute RAM byte	x	x	x	x	d3	d2	d1	d0

d3	d2	d1	d0	Function
0	0	0	0	Normal display
0	1	0	1	Reverse display
0	0	1	1	Inhibit display
1	0	0	0	Blink of normal display
1	1	0	1	Blink of reverse display
1	0	1	1	Blink of inhibit display

● Display Mode

Code	Function	Operand
10010000	Display off	---
1001xx10	Cursor on, blink off	---
1001xx11	Cursor on, blink on	---
100101xx	Text on, graphic off	---
100110xx	Text off, graphic on	---
100111xx	Text on, graphic on	---

1	0	0	1	d3	d2	d1	d0

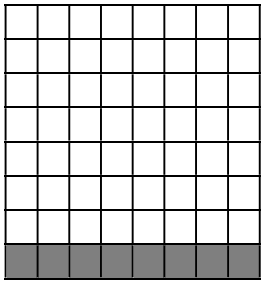
d0: Cursor blink on : 1, off : 0
d1: Cursor display on : 1, off : 0
d2: Text display on : 1, off : 0
d3: Graphic display on : 1, off : 0

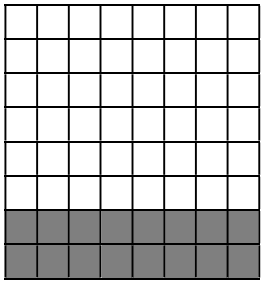
Note : It is necessary to turn on "Text display" and "Graphic display" in following case.
1) Combination of text/graphic display, 2) Attribute function.

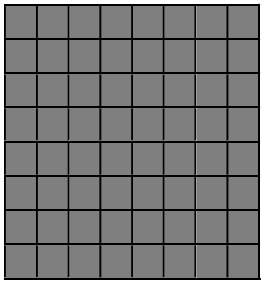
● Cursor Pattern Select

Code	Function	Operand
10100000	1 line cursor	---
10100001	2 lines cursor	---
10100010	3 lines cursor	---
10100011	4 lines cursor	---
10100100	5 lines cursor	---
10100101	6 lines cursor	---
10100110	7 lines cursor	---
10100111	8 lines cursor	---

When cursor display is ON, this command selects the cursor pattern from 1 line to 8 lines. The cursor address is defined by cursor pointer set command.


1 line cursor

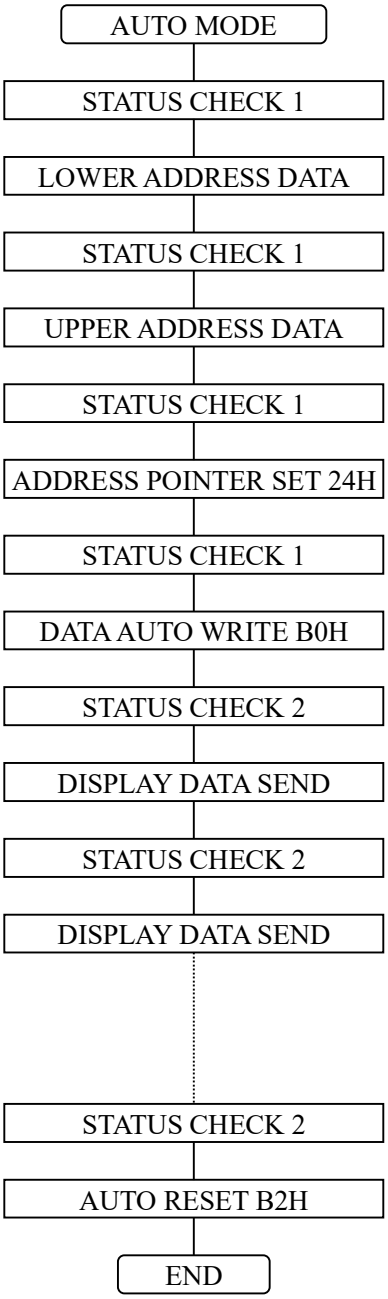

2 lines cursor

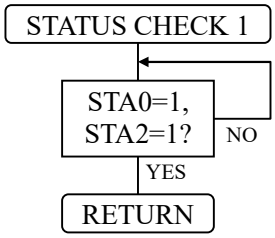

8 lines cursor

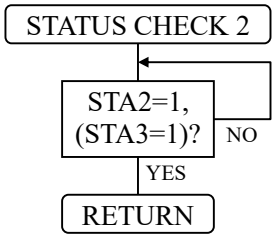
● Data Auto Read/Write

Code	Hex	Function	Operand
10110000	B0H	Data auto write set	---
10110001	B1H	Data auto read set	---
10110010	B2H	Auto reset	---

This command is convenient to send full screen data from external display RAM. After setting auto mode, "Data write (or read)" command is not necessary between each data. "Data auto write (or read)" command should follow the "Address pointer set" and address pointer is automatically increment by + 1 after each data. After sending (or receiving) all data "Auto reset" is necessary to return normal operation because all data is regarded "Display data" and no command can be accepted in the auto mode.
Note : Status check for auto mode (STA2,STA3) should be checked between each data. Auto reset should be performed after checking STA3=1 (STA2=1). Please refer following flow chart.



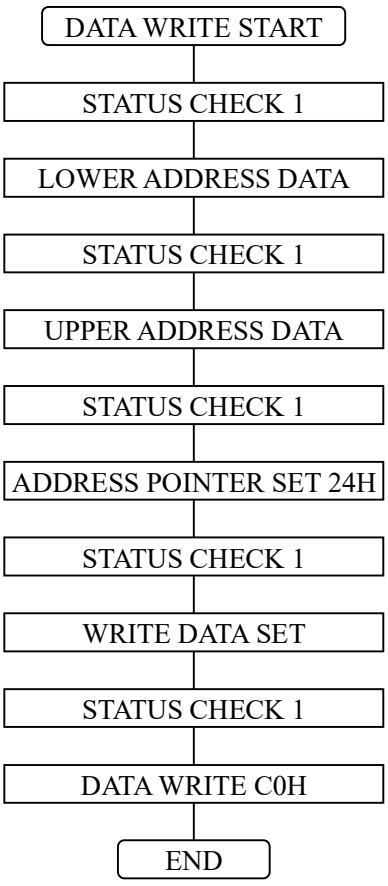


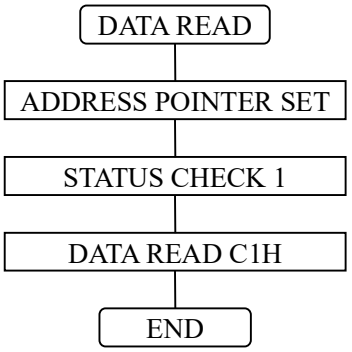


● Data Read Write

Code	Hex	Function	Operand
11000000	C0H	Data write and ADP increment	Data
11000001	C1H	Data read and ADP increment	---
11000010	C2H	Data write and ADP decrement	Data
11000011	C3H	Data read and ADP decrement	---
11000100	C4H	Data write and ADP nonvariable	Data
11000101	C5H	Data read and ADP nonvariable	---

This command is used for data write from MPU to external display RAM, and data read from external display RAM to MPU. Data write/data read should be executed after setting address by address pointer set command. Address pointer can be automatically increment or decrement by setting this command.
Note : This command is necessary for each 1 byte data. Please refer following flow chart.



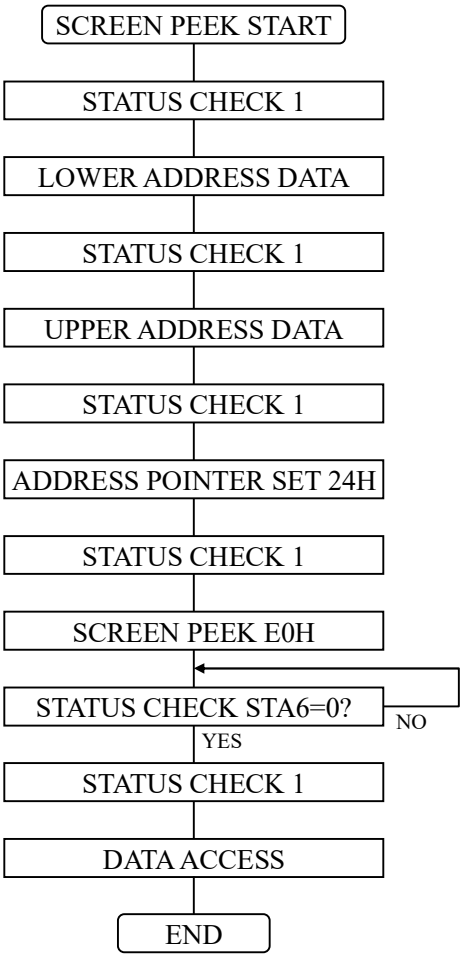


● Screen Peek

Code	Hex	Function	Operand
11100000	E0H	Screen Peek	---

This command is used to transfer displayed 1 byte data to data stack, and this 1 byte data can be read from MPU by data access. The logical combination data of text and graphic display on LCD screen can be read by this command.

The status (STA6) should be checked just after "Screen peek" command. If the address determined by "Address pointer Set" command is not in graphic area, this command ignored and status flag (STA6) is set. Please refer following flow chart.

