

Title : PLED 20 x 2 Character Module PDC2002M02 Specification

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Dept. : 產品設計

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	Control Document	
	Yes No	
	Confidential Document	

PDC2002M

**PLED 20x2 Characters Module PDC2002M02
Specifications**

Date: 2004/3/25

PLED 20x2 Character Module PDC2002M02 Specification

1. Features

1. 2 lines of 20 characters of 5x8 (dots)
2. Low power consumption
3. High contrast ratio and wide viewing angle
4. Compatible with LCD 20x2 type
5. Controller is compatible with HD44780
6. 4-bits or 8-bit MPU interface
7. High speed MPU interface:2 MHz(VDD=5V)
8. 80x8 bit Display RAM(80 characters max.)

2. Absolute maximum ratings

<i>Symbol</i>	<i>Parameter</i>	<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
VDD	Supply voltage for Logic	4.5	5.0	5.5	V
Topr	Operating temperature	-20	25	60	
Tstg	Storage temperature	-30		70	
Vbt	Brightness control voltage		3		V
Tsolder	Soldering Temperature	260	for 5 seconds		
Pd	Module power consumption @ Vbt=3V VDD=5V	50	80	130	mW

<i>Item</i>	<i>Operating</i>		<i>Storage</i>	
	<i>Min.</i>	<i>Max.</i>	<i>Min.</i>	<i>Max.</i>
Ambient Temperature	-20°C	60°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)

<i>Item</i>	<i>Symbol</i>	<i>Condition</i>	<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
Power supply voltage	VDD		4.5		5.5	V
Brightness control voltage	VBT			3		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)

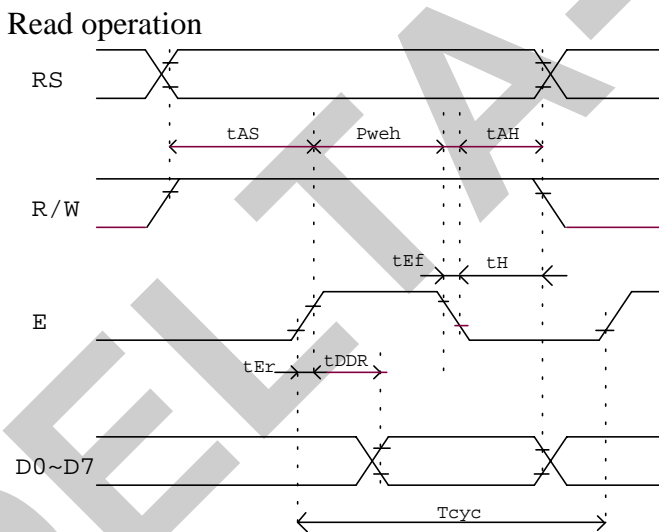
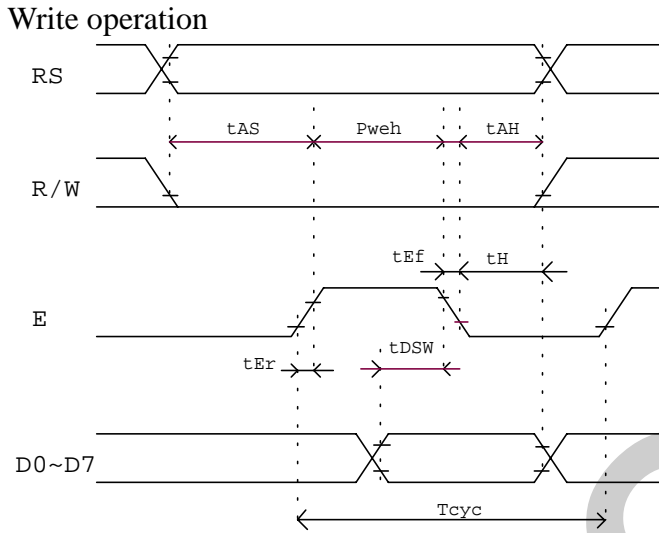
Write operation

<i>Item</i>	<i>Symbol</i>	<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
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

<i>Item</i>	<i>Symbol</i>	<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
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



3.4 Display Data RAM (DDRAM)

The Display Data RAM (DDRAM) is used to store the Display Data which is represented as 8-bit character code. The Display Data RAM supports an extended capacity of 80 x 8-bits or 80 characters.

