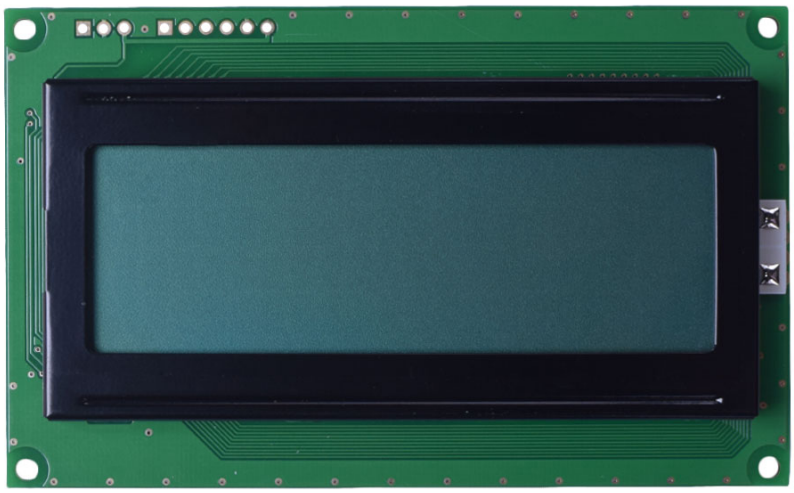
DisplayModule



DM-LCD2004-407

SERIAL CHARACTER LCD WITH I2C, SPI OR RS-232(TTL) INTERFACE

Contents

1 Revision History

Date	Changes
2015-01-21	First release

2 Main Features

Item	Specification	Unit
Number of Characters	20 characters x 4 lines	
Display Mode	STN Gray, Transflective	-
Resolution	5 x 8 pixels with cursor	
Controller IC	SPLC780D and PIC16F690	-
Interface	Serial Interface:I2C, SPI or RS-232(TTL)	-
Power Supply	5V	V
View Direction	6:00	-
Duty	1/16 duty, 1/5 bias	
Backlight	Yellow/Green LED	-
Weight	67.3	g

3 Pin Description

3.1 P1

Pin No.	Symbol	Function Description
1	RX	RS-232(TTL) Serial input port
2	VSS	Signal ground for LCM (GND)
3	VDD	Power supply for logic (+5.0V) for LCM