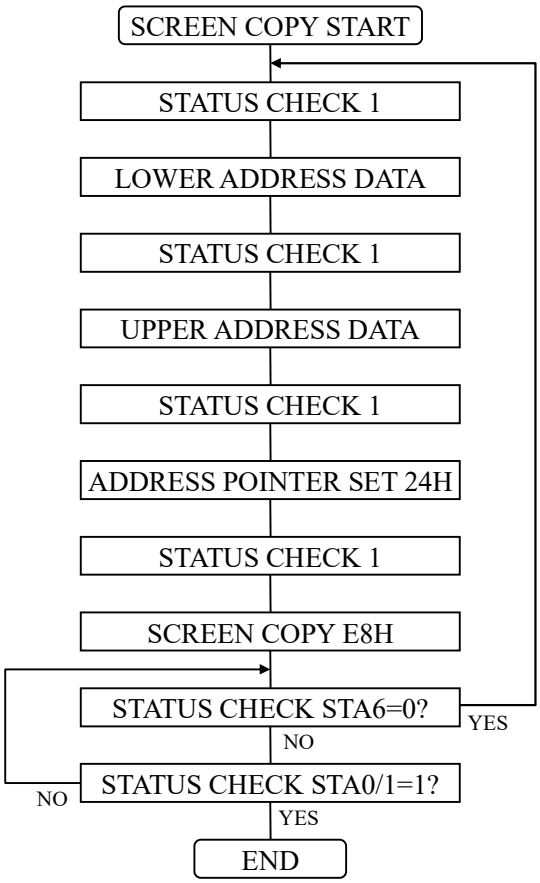


● Screen Copy

Code	Hex	Function	Operand
11101000	E8H	Screen copy	---

This command is used to copy displayed 1 line data to graphic area. The start point of 1 line data in the screen is determined by the address pointer. Please refer following flow chart.

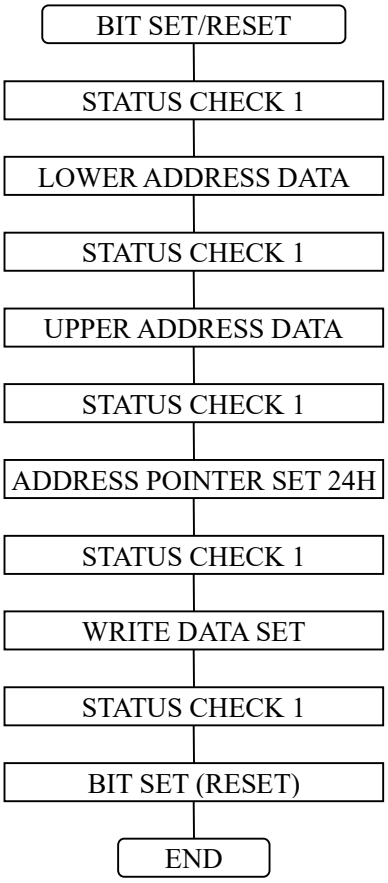
Note 1 : In attribute function, this command is invalid. (Because attribute data is in the graphic area.)
Note 2 : In case of 2 screen drive, this command is invalid. (Because T6963C cannot separate upper screen data and lower screen data.)



● Bit Set/Reset

Code	Function	Operand
11110xxx	bit reset	---
11111xxx	bit set	---
1111x000	bit 0 (LSB)	---
1111x001	bit 1	---
1111x010	bit 2	---
1111x011	bit 3	---
1111x100	bit 4	---
1111x101	bit 5	---
1111x110	bit 6	---
1111x111	bit 7 (MSB)	---

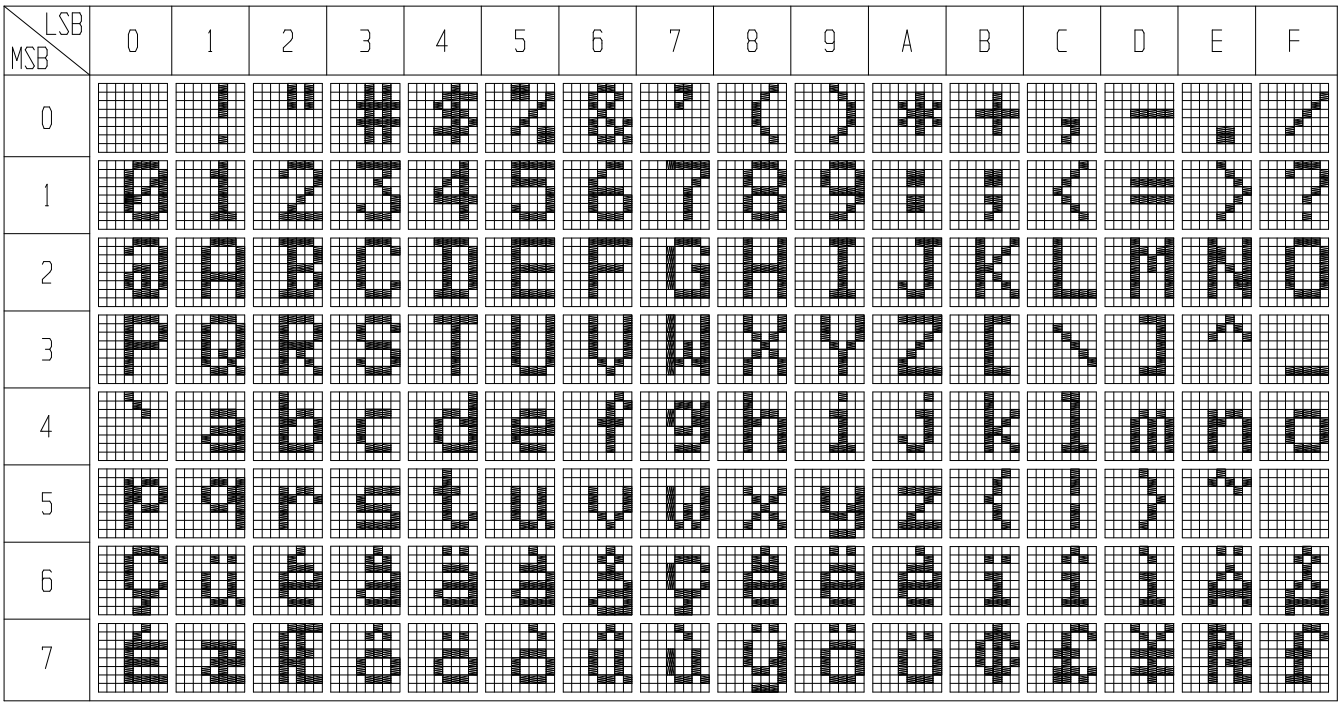
This command is used to set or reset a bit of 1 byte is specified by address pointer. Plural bits in the 1 byte data cannot be set/reset at a time. Please refer following flow chart.



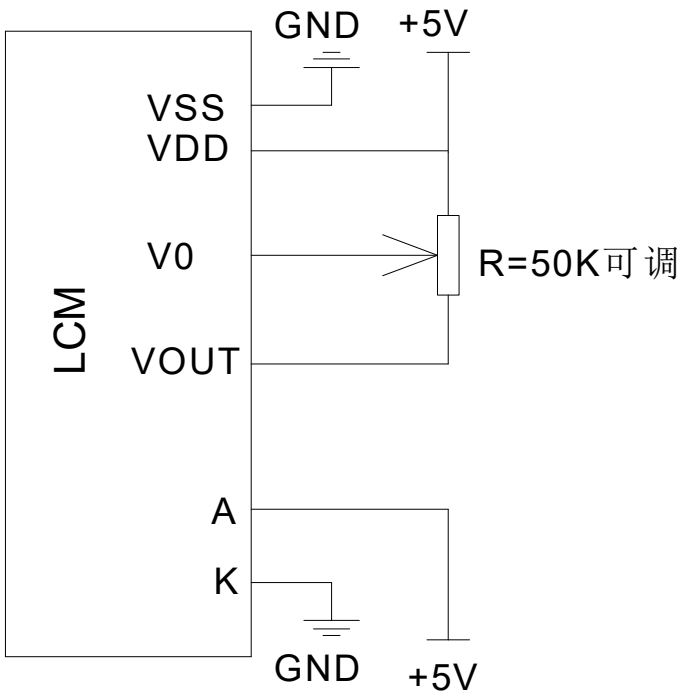
Command List

Command	Code	D1	D2	Function
Register Set	00100001	X address	Y address	Cursor pointer set
	00100010	Data	00H	Offset register set
	00100100	Low address	High address	Address pointer set
Control Word Set	01000000	Low address	High address	Text home address set
	01000001	Columns	00H	Text area set
	01000010	Low address	High address	Graphic home address set
	01000011	Columns	00H	Graphic area set
Mode Set	1000x000	---	---	"OR" mode
	1000x001	---	---	"EXOR" mode
	1000x011	---	---	"AND" mode
	1000x100	---	---	"Text attribute" mode
	10000xxx	---	---	Internal CG ROM mode
	10001xxx	---	---	External CG RAM mode
Display Mode	10010000	---	---	Display off
	1001xx10	---	---	Cursor on, blink off
	1001xx11	---	---	Cursor on, blink on
	100101xx	---	---	Text on, graphic off
	100110xx	---	---	Text off, graphic on
	100111xx	---	---	Text on, graphic on
Cursor Pattern Select	10100000	---	---	1 line cursor
	10100001	---	---	2 lines cursor
	10100010	---	---	3 lines cursor
	10100011	---	---	4 lines cursor
	10100100	---	---	5 lines cursor
	10100101	---	---	6 lines cursor
	10100110	---	---	7 lines cursor
	10100111	---	---	8 lines cursor
Data Auto Read/Write	10110000	---	---	Data auto write set
	10110001	---	---	Data auto read set
	10110010	---	---	Auto reset
Data Read Write	11000000	Data	---	Data write and ADP increment
	11000001	---	---	Data read and ADP increment
	11000010	Data	---	Data write and ADP decrement
	11000011	---	---	Data read and ADP decrement
	11000100	Data	---	Data write and ADP nonvariable
	11000101	---	---	Data read and ADP nonvariable
Screen Peek	11100000	---	---	Screen peek
Screen Copy	11101000	---	---	Screen copy
Bit Set/Reset	11110xxx	---	---	bit reset
	11111xxx	---	---	bit set
	1111x000	---	---	bit 0 (LSB)
	1111x001	---	---	bit 1
	1111x010	---	---	bit 2
	1111x011	---	---	bit 3
	1111x100	---	---	bit 4
	1111x101	---	---	bit 5
	1111x110	---	---	bit 6
	1111x111	---	---	bit 7 (MSB)