DDRAM	00	01	02	03	04	05	.....	22	23	24	25	26	27
Address (Hex)	40	41	42	43	44	45	.....	62	63	64	65	66	67

To illustrate, for 2-line x 20 characters display, the relationship between the DDRAM address

and position of the PLED panel is shown below.

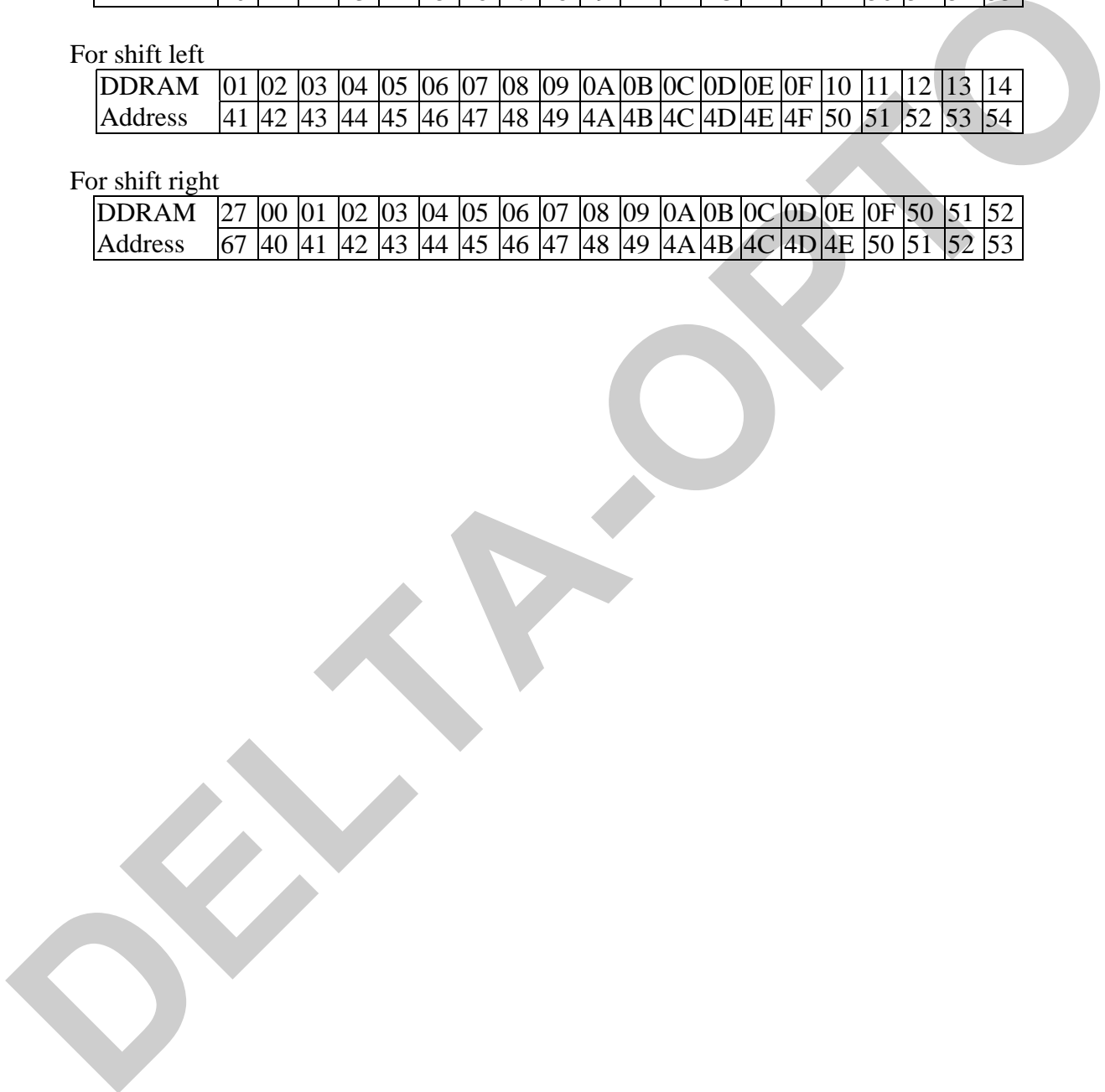
Display Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
DDRAM Address	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13
	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	51	52	53

