

Title : PLED 16x2 Characters Module PDC1602M03 Specifications

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Dept. : System Products

Approved By	Review By	Prepared By
	Control Yes Document No	
	Confidential Document	

PLED 16x2 Characters Module PDC1602M03 Specifications

1. Features

1. 2 lines of 16 characters of 5x8 (dots)
2. Low power consumption
3. High contrast ratio and wide viewing angle
4. Compatible with LCD 16x2 type
5. Controller is compatible with HD44780

2. Absolute maximum ratings

Symbol	Parameter	Min	Typ	Max	Unit
VDD	Supply voltage for Logic	4.5	5.0	5.5	V
Topr	Operating temperature	-20	25	50	°C
Tstg	Storage temperature	-30		70	°C
Vbt	Brightness control voltage	2.5	3	5	V
Tsolder	Soldering Temperature	260°C for 5 seconds			
Pd	Module power consumption @ Vbt=3V (Note 1)	50	63	113	mW
Ps	Power saving mode @ Vbt=2.5V (Note 2)	38	50	63	mW

Item	Operating		Storage	
	Min.	Max.	Min.	Max.
Ambient Temperature	-20°C	50°C	-30°C	70°C
Humidity	45°C 85%RH		45°C 85%RH	
Corrosive gas	Not Acceptable		Not Acceptable	

Note 1. Power consumption was measured with VBT=3V, VDD=5V and 3 test patterns (all pixels off, random texts, all pixels on)

Note 2. Power consumption was measured with VBT=2.5V, VDD=5V and 3 test patterns (all pixels off, random texts, all pixels on)

3. Electrical Characteristics

3.1 DC Electrical Characteristics

(Ta= -20 to 50°C)

Item	Symbol	Condition	Min	Typ	Max	Unit
Power supply voltage	VDD		4.5	5	5.5	V
Brightness control voltage	VBT		2.5	3	5	V
Power supply current	Icc	VDD=5V, (Logical only)		0.35	0.6	mA
High level input voltage	Vih		0.7VDD		VDD	V
Low level input voltage	Vil		-0.3		0.55	V
Leakage current	Il		-1		1	uA

3.2 AC Electrical Characteristics

(Ta= -20 to 50°C)

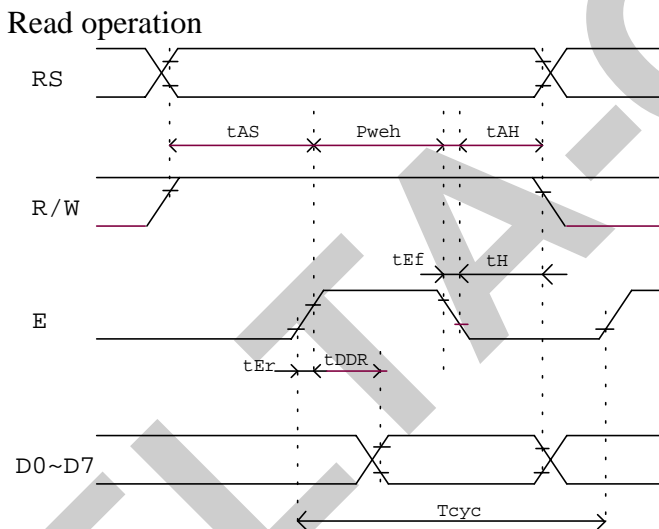
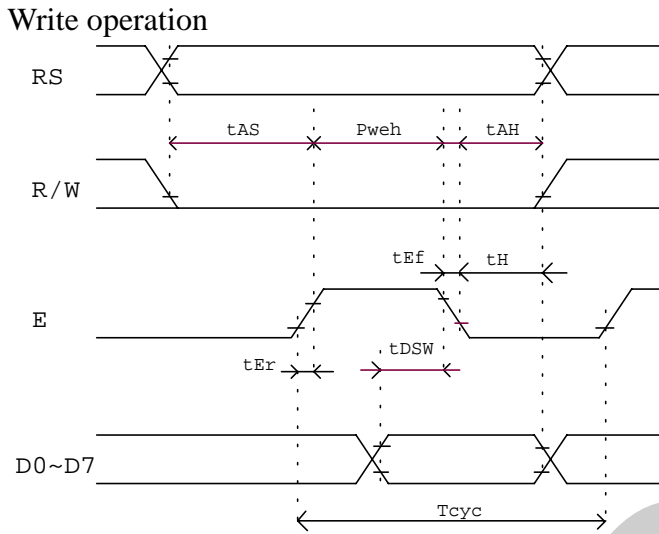
Write operation

