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HM-0020

LCD Module User Manual V1.0

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Date: 2013-1-15	Date:	Date:

Table of Content

1 Basic Specifications

1.1 Display Specifications

1) LCD Display Mode : STN-Blue, Negative, Transmissive

2) Display Color : Display Data = “1”: Light Gray (*1)

: Display Data = “0”: Deep Blue (*2)

3) Viewing Angle : 6H

4) Driving Method : 1/16 duty, 1/5 bias

5) Back Light : White LED Backlight

Note:

*1. Color tone may slightly change by temperature and driving condition.

*2. The color is defined as the inactive / background color.

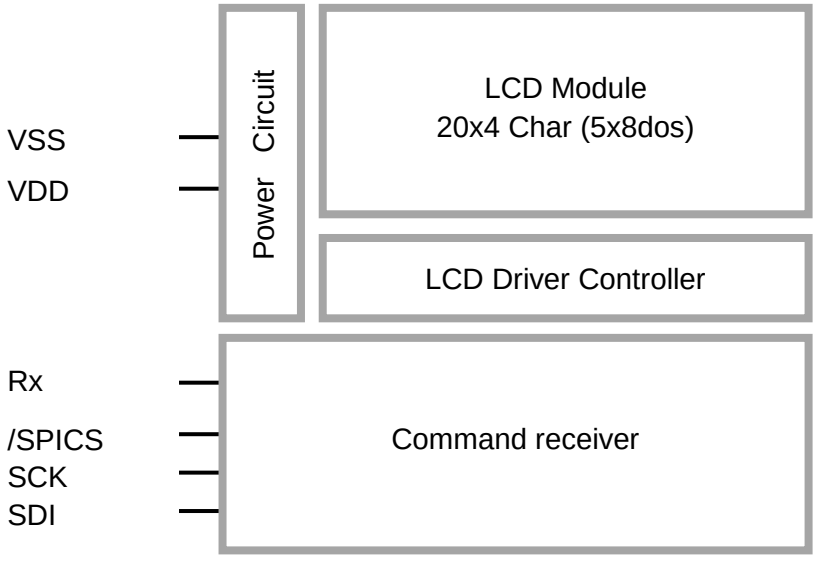
1.2 Functions and Features

- 4 lines x 20 characters;
- Serial Interface: UART, SPI;
- Single 5.0V power supply;
- 5x8 pixels with cursor;
- ROSH Compliant.

1.3 Mechanical Specifications

Outline Dimension : 98.0x 60.0 x MAX13.7
(See attached outline drawing for details)

1.4 Block Diagram



1.5 Terminal Functions

Terminal K1: UART (Default)

Pin No.	Pin Name	I/O	Descriptions
1	Rx	Input	UART serial input port
2	VSS	Power	Power supply, Ground (0V)
3	VDD	Power	Positive power supply

Terminal K2: SPI

Pin No.	Pin Name	I/O	Descriptions
1	/SPICS	Input	Data enable
2	NC	--	NO connect, leave open
3	SCK	Input	Serial clock
4	SDI	Input	Serial data in
5	VSS	Power	Power supply, Ground (0V)
6	VDD	Power	Positive power supply

Note:
*1. Power could be provided by terminal K1 (VSS, VDD) or K2 (VSS, VDD).
*2. Terminal could be selected by on board jumper.

JP1	JP2	Mode
Close	Close	Reserved
Open	Close	SPI
Close	Open	Reserved
Open	Open	UART

2 Absolute Maximum Ratings

Items	Symbol	Min	Max	Unit	Condition
Supply Voltage	V_{DD}	0	5.5	V	V_{SS} = 0V
Input Voltage	V_{IN}	0	V_{DD}	V	V_{SS} = 0V
Operating Temperature	T_{OP}	-20	70	°C	No Condensation
Storage Temperature	T_{ST}	-30	80	°C	No Condensation

Note:
Any Stresses exceeding the Absolute Maximum Ratings may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

