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OSD1602-3 PLED 16x2 Character Module



OSD1602-3 Specifications

1. Features

- ◆ 2 lines of 16 characters of 5x8 (dots)
- ◆ Low power consumption
- ◆ High contrast ratio and wide viewing angle
- ◆ Compatible with LCD 16x2 type
- ◆ Controller is compatible with HD44780

2. Absolute maximum ratings

Symbol	Parameter	Min	Typ	Max	Unit
V _{DD}	Supply voltage for Logic	4.5	5.0	5.5	V
T _{OP}	Operating temperature	-20	25	50	°C
T _{ST}	Storage temperature	-30		70	°C
V _{BT}	Brightness control voltage		3		V
Pd	Module power consumption @Vbt=3V VDD=5V		63		mW

Item	Operating		Storage	
	Min.	Max.	Min.	Max.
Ambient Temperature	-20°C	50°C	-30°C	70°C
Humidity	40°C 90%RH		40°C 90%RH	
Corrosive gas	Not Acceptable		Not Acceptable	

3. Electrical Characteristics

3.1 DC Electrical Characteristics

(Ta= -20 to 50 °C)

Item	Symbol	Condition	Min	Typ	Max	Unit
Power supply voltage	V _{DD}		4.5	5	5.5	V
Brightness control voltage	V _{BT}			3		V
Power supply current	I _{CC}	VDD=5V, (Logical only)		0.35	0.6	mA
High level input voltage	V _{IH}		0.7VDD		VDD	V
Low level input voltage	V _{IL}		-0.3		0.55	V
Leakage current	I _L		-1		1	uA

3.2 AC Electrical Characteristics

(Ta= -20 to 50 °C)

Write operation

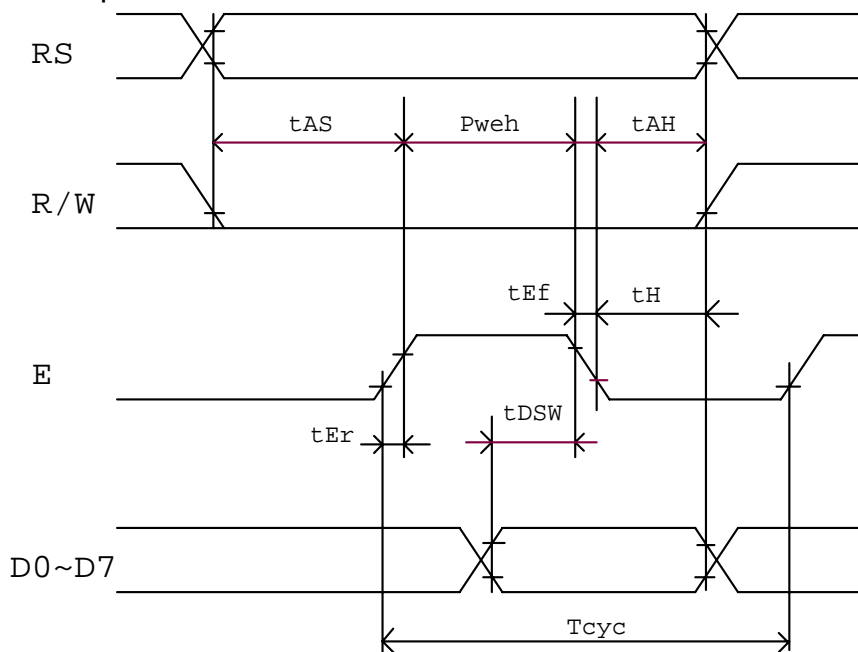
Item	Symbol	Min	Typ	Max	Unit
Enable Cycle Time	Tcyc	500			ns
Enable Pulse Width (High level)	Pweh	230			ns
Enable Rise/ Fall Time	tEf, tEr			20	ns
Address Set-up Time	tAS	40			ns
Address Hold Time	tAH	10			ns
Data Set-up Time	tDSW	80			ns
Data Hold Time	tH	10			ns