ROM CODE 0101

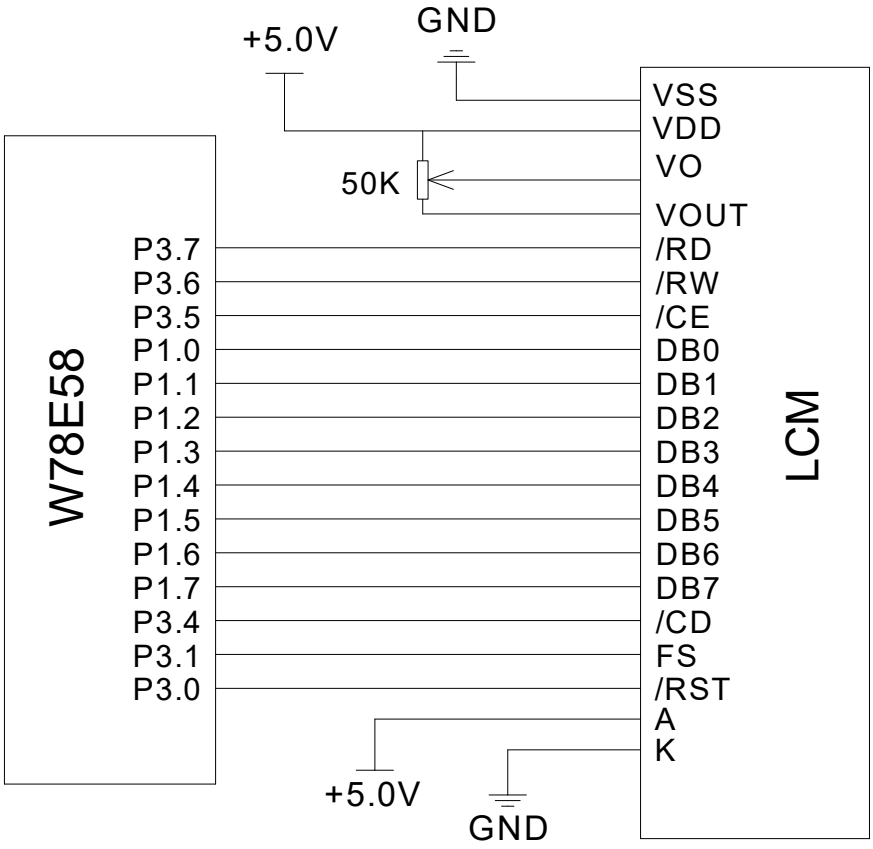


■ POWER SUPPLY FOR LCM MODULE



■ EXAMPLE

▼ Application Circuit



Programme

```
  TRST EQU P3.0
TWR EQU P3.6
TRD EQU P3.7
TCE EQU P3.5
TCD EQU P3.4
TFS EQU P3.1
      ORG 0000H
      LJMP STAR
ORG 0003H
LJMP INNT
ORG 0030H
      LCALL DELAY
      CLR TRST
      LCALL DELAY
      SETB TRST;RST=1
      LCALL DELAY
      STAR:MOV SP,#60H
      MOV IE,#81H
      MOV IP,#01H
      MOV TCON,#00H
      SETB TCE;CE=1
      CLR TFS
      LCALL INST
      MOV R1,#60H
      LCALL CG

MOV A,#94H              ;TEXT ON,GRAPHIC OFF,CURSOR OFF
LCALL CMD
LCALL BLANK
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY

      MOV A,#98H              ;TEXT OFF,GRAPHIC ON,CURSOR OFF
      LCALL CMD
      LCALL DISPLAY
      LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
```

```
LCALL DELAY

      MOV A,#00H              ;TEXT HOME ADD00H
LCALL DT1
MOV A,#11H
LCALL DT1
MOV A,#42H
LCALL CMD;
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY


MOV A,#00H              ;TEXT HOME ADD00H
LCALL DT1
MOV A,#20H
LCALL DT1
MOV A,#42H
LCALL CMD;
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY


MOV A,#00H              ;TEXT HOME ADD00H
LCALL DT1
MOV A,#2FH
LCALL DT1
MOV A,#42H
LCALL CMD;
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
```

```
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
MOV A,#98H              ;TEXT OFF,GRAPHIC ON,CURSOR OFF
LCALL CMD
LCALL DISPLAY1
MOV A,#00H              ;TEXT HOME ADD00H
LCALL DT1
MOV A,#02H
LCALL DT1
MOV A,#42H
LCALL CMD
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
MOV A,#00H              ;TEXT HOME ADD00H
LCALL DT1
MOV A,#11H
LCALL DT1
MOV A,#42H
LCALL CMD;
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
MOV A,#00H              ;TEXT HOME ADD00H
LCALL DT1
MOV A,#20H
LCALL DT1
MOV A,#42H
LCALL CMD;
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
MOV A,#00H              ;TEXT HOME ADD00H
LCALL DT1
MOV A,#2FH
LCALL DT1
MOV A,#42H
LCALL CMD;
LCALL DELAY
LCALL DELAY
LCALL DELAY
LCALL DELAY
```

```
      LCALL DELAY
      LCALL DELAY
      LCALL DELAY


      MOV A,#98H              ;TEXT OFF,GRAPHIC ON,CURSOR OFF
      LCALL CMD
      LCALL DISPLAY2
      MOV A,#00H              ;TEXT HOME ADD00H
      LCALL DT1
      MOV A,#02H
      LCALL DT1
      MOV A,#42H
      LCALL CMD
      LCALL DELAY
      LCALL DELAY
      LCALL DELAY
      LCALL DELAY
      LCALL DELAY
      LCALL DELAY
      LCALL DELAY
      LCALL DELAY
      LCALL DELAY
      LCALL DELAY
      LCALL DELAY
      LCALL DELAY
      LCALL DELAY
      LJMP STAR
;************ INST
 INST:MOV A,#00H ;TEXT HOME ADD 00H
      LCALL DT1
      MOV A,#00H
      LCALL DT1
      MOV A,#40H
      LCALL CMD;

      MOV A,#1EH ; TEXT AREA 0023H (35)
      LCALL DT1
      MOV A,#00H
      LCALL    DT1
      MOV A,#41H
      LCALL CMD

      MOV A,#00H ;GRAPHIC HOME ADD 0200H
      LCALL DT1
      MOV A,#02H
      LCALL DT1
      MOV A,#42H
      LCALL CMD
;
      MOV A,#1EH ;28H ;GRAPHIC AREA 0023H(35)
      LCALL DT1
      MOV A,#00H
      LCALL DT1
      MOV A,#43H
      LCALL CMD
      ;
      MOV A,#80H ;INTERNAL CHARA.GENERATOR AND 'OR' MODE
      LCALL CMD;
```

```
      MOV A,#0A0H
      LCALL CMD
;
      MOV A,#08H ;OFFSET REGISTER SET(4400H)
      LCALL DT1
      MOV A,#00H
      LCALL DT1
      MOV A,#22H
      LCALL CMD
      RET
;****************************************
       CG:MOV A,#00H
      LCALL DT1
      MOV A,#44H
      LCALL DT1
      MOV A,#24H
      LCALL CMD ;
      MOV A,#0B0H
      LCALL CMD
      MOV DPTR,#CGRAM  ;
      MOV R2,#25H
      CG2:MOV R1,#08H
      CG1:MOV A,#00H
            MOVC A,@A+DPTR
      LCALL DT2
      INC DPTR                    ;ADT
      DJNZ R1,CG1
      DJNZ R2,CG2
      MOV A,#0B2H
      LCALL CMD
      RET
;*****************************DISPLAY CLEAR
   BLANK:MOV A,#00H                ;ADDRESS POINTER SET 00H
      LCALL DT1
      MOV A,#00H
      LCALL DT1
      MOV A,#24H
      LCALL CMD;
      MOV A,#0B0H               ;AUTO SET
      LCALL CMD
      MOV R2,#00H
      MOV R3,#80H
   TXCR1:MOV A,#80H
      LCALL DT2
      MOV A,#00H
      LCALL DT2
      MOV A,#00H
      LCALL DT2
      LCALL DT2
            MOV R1,#00H
     TXCR:MOV A,R2
            LCALL DT2
            MOV A,R2
      LCALL DT2                 ;ADT
      MOV A,R2
            LCALL DT2
            INC R1
      INC R2
      CJNE R1,#08H,TXCR
      MOV A,#00H
```

```
      LCALL DT2
      MOV A,#00H
      LCALL DT2
      MOV A,#80H
      LCALL DT2
      DJNZ R3,TXCR1
      MOV A,#0B2H          ;AUTO RESET
      LCALL CMD
      RET
;
DISPLAY:MOV A,#00H
      LCALL DT1
      MOV A,#02H
      LCALL DT1
      MOV A,#24H
      LCALL CMD
      MOV A,#0B0H          ;AUTO SET
      LCALL CMD
      MOV R0,#10H
    TX12:MOV R1,#78H
    TX10:MOV A,#0FH
      LCALL DT2             ;ADT
      DJNZ R1,TX10
      MOV R1,#78H
    TX11:MOV A,#0F0H
      LCALL DT2             ;ADT
      DJNZ R1,TX11
      DJNZ R0,TX12
      MOV A,#0B2H          ;AUTO RESET
      LCALL CMD

      MOV 21H,#02H
      MOV 22H,#00H
      MOV 23H,#11H
      MOV 24H,#00H
      MOV R0,#80H
    TX22:MOV R1,#1EH
    TX20:MOV A,22H
          MOV DPL,A
      LCALL DT1
      MOV A,21H
      MOV DPH,A
      LCALL DT1
      MOV A,#24H
      LCALL CMD
      MOV A,#0C5H          ;AUTO SET
      LCALL CMD
          LCALL DT3
          MOV 25H,A
          INC DPTR
          MOV A,DPL
          MOV 22H,A
          MOV A,DPH
          MOV 21H,A
          MOV A,24H
          MOV DPL,A
      LCALL DT1
      MOV A,23H
      MOV DPH,A
```

```
  LCALL DT1
  MOV A,#24H
  LCALL CMD
  MOV A,25H
  CPL A
  LCALL DT1
  MOV A,#0C4H             ;AUTO SET
  LCALL CMD
        INC DPTR
        MOV A,DPL
        MOV 24H,A
        MOV A,DPH
        MOV 23H,A
  DJNZ R1,TX20
  DJNZ R0,TX22

        MOV A,#00H
  LCALL DT1
  MOV A,#20H
  LCALL DT1
  MOV A,#24H
  LCALL CMD
  MOV A,#0B0H             ;AUTO SET
  LCALL CMD
  MOV R0,#40H
TX32:MOV R1,#1EH
TX30:MOV A,#0AAH
  LCALL DT2                ;ADT
  DJNZ R1,TX30
  MOV R1,#1EH
TX31:MOV A,#55H
  LCALL DT2                ;ADT
  DJNZ R1,TX31
  DJNZ R0,TX32
  MOV A,#0B2H             ;AUTO RESET
  LCALL CMD

        MOV 21H,#20H
  MOV 22H,#00H
  MOV 23H,#2FH
  MOV 24H,#00H
  MOV R0,#80H
TX42:MOV R1,#1EH
TX40:MOV A,22H
        MOV DPL,A
  LCALL DT1
  MOV A,21H
  MOV DPH,A
  LCALL DT1
  MOV A,#24H
  LCALL CMD
  MOV A,#0C5H             ;AUTO SET
  LCALL CMD
        LCALL DT3
        MOV 25H,A
        INC DPTR
        MOV A,DPL
        MOV 22H,A
        MOV A,DPH
```

```
        MOV 21H,A
        MOV A,24H
        MOV DPL,A
    LCALL DT1
    MOV A,23H
    MOV DPH,A
    LCALL DT1
    MOV A,#24H
    LCALL CMD
    MOV A,25H
    CPL A
    LCALL DT1
    MOV A,#0C4H             ;AUTO SET
    LCALL CMD
        INC DPTR
        MOV A,DPL
        MOV 24H,A
        MOV A,DPH
        MOV 23H,A
    DJNZ R1,TX40
    DJNZ R0,TX42
        RET

DISPLAY1:MOV A,#00H
      LCALL DT1
      MOV A,#02H
      LCALL DT1
      MOV A,#24H
      LCALL CMD
      MOV A,#0B0H           ;AUTO SET
      LCALL CMD
        MOV R0,#40H
  TX112:MOV R1,#1EH
  TX110:MOV A,#0AAH
    LCALL DT2               ;ADT
    DJNZ R1,TX110
    MOV R1,#1EH
  TX111:MOV A,#0AAH
    LCALL DT2               ;ADT
    DJNZ R1,TX111
    DJNZ R0,TX112

    MOV R0,#40H
  TX122:MOV R1,#1EH
  TX120:MOV A,#55H
    LCALL DT2               ;ADT
    DJNZ R1,TX120
    MOV R1,#1EH
   TX121:MOV A,#55H
    LCALL DT2               ;ADT
    DJNZ R1,TX121
    DJNZ R0,TX122

    MOV R0,#40H
  TX132:MOV R1,#1EH
  TX130:MOV A,#0FFH
    LCALL DT2               ;ADT
    DJNZ R1,TX130
    MOV R1,#1EH
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  TX131:MOV A,#00H
     LCALL DT2                  ;ADT
     DJNZ R1,TX131
     DJNZ R0,TX132

     MOV R0,#40H
  TX142:MOV R1,#1EH
  TX140:MOV A,#00H
     LCALL DT2                 ;ADT
     DJNZ R1,TX140
     MOV R1,#1EH
  TX141:MOV A,#0FFH
     LCALL DT2                 ;ADT
     DJNZ R1,TX141
     DJNZ R0,TX142
          MOV A,#0B2H              ;AUTO RESET
     LCALL CMD
          RET
DISPLAY2:MOV A,#00H
       LCALL DT1
       MOV A,#02H
       LCALL DT1
       MOV A,#24H
       LCALL CMD
       MOV A,#0B0H               ;AUTO SET
       LCALL CMD
       MOV DPTR,#TAB
       MOV R0,#80H
    TX212:MOV R1,#1EH
    TX210:MOV A,#00H
           MOVC A,@A+DPTR
       LCALL DT2
       INC DPTR                      ;ADT
       DJNZ R1,TX210
       DJNZ R0,TX212
       MOV A,#0B2H               ;AUTO RESET
       LCALL CMD
       RET

;*****************************SUB PROGRAM
     DT1:MOV R5,A
          MOV P1,#0FFH
          SETB TCE ;CE=1
     SETB TCD ;C/D=0
     SETB TWR ;WR=1
     CLR TRD   ;RD=0
     CLR TCE   ;CE=0
   DT11:MOV A,P1
     ANL A,#03H
     CJNE A,#03H,DT11
     SETB TCE
     MOV A,R5
     CLR TCD       ;C/D=0
     NOP
     SETB TRD      ;RD=1
     CLR TWR       ;WR=0 VALID
     MOV P1,A
     CLR TCE
     NOP
```

```
      SETB TCE      ;CE=1
      SETB TWR
      RET
;*******************************
      DT2:MOV R5,A
            MOV P1,#0FFH
      SETB TCE      ;CE=1
      SETB TCD      ;C/D=0
      SETB TWR      ;WR=1
      CLR TRD       ;RD=0
      CLR TCE       ;CE=0
     DT22:MOV A,P1
      ANL A,#08H
      CJNE A,#08H,DT22
      SETB TCE
      MOV A,R5
      CLR TCD       ;C/D=0
      NOP
      SETB TRD      ;RD=1
      CLR TWR       ;WR=0 VALID
      MOV P1,A
            CLR TCE
      NOP
      SETB TCE
      SETB TWR
      RET;
;*******************************
      DT3:MOV P1,#0FFH
            SETB TCE ;CE=1
      SETB TCD ;C/D=0
      SETB TWR ;WR=1
      CLR TRD    ;RD=0
      CLR TCE    ;CE=0
     DT31:MOV A,P1
      ANL A,#03H
      CJNE A,#03H,DT31
      MOV P1,#0FFH
      SETB TCE
      CLR TCD ;C/D=0
            NOP
            SETB TWR ;WR=1
      CLR TRD    ;RD=0
      CLR TCE    ;CE=0
      MOV A,P1
      SETB TCE      ;CE=1
      SETB TRD
      RET
;*********************************
      CMD:MOV R5,A
      MOV P1,#0FFH
      SETB TCE      ;CE=1
      SETB TCD      ;C/D=0
      SETB TWR      ;WR=1
      CLR TRD       ;RD=0
      CLR TCE       ;CE=0
     CMD1:MOV A,P1
      ANL A,#03H
      CJNE A,#03H,CMD1
      SETB TCE
```

```
      MOV A,R5
      SETB TCD      ;C/D=1
      NOP
      SETB TRD      ;RD=1
      CLR TWR       ;WR=0
      MOV P1,A
      CLR TCE       ;CE=0
      NOP
      SETB TCE      ;CE=1
      SETB TWR      ;WR=1
      RET
;*****************************
  DELAY: MOV R6,#0FFH
      MOV R7,#0FFH
  DELAY1: DJNZ R7,DELAY1
        DJNZ R6,DELAY1
      RET
  DELAYI:MOV R6,#20H
DELAYI1:MOV B,#0FFH
DELAYI2:DJNZ B,DELAYI2
            DJNZ R6,DELAYI1
            RET
  DELAY2:MOV R7,#05H
      TT5:MOV R6,#0FFH
      TT4:NOP
            DJNZ R6,TT4
            DJNZ R7,TT5
            RET

DELAY37us:MOV R7,#37
           TT:MOV R6,#1
DELAY1D2us:DJNZ R6,DELAY1D2us
                DJNZ R7,TT
                RET

DELAY40ms:MOV R7,#40
         TTT:LCALL DELAY1ms
               DJNZ R7,TTT
               RET
DELAY400ms:MOV R7,#10
           EEE:MOV R4,#40
            EE:LCALL DELAY1ms
                DJNZ R4,EE
                DJNZ R7,EEE
                RET

DELAY1ms:MOV R6,#8
      TTTT:MOV R5,#209
DELAY125D4us:DJNZ R5,DELAY125D4us
               DJNZ R6,TTTT
               RET

DELAY1D52ms:MOV R7,#2
      TTTTT:LCALL DELAY1ms
               DJNZ R7,TTTTT
               RET
      INNT:PUSH ACC
             MOV A,R6
             PUSH ACC
```