3 Electrical Characteristics

3.1 DC Characteristics

V_{SS}=0V, V_{DD}=5.0V, T_{OP}=25°C

Items	Symbol	MIN	TYP	MAX	Unit	Condition/Application Pin
Operating Voltage	V_{DD}	4.7	5.0	5.3	V	VDD
Operating Current	I_{DD}	50	60	70	mA	VDD,100% back light
Operating Current	I_{DD}	15	20	25	mA	VDD, 0% back light
UART Input High Voltage	$V_{UART\_IN\_H}$	3.6	--	V_{DD}	V	RX
UART Input Low Voltage	$V_{UART\_IN\_L}$	0	--	0.6	V	
SPI Input High Voltage	$V_{SPI\_IN\_H}$	3.6	--	V_{DD}	V	/SPCS, SCK, SDI
SPI Input Low Voltage	$V_{SPI\_IN\_L}$	0	--	0.6	V	

3.2 AC Characteristics

3.2.1 UART AC Characteristics

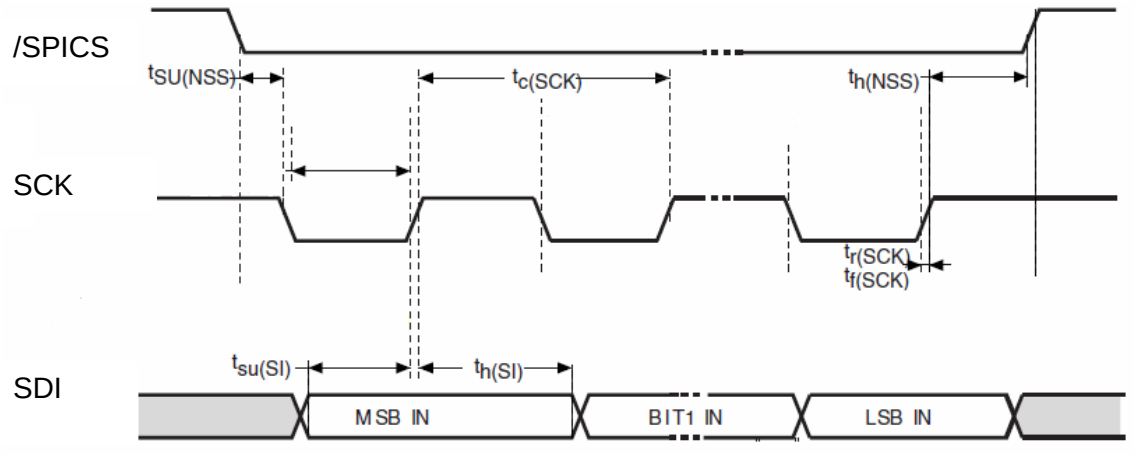
UART Mode configured as follow:

- Baud rate = 9600 bps (default)
- Word length = 8 Bits
- One stop bit
- No parity

3.2.2 SPI AC Characteristics

V_{SS}=0V, V_{DD}=5.0V, T_{OP}=25°C

Items	Symbol	MIN	MAX	Unit
SPI clock frequency	f_{SCK} $1/t_{c(SCK)}$	--	8	MHz
SPI clock rise time	$t_{r(SCK)}$	--	5	ns
SPI clock fall time	$t_{f(SCK)}$	--	5	ns
/SPICS setup time	$t_{su(SPICS)}$	1250	--	ns
/SPICS hold time	$t_{h(SPICS)}$	325	--	ns
Data input setup time	$t_{su(SDI)}$	6	--	ns
Data input hold time	$t_{h(SDI)}$	6	--	ns
SPI slave input clock duty cycle	DuCy(SCK)	31	60	%



4 Function Specifications

4.1 Operation Mode

4.1.1 UART Mode

UART is 5V limited RS-232 signal, where Hi=1, Lo=0;
Baud rate is ranged from 300 to 115200, and is changeable with a command (0x61). Once the Baud rate has been changed, it will be retained whether power off or reset. Baud rate will be revert back to default if SPI mode is selected.

4.1.2 SPI Mode

SPI is configured as slave device in Mode 3(1, 1), up to 8MHz clock rate;
SCK has a high-level idle state; the second edge on the SCK is the first MSB capture strobe;
SPI is in an 8-bit data frame with MSB first;
It suggests to toggle /SPICS for every data transfer, where /SPICS also works for init serial transfer counter.