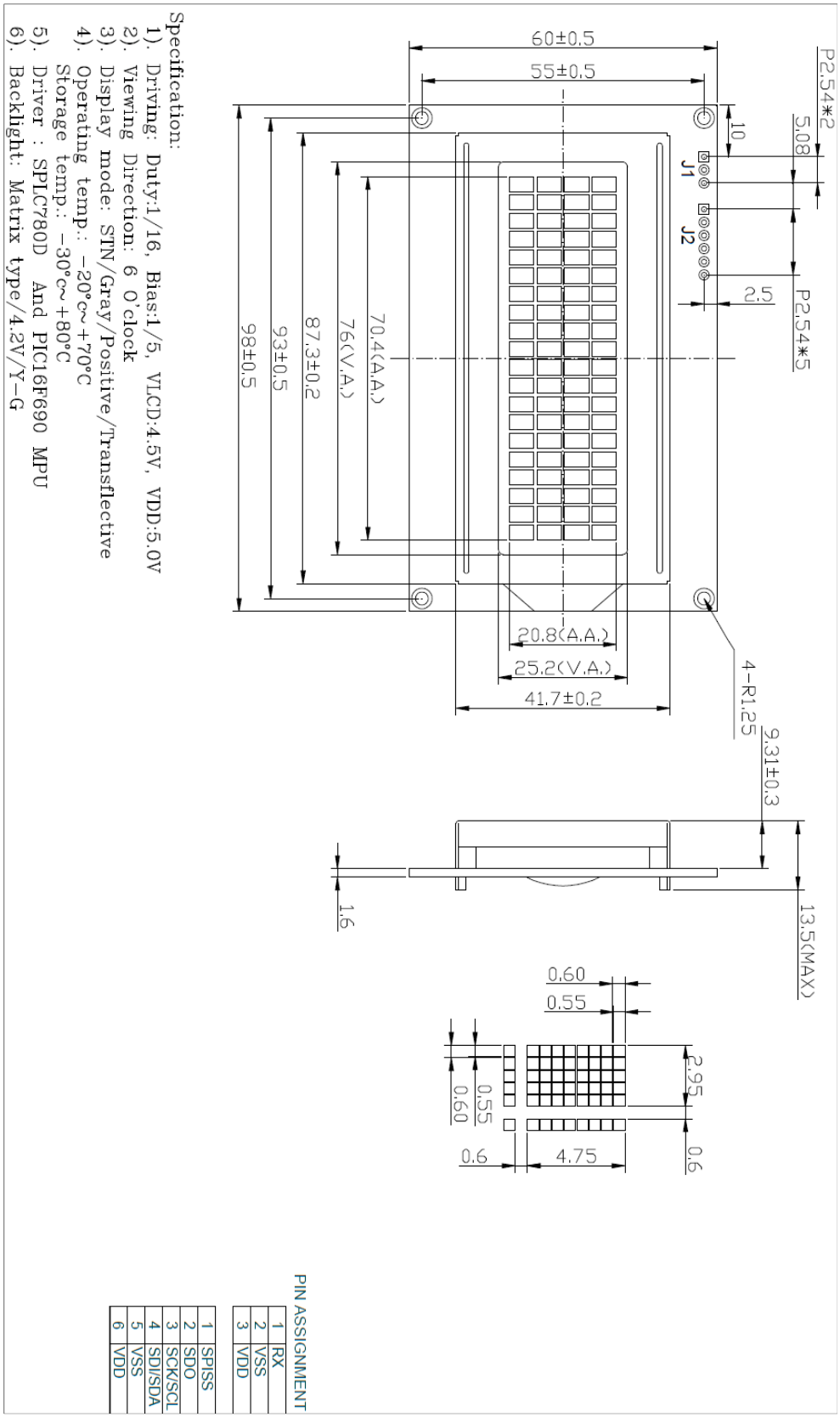
3.2 P2

Pin No.	Symbol	Function Description
1	SPISS	SPI or I2C input port
2	SDO	SPI or I2C input port
3	SCK/SCL	SPI or I2C input port
4	SDI/SDA	SPI or I2C input port
5	VSS	Signal ground for LCM (GND)
6	VDD	Power Supply for logic (+5.0V) for LCM

3.3 P3

Pin No.	Symbol	Function Description
1	VPP	Programmed voltage
2	VDD	Power supply for logic (+5V) for LCM
3	VSS	Signal ground for LCM (GND)
4	PA0	Port A0
5	PA1	Port A1

4 Mechanical Drawing



5 Electrical Characteristics

Item	Symbol	Condition	Min	Typ.	Max	Unit
Supply Voltage For Logic	VDD		4.7	5.0	5.5	V
Digital Operation Current	IDD	VDD=5.0V	-	248		mA
Low Level Input Voltage	V_{IL}		0	-	0.6	V
High Level Input Voltage	V_{IH}		2.2	-	VDD	V
Low Level Output Voltage	V_{OL}		-	-	0.4	V
High Level Output Voltage	V_{OH}		2.4	-		V
Operating Temperature	TOP	Absolute Max	-20	-	+70	℃
Storage Temperature	TST	Absolute Max	-30	-	+80	℃

6 Optical Characteristics

Item	Symbol	Min	Typ	Max	Unit	Note
View Angles Top--Bottom	AV	10		60	°	
View Angles Left--Right	AH	-45		45	°	
Response Time (25°C)	Tr + Tf		250	350	ms	
Contrast Ratio	CR		3			

7 Communication Information

7.1 I2C protocol

To enter the I2C mode, a jumper is placed on **R2** of the interface board and 2 pull-up resistors (nominal value of 1K to 10K Ohm), must be placed on SDA and SCK communication lines, R7 and R8.
The default I2C address is **50 (32 hex)**. The I2C address can be changed to any 8-bit value by command function, with the exception that the LSB (least significant bit) must always be '0'. Once the I2C address has been changed, it will be saved in the system memory, and it will revere back to the default address if either RS232 or SPI protocol is selected.
The I2C interface is capable of receiving data at up to 400KHz-clock rate.

7.2 SPI protocol

To enter the SPI mode, a jumper is placed on **R1** of the interface board.
The SPI mode has a normally high level idle clock; data sampled on the rising edge of the clock and Slave Select is enabled.

7.3 RS-232 (TTL) protocol

To enter the RS232 mode, both jumpers, **R1** and **R2** are removed.
The RS232 signal must be 5V, TTL compatible. The communication format is 8-bit data, one stop bit, no parity and no hand shaking. The default BAUD rate is 9600, and it is changeable with a command function, once the BAUD rate is changed, it will be saved in the system memory, and it can be reverted back to default BAUD rate if either I2C or SPI protocol is selected.