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            MOV A,R7
            PUSH ACC
    INNT1:SETB P3.3
            SETB P3.3
            LCALL DELAY1ms
            MOV C,P3.3
            MOV C,P3.3
            JC INNT1
            POP ACC
            MOV R7,A
            POP ACC
            MOV R6,A
            POP ACC
            RETI
          RETI
;*****************************
CGRAM:DB 0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH
      DB 0FFH,00H,0FFH,00H,0FFH,00H,0FFH,00H
      DB 00H,0FFH,00H,0FFH,00H,0FFH,00H,0FFH
      DB 0AAH,55H,0AAH,55H,0AAH,55H,0AAH,55H
      DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
      DB 00H,00H,00H,00H,00H,00H,00H,00H
      DB 0AAH,0AAH,0AAH,0AAH,0AAH,0AAH,0AAH,0AAH
      DB 55H,55H,55H,55H,55H,55H,55H,55H
      DB 0FFH,0FFH,00H,00H,00H,00H,00H,00H
      DB 00H,0FFH,0FFH,00H,00H,00H,00H,00H
      DB 00H,00H,0FFH,0FFH,00H,00H,00H,00H
      DB 00H,00H,00H,0FFH,0FFH,00H,00H,00H
      DB 00H,00H,00H,00H,0FFH,0FFH,00H,00H
      DB 00H,00H,00H,00H,00H,0FFH,0FFH,00H
      DB 00H,00H,00H,00H,00H,00H,0FFH,0FFH
      DB 0AAH,0AAH,00H,00H,00H,00H,00H,00H
      DB 00H,0AAH,0AAH,00H,00H,00H,00H,00H
      DB 00H,00H,0AAH,0AAH,00H,00H,00H,00H
      DB 00H,00H,00H,0AAH,0AAH,00H,00H,00H
      DB 00H,00H,00H,00H,0AAH,0AAH,00H,00H
      DB 00H,00H,00H,00H,00H,0AAH,0AAH,00H
      DB 00H,00H,00H,00H,00H,00H,0AAH,0AAH
      DB 55H,55H,00H,00H,00H,00H,00H,00H
      DB 00H,55H,55H,00H,00H,00H,00H,00H
      DB 00H,00H,55H,55H,00H,00H,00H,00H
      DB 00H,00H,00H,55H,55H,00H,00H,00H
      DB 00H,00H,00H,00H,55H,55H,00H,00H
      DB 00H,00H,00H,00H,00H,55H,55H,00H
      DB 00H,00H,00H,00H,00H,00H,55H,55H
      DB 0FFH,00H,00H,00H,00H,00H,00H,00H
      DB 00H,0FFH,00H,00H,00H,00H,00H,00H
      DB 00H,00H,0FFH,00H,00H,00H,00H,00H
      DB 00H,00H,00H,0FFH,00H,00H,00H,00H
      DB 00H,00H,00H,00H,0FFH,00H,00H,00H
      DB 00H,00H,00H,00H,00H,0FFH,00H,00H
      DB 00H,00H,00H,00H,00H,00H,0FFH,00H
      DB 00H,00H,00H,00H,00H,00H,00H,0FFH