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

Read operation

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

3.3 Timing Chart



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	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

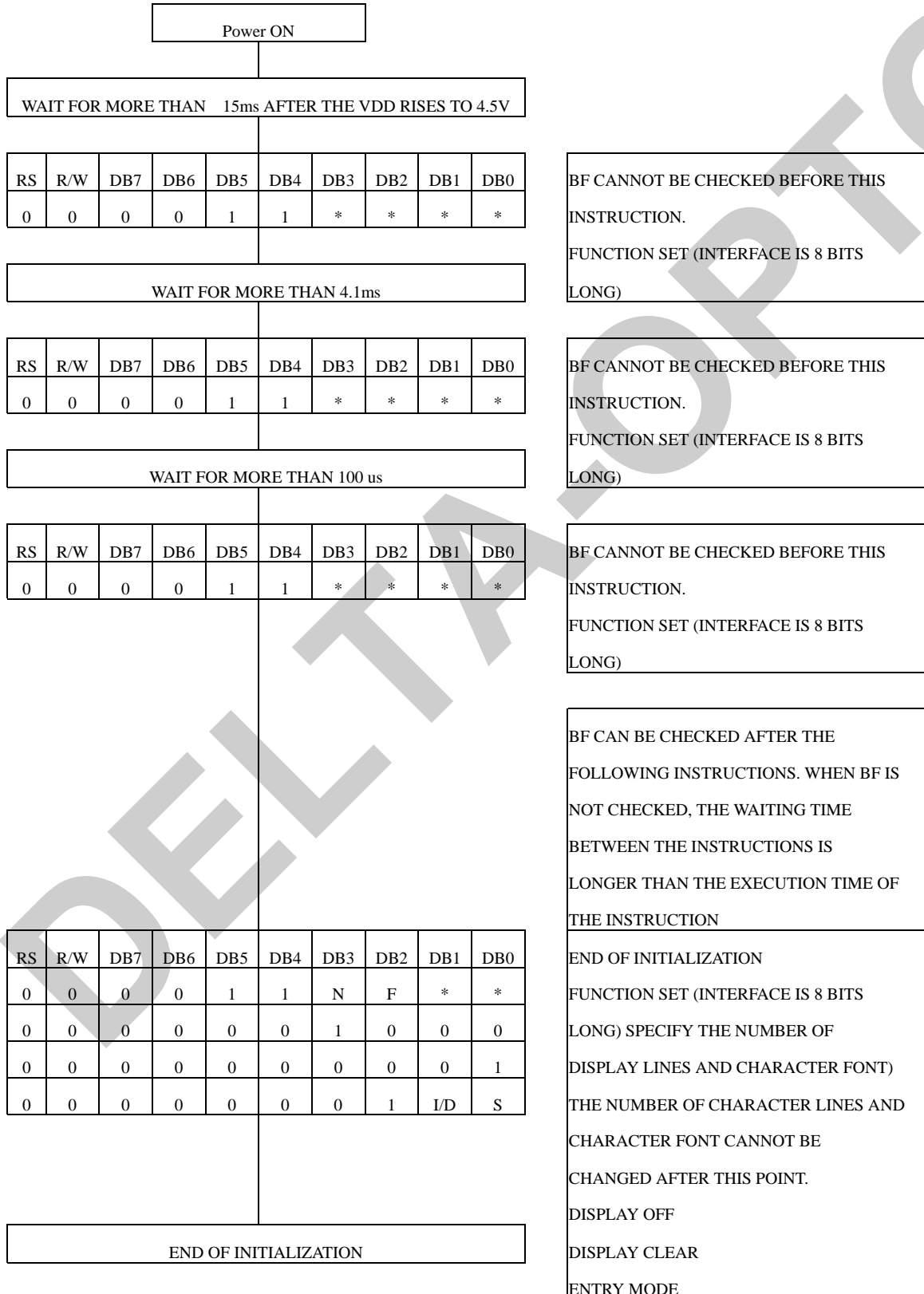
3.6 Instruction set

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
Return home	0	0	0	0	0	0	0	0	1	X	Sets DDRAM address 0 into address counter DDRAM contents remain unchanged	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	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	1	S/C	R/L	X	X		Moves cursor & shifts display without changing DDRAM contents	37us
Function set	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	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		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