Changing the I2C Slave Address

Syntax: hexadecimal 0xFE 0x62 [addr]

Parameter

Parameter	Length	Description
[addr]	1 byte	New I^2C address, 0x00 – 0xFE The LSB is always '0'.

Description: This command sets the I2C address. The address must be an even number (LSB=0). The address change requires 20 microseconds to take effect; therefore, the subsequent input must have an appropriate delay. The default I2C address can be restored if SPI or RS232 is selected as the communication mode.
Default: 0 x 50

Changing BAUD Rate

Syntax: hexadecimal 0xFE 0x61 [baud]

Parameter

Parameter	Length	Description
[BAUD]	1 byte	New RS-232 BAUD Rate, 1 - 8

Description: This command sets the RS-232 BAUD rate. The signal byte parameter selects the desired BAUD rate as in the table below. The new BAUD rate requires 20 microseconds to take effect; therefore, the subsequent input must have an appropriate delay. The default BAUD rate can be restored if I2C or SPI is selected as the communication mode. Illegal parameter input will be discarded.
Default: 9600 BAUD

Parameter	BAUD
1	300
2	1200
3	2400
4	9600
5	14400
6	19.2K
7	57.6K
8	115.2K

8 Table of Commands

Prefix	CMD	Param	Description
0xFE	0x41	None	Display on
0xFE	0x42	None	Display off
0xFE	0x45	1 Byte	Set cursor
0xFE	0x46	None	Cursor home
0xFE	0x47	None	Underline cursor on
0xFE	0x48	None	Underline cursor off
0xFE	0x49	None	Move cursor left one place
0xFE	0x4A	None	Move cursor right one place
0xFE	0x4B	None	Blinking cursor on
0xFE	0x4C	None	Blinking cursor off
0xFE	0x4E	None	Backspace
0xFE	0x51	None	Clear screen
0xFE	0x52	1 Byte	Set contrast
0xFE	0x53	1 Byte	Set backlight brightness
0xFE	0x54	9 Byte	Load custom character
0xFE	0x55	None	Move display one place to the left
0xFE	0x56	None	Move display one place to the right
0xFE	0x61	1 Byte	Change RS232 BAUD rate 232
0xFE	0x62	1 Byte	Change I2C address
0xFE	0x70	None	Display firmware version number
0xFE	0x71	None	Display RS232 BAUD rate
0xFE	0x72	None	Display I2C address
0xFE	0xFE	1 Byte	Send control byte to

9 Build-In Function

Introduction

There several build-in functions in the serial interface to facilitate the LCD control, these functions eliminate the needs for end user to understand the HD44780 instruction set and timing requirements. It also provides control for features that are not accessible with a serial connection.

Turn On Display

Syntax hexadecimal 0xFE 0x41

Parameter

Parameter	Length	Description
None	None	Turn on LCD screen

Description This command turns on the LCD display screen. The display text is not altered
Default LCD screen is on

Turn Off Display

Syntax hexadecimal 0xFE 0x42

Parameter

Parameter	Length	Description
None	None	Turn off LCD screen

Description This command turns off the LCD display screen. The display text is not altered
Default LCD screen is on

Set Cursor Position

Syntax hexadecimal 0xFE 0x45 [pos]

Parameter

Parameter	Length	Description
[pos]	1 byte	Put cursor at location specified by [pos], 0x00 to 0x67

Description This command moves the cursor to a specified location where the next character will be displayed. A typical cursor position for a 4-line display is show below; a cursor position outside these ranges will not be viewable.

	Column 1	Column 20
Line 1	0 x 00	0 x 13
Line 2	0 x 40	0 x 53
Line 3	0 x 14	0 x 27
Line 4	0 x 54	0 x 67

Default After a reset, the cursor is on position 0x00

Home Cursor

Syntax hexadecimal 0xFE 0x46

Parameter

Parameter	Length	Description
None	None	Position cursor at line 1 column 1

Description This command moves the cursor to line 1, column 1 of the LCD screen. The display text is not altered.
Default None

Turn On Underline Cursor

Syntax hexadecimal 0xFE 0x47

Parameter

Parameter	Length	Description
None	None	Turn on underline cursor

Description This command turn on the underline cursor, the cursor position is where the next character will appear

Default Underline cursor is off

Turn Off Underline Cursor

Syntax hexadecimal 0xFE 0x48

Parameter

Parameter	Length	Description
None	None	Turn off underline cursor

Description This command turns off the underline cursor

Default Underline cursor is off

Move Cursor Left One Space

Syntax hexadecimal 0xFE 0x49

Parameter

Parameter	Length	Description
None	None	Move cursor left 1 space

Description This command moves the cursor position left 1 space whether the cursor is turn on or not. The display character is not altered.