TAB:DB   0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH
DB   0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,080H,000H
DB   000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H
DB   000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,001H,080H,000H,000H,000H
DB   000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H
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DB  000H,000H,000H,000H,000H,000H,000H,000H,000H,001H,080H,000H,000H,000H,000H,000H
DB  000H,000H,000H,000H,000H,002H,000H,000H,000H,000H,000H,001H,000H,000H,080H,00FH
DB  0FCH,000H,080H,000H,014H,001H,000H,001H,080H,000H,000H,000H,008H,000H,000H,03FH
DB  0FEH,03FH,0FCH,001H,080H,000H,080H,000H,020H,001H,000H,000H,080H,000H,080H,03FH
DB  0FEH,000H,012H,002H,020H,001H,080H,000H,000H,01FH,0FCH,03FH,0FEH,022H,042H,001H
DB  000H,000H,0C0H,000H,080H,002H,030H,001H,000H,000H,080H,03FH,0FFH,000H,080H,07FH
DB  0FFH,004H,010H,001H,080H,000H,000H,000H,000H,000H,000H,022H,042H,001H,000H,000H
DB  080H,000H,080H,003H,020H,001H,010H,000H,080H,020H,082H,00FH,0FCH,000H,010H,00FH
DB  0F8H,001H,080H,000H,000H,000H,000H,000H,000H,022H,042H,001H,000H,07FH,0FFH,000H
DB  080H,002H,020H,03FH,0F8H,000H,080H,00EH,0B8H,000H,000H,01FH,0D0H,005H,010H,001H
DB  080H,000H,000H,000H,000H,000H,000H,022H,042H,001H,000H,000H,000H,000H,0FFH,002H
DB  020H,001H,010H,000H,080H,000H,080H,03FH,0FFH,000H,010H,002H,002H,001H,080H,000H
DB  002H,000H,000H,000H,000H,022H,042H,001H,010H,000H,000H,03FH,080H,002H,020H,001H
DB  010H,07FH,0FFH,00EH,0B8H,040H,002H,03FH,0F0H,03FH,0FFH,001H,080H,03FH,0FFH,000H
DB  000H,01FH,0FCH,022H,042H,01FH,0F8H,002H,040H,000H,080H,004H,010H,002H,010H,000H
DB  080H,001H,040H,01FH,0FCH,000H,010H,004H,010H,001H,080H,000H,000H,000H,000H,000H
DB  000H,024H,042H,002H,010H,003H,020H,000H,080H,004H,010H,002H,010H,000H,080H,002H
DB  030H,000H,000H,01FH,0D0H,008H,00CH,001H,080H,000H,000H,000H,000H,000H,000H,024H
DB  03EH,002H,010H,002H,010H,000H,080H,008H,008H,002H,010H,000H,080H,00DH,00FH,00FH
DB  0F8H,010H,050H,017H,0F7H,001H,080H,000H,000H,000H,000H,000H,000H,028H,002H,002H
DB  010H,004H,008H,000H,080H,008H,008H,004H,010H,000H,080H,070H,084H,008H,008H,012H
DB  050H,060H,002H,001H,080H,000H,000H,000H,002H,000H,000H,030H,002H,002H,010H,004H
DB  00CH,000H,082H,010H,004H,004H,012H,000H,080H,00FH,0F0H,00FH,0F8H,012H,050H,007H
DB  0F0H,001H,080H,000H,000H,03FH,0FFH,000H,000H,020H,002H,002H,012H,008H,006H,000H
DB  082H,020H,007H,008H,012H,000H,080H,000H,020H,004H,010H,012H,049H,000H,000H,001H
DB  080H,000H,000H,000H,000H,03FH,0FFH,03FH,0FEH,07FH,0FFH,010H,006H,000H,082H,040H
DB  002H,010H,013H,000H,080H,001H,040H,002H,020H,005H,009H,000H,000H,001H,080H,000H
DB  000H,000H,000H,000H,000H,020H,002H,000H,000H,020H,004H,000H,07CH,000H,000H,020H
DB  01EH,000H,080H,000H,080H,03FH,0FFH,008H,0C5H,01FH,0FCH,001H,080H,000H,000H,000H
DB  000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H
DB  000H,000H,080H,000H,000H,030H,043H,000H,000H,001H,080H,000H,000H,000H,000H,000H
DB  000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H
DB  000H,000H,000H,000H,000H,000H,000H,001H,080H,000H,000H,000H,000H,000H,000H,000H
DB  000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H
DB  000H,000H,000H,000H,000H,001H,080H,000H,010H,008H,000H,000H,020H,008H,040H,010H
DB  001H,000H,040H,008H,020H,000H,000H,000H,008H,000H,000H,004H,000H,002H,020H,000H
DB  080H,000H,080H,001H,080H,01FH,010H,00CH,004H,07CH,020H,004H,040H,011H,0E1H,000H
DB  040H,008H,020H,07FH,0FFH,000H,07CH,03FH,0FFH,006H,0FEH,002H,020H,000H,082H,000H
DB  080H,001H,080H,010H,0FEH,009H,0FEH,044H,020H,020H,04EH,011H,021H,03EH,040H,008H
DB  030H,001H,080H,01FH,080H,001H,000H,004H,002H,002H,024H,07FH,0FFH,000H,080H,001H
DB  080H,01EH,012H,018H,040H,04BH,0FEH,010H,070H,011H,025H,008H,07CH,07EH,048H,001H
DB  000H,000H,080H,001H,000H,008H,004H,022H,026H,000H,080H,000H,080H,001H,080H,010H
DB  0FFH,010H,040H,050H,020H,003H,0C2H,07DH,025H,008H,088H,008H,08CH,00FH,0F8H,000H
DB  080H,001H,008H,008H,008H,01AH,028H,000H,080H,03FH,0FFH,001H,080H,010H,012H,030H
DB  040H,048H,020H,008H,042H,011H,0E5H,008H,088H,009H,007H,008H,008H,000H,082H,001H
DB  0FCH,018H,010H,012H,030H,000H,084H,000H,080H,001H,080H,01EH,0FEH,050H,044H,044H
DB  020H,008H,03EH,014H,085H,03EH,088H,00EH,0FAH,008H,008H,07FH,0FFH,001H,008H,028H
DB  020H,002H,020H,03FH,0FEH,000H,080H,001H,080H,010H,010H,013H,0FEH,047H,0FFH,010H
DB  000H,018H,085H,009H,010H,008H,000H,008H,008H,000H,080H,002H,008H,048H,040H,002H
DB  030H,000H,000H,000H,080H,001H,080H,07FH,010H,010H,084H,044H,020H,000H,080H,033H
DB  0E5H,00AH,010H,018H,000H,00FH,0F8H,000H,080H,002H,008H,008H,080H,00AH,028H,000H
DB  000H,001H,040H,001H,080H,010H,0FEH,010H,084H,054H,020H,03FH,0FFH,050H,0A5H,008H
DB  028H,068H,0FCH,008H,008H,000H,080H,002H,008H,008H,080H,072H,026H,00FH,0F8H,001H
DB  020H,001H,080H,014H,010H,010H,084H,04AH,022H,001H,0A0H,010H,0A5H,00EH,028H,008H
DB  084H,008H,008H,000H,080H,004H,008H,009H,000H,022H,024H,008H,008H,002H,010H,001H
DB  080H,013H,0FFH,010H,084H,042H,022H,002H,090H,011H,021H,030H,044H,008H,084H,008H
DB  008H,000H,080H,004H,008H,009H,002H,004H,020H,008H,008H,002H,088H,001H,080H,02FH
DB  010H,010H,084H,042H,022H,00CH,08CH,011H,021H,000H,084H,008H,084H,008H,008H,000H
DB  080H,008H,008H,00AH,002H,004H,021H,008H,008H,004H,04CH,001H,080H,072H,010H,010H
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DB  084H,043H,0FEH,030H,087H,012H,021H,001H,003H,008H,084H,008H,008H,000H,080H,010H
DB  070H,00AH,002H,008H,021H,00FH,0F8H,008H,066H,001H,080H,020H,010H,017H,0FFH,042H
DB  002H,000H,082H,054H,0A5H,002H,002H,028H,0FCH,00FH,0F8H,000H,080H,020H,020H,009H
DB  0FEH,010H,01FH,008H,008H,010H,043H,001H,080H,000H,010H,010H,000H,040H,000H,000H
DB  080H,020H,042H,004H,000H,010H,000H,008H,008H,000H,000H,000H,000H,008H,000H,020H
DB  000H,000H,000H,020H,002H,001H,080H,000H,000H,000H,000H,000H,000H,000H,000H,000H
DB  000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H
DB  000H,000H,000H,001H,080H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H
DB  000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H
DB  000H,001H,080H,040H,080H,011H,000H,022H,000H,000H,000H,004H,000H,088H,040H,000H
DB  000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,001H
DB  080H,040H,0C0H,011H,000H,032H,000H,0FFH,0F9H,0FFH,0F8H,0C8H,060H,000H,000H,000H
DB  000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,001H,080H,041H
DB  003H,0FFH,0F8H,021H,000H,080H,000H,000H,000H,0AAH,040H,070H,008H,01EH,00EH,000H
DB  087H,0E1H,0C3H,0F8H,070H,038H,004H,00FH,0F0H,03EH,01FH,0C1H,083H,0F7H,0F0H,011H
DB  000H,040H,080H,0BFH,0E0H,03FH,0C1H,02AH,080H,088H,018H,022H,011H,001H,084H,002H
DB  020H,010H,088H,044H,00AH,008H,010H,041H,010H,021H,080H,044H,010H,011H,000H,040H
DB  0C0H,0A2H,020H,020H,042H,0BEH,0F9H,004H,028H,041H,021H,002H,084H,004H,010H,011H
DB  004H,082H,00AH,008H,008H,080H,090H,011H,080H,044H,010H,020H,080H,080H,060H,0BFH
DB  0E0H,03FH,0C0H,0C1H,091H,004H,048H,001H,001H,004H,088H,004H,000H,021H,004H,082H
DB  00AH,008H,009H,000H,010H,009H,080H,054H,010H,020H,0C1H,000H,038H,0A2H,020H,000H
DB  000H,0BEH,091H,004H,008H,001H,003H,004H,08FH,085H,0C0H,020H,088H,082H,011H,008H
DB  011H,000H,010H,009H,080H,064H,010H,010H,082H,07FH,090H,0A2H,021H,0FFH,0F9H,080H
DB  091H,004H,008H,002H,00EH,008H,088H,046H,020H,040H,070H,082H,011H,00FH,0E1H,000H
DB  010H,009H,080H,0C7H,0F0H,011H,000H,010H,080H,0BFH,0E1H,000H,012H,09EH,091H,004H
DB  008H,002H,001H,010H,080H,024H,010H,040H,088H,046H,011H,008H,011H,000H,010H,009H
DB  083H,044H,010H,00AH,000H,010H,080H,0A2H,020H,03FH,080H,092H,051H,004H,008H,004H
DB  000H,0A0H,080H,024H,010H,041H,004H,03AH,03FH,088H,009H,000H,010H,009H,080H,044H
DB  010H,004H,000H,010H,081H,002H,000H,004H,000H,092H,051H,004H,008H,008H,000H,0BFH
DB  0C0H,024H,010H,041H,004H,002H,020H,088H,009H,000H,010H,009H,080H,044H,010H,00AH
DB  000H,010H,081H,03FH,0F0H,07FH,0C0H,092H,021H,004H,008H,010H,020H,080H,088H,024H
DB  010H,081H,004H,082H,020H,088H,008H,080H,090H,011H,080H,044H,010H,011H,000H,020H
DB  081H,002H,000H,004H,000H,093H,050H,088H,008H,020H,031H,000H,084H,042H,020H,080H
DB  088H,044H,040H,048H,010H,041H,010H,021H,080H,047H,0F0H,020H,0C0H,042H,082H,002H
DB  000H,0FFH,0E8H,0A2H,090H,070H,008H,07FH,00EH,000H,083H,081H,0C0H,080H,070H,038H
DB  040H,04FH,0E0H,03EH,01FH,0C1H,081H,044H,010H,0C0H,038H,081H,002H,0FFH,0F8H,004H
DB  008H,0C1H,018H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H
DB  000H,000H,000H,001H,080H,080H,003H,000H,011H,000H,000H,000H,000H,003H,0F8H,082H
DB  010H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H
DB  000H,001H,080H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H
DB  000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,001H,001H
DB  080H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H
DB  000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,001H,080H,000H,000H
DB  000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H
DB  000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,001H,080H,000H,000H,000H,000H
DB  000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H
DB  000H,000H,000H,000H,000H,000H,000H,000H,000H,001H,081H,0FFH,03FH,0C1H,0E0H,080H
DB  090H,012H,002H,040H,020H,009H,001H,007H,083H,0F8H,00FH,007H,0F0H,03EH,03FH,0E8H
DB  009H,001H,040H,081H,040H,050H,017H,0F9H,081H,000H,020H,002H,010H,080H,090H,012H
DB  004H,040H,030H,019H,081H,008H,042H,004H,010H,084H,008H,041H,002H,008H,009H,001H
DB  041H,041H,020H,088H,020H,011H,081H,000H,020H,004H,008H,080H,090H,012H,008H,040H
DB  030H,019H,041H,010H,022H,002H,020H,044H,004H,080H,082H,008H,008H,082H,021H,042H
DB  011H,008H,020H,021H,081H,000H,020H,008H,000H,080H,090H,012H,010H,040H,028H,029H
DB  041H,020H,012H,002H,040H,024H,004H,080H,002H,008H,008H,082H,021H,042H,011H,004H
DB  040H,021H,081H,000H,020H,008H,000H,080H,090H,012H,020H,040H,028H,029H,021H,020H