Read operation

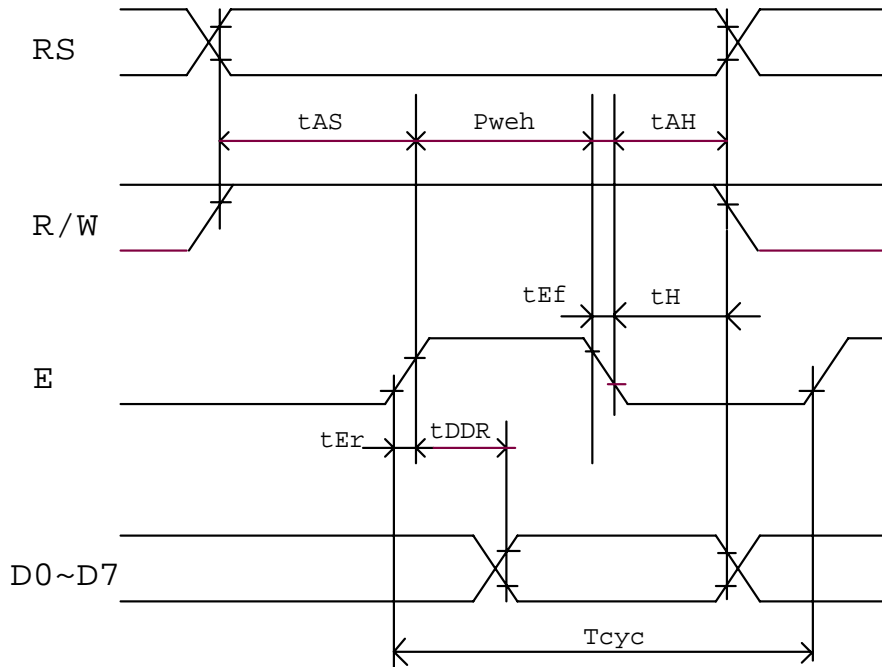
Item	Symbol	Min	Typ	Max	Unit
Enable Cycle Time	Tcyc	500			ns
Enable Pulse Width (High level)	Pweh	230			ns
Enable Rise/ Fall Time	tEf, tEr			20	ns
Address Set-up Time	tAS	40			ns
Address Hold Time	tAH	10			ns
Data Delay Time	tDDR			160	ns
Data Hold Time	tH	5			ns

3.3 Timing Chart

Write operation



Read operation



3.4 Display Data RAM (DDRAM)

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

For shift left

01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10
41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50

For shift right

27	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E
67	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E



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3.5 Correspondence between character codes and char patterns

UPPER BITS \ LOWER BITS	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000 CG RAMI			0	1	2	3	4	5			6	7	8	9	0	1
0001 CG ---		!	1	2	3	4	5			.	7	8	9	0	1	2
0010 CG ---		"	2	3	4	5	6			7	8	9	0	1	2	3
0011 CG ---		#	3	4	5	6	7			8	9	0	1	2	3	4
0100 CG DAME		\$	4	5	6	7	8			9	0	1	2	3	4	5
0101 CG ---		%	5	6	7	8	9			.	1	2	3	4	5	6
0110 CG RAMI		&	6	7	8	9	0			1	2	3	4	5	6	7
0111 CG RAMI		'	7	8	9	0	1			2	3	4	5	6	7	8
1000 CG RAMI		(	8	9	0	1	2			3	4	5	6	7	8	9
1001 CG RAMI		)	9	0	1	2	3			4	5	6	7	8	9	0
1010 CG RAMI		*	0	1	2	3	4			5	6	7	8	9	0	1
1011 CG RAMI		+	1	2	3	4	5			6	7	8	9	0	1	2
1100 CG RAMI		,	2	3	4	5	6			7	8	9	0	1	2	3
1101 CG RAMI		-	3	4	5	6	7			8	9	0	1	2	3	4
1110 CG RAMI		.	4	5	6	7	8			9	0	1	2	3	4	5
1111 CG RAMI		/	5	6	7	8	9			0	1	2	3	4	5	6



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Optional Cyrillic Font

Upper 4 bit Lower 4 bit	LLLL	LLLH	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
LLLL	CG RAM (1)			00P' P							604. 24					
LLLH	CG RAM (2)		!	100a a							79u. 14					
LLHL	CG RAM (3)		"	20Rb r							86u. 14					
LLHH	CG RAM (4)		#	30Sc s							93u. 14					
LHLL	CG RAM (5)		\$	40Tt t							00u. 14					
LHLH	CG RAM (6)		%	50Uu u							07u. 14					
LHHL	CG RAM (7)		&	60Vv v							14u. 14					
LHHH	CG RAM (8)		'	70Ww w							21u. 14					
HLLL	CG RAM (1)		(	80Xx x							28u. 14					
HLLH	CG RAM (2)		)	90Yy y							35u. 14					
HLHL	CG RAM (3)		*	# JZjz							42u. 14					
HLHH	CG RAM (4)		+	# Kk k							49u. 14					
HHLL	CG RAM (5)		.	< L l l							56u. 14					
HHLH	CG RAM (6)		-	= M m m							63u. 14					
HHHL	CG RAM (7)		.	> N n n							70u. 14					
HHHH	CG RAM (8)		/	? O o o							77u. 14					