Default None

Move Cursor Right One Space

Syntax hexadecimal 0xFE 0x4A

Parameter

Parameter	Length	Description
None	None	Move cursor right 1 space

Description This command moves the cursor position left 1 space whether the cursor is turned on or not. The displayed character is not altered.

Default None

Turn On Blinking Cursor

Syntax hexadecimal 0xFE 0x4B

Parameter

Parameter	Length	Description
None	None	Turn on the blinking cursor

Description This command turn on the blinking cursor, both the cursor and the character on the cursor will blink.

Default The blinking cursor is off

Turn Off Blinking Cursor

Syntax hexadecimal 0xFE 0x4C

Parameter

Parameter	Length	Description
None	None	Turn off the blinking cursor

Description This command turns off the blinking cursor.

Default The blinking cursor is off

Back Space

Syntax hexadecimal 0xFE 0x4E

Parameter

Parameter	Length	Description
None	None	Move cursor back one space and delete the character on the ursor.

Description This command is destructive backspace. The cursor is moved back one space and the character on the cursor is deleted.

Default None

Clear Screen

Syntax hexadecimal 0xFE 0x51

Parameter

Parameter	Length	Description
None	None	Clear LCD and move cursor to line 1 column 1.

Description This command clears the entire display and place the cursor at line 1 column 1.

Default None

Set Display Contrast

Syntax hexadecimal 0xFE 0x52 [contrast]

Parameter

Parameter	Length	Description
[contrast]	1 byte	Set the display contrast, value between 1 and 50

Description This command sets the display contrast. The contrast setting can be between 1 and 50, where 50 is the highest contrast.

Default Default contrast value is 40

Set Backlight Brightness

Syntax hexadecimal 0xFE 0x53 [brightness]

Parameter

Parameter	Length	Description
[brightness]	1 byte	Set the LCD backlight brightness level, value between 1 to 16

Description This command sets the backlight brightness level. The value can be between 1 to 16.

Default Default contrast value is 1.

Load Custom Characters

Syntax hexadecimal 0xFE 0x54 [addr] [d0 ...d7]

Parameter

Parameter	Length	Description
[addr]	1 byte	Custom character address, 0 – 7
[D0...D7]	8 bytes	Custom character pattern bit map

Description There is space for eight user-defined custom characters. This command loads the custom character into one of the eight locations. The custom character pattern is bit mapped into 8 data bytes. The bit map for Spanish character '¿' is shown in table below. To display the custom character, user has to enter the address of the character (0 to 8).

Default None

Bit	7	6	5	4	3	2	1	0	Hex
Byte 1	0	0	0	0	0	**1**	0	0	0x04
Byte 2	0	0	0	0	0	0	0	0	0x00
Byte 3	0	0	0	0	0	**1**	0	0	0x04
Byte 4	0	0	0	0	**1**	0	0	0	0x08
Byte 5	0	0	0	**1**	0	0	0	0	0x10
Byte 6	0	0	0	**1**	0	0	0	**1**	0x11
Byte 7	0	0	0	0	**1**	**1**	**1**	0	0x0E
Byte 8	0	0	0	0	0	0	0	0	0x00

Shift Display to the Left

Syntax hexadecimal 0xFE 0x55

Parameter	Parameter	Length	Description
	None	None	Shift the LCD screen to the left 1 space.

Description This command shifts the display to the left 1 space. The cursor position also moves with the display, and the display data is not altered.

Default None

Shift Display to the Right

Syntax hexadecimal 0xFE 0x56

Parameter	Parameter	Length	Description
	None	None	Shift the LCD screen to the right 1 space.

Description This command shifts the display to the right 1 space. The cursor position also moves with the display, and the display data is not altered.

Default None

Display Firmware Version Number

Syntax hexadecimal 0xFE 0x70

Parameter	Parameter	Length	Description
	None	None	Display the firmware version number.

Description This command display the micro-controller firmware version number.

Default None

Display RS-232 Baud Rate

Syntax hexadecimal 0xFE 0x71

Parameter	Parameter	Length	Description
	None	None	Display Baud Rate

Description This command displays the RS-232 BAUD rate.

