深圳市拓普微科技开发有限公司
SHENZHEN TOPWAY TECHNOLOGY CO., LTD.

HMT070CB-C

Smart TFT Module
User's Manual

Prepared by: Date:	Checked by: Date:	Approved by: Date:

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1.0	Initial release	2011-12-10
1.1	Refine description, add command table	2012-10-30

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1. General Information

TOPWAY HMT070CB-C is a Smart TFT Module. The onboard 32bit ARM processor act as a graphic engine offer lots of outstanding high performance features. It could also simply the host operation and increase reliability of the system. It is suitable for industry control, instrumentation, medical electronics, power electric equipment, etc

1.1 Highlight

- Wide viewing angle 7 inch TFT Display
- 800(RGB) x 480 pixels, 65k color
- Wide range of single DC power supply
- Wide operating temperature
- RS232-C interface
- High reliability resistive touch screen
- Rich software instructions for graphics, text and picture operations
- 128MB Flash memory on board for preload picture or font library.
- Instance call and show preloaded picture
- ASCII and GB code for text display
- Expandable font libraries
- Sport double layer graphic and text display
- Real time clock and buzzer feature
- Adjustable backlight brightness
- Industrial level structure and hardware design
- Comply with ROHS.

2. Basic Specifications

Outline Dimension:	190.0x112.0x16.0(mm) (refer to outline drawing)
Mounting Dimension:	179.8x101.9(mm) and 171.7x103.6(mm) (refer to outline drawing)
Display Size:	7.0 inches
Resolution:	800*(RGB)*480
Color Depth:	16bits(RGB=565), 65k(65536) colors
Backlight Type:	LEDs
User Interface:	RS232-C (optional 3.3V UART)
Font Library:	32MB (support up to 60 Font Libraries)
Picture Library:	96MB (support up to 130 bmp pictures)
RTC:	year, month, date, hour, minute, second, day of week (up to year 2099)
Buzzer:	Beep time and frequency could be adjusted by command
Touch Panel:	resistive touch panel

2.1 RS232 Interface Terminal (K1)

PIN No.	PIN Name	I/O	Description
1, 2	Vin	P	Power supply (DC9V～18V, DC12V is recommend)
3	(NC)	-	No connection
4	Dout	O	Data output from LCD module
5, 6	Din	I	Data Input to LCD Module
7, 8	GND	P	Ground

Note.

- User data and commands transfer through this terminal
- Over ranged signal input will damage the module
  please confirm the interface setting before applying the signal
- K1 signal level configuration

JP2	JP3	JP4	JP5	K1 signal
Open	Open	Close	Close	RS232-C Level (Default)
Close	Close	Open	Open	3.3V TTL/CMOS Level

3. Absolute Maximum

GND=0V

Item	Symbol	Min.	Max.	Unit	Condition
Power Voltage	Vin	6	24	V	
Operating Temperature	Top	-20	70	°C	No Condensation
Storage Temperature	Tst	-30	80	°C	No Condensation

Note: Any stresses exceeding the absolute maximum may cause unrecoverable damage to the LCD module.

4. Electrical Characteristics

4.1 DC Characteristics

VIN=12V, Top=25℃, GND=0V

Item	Symbol	Min.	Typ.	Max.	Unit	Condition
Power Voltage	V_{IN}	9.0	12.0	18.0	V	
Current	I_{VIN}	-	230	-	mA	Backlight on (Brightness=max.)
	I_{VIN}	-	130	-	mA	Backlight off
RS232-C input (low)	$V_{DIN\_RS\_L}$	-3.0	-	-15.0	V	MARK, logic 1
RS232-C input (high)	$V_{DIN\_RS\_H}$	+3.0	-	+15.0	V	SPACE, logic 0
RS232-C output (low)	$V_{DOUT\_RS\_L}$	-3.0	-	-15.0	V	MARK, logic 1
RS232-C output (high)	$V_{DOUT\_RS\_H}$	+3.0	-	+15.0	V	SPACE, logic 0
UART input (low)	$V_{DIN\_TTL\_L}$	0	-	0.8	V	logic 0
UART input (high)	$V_{DIN\_TTL\_H}$	2.0	-	3.3	V	logic 1
UART output (low)	$V_{DOUT\_TTL\_L}$	0	-	0.8	V	logic 0
UART output (high)	$V_{DOUT\_TTL\_H}$	2.0	-	3.3	V	logic 1

4.2 AC Characteristics

Start bit	1
Data bit	8
Paraity bit	None
Stop bit	1
Baud Rate	115200bps (default) (*1)

Note.
*1. Baud Rate could be adjusted by software in range of : 1200bps～115200bps

4.3 Command Packet Format

All commands are organized in packet with 4 data blocks:

Data block Sequence	Data	Description
1	0xAA	Packet header,1byte,fixed as 0xAA
2	(Command code)	Command code, 1byte
3	(Parameter or Data)	Parameter or Data. Maximum 500bytes.
4	0xCC 0x33 0xC3 0x3C	Packet tail,4 bytes, fixed as 0xCC 0x33 0xC3 0x3C

5. Functional Specification

5.1 Font Library Space

Total 32M byte of flash memory is available for font library.
By default the following font library are preloaded:

- 4x ASCII (8x16,16x32,24x48,32x64)
- 2x GBK (Chinese,16x16,24x24 dots character)
- 2x GB2312 (Chinese,32x32,64x64 dots character)

5.2 Picture and Data Space

Total 96M byte of flash memory is available for BMP pictures (800x480, 16bit color) preload. Where, user could assign 32M byte (max.) as custom data storage.