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```
write_command(0x01); //clear display
write_command(0x06); // display Insert mode: cursor shift right and AC++
}

void main(void)          //the main function start
{
int i;

// initial I/O port-----

DDRB = 0xff;
DDRA = 0xff;
DDRC = 0xff;
DDRD = 0xff;

//-----

clrEN();

for (;;)
{
initial_LCD();

write_command(0x02); // cursor to zero
write_command(0x81); // display data adress = 0;

    for ( i = 0 ; i < 96  ; i ++ )
    {
write_data(0xA0+i); // show the some character on LCD
delay2(delaytime3);
    }

} //end of for(;;)

} // void main(void)
```

10 Precaution in Design

- (1) Please do not expose the module to mechanical stress, which will cause damage to the metal, plastic, and PLED glass.
- (2) Polarizer is easily scratched and should be carefully handled. Please do not touch the polarizer use hard material, such as tweezers, pencil lead and glass. Please do not touch it with bare hand.
- (3) This module is easily damaged when exposed to static discharge, please take care of static electricity and insure human body grounding.
- (4) The Half-Brightness Decay life will be longer than 10K hours in room temperature.



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3.6 Instruction set

Instruction	Code										Description	Execution time
	RS	R/W	D7	D6	D5	D4	D3	D2	D1	D0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Clear entire display. Sets DDRAM address 0 into address counter	1.52ms
Entry mode set	0	0	0	0	0	0	0	1	I/D	S	Sets cursor move direction and specifies display shift	37us