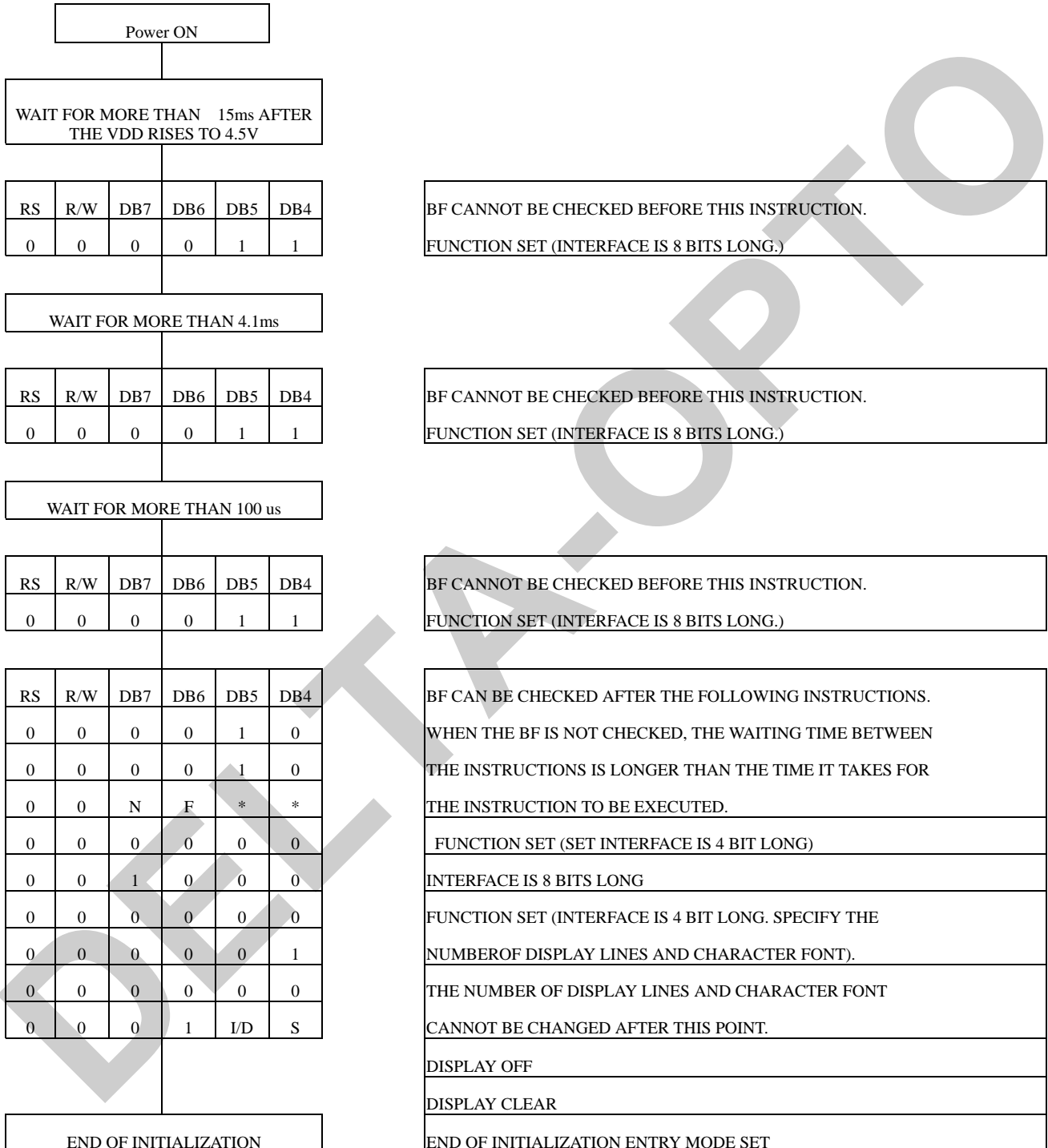
8-BIT INTERFACE

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

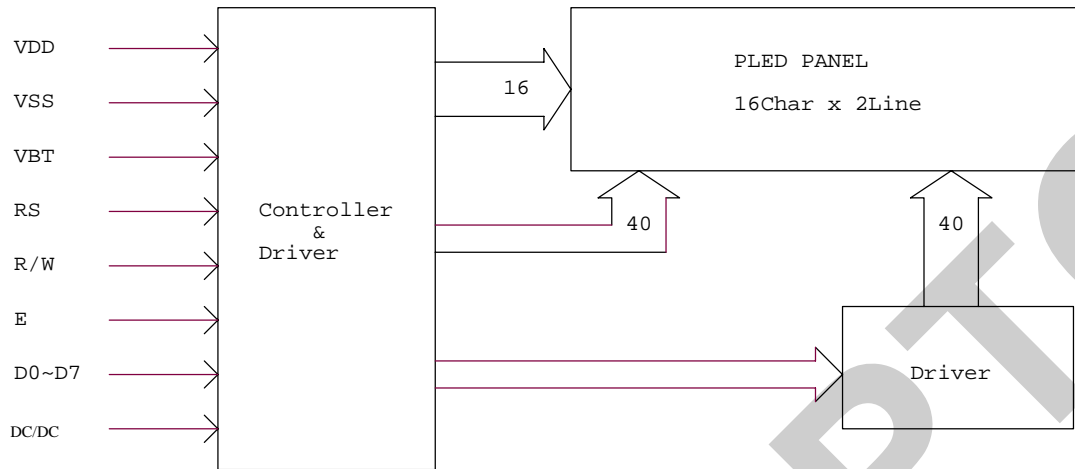


4-BIT INTERFACE

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



3.8 Block Diagram



3.9 Brightness Control

VBT	Brightness (nits)	Power consumption (measured with random texts)
2.5V	18(typical)	50 mW
3.0V	38(typical)	63 mW

- Note:
1. When random texts pattern is running, averagely, at any instance, about 1/4 of pixels will be on.
 2. If VBT is not operated within 2.5V and 3V, non-uniformity display may occur.