For shift left

DDRAM Address	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13	14
	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	51	52	53	54

For shift right

DDRAM Address	27	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	50	51	52
	67	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	50	51	52	53



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 RAM1			0	1	2	3	4				5	6	7	8	9
0001	CG RAM2		!	!	!	!	!	!			!	!	!	!	!	!
0010	CG RAM3		"	"	"	"	"	"			"	"	"	"	"	"
0011	CG RAM4		#	#	#	#	#	#			#	#	#	#	#	#
0100	CG RAM5		\$	\$	\$	\$	\$	\$			\$	\$	\$	\$	\$	\$
0101	CG RAM6		%	%	%	%	%	%			%	%	%	%	%	%
0110	CG RAM7		&	&	&	&	&	&			&	&	&	&	&	&
0111	CG RAM8		'	'	'	'	'	'			'	'	'	'	'	'
1000	CG RAM1		((((((((((((
1001	CG RAM2))))))))))))
1010	CG RAM3		*	*	*	*	*	*			*	*	*	*	*	*
1011	CG RAM4		+	+	+	+	+	+			+	+	+	+	+	+
1100	CG RAM5		,	,	,	,	,	,			,	,	,	,	,	,
1101	CG RAM6		-	-	-	-	-	-			-	-	-	-	-	-
1110	CG RAM7		.	.	.	.	.	.			.	.	.	.	.	.
1111	CG RAM8		/	/	/	/	/	/			/	/	/	/	/	/