5.3 Display Coordinate

The top-left corner point is the origin (0, 0) of the display.

6. Command Table

Type	Name	Code	Description
Handshake	hand_shake	0x00	Respond “OK” as alive, and suffix configuration and version information
Draw pixels	draw_pixel_bg	0x50	Draw pixels with background color
	draw_piexl_fg	0x51	Draw piexls with foreground color
Draw Lines	draw_line_fg	0x56	Draw lines with foreground color
	draw_line_bg	0x5D	Draw lines with background color
Draw Circles	draw_circle	0x57,0x01	Draw circle
Fill Circles	fill_circle	0x57,0x03	Fill circle
Draw Rectangles	draw_rect_fg	0x59	Draw rectangles with foreground color
	draw_rect_bg	0x69	Draw rectangles with background color
Fill Rectangles	fill_rect_bg	0x5A	Fill rectangles with background color
	fill_rect_fg	0x5B	Fill rectangles with foreground color
Display mode Configuration	set_color	0x40	Set color palette
	set_char_sp	0x41	Set character spacing
	Set_color_bg	0x42	Select and set background color
	set_color_fg	0x43	Select and set foreground color
	set_cursor_mode	0x44	Set cursor mode
Text display	read_fontlib	0x53	Read font library information
	disp_char	0x54	Select font library and display characters with appointed background and foreground colors
	disp_char_fg	0x55	Select font and display characters with foreground color
	set_textbox	0x45	Set text box / close text box
Area operation	clr_screen	0x52	Clear area/screen
Picture/Icon display	disp_pic	0x70	Display a full screen picture
	save_pic	0xE2	Save a specific picture to Flash
	cut_pic	0x9E	Cut and paste part of a specific picture/ Icon
	cut_pic_trans	0x9D	Cut and paste part of a specific picture/ Icon with transparent mode
Picture/Font library load	download_pic	0x72,0x00	Download pictures
	download_fontlib	0x72,0x01	Download font libraries
Touch panel operation	read_touch_code	0x78	Read touch code
	set_touch_code	0x98	Set touch code
	read_touch_coordiante	0x72	Touch point coordinates upload
	touch_calib	0xe4	Touch panel calibration
Buzzer Control	buzzer_ctrl	0x79	Beep time and frequency control
Backlight	backlight_ctrl	0x5F	64 degree backlight brightness

control			control
RTC	RTC_adjust	0xE7	Date and time adjustment
	RTC_read	0x9B,0x5A	RT clock upload
	RTC_disp	0x9B,0x00	RT clock display in default mode
	RTC_set	0x9B,0XFF	RT clock display mode set up
Work mode configuration	Set_workmode	0xE0	Baud Rate and system parameter configuration

Note.
For details, please refer to Software Manual.

7. Optical Characteristics

Item	Symbol	Condition	MIN.	TYP.	MAX.	UNIT	Note.
Viewing Angle (CR≥10)	θ_L	9 o'clock	60	70	-	degree	*2
	θ_R	3 o'clock	60	70	-		
	θ_T	12 o'clock	40	50	-		
	θ_B	6 o'clock	60	70	-		
Response Time	T_f	Normal θ=0°	-	10	20	msec	*3
	T_r		-	15	30	msec	
Contrast Ratio	CR		400	500	-	-	*1
Color Chromaticity	W_X		0.26	0.31	0.26	-	
	W_Y		0.28	0.33	0.38	-	
Luminance	L		-	250	-	cd/m^2	*4
Luminance uniformity	Y_U		70	75	-	%	*4