Display On/Off control	0	0	0	0	0	0	1	D	C	B	Sets entire display (D) On/Off Sets cursor (C) On/Off Sets Blinking (B) of cursor position character	37us
Cursor/display shift	0	0	0	0	0	1	S/C	R/L	X	X	Moves cursor & shifts display without changing DDRAM contents	37us
Function set	0	0	0	0	1	DL	N	F	X	X	Sets interface data length (DL) Sets number of display lines (N) Sets character font (F)	37us
Set CGRAM address	0	0	0	1	ACG	ACG	ACG	ACG	ACG	ACG	Sets CGRAM address. CGRAM data is sent and received after this setting.	37us
Set DDRAM address	0	0	1	ADD	ADD	ADD	ADD	ADD	ADD	ADD	Sets DDRAM address. The DDRAM data bus sent and received after this setting	37us
Read busy flag & address	0	1	BF	AC	AC	AC	AC	AC	AC	AC	Reads busy flag (BF) indicating that internal operation is being performed Reads address counter contents	0us
Write data into the CGRAM or DDRAM	1	0	Write data							Write data into the CGRAM or DDRAM		37us
Read data into the CGRAM or DDRAM	1	1	Read data							Read data from the CGRAM or DDRAM		37us
	I/D =1: Increment I/F=0:Decrement S =1: Display shift on D =1: Display on C =1: Cursor display on B =1: Cursor blink on S/C =1: Shift display S/C=0: Move cursor R/L =1: Shift right R/L=0:Shift left DL =1: 8-bit DL=0:4-bit N =1: Dual line N =0: Single line F =1:5x10 dots F =0:5x8 dots BF =1:Internal operation BF =0:Ready for instruction										DDRAM: Display Data RAM CGRAM: Character Generator RAM ACG: Character Generator RAM Address ADD: Display Data RAM Address AC: Address Counter	

3.7 Initialization via Instruction 8-BIT INTERFACE