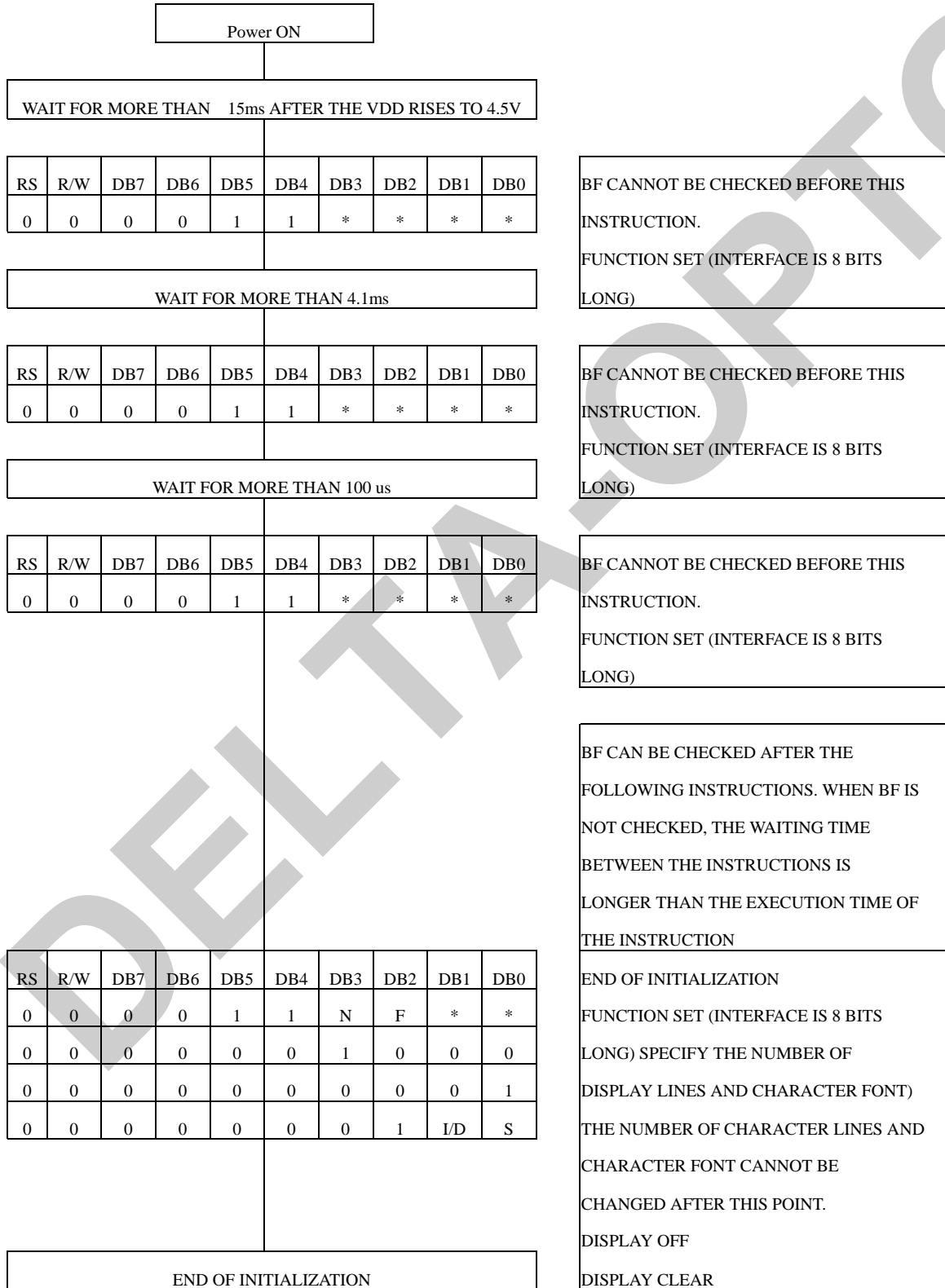
3.6 Instruction set

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

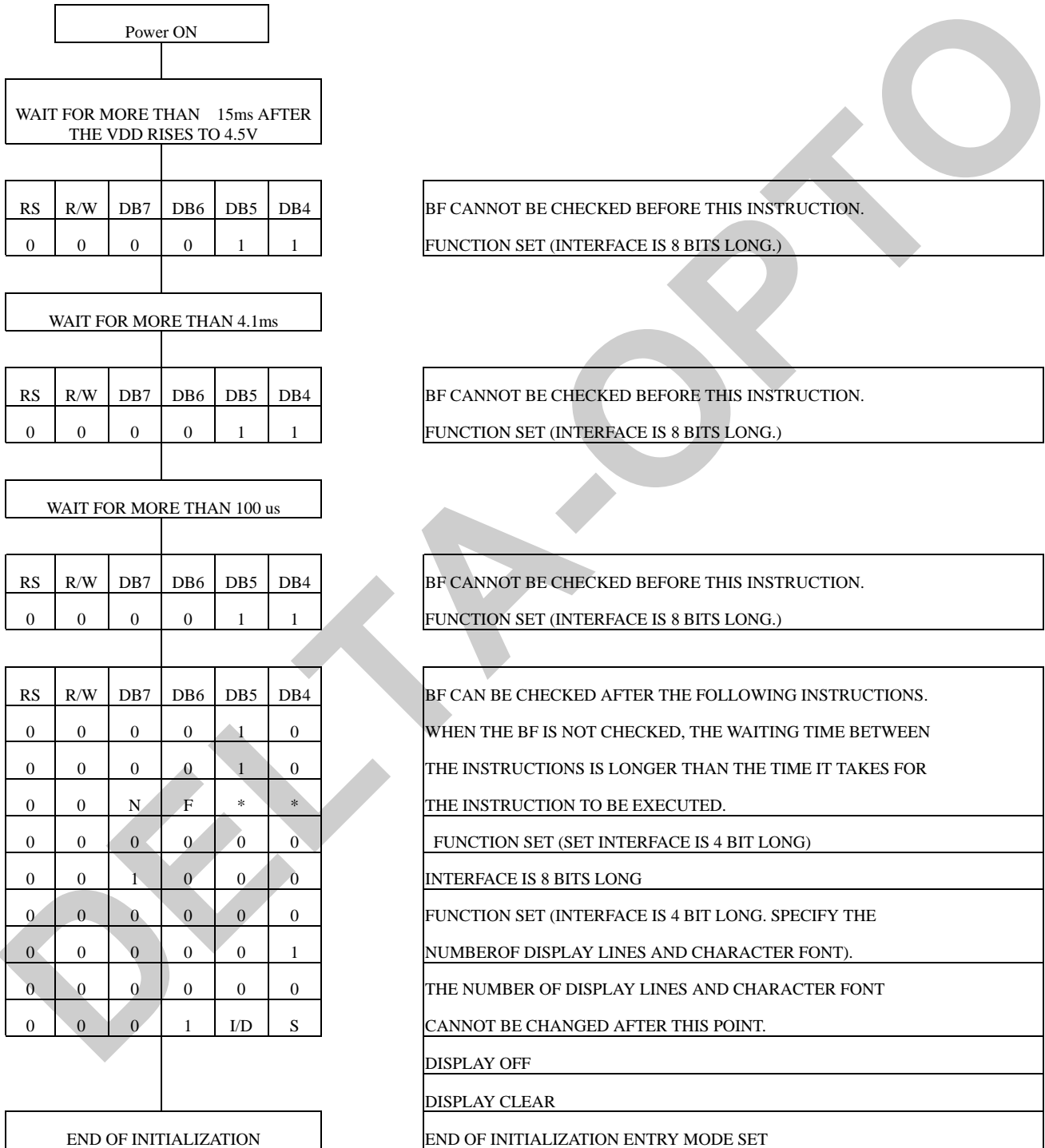
The following procedures are followed during the initialization of an 8-bit MPU



ENTRY MODE

4-BIT INTERFACE

The following procedures are followed during the initialization of an 4-bit MPU



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 THE BF IS NOT CHECKED, THE WAITING TIME BETWEEN