DB  012H,002H,040H,024H,004H,040H,002H,008H,008H,082H,022H,022H,00AH,002H,080H,041H
DB  081H,0FEH,020H,008H,000H,0FFH,090H,012H,060H,040H,024H,049H,011H,020H,012H,004H
DB  040H,024H,008H,038H,002H,008H,008H,044H,022H,022H,004H,002H,080H,081H,081H,000H
DB  03FH,088H,07CH,080H,090H,012H,0A0H,040H,024H,049H,011H,020H,013H,0F8H,040H,027H
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DB  0F0H,007H,002H,008H,008H,044H,012H,024H,00AH,001H,000H,081H,081H,000H,020H,008H
DB  004H,080H,090H,013H,010H,040H,022H,089H,009H,020H,012H,000H,040H,024H,020H,000H
DB  082H,008H,008H,044H,014H,014H,011H,001H,001H,001H,081H,000H,020H,008H,004H,080H
DB  092H,012H,008H,040H,022H,089H,005H,020H,012H,000H,040H,024H,010H,000H,082H,008H
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DB  008H,040H,022H,089H,005H,010H,022H,000H,023H,064H,010H,080H,082H,008H,008H,028H
DB  014H,014H,020H,081H,002H,001H,081H,000H,020H,002H,010H,080H,092H,012H,004H,040H
DB  021H,009H,003H,008H,042H,000H,010H,0C4H,008H,041H,002H,004H,010H,010H,008H,008H
DB  040H,041H,004H,001H,081H,0FFH,020H,001H,0E0H,080H,091H,0E2H,002H,07FH,021H,009H
DB  001H,007H,082H,000H,00FH,064H,004H,03EH,002H,003H,0E0H,010H,008H,008H,080H,021H
DB  00FH,0F9H,080H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H
DB  000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,001H
DB  080H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H
DB  000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,001H,080H,000H,000H
DB  000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H
DB  000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,001H,080H,000H,000H,000H,000H
DB  000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H
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DB  000H,000H,000H,000H,000H,001H,080H,000H,080H,000H,001H,000H,00CH,000H,080H,089H
DB  001H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,020H
DB  000H,040H,03FH,001H,080H,000H,080H,000H,001H,000H,010H,000H,080H,001H,001H,000H
DB  000H,000H,000H,000H,000H,000H,001H,000H,000H,000H,000H,000H,000H,010H,000H,040H
DB  0C0H,0C1H,080H,000H,080H,000H,001H,000H,010H,000H,080H,001H,001H,000H,000H,000H
DB  000H,000H,000H,000H,001H,000H,000H,000H,000H,000H,000H,000H,000H,041H,000H,021H
DB  080H,078H,0B8H,01CH,01DH,00EH,03CH,074H,0B8H,089H,005H,02EH,071H,070H,070H,0B8H
DB  01DH,02CH,0F3H,0D0H,0A0H,0C2H,018H,030H,07FH,080H,000H,042H,01DH,021H,080H,084H
DB  0C4H,022H,023H,011H,010H,08CH,0C4H,089H,009H,031H,089H,088H,088H,0C4H,023H,031H
DB  009H,010H,0A0H,0C2H,014H,050H,041H,000H,000H,042H,023H,011H,081H,004H,082H,040H
DB  041H,020H,091H,004H,084H,089H,011H,021H,009H,009H,004H,082H,041H,021H,001H,010H
DB  091H,025H,022H,090H,082H,001H,0C4H,044H,041H,011H,080H,01CH,082H,040H,041H,020H
DB  091H,004H,084H,089H,021H,021H,009H,009H,004H,082H,041H,021H,001H,010H,091H,025H
DB  022H,088H,082H,002H,038H,044H,081H,011H,080H,0E4H,082H,040H,041H,03FH,091H,004H
DB  084H,089H,061H,021H,009H,009H,004H,082H,041H,020H,0F1H,010H,08AH,028H,0A1H,008H
DB  084H,000H,000H,044H,082H,011H,081H,004H,082H,040H,041H,020H,011H,004H,084H,089H
DB  091H,021H,009H,009H,004H,082H,041H,020H,009H,010H,08AH,028H,0A2H,085H,008H,000H
DB  000H,044H,082H,011H,081H,004H,082H,040H,041H,020H,091H,004H,084H,089H,011H,021H
DB  009H,009H,004H,082H,041H,020H,009H,010H,08AH,028H,0A2H,085H,008H,000H,000H,044H
DB  082H,021H,081H,00CH,0C4H,022H,023H,011H,010H,08CH,084H,089H,009H,021H,009H,008H
DB  088H,0C4H,023H,021H,009H,011H,084H,010H,044H,045H,010H,000H,000H,004H,046H,041H
DB  080H,0F4H,0B8H,01CH,01DH,00EH,010H,074H,084H,089H,005H,021H,009H,008H,070H,0B8H
DB  01DH,020H,0F1H,0CEH,084H,010H,048H,022H,03FH,080H,000H,042H,03BH,081H,080H,000H
DB  000H,000H,000H,000H,000H,004H,000H,008H,000H,000H,000H,000H,000H,080H,001H,000H
DB  000H,000H,000H,000H,000H,002H,000H,000H,000H,001H,000H,011H,080H,000H,000H,000H
DB  000H,000H,001H,008H,000H,008H,000H,000H,000H,000H,000H,080H,001H,000H,000H,000H
DB  000H,000H,000H,002H,000H,000H,000H,000H,0C0H,061H,080H,000H,000H,000H,000H,000H
DB  000H,0F0H,000H,030H,000H,000H,000H,000H,000H,080H,001H,000H,000H,000H,000H,000H
DB  000H,00CH,000H,000H,000H,000H,03FH,081H,080H,000H,000H,000H,000H,000H,000H,000H
DB  000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H
DB  000H,000H,000H,000H,000H,001H,080H,000H,000H,000H,000H,000H,000H,000H,000H,000H
DB  000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H
DB  002H,000H,000H,001H,080H,000H,010H,000H,000H,000H,000H,000H,000H,000H,000H,000H
DB  000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,002H,000H
DB  000H,001H,080H,044H,03CH,038H,040H,040H,0E0H,020H,048H,000H,000H,000H,000H,050H
DB  03CH,03FH,024H,080H,000H,000H,000H,01CH,009H,0E1H,002H,000H,005H,000H,000H,001H
DB  080H,044H,052H,044H,080H,0A1H,010H,0F8H,084H,000H,000H,000H,000H,050H,042H,021H
DB  024H,080H,000H,000H,000H,022H,00AH,011H,002H,000H,005H,000H,000H,001H,080H,044H
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DB   092H,044H,080H,0A1H,010H,020H,084H,000H,000H,000H,000H,048H,042H,021H,024H,080H
DB   000H,000H,000H,041H,012H,011H,082H,000H,005H,000H,000H,001H,080H,088H,090H,045H
DB   001H,011H,010H,050H,084H,000H,000H,000H,010H,048H,042H,021H,024H,091H,000H,004H
DB   080H,041H,013H,001H,042H,078H,008H,080H,000H,001H,083H,0FEH,090H,045H,001H,010H
DB   0A0H,051H,002H,000H,001H,0FCH,010H,048H,042H,021H,000H,000H,000H,038H,070H,001H
DB   011H,081H,042H,085H,0F8H,0FCH,000H,001H,080H,088H,070H,039H,002H,008H,0C0H,001H
DB   002H,000H,000H,000H,010H,048H,042H,021H,000H,000H,000H,0C0H,00CH,002H,012H,061H
DB   022H,084H,080H,008H,000H,001H,080H,088H,01CH,002H,070H,001H,040H,001H,002H,000H
DB   000H,000H,0FEH,044H,042H,021H,000H,000H,001H,000H,002H,004H,024H,011H,012H,084H
DB   060H,030H,000H,001H,080H,088H,012H,002H,088H,002H,022H,001H,002H,000H,000H,000H
DB   010H,045H,081H,0A1H,000H,000H,000H,0C0H,00CH,008H,024H,009H,012H,084H,010H,040H
DB   000H,001H,083H,0FEH,012H,004H,088H,002H,014H,001H,002H,000H,079H,0FCH,010H,044H
DB   042H,021H,000H,000H,000H,038H,070H,008H,022H,009H,00AH,078H,010H,040H,000H,001H
DB   081H,010H,092H,004H,088H,002H,008H,001H,002H,000H,000H,000H,010H,044H,042H,021H
DB   000H,000H,000H,004H,080H,008H,021H,091H,006H,000H,023H,020H,000H,001H,081H,010H
DB   054H,008H,088H,001H,014H,001H,002H,000H,000H,000H,000H,042H,042H,021H,000H,000H
DB   000H,000H,000H,000H,040H,061H,002H,0FCH,02CH,0A0H,000H,001H,081H,010H,038H,008H
DB   070H,000H,0E2H,000H,084H,000H,000H,000H,000H,042H,042H,021H,000H,011H,008H,000H
DB   000H,008H,040H,031H,002H,000H,030H,060H,000H,001H,080H,000H,010H,000H,000H,000H
DB   000H,000H,084H,000H,000H,000H,000H,040H,042H,021H,000H,010H,008H,000H,000H,000H
DB   004H,010H,000H,000H,040H,010H,000H,001H,080H,000H,000H,000H,000H,000H,000H,000H
DB   084H,000H,000H,000H,000H,040H,042H,021H,000H,010H,008H,000H,000H,000H,002H,010H
DB   000H,000H,000H,000H,000H,001H,080H,000H,000H,000H,000H,000H,000H,000H,048H,0FFH
DB   080H,000H,000H,040H,03CH,03FH,000H,000H,000H,000H,000H,000H,001H,0E0H,000H,000H
DB   000H,000H,000H,001H,080H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H
DB   000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H
DB   000H,001H,080H,004H,000H,000H,000H,000H,000H,000H,040H,000H,040H,000H,000H,000H
DB   000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,001H
DB   080H,004H,000H,000H,000H,001H,0F0H,000H,0A0H,000H,0E0H,000H,000H,000H,004H,000H
DB   000H,001H,00CH,010H,000H,000H,000H,000H,000H,000H,000H,000H,000H,001H,080H,00EH
DB   000H,000H,000H,006H,00CH,001H,010H,001H,0F0H,000H,000H,000H,00AH,000H,000H,000H
DB   08CH,020H,000H,000H,000H,000H,000H,003H,0FFH,0F0H,000H,001H,080H,00EH,000H,000H
DB   000H,009H,0F2H,002H,008H,003H,0F8H,000H,000H,000H,011H,000H,000H,000H,040H,040H
DB   000H,000H,000H,000H,000H,003H,0FFH,0F0H,001H,001H,080H,00EH,000H,000H,000H,00AH
DB   00AH,004H,004H,007H,0FCH,000H,000H,000H,011H,000H,006H,000H,020H,080H,000H,000H
DB   000H,000H,060H,003H,0FFH,0F0H,001H,001H,080H,01FH,000H,000H,000H,014H,005H,008H
DB   002H,00FH,0FEH,000H,000H,000H,020H,080H,006H,000H,011H,000H,000H,000H,000H,000H
DB   0F0H,043H,0FFH,0F0H,002H,001H,083H,0FFH,0F8H,078H,01EH,014H,005H,010H,001H,01FH
DB   0FFH,000H,000H,000H,020H,080H,00FH,000H,00AH,000H,000H,000H,000H,001H,0D8H,040H
DB   000H,000H,004H,001H,080H,0FFH,0E0H,084H,03FH,014H,005H,020H,000H,0BFH,0FFH,09FH
DB   0E7H,0F8H,040H,040H,00FH,001H,084H,030H,000H,000H,000H,000H,040H,040H,000H,000H
DB   00CH,001H,080H,07FH,0C1H,004H,03FH,014H,005H,010H,001H,01FH,0FFH,010H,027H,0F8H
DB   040H,040H,01FH,081H,08AH,030H,000H,030H,040H,000H,040H,040H,000H,000H,014H,001H
DB   080H,03FH,081H,004H,07FH,014H,005H,008H,002H,00FH,0FEH,010H,027H,0F8H,080H,020H
DB   01FH,080H,011H,000H,000H,019H,080H,000H,040H,040H,000H,000H,024H,001H,080H,03FH
DB   081H,004H,03FH,00AH,00AH,004H,004H,007H,0FCH,010H,027H,0F8H,080H,020H,03FH,0C0H
DB   020H,080H,0FFH,0F9H,0FFH,0F0H,040H,043H,0FFH,0F0H,044H,001H,080H,07FH,0C0H,084H
DB   03FH,009H,0F2H,002H,008H,003H,0F8H,010H,027H,0F9H,000H,010H,03FH,0C0H,040H,040H
DB   000H,020H,040H,000H,040H,043H,0FFH,0F0H,004H,001H,080H,07BH,0C0H,078H,01EH,006H
DB   00CH,001H,010H,001H,0F0H,010H,027H,0F9H,000H,010H,07FH,0E0H,08CH,020H,000H,000H
DB   000H,000H,040H,043H,0FFH,0F0H,004H,001H,080H,060H,0C0H,000H,000H,001H,0F0H,000H
DB   0A0H,000H,0E0H,01FH,0E7H,0FBH,0FFH,0F8H,07FH,0E1H,00CH,010H,000H,000H,000H,000H
DB   040H,043H,0FFH,0F0H,004H,001H,080H,080H,020H,000H,000H,000H,000H,000H,040H,000H
DB   040H,000H,000H,000H,000H,000H,000H,002H,000H,008H,000H,000H,000H,000H,040H,0D0H
DB   000H,000H,004H,001H,080H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H
DB   000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,000H,040H,060H,000H,000H
DB   000H,001H,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH
DB   0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH
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■ RELIABILITY