4.2 Display Memory Map

There are two main memory-areas in the LCD module for display.

- Character Generator RAM (CGRAM)
- Display Data RAM (DDRAM)

4.2.1 Character Generator RAM (CGRAM)

CGRAM is for storing the user-defined characters (5x8 dots font).
Totally 8 user-defined characters (character code = 00h ~ 07h) could be created.

The user-defined character codes are 00h and 07h. They could be called into DDRAM as normal character.

User-Defined Character Codes	CGRAM Data sequence	CGRAM Data (Font Pattern)							
		D7 ~ D5			D4 ~ D0				
0x00	1st	0	0	0	0	0	1	0	0
	2nd	0	0	0	0	0	0	0	0
	3rd	0	0	0	0	0	1	0	0
	4th	0	0	0	0	1	0	0	0
	5th	0	0	0	1	0	0	0	0
	6th	0	0	0	1	0	0	0	0
	7th	0	0	0	0	1	1	1	0
	8th	0	0	0	0	0	0	0	0
0x01	1st : 8th	Not Use			5 x 8 dots font pattern				
0x02	1st : 8th	Not Use			5 x 8 dots font pattern				
0x03	1st : 8th	Not Use			5 x 8 dots font pattern				
0x04	1st : 8th	Not Use			5 x 8 dots font pattern				
0x05	1st : 8th	Not Use			5 x 8 dots font pattern				
0x06	1st : 8th	Not Use			5 x 8 dots font pattern				
0x07	1st : 8th	Not Use			5 x 8 dots font pattern				

Note:
*1. Module receives the character's data sequence automatically;
*2. '¿' is loaded where user-defined character code is 0x00, as showed above.

4.2.2 Display Data RAM (DDRAM)

ROM Characters (Character Code = 10h ~ FFh) could be written into DDRAM for displaying the character (5x8 dots font). User-defined characters (Character Code = 00h ~ 07h) stored in CGRAM could also be used. Character's address is showed below.

		COLUMN										
		1st	2nd	3rd	4th	5th	. . . . .	16th	17th	18th	19th	20th
ROW	1st	00h	01h	02h	03h	04h	. . . . .	0Fh	10h	11h	12h	13h
	2nd	40h	41h	42h	43h	44h	20 x 4 Characters (5x8 dots font)	4Fh	50h	51h	52h	53h
	3rd	14h	15h	16h	17h	18h		23h	24h	25h	26h	27h
	4th	54h	55h	56h	57h	58h	. . . . .	63h	64h	65h	66h	67h

Note:

*1. The mapping is based on top view of the LCD module

4.3 Commands and Data Packet

4.3.1 Commands Packet

Commands sequence as follow(*1):

Step	Descriptions
1	Prefix(0xfe)
2	Command
3	Parameter1
4	Parameter2
:	:
11(MAX)	Parameter9

Note:

*1. Prefix is 0xfe and it's obligatory.

*2.Command packet length depends on command.

4.3.2 Display Data Packet

All the received byte other than command (with prefix) will decode as Display Data (char). 80 bytes of data input buffer support continued display data transfer.

Display Data: 0x00 ~ 0x07 : display the user-defined character;

0x20 ~ 0x7F : display the standard ASCII characters;

0xA0 ~ 0xFD : display extend ASCII characters;

0xFE : reserved as command prefix;

Others : ignored.