 THE INSTRUCTIONS IS LONGER THAN THE TIME IT TAKES FOR
 THE INSTRUCTION TO BE EXECUTED.

FUNCTION SET (SET INTERFACE IS 4 BIT LONG)

INTERFACE IS 8 BITS LONG

FUNCTION SET (INTERFACE IS 4 BIT LONG. SPECIFY THE
 NUMBEROF DISPLAY LINES AND CHARACTER FONT).

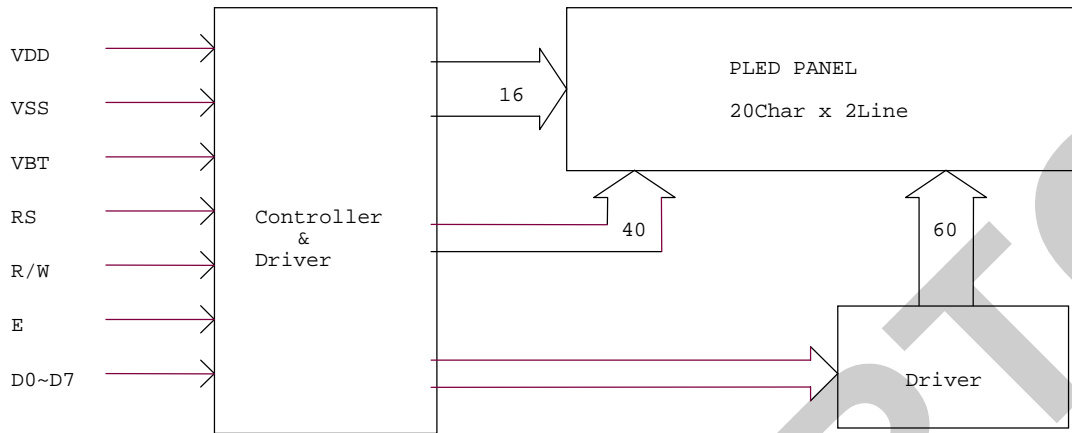
THE NUMBER OF DISPLAY LINES AND CHARACTER FONT
 CANNOT BE CHANGED AFTER THIS POINT.