▼ Content of Reliability Test

No.	Test Item	Content of Test	Test Condition	Applicable Standard
Environmental Test				
1	High temperature storage	Endurance test applying the high storage temperature for a long time.	80 °C 200 hrs	------
2	Low temperature storage	Endurance test applying the low storage temperature for a long time.	-30 °C 200 hrs	------
3	High temperature operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	70 °C 200 hrs	------
4	Low temperature operation	Endurance test applying the electric stress under low temperature for a long time.	-20 °C 200 hrs	------
5	High temperature / Humidity storage	Endurance test applying the high tempera-ture and high humidity storage for a long time.	50 °C , 90 %RH 96 hrs	MIL-202E-103B JIS-C5023
6	High temperature / Humidity operation	Endurance test applying the electric stress (Voltage & Current) and temperature / humidity stress to the element for a long time.	40 °C 90 %RH 96 hrs	MIL-202E-103B JIS-C5023
7	Temperature cycle	Endurance test applying the low and high temperature cycle. -10°C 30min. ⇌ 25°C 5min. ⇌ 60°C 30min. 1 cycle	-10°C / 60°C 10 cycles	------
Mechanical Test				
8	Vibration test	Endurance test applying the vibration during transportation and using.	10~22Hz → 1.5mmp-p 22~500Hz → 1.5G Total 0.5hrs	MIL-202E-201A JIS-C5025 JIS-C7022-A-10
9	Shock test	Constructional and mechanical endurance test applying the shock during transportation.	50G half sign wave 11 msedc 3 times of each direction	MIL-202E-213B
10	Atmospheric pressure test	Endurance test applying the atmospheric pressure during transportation by air.	115 mbar 40 hrs	MIL-202E-105C
Others				
11	Static electricity test	Endurance test applying the electric stress to the terminal.	VS=800V , RS=1.5 kΩ CS=100 pF 1 time	MIL-883B-3015.1