Default None

Display I^2C Address

Syntax	hexadecimal	0xFE	0x72

Parameter	Parameter	Length	Description
	None	None	Display I^2C Address

Description This command displays the current I2C slave address.
Default None

Direct HD44780 Command

Syntax	hexadecimal	0xFE	0xFE [cmd]

Parameter	Parameter	Length	Description
	[cmd]	1 byte	Direct interface to the LCD controller, HD44780

Description This command is for advanced programmer, it allows LCD instruction to send directly to the SPLC780D controller.
Default None

ASCII TEXT

To display normal text, just enter its ASCII number, a number from 0x00 to 0x07 displays the user defined custom character, 0x20 to 0x7F displays the stand set of characters. And numbers from 0xA0 to 0xFD display characters and symbols that are factory-masked on the SPLC780D controller and 0xFE is reserved for function command.

10 Built-in Font Table

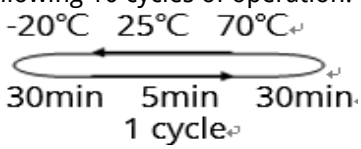
Upper 4 Bits / Lower 4 Bits	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
xxxx0000	CG RAM (1)			0	@	P	`	p				ー	タ	ミ	α	p
xxxx0001	(2)		!	1	A	Q	a	q			。	ア	チ	ム	ä	q
xxxx0010	(3)		"	2	B	R	b	r			「	イ	ツ	メ	ß	θ
xxxx0011	(4)		#	3	C	S	c	s			」	ウ	テ	モ	ε	∞
xxxx0100	(5)		$	4	D	T	d	t			、	エ	ト	ヤ	μ	Ω
xxxx0101	(6)		%	5	E	U	e	u			・	オ	ナ	ユ	σ	ü
xxxx0110	(7)		&	6	F	V	f	v			ヲ	カ	ニ	ヨ	ρ	Σ
xxxx0111	(8)		'	7	G	W	g	w			ァ	キ	ヌ	ラ	g	π
xxxx1000	(1)		(	8	H	X	h	x			ィ	ク	ネ	リ	√	x̄
xxxx1001	(2)		)	9	I	Y	i	y			ゥ	ケ	ノ	ル	⁻¹	y
xxxx1010	(3)		*	:	J	Z	j	z			ェ	コ	ハ	レ	j	千
xxxx1011	(4)		+	;	K	[	k	{			ォ	サ	ヒ	ロ	×	万
xxxx1100	(5)		,	<	L	¥	l	|			ャ	シ	フ	ワ	¢	円
xxxx1101	(6)		-	=	M	]	m	}			ュ	ス	ヘ	ン	£	÷
xxxx1110	(7)		.	>	N	^	n	→			ョ	セ	ホ	゛	ñ	
xxxx1111	(8)		/	?	O	_	o	←			ッ	ソ	マ	°	ö	■

11 Driver/Controller Information

Built-in PIC16F690 IC

https://drive.google.com/file/d/0Bxu0OURUiyL5MXk0MXJraUMxTlE/view?usp=sharing

12 Reliability

Test Item	Content of Test	Test Condition	Note
High Temperature Storage	Endurance test applying the high storage temperature for a long time.	80℃ 200hrs	2
Low Temperature Storage	Endurance test applying the high storage temperature for a long time.	-30℃ 200hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	70℃ 200hrs	-
Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	-20 ℃ 200hrs	1
High Temperature/ Humidity Operation	The module should be allowed to stand at 60℃,90%RH max, for 96hrs under no-load condition excluding the polarizer. Then taking it out and drying it at normal temperature.	60℃,90%RH 96hrs	1,2
Thermal Shock Resistance	The sample should be allowed stand the following 10 cycles of operation. 	-20℃/70℃ 10 cycles	-
Vibration Test	Endurance test applying the vibration during transportation and using.	Total fixed amplitude: 15mm; Vibration: 10~55Hz; One cycle 60 seconds to 3 directions of X, Y, Z, for each 16 minutes.	3
Static Electricity Test	Endurance test apply the electric stress to the terminal.	VS=800V, RS=1.5kΩ, CS=100pF, 1 time.	-

Note1: No dew condensation to be observed.
Note2: The function test shall be conducted after 4 hours storage at the normal. Temperature and humidity after remove from the rest chamber.
Note3: Test performed on product itself, not inside a container

13 Warranty and Conditions

http://www.displaymodule.com/pages/faq