DISPLAY OFF

DISPLAY CLEAR

END OF INITIALIZATION ENTRY MODE SET

3.8 Block Diagram



4 Interface Pin Function

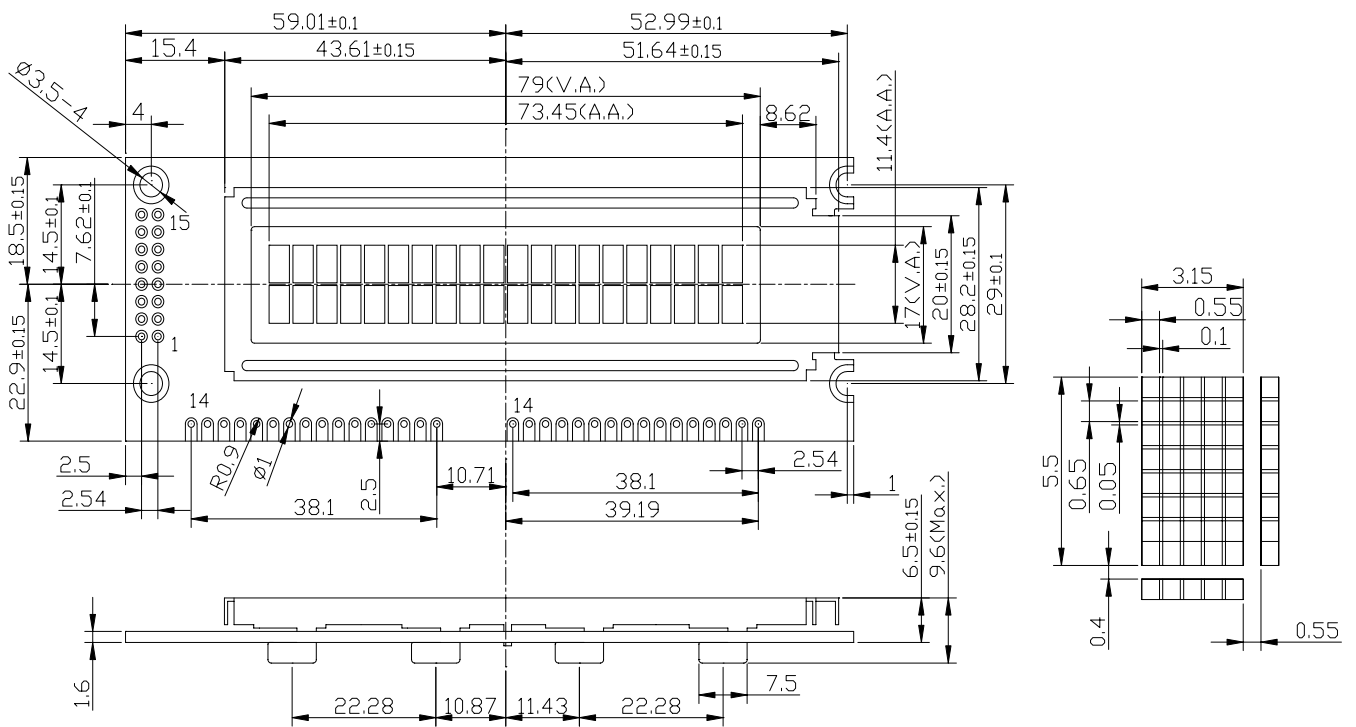
Pin No.	Symbol	I/O	Function
1	VSS	I	Ground
2	VDD	I	Power supply for logic
3	VBT	I	Brightness adjustment
4	RS	I	H: Data L: Instruction code
5	R/W	I	H: Read L: Write
6	E	I	H→L: Enable
7	D0	I	Data bus
8	D1	I	
9	D2	I	
10	D3	I	
11	D4	I	
12	D5	I	
13	D6	I	
14	D7	I	