4.4 Commands Table

Function Name	Command	Function Descriptions
Display ON	0x41	Reset default. Turn on LCD display screen (*2).
Display OFF	0x42	Turn off LCD display screen (*2).
Set Position	0x45 [pointer_addr]	Move cursor pointer to a specified address (0x00 to 0x67) where the next character will be displayed. (see 4.2.2) (*2)(*6)
Return Home	0x46	Return cursor pointer home (0x00) (*2). (Reset default)
Underline Cursor ON	0x47	Turn on underlined cursor.
Underline Cursor OFF	0x48	Turn off underlined cursor. (Reset default)
Move Cursor Left	0x49	Move cursor pointer left by 1 address.
Move cursor Right	0x4a	Move cursor pointer right by 1 address.
Blinking Cursor On	0x4b	Turn on blinking cursor.
Blinking Cursor OFF	0x4c	Turn off blinking cursor. (Reset default)
Backspace	0x4e	Backspace. The cursor pointer moves back one space and clears as “space”.
Clear Screen	0x51	Clear the entire display by filling with “space” and return cursor pointer home (0x00).
Set Display Contrast	0x52 [contrast]	Set display contrast level. Contrast: 0x01 ~ 0x32. (Reset default contrast is 0x20). (*6)
Set Backlight Brightness	0x53 [brightness]	Set backlight brightness level. Brightness: 0x01 ~ 0x08. (Reset default backlight brightness is 0x05). (*6)
Load User-defined Characters	0x54 [character code] [CGRAM 1st Data] [CGRAM 2nd Data] : [CGRAM 8th Data]	Load user-defined character (*3). The user-defined character pattern is bit mapped into 8 data bytes.
Move display Left	0x55	Shifts displayed content to left by 1 address, and the cursor pointer shifts too.
Move display Right	0x56	Shifts displayed content to right by 1 address, and the cursor pointer Shifts too.
Set UART Baud rate	0x61 [Baud_code]	Set the UART Baud Rate. The single byte parameter selects the desired Baud Rate (*4) (*5). (Default reset Baud_code is 4) (*6)
Display firmware version	0x70	Display firmware version on LCD.
Display UART baud rate	0x71	Display UART baud rate on LCD.

Note:
*1. Do not use any other command not listed, or the system malfunction may result.
*2. The display text is not altered.
*3. User-defined characters’ data stored in CGRAM (see 4.2.1).

*4. The change requires 20 microseconds to take effect; therefore, the subsequent input must have an appropriate delay.
*5. The validated baud rate range is as below:

Baud_code	Baud Rate
1	300 bps
2	1200 bps
3	2400 bps
4	9600 bps
5	14400 bps
6	19200 bps
7	57600 bps
8	115200 bps

*6. Command will set default baud rate for other values .

5 Design and Handling Precaution

1. The LCD panel is made by glass. Any mechanical shock (eg. dropping form high place) will damage the LCD module.
2. Do not add excessive force on the surface of the display, which may cause the Display color change abnormally.
3. The polarizer on the LCD is easily get scratched. If possible, do not remove the LCD protective film until the last step of installation.
4. Never attempt to disassemble or rework the LCD module.
5. Only Clean the LCD with Isopropyl Alcohol or Ethyl Alcohol. Other solvents (eg. water) may damage the LCD.
6. When mounting the LCD module, make sure that it is free form twisting, warping and distortion.
7. Ensure to provide enough space (with cushion) between case and LCD panel to prevent external force adding on it, or it may cause damage to the LCD or degrade the display result.
8. Only hold the LCD module by its side. Never hold LCD module by add force on the heat seal or TAB.
9. Never add force to component of the LCD module. It may cause invisible damage or degrade of the reliability.
10. LCD module could be easily damaged by static electricity. Be careful to maintain an optimum anti-static work environment to protect the LCD module.
11. When peeling off the protective film from LCD, static charge may cause abnormal display pattern. It is normal and will resume to normal in a short while.
12. Take care and prevent get hurt by the LCD panel sharp edge.
13. Never operate the LCD module exceed the absolute maximum ratings.
14. Keep the signal line as short as possible to prevent noisy signal applying to LCD module.
15. Never apply signal to the LCD module without power supply.
16. IC chip (e.g. TAB or COG) is sensitive to the light. Strong lighting environment could possibly cause malfunction. Light sealing structure casing is recommended.
17. LCD module reliability may be reduced by temperature shock.
18. When storing the LCD module, avoid exposure to the direct sunlight, high humidity, high temperature or low temperature. They may damage or degrade the LCD module

6 Document Revision History

Rev.	Descriptions	Release Date
1.0	Preliminary release firmware version: 1.0.1	2012-12-25