The procedures of the initialization of an 8-bit MPU as follows.

Power ON

WAIT FOR MORE THAN 15ms AFTER THE VDD RISES TO 4.5V

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

WAIT FOR MORE THAN 4.1ms

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

WAIT FOR MORE THAN 100 us

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

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	1	N	F	*	*
0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	1	I/D	S

END OF INITIALIZATION

BF CANNOT BE CHECKED BEFORE THIS INSTRUCTION.
 FUNCTION SET (INTERFACE IS 8 BITS LONG)

BF CANNOT BE CHECKED BEFORE THIS INSTRUCTION.
 FUNCTION SET (INTERFACE IS 8 BITS LONG)

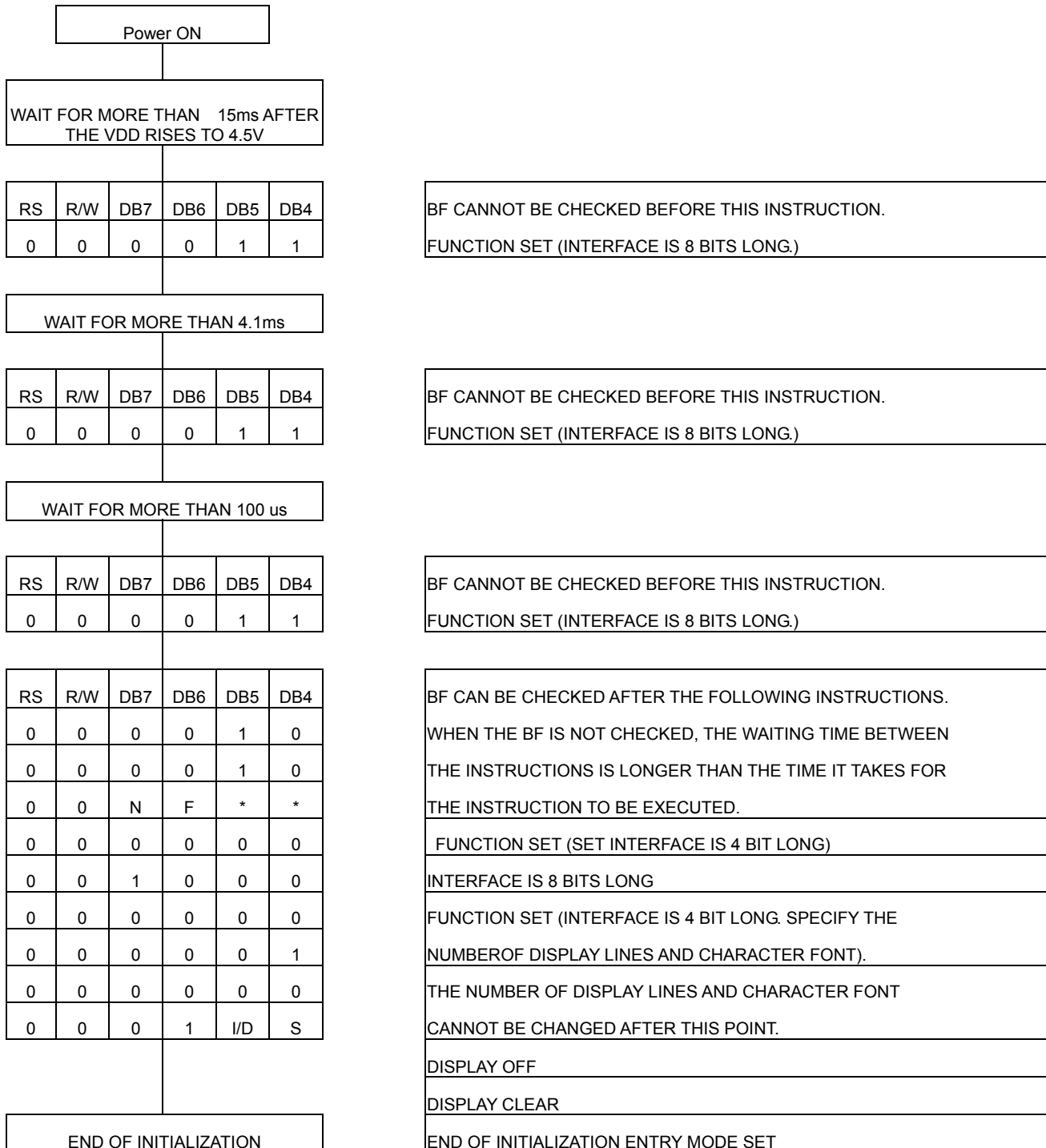
BF CANNOT BE CHECKED BEFORE THIS INSTRUCTION.
 FUNCTION SET (INTERFACE IS 8 BITS LONG)

BF CAN BE CHECKED AFTER THE FOLLOWING INSTRUCTIONS. WHEN BF IS NOT CHECKED, THE WAITING TIME BETWEEN THE INSTRUCTIONS IS LONGER THAN THE EXECUTION TIME OF THE INSTRUCTION

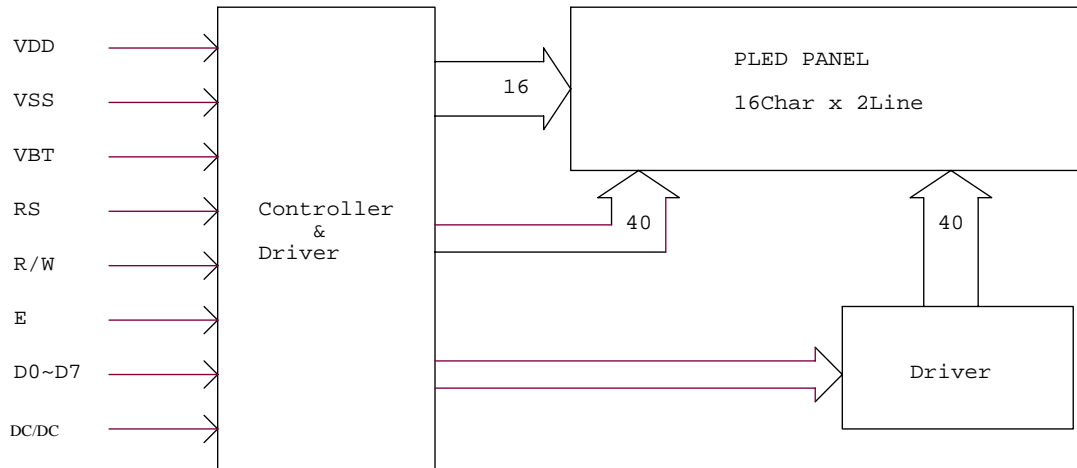
END OF INITIALIZATION
 FUNCTION SET (INTERFACE IS 8 BITS LONG) SPECIFY THE NUMBER OF DISPLAY LINES AND CHARACTER FONT)
 THE NUMBER OF CHARACTER LINES AND CHARACTER FONT CANNOT BE CHANGED AFTER THIS POINT.
 DISPLAY OFF
 DISPLAY CLEAR
 ENTRY MODE

4-BIT INTERFACE

The procedures of the initialization of a 4-bit MPU as follows.



Block Diagram



4 Interface Pin Function

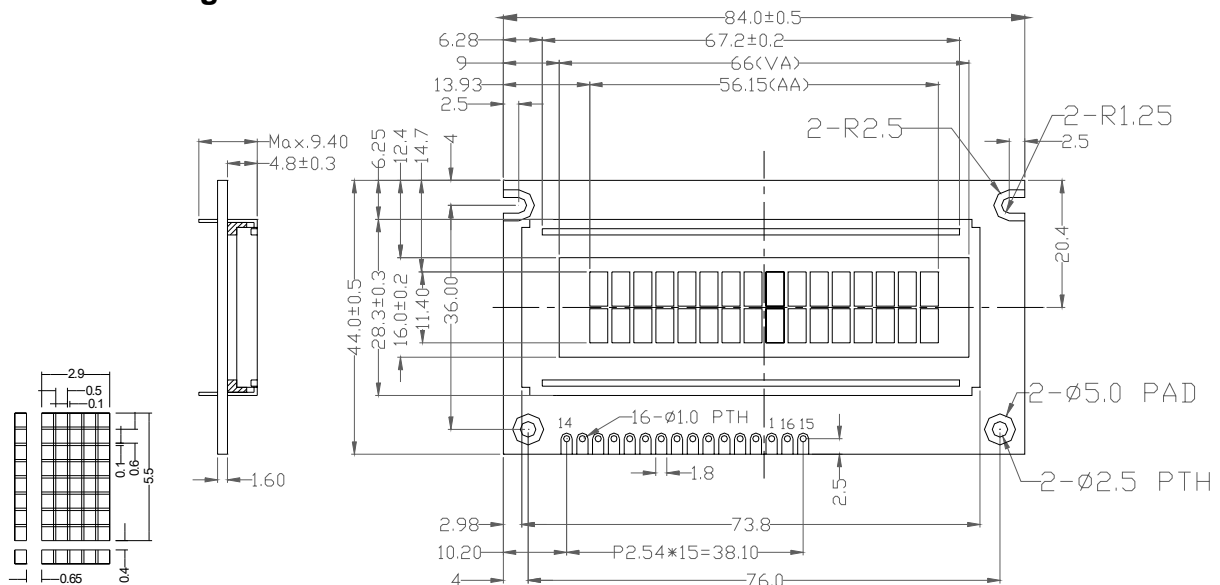
Pin No.	Symbol	I/O	Function
1	V _{SS}	I	Ground
2	V _{DD}	I	Power supply for logic
3	V _{BT}	I	Brightness adjustment