 3. You have to use the saving mode by VBT 2.5-V in order to make long life.

4 Interface Pin Function

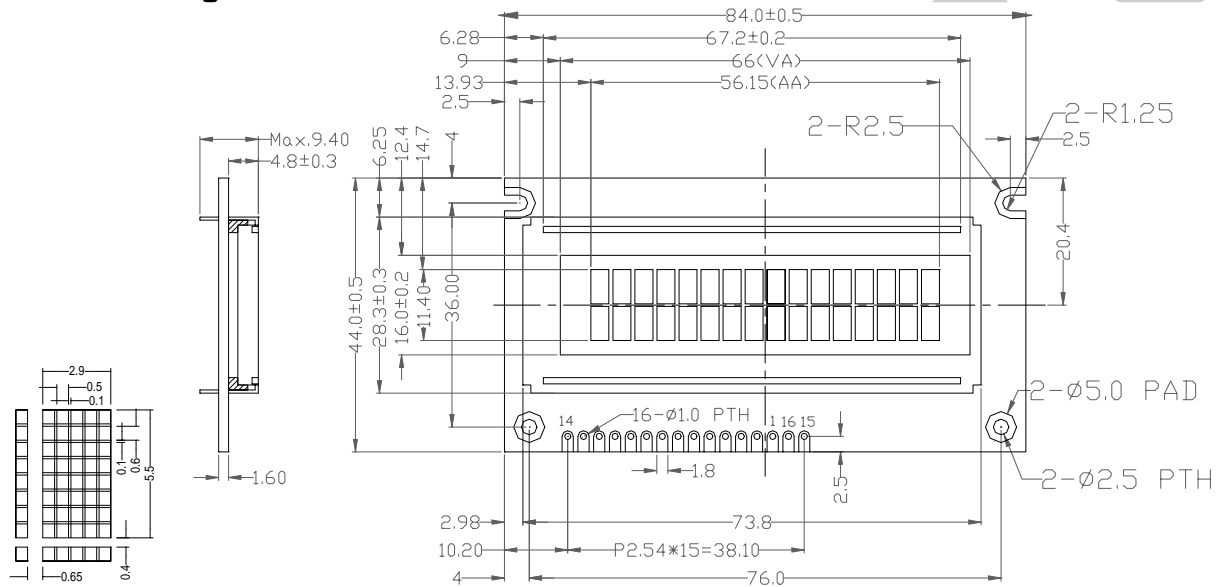
Pin No.	Symbol	I/O	Function
1	VSS	I	Ground
2	VDD	I	Power supply for logic
3	VBT	I	Brightness adjustment
4	RS	I	H: Data L: Instruction code
5	R/W	I	H: Read L: Write
6	E	I	H L: Enable
7	D0	I	Data bus
8	D1	I	
9	D2	I	
10	D3	I	
11	D4	I	
12	D5	I	
13	D6	I	
14	D7	I	
15	NC		
16	NC		

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	With polarizer	-	40	-	nits
Color		-	YG ¹	-	