5 Physical specifications

5.1 Mechanical specifications

NO.	Item	Specification	Unit
1	Active display area	73.45x11.4	mm
2	Viewing area	79.0x17.0	mm
3	Module dimension	113.0x41.4x9.6	mm
4	Dot size	0.5x0.65	mm
5	Weight	34	g

5.2 Drawing



6 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	30	40	50	nits
Color		-	YG ¹	-	

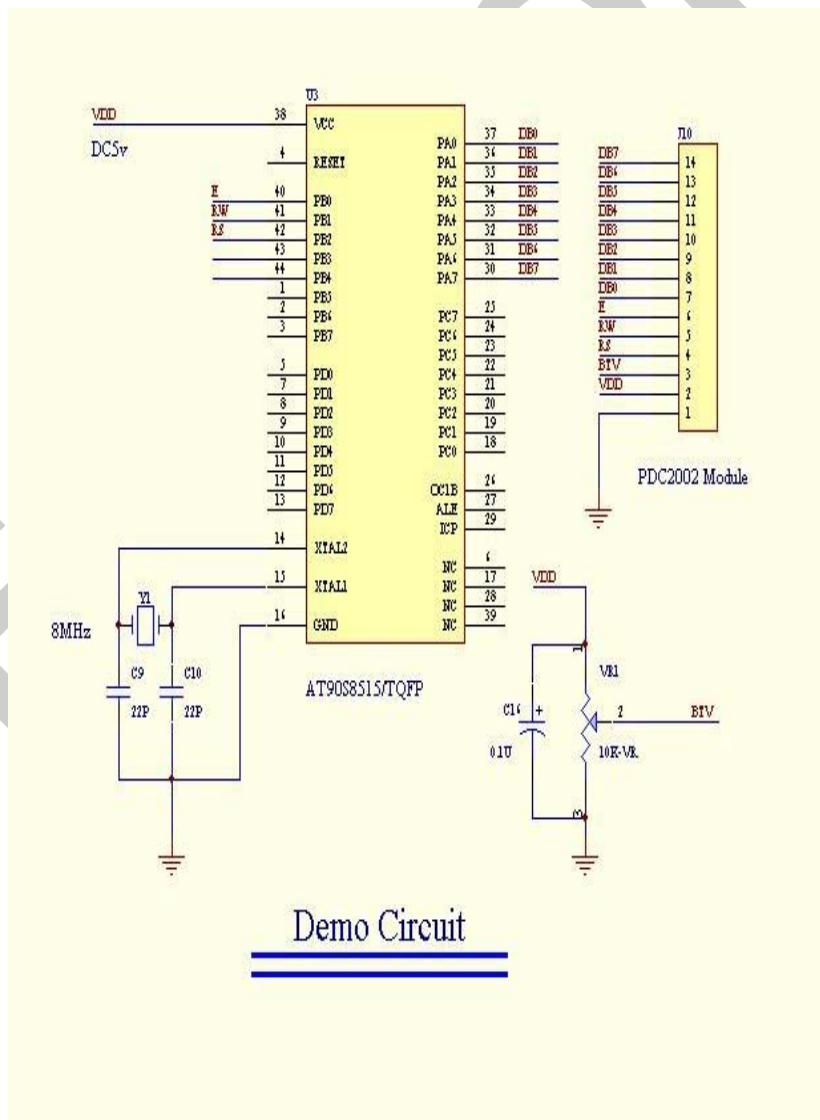
Note 1. YG.= yellow green

7 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	60°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	Thermal shock test	-20 60 , 20 cycles

8 Application Note

(1) Ref. Circuit



(2) Ref. Programming

 'It is a PDC2002 pattern program and show A,B,C....on module.
 'Here use BASCOM-AVR compile.