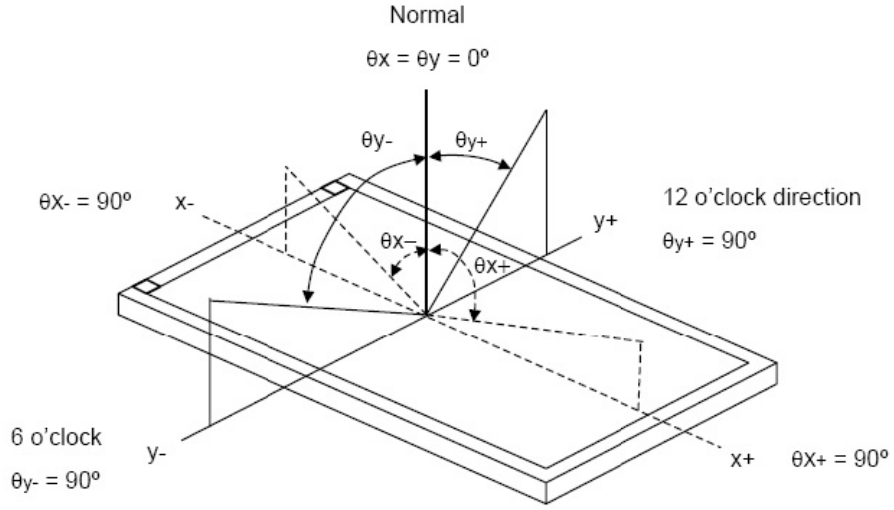
Note:

*1. Definition of Contrast Ratio

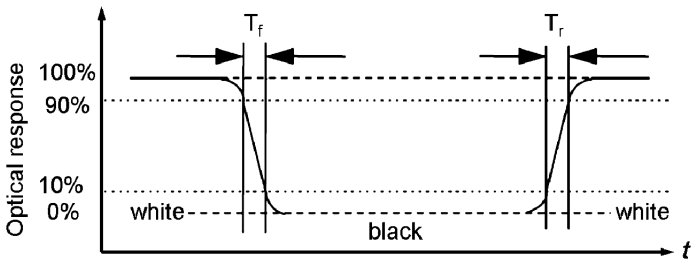
The contrast ratio could be calculate by the following expression:

Contrast Ratio (CR) = Luminance with all pixels white / Luminance with all pixels black

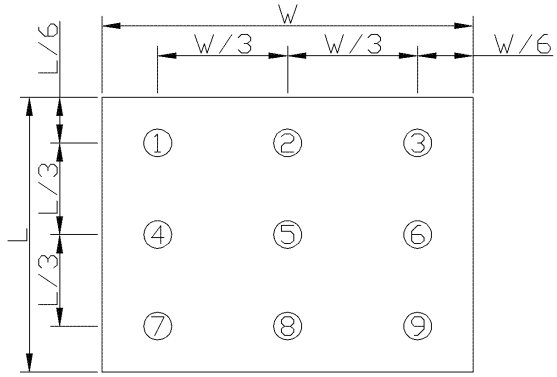
*2 Definition of Viewing Angle



*3 Definition of response time



*4 Definition of Luminance Uniformity



Luminance uniformity (Lu)=
Min. Luminance form pt1~pt9 / Max Luminance form Pt1~pt9

8. Precautions of Using LCD Modules

Mounting

- Mounting must use holes arranged in four corners or four sides.
- The mounting structure so provide even force on to LCD module. Uneven force (ex. Twisted stress) should not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- It is suggested to attach a transparent protective plate to the surface in order to protect the polarizer. It should have sufficient strength in order to the resist external force.
- The housing should adopt radiation structure to satisfy the temperature specification.
- Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- Do not touch, push or rub the exposed polarizer with glass, tweezers or anything harder than HB pencil lead. Never rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth.(Some cosmetics deteriorate the polarizer.)
- When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizer. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer

Operating

- The spike noise causes the mis-operation of circuits. It should be within the ±200mV level (Over and under shoot voltage)
- Response time depends on the temperature.(In lower temperature, it becomes longer.)
- Brightness depends on the temperature. (In lower temperature, it becomes lower.) And in lower temperature, response time(required time that brightness is stable after turned on) becomes longer.
- Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- When fixed patterns are displayed for a long time, remnant image is likely to occur.
- Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference

Electrostatic Discharge Control

- Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

Strong Light Exposure

- Strong light exposure causes degradation of polarizer and color filter.

Storage

- When storing modules as spares for a long time, the following precautions are necessary.
- Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5℃ and 35℃ at normal humidity .
- The polarizer surface should not come in contact with any other object. It is recommended that they be stored in the container in which they were shipped.

Protection Film

- When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
- The protection film is attached to the polarizer with a small amount of glue. If some stress is applied to rub the protection film against the polarizer during the time you peel off the film, the glue is apt tore main on the polarizer. Please carefully peel off the protection film without rubbing it against the polarizer.
- When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the polarizer after the protection film is peeled off.
- You can remove the glue easily. When the glue remains on the polarizer surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

Transportation

- The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.

9. Appendix (Inspection items and criteria for appearance defect)

9.1 Bright/Dark Dots:

Defect Type	Specification	Major	Minor
Bright Dots	N≤ 2		●
Dark Dots	N≤ 3		●
Total Bright and Dark Dots	N≤ 4		●

Note: 1. **The definition of dot:** The size of a defective dot over 1/2 of whole dot is regarded as one defective dot.
2. **Bright dot:** Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.
3. **Dark dot:** Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue pattern.