Note 1. YG=yellow green

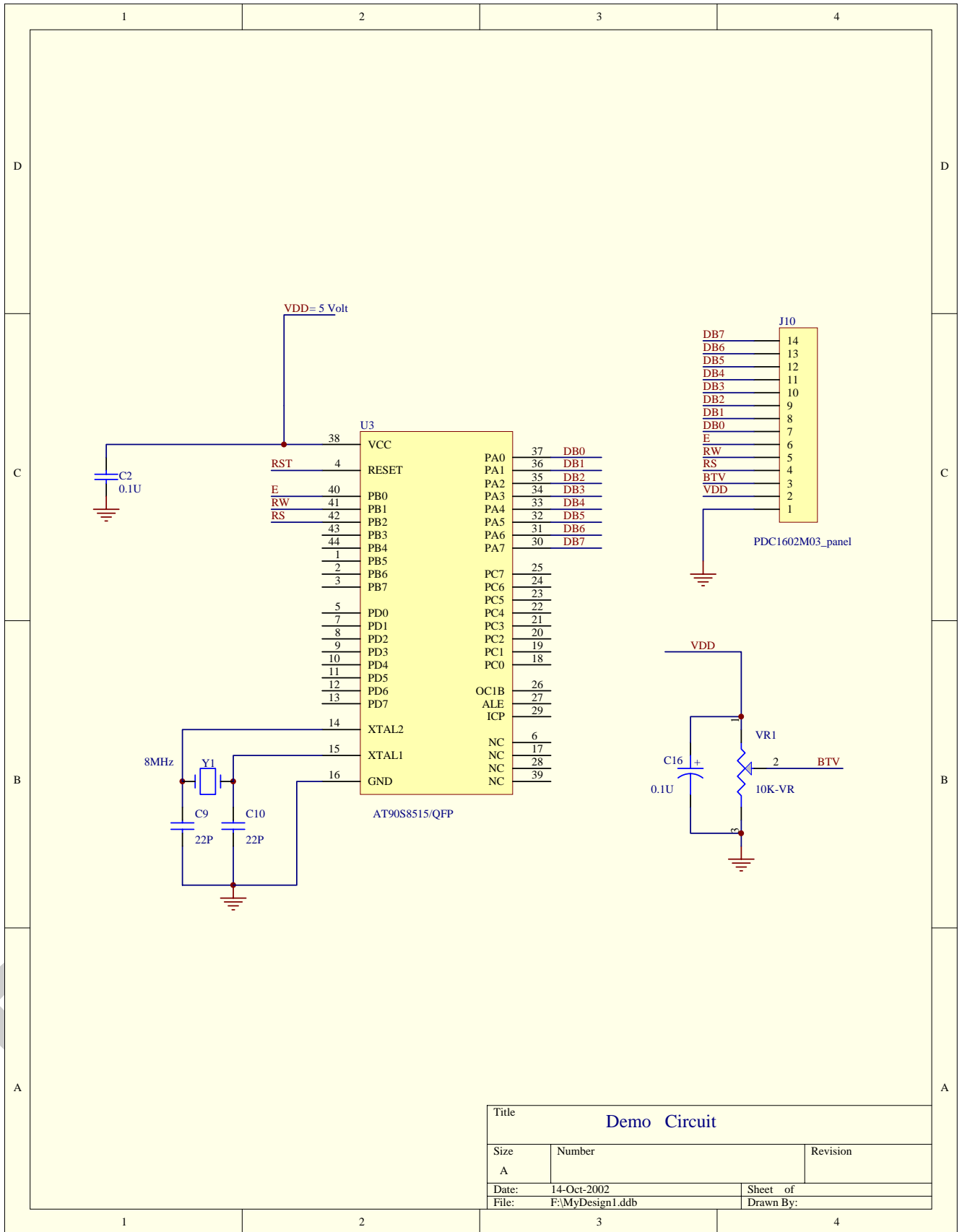
8 Reliability test items

<i>NO.</i>	<i>Test items</i>	<i>Conditions</i>
1	High temperature storage	70°C , 120 hrs
2	Low temperature storage	-30°C, 120 hrs
3	High temperature operation	50°C, 120 hrs
4	Low temperature operation	-20°C, 120 hrs
5	High temperature and high humidity storage test	40°C, 90% RH, 120 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)



Title		
Demo Circuit		
Size	Number	Revision
A		
Date:	14-Oct-2002	Sheet of
File:	F:\MyDesign1.ddb	Drawn By:

(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-----
```

```
void delay(void) // functin 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;
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 of intial the LCD
{
write_command(0x38); // 8 bits data length ; 2 Line display; 5x7 dots per word
write_command(0x08); //display off; no cursor;
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 by barehand.
- (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 longer than 10K hours in room temp.