' Project name : 20x2 character module
 ' file name : demo2002.bas
 ' MCU : AVR AT90S8515
 ' Xtal : 8MHz
 ' Panel I/F : RS, RW, Enable, BTV
 ' Writer : Cheng-Nan Yeh
 ' Date : Dec.26, 2002 rev:A

' DB0=PA0: DB1=PA1: DB2=PA2: DB3=PA3
 ' DB4=PA4: DB5=PA5: DB6=PA6: DB7=PA7
 ' RS=PB2: RW=PB1: Enable=PB0

-----initial setting

\$regfile = "8515DEF.DAT"

Config Porta = Output

Config Portb = Output

Dim J As Integer , Cara As Byte , I As Byte

Dim Command_diable As Byte, Command_enable As Byte

Dim Command_write_data As Byte , Command_clear_display As Byte

Dim Command_move_right As Byte , Command_display_on As Byte

Dim Command_line2_char5x7 As Byte , Command_ddram_&H00 As Byte

Dim Command_ddram_&H40 As Byte , Write_char As Byte

Command_diable = &H00

Command_enable = &H01

Command_clear_display = &H01

Command_move_right = &H1D

Command_display_on = &H0C

Command_line2_char5x7 = &H38

Command_ddram_&H00 = &H80

Command_ddram_&H40 = &HC0

Command_write_data = &H05

Write_char = &H40

C = 1

I = 0

-----clear module display and cursor back home

Portb = Command_enable

'RS=0, RW=0, Enable=1

Porta = Command_clear_display

Waitus 500

'wait 500uS for MCU internal delay time

'You need to set PB0=0 after PB0=1 for MCU.

Portb = Command_diable

-----setting S/C, R/L, I/D, S

Portb = Command_enable

Porta = Command_move_right

'S/C=1 ,R/L=1 ,I/D=0, S=1

Waitus 500

Portb = Command_diable

-----display on / off

Portb = Command_enable

Porta = Command_display_on

'D=1, C=0, B=0

Waitus 500

```

Portb = Command_diable
'-----setting 5x7 Char. 2-Line
Portb = Command_enable
Porta = Command_line2_char5x7          'DL=1, N=1, F=0
Waitus 500
Portb = Command_diable
'-----
"-----fill in any data to module
"-----setting DDRAM address &H00
For J = 1 To 20 Step 1
Portb = Command_enable
Porta = Command_ddram_&H00 + I        'set address is &H00
Waitms 10                             '      and next one
Portb = Command_diable
'-----write data up
Portb = Command_write_data
Porta = Write_char + C                'write Char. is "A" and next one.
Waitms 10
Portb = Command_diable
Cara = Cara + 1
'-----setting DDRAM address &H40
Portb = Command_enable
Porta = Command_ddram_&H40 + I        'set address is &H40
Waitms 10                             '      and next one
Portb = Command_diable
'-----write data down
Portb = Command_write_data
Porta = Write_char + C                'write Char. is "B" and next one.
Waitms 10
Portb = Command_diable
'-----
C = C + 1
I = I + 1
If I = 20 Then I = 0                  'if DDRAM address is end then come back &H00.
If C = 40 Then C = 0
Next J
'-----end program
End

```

' Ps.. You should down load free [BASCOM-AVR DEMO](http://www.mcselec.com/) compile from <http://www.mcselec.com/>

9 Precaution in Design

- (1) Please do not give a stress on the module which cause damage on the metal, plastic, and pled glass.
- (2) Polarizer is easily scratched and should be carefully handled then. 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 suffers from static discharge, please take care of static electricity and insure human body grounding.
- (4) The Half-Brightness Decay Life will longer than 10K hours when module operate in room temp.