4	RS	I	H: Data L: Instruction code
5	R/W	I	H: Read L: Write
6	E	I	H→L: Enable
7	D0	I	Data bus
8	D1	I	
9	D2	I	
10	D3	I	
11	D4	I	
12	D5	I	
13	D6	I	
14	D7	I	
15	NC		No Connection
16	NC		No Connection

6 Physical specifications

6.1 Mechanical specifications

NO.	Item	Specification	Unit
1	Active display area	56.15x11.4	mm
2	Viewing area	66.0x16.0	mm
3	Module dimension	84.0x44.0x9.4	mm
4	Dot size	0.5x0.6	mm
5	Weight	27	g

6.2 Drawing



7 Optical specifications

Item	Condition	Min.	Typ.	Max.	Unit
Response time	Rise	-	10	-	us
	Fall	-	10	-	us
Contrast ratio	100 lux	-	100	-	
Viewing angle	Top	-	80	-	deg
	Bottom	-	80	-	deg
	Left	-	80	-	deg
	right	-	80	-	deg
Brightness	V _{BT} =3V, With polarizer	-	40	-	nits
Color		-	YG ¹	-	

Note 1. YG=yellow green



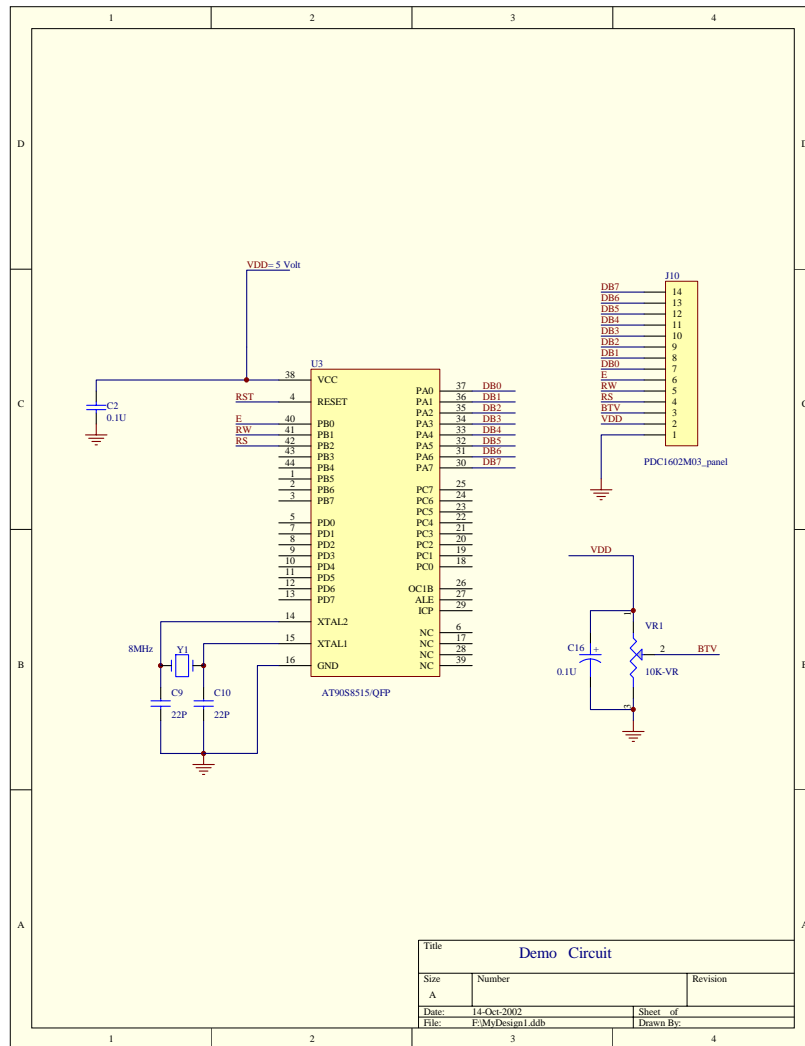
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8 Reliability test items

NO.	Test items	Conditions
1	High temperature storage	70 °C , 240 hrs
2	Low temperature storage	-30 °C,240 hrs
3	High temperature operation	50 °C,240 hrs
4	Low temperature operation	-20 °C,240 hrs
5	High temperature and high humidity storage test	40°C, 90% RH, 240 hrs
6	Temperature Shock (operating)	-20 °C (30 mins.) -->25 °C(5 mins.) --> +70 °C (30 mins.) --> 25 °C(5 mins.) --> -20 °C (30 mins.), 20 Cycles
7	ESD test (IEC61000-4-2)	1. Static (contact: level 2 , air: level 2) 2. Operation (contact: level 2 , air: level 2)

9 Application Note

- (1) Ref. Circuit
 (see Demo-circuit drawing on next page)



(2) Ref. Program (The program use language-C to run Random-texts.)