*** Supply voltage for logic system = 5V. Supply voltage for LCD system = Operating voltage at 25°C.

▼ Failure Judgement Criterion

Criterion Item	Test Item No.											Failure Judgment Criterion
	1	2	3	4	5	6	7	8	9	10	11	
Basic specification												Out of the Basic Specification
Electrical characteristic												Out of the DC and AC Characteristic
Mechanical characteristic												Out of the Mechanical Specification Color change : Out of Limit Apperance Specification
Optical characteristic												Out of the Apperance Standard

■ INSPECTION CRITERIA

see :Q/XRD0002-05

■ PRECAUTIONS FOR USING LCD MODULES

▼ Handing Precautions

(1) The display panel is made of glass. Do not subject it to a mechanical shock by dropping it or impact.

(2) If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.

(3) Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

(4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

(5) If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with one of the following solvents :

- Isopropyl alcohol
- Ethyl alcohol

(6) Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.

- Water
- Ketone
- Aromatic solvents

(7) Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.

■ USING LCD MODULES

▼ Liquid Crystal Display Modules

LCD is composed of glass and polarizer. Pay attention to the following items when handling.

(1) Please keep the temperature within specified range for use and storage. Polarization degradation, bubble generation or polarizer peel-off may occur with high temperature and high humidity.

(2) Do not touch, push or rub the exposed polarizers with anything harder than an HB pencil lead (glass, tweezers, etc.).

(3) N-hexane is recommended for cleaning the adhesives used to attach front/rear polarizers and reflectors made of organic substances which will be damaged by chemicals such as acetone, toluene, ethanol and isopropylalcohol.

(4) When the display surface becomes dusty, wipe gently with absorbent cotton or other soft material like chamois soaked in petroleum benzin. Do not scrub hard to avoid damaging the display surface.

(5) Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading.

(6) Avoid contacting oil and fats.

(7) Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarizers. After products are tested at low temperature they must be warmed up in a container before coming is contacting with room temperature air.

(8) Do not put or attach anything on the display area to avoid leaving marks on.

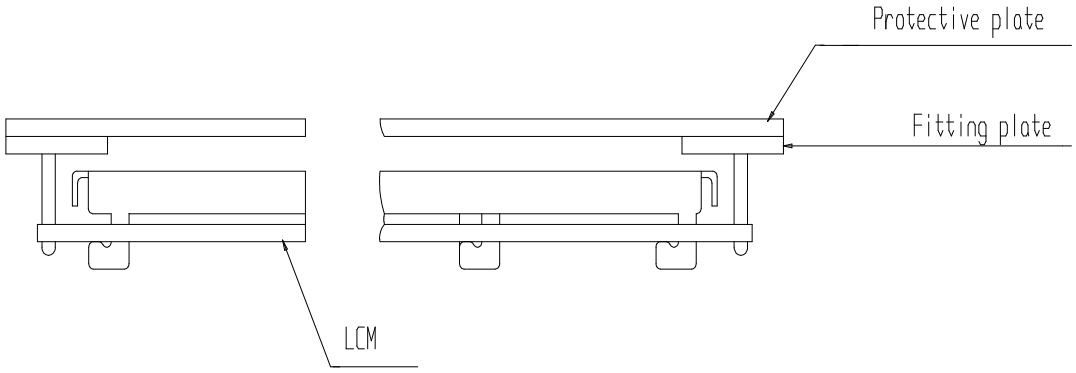
(9) Do not touch the display with bare hands. This will stain the display area and degradate insulation between terminals (some cosmetics are determinated to the polarizers).

(10) As glass is fragile. It tends to become or chipped during handling especially on the edges. Please avoid dropping or jarring.

▼ Installing LCD Modules

The hole in the printed circuit board is used to fix LCM as shown in the picture below. Attend to the following items when installing the LCM.

(1) Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



(2) When assembling the LCM into other equipment, the spacer to the bit between the LCM and the fitting plate should have enough height to avoid causing stress to the module surface, refer to the individual specifications for measurements. The measurement tolerance should be ±0.1mm.

▼ Precaution for Handing LCD Modules

Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.

(1) Do not alter, modify or change the shape of the tab on the metal frame.

(2) Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.

(3) Do not damage or modify the pattern writing on the printed circuit board.

(4) Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector.
(5) Except for soldering the interface, do not make any alterations or modifications with a soldering iron.
(6) Do not drop, bend or twist LCM.

Electro-Static Discharge Control

Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC.

(1) Make certain that you are grounded when handing LCM.
(2) Before remove LCM from its packing case or incorporating it into a set, be sure the module and your body have the same electric potential.
(3) When soldering the terminal of LCM, make certain the AC power source for the soldering iron does not leak.
(4) When using an electric screwdriver to attach LCM, the screwdriver should be of ground potentiality to minimize as much as possible any transmission of electromagnetic waves produced sparks coming from the commutator of the motor.
(5) As far as possible make the electric potential of your work clothes and that of the work bench the ground potential.
(6) To reduce the generation of static electricity be careful that the air in the work is not too dried. A relative humidity of 50%-60% is recommended.

Precaution for soldering to the LCM

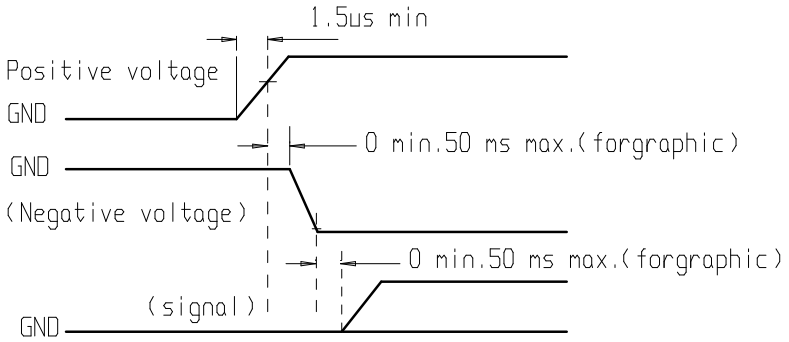
(1) Observe the following when soldering lead wire, connector cable and etc. to the LCM.
- Soldering iron temperature : 280°C ± 10°C.
- Soldering time : 3-4 sec.
- Solder : eutectic solder.

If soldering flux is used, be sure to remove any remaining flux after finishing to soldering operation. (This does not apply in the case of a non-halogen type of flux.) It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage dur to flux spatters.

(2) When soldering the electroluminescent panel and PC board, the panel and board should not be detached more than three times. This maximum number is determined by the temperature and time conditions mentioned above, though there may be some variance depending on the temperature of the soldering iron.
(3) When remove the electroluminescent panel from the PC board, be sure the solder has completely melted, the soldered pad on the PC board could be damaged.

Precautions for Operation

(1) Viewing angle varies with the change of liquid crystal driving voltage (VO). Adjust VO to show the best contrast.
(2) Driving the LCD in the voltage above the limit shortens its life.
(3) Response time is greatly delayed at temperature below the operating temperature range. However, this does not mean the LCD will be out of the order. It will recover when it returns to the specified temperature range.
(4) If the display area is pushed hard during operation, the display will become abnormal. However, it will return to normal if it is turned off and then back on.
(5) Condensation on terminals can cause an electrochemical reaction disrupting the terminal circuit. Therefore, it must be used under the relative condition of 40°C , 50% RH.
(6) When turning the power on, input each signal after the positive/negative voltage becomes stable.



Storage

When storing LCD's as spares for some years, the following precaution are necessary.

(1) Store them in a sealed polyethylene bag. If properly sealed, there is no need for dessicant.

(2) Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0°C and 35°C.

(3) The polarizer surface should not come in contact with any other objects. (We advise you to store them in the container in which they were shipped.)

(4) Environmental conditions :

- Do not leave them for more than 168hrs. at 80°C.
- Should not be left for more than 48hrs. at -30°C.

Safety

(1) It is recommended to crush damaged or unnecessary LCD's into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.

(2) If any liquid out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

Limited Warranty

Unless agreed between TPS and customer, TPS will replace or repair any of its LCD modules which are found to be functionally defective when inspected in accordance with TPS LCD acceptance standards (copies available upon request) for a period of one year from date of shipments. Cosmetic/ visual defects must be returned to TPS within 90 days of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of TPS limited to repair and/or replacement on the terms set forth above. TPS will not be responsible for any subsequent or consequential events.

Return LCM under warranty

No warranty can be granted if the precautions stated above have been disregarded. The typical examples of violations are :

- Broken LCD glass.
- PCB eyelet's damaged or modified.
- PCB conductors damaged.
- Circuit modified in any way, including addition of components.
- PCB tampered with by grinding, engraving or painting varnish.
- soldering to or modifying the bezel in any manner.

Module repairs will be invoiced to the customer upon mutual agreement. Modules must be returned with sufficient description of the failures or defects. Any connectors or cable installed by the customer must be removed completely without damaging the PCB eyelet's, conductors and terminals.