```
//LCD display test Rounting 2002/04/15
```

```
#include <io8515.h>
```

```
//-----SET 1602LCD MODULE CONTROL I/O PORT-----
```

```
#define RS 0x04
#define RW 0x02
#define EN 0x01
```

```
#define P0 PORTA
#define P0_IO DDRA
#define P0_in PINA
```

```
//end of SET 1602LCD MODULE CONTROL I/O PORT-----
```



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```
void delay(void) // function of delay time
{
float j,k;
for ( j=0;j<1;j++)
{
for ( k=0;k<1;k++)
{
j=j;
k=k;
}
}
}

void setRS(void) // Set RS High
{
PORTB |= RS;
delay();
}
void clrRS(void) // Set RS Low
{
PORTB &=(~RS);
delay();
}
void setRW(void) // Set RW High
{
PORTB |= RW;
delay();
}
void clrRW(void) // Set RS Low
{
PORTB &=(~RW);
delay();
}
void setEN(void) // Set EN High
{
PORTB |= EN;
delay();
}
void clrEN(void) // Set RS Low
{
PORTB &=(~EN);
delay();
}

void write_command(unsigned char command) //function of write instruction to LCD
{
unsigned char in;

while (1) //check the busy flag
{
P0_IO=0xff;
```



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```
P0= 0xFF ;
clrRS();
setRW();
setEN();
P0_IO=0x00;
in = P0_in;
clrEN();
if( (in & 0x80) == 0 )
{
break;
}
}

delay();

P0_IO=0xff;
PORTA = command;
clrRW();
clrRS();
setEN();
clrEN();

}

void write_data(unsigned char DD) // function of write the data to Display RAM of LCD
{
unsigned char in1;

while (1) //check the busy flag
{
P0_IO=0xff;
P0 = 0xFF ;
clrRS();
setRW();
setEN();
P0_IO=0x00;
in1 = P0_in;
clrEN();
if( (in1 & 0x80) == 0 )
{
break;
}
}
P0_IO=0xff;
P0 = DD;
clrRW();
setRS();
setEN();
clrEN();

}

void initial_LCD(void) // function to initialize the LCD
{
write_command(0x38); // 8 bits data length ; 2 Line display; 5x7 dots per word
write_command(0x08); //display off; no cursor;
```



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```
write_command(0x01); //clear display
write_command(0x06); // display Insert mode: cursor shift right and AC++
}

void main(void)          //the main function start
{
int i;

// initial I/O port-----

DDRB = 0xff;
DDRA = 0xff;
DDRC = 0xff;
DDRD = 0xff;

//-----

clrEN();

for (;;)
{
initial_LCD();

write_command(0x02); // cursor to zero
write_command(0x81); // display data adress = 0;

    for ( i = 0 ; i < 96 ; i ++ )
    {
        write_data(0xA0+i); // show the some character on LCD
        delay2(delaytime3);
    }

} //end of for(;;)

} // void main(void)
```

10 Precaution in Design

- (1) Please do not expose the module to mechanical stress, which will cause damage to the metal, plastic, and PLED glass.
- (2) Polarizer is easily scratched and should be carefully handled. Please do not touch the polarizer use hard material, such as tweezers, pencil lead and glass. Please do not touch it with bare hand.
- (3) This module is easily damaged when exposed to static discharge, please take care of static electricity and insure human body grounding.
- (4) The Half-Brightness Decay life will be longer than 10K hours in room temperature.