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

HMB043FD-1C

LCD Module User Manual

Prepared by:	Checked by:	Approved by:
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Date: 2017-12-18	Date:	Date:

Rev.	Descriptions	Release Date
0.1	- Preliminary Draft release	2017-12-18

Table of Content

1 Basic Specification

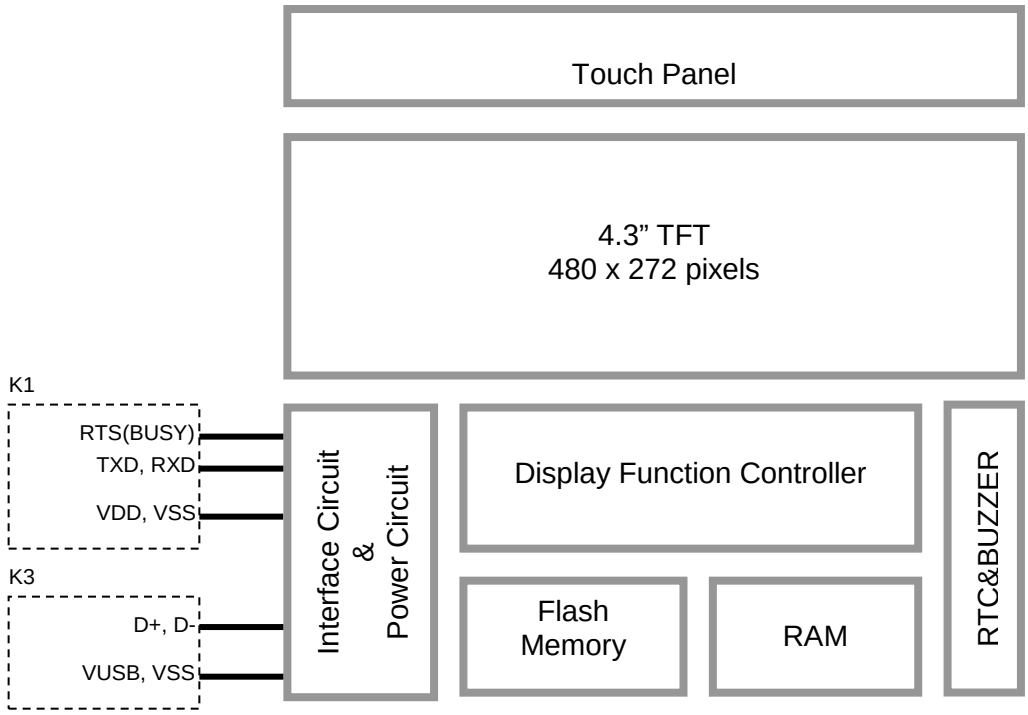
TOPWAY HMB043FD-1C is a Smart TFT Module with 32bit MCU on board. Its graphics engine provides numbers of outstanding features. It supports TOPWAY TML 2.4 for preload and pre-design display interface that simplify the host operation and development time. Suitable for industry control, instrumentation, medical electronics, power electric equipment applications.

1.1 General Specification

Screen Size(Diagonal) :	4.3”
Resolution :	480(RGB) x 272
Color Depth :	65k color (16bit)
Pixel Configuration :	RGB Stripe
Display Mode :	Transmissive / Normal White
Viewing Direction :	12H (*1) (gray-scale inverse) 6H (*2)
Outline Dimension :	121.9 x 74.7 x 26.4 (mm) (see attached drawing for details)
Active Area :	95.04 x 53.86(mm)
Backlight :	LED
Surface Treatment :	Anti-Glare Treatment
Operating Temperature :	-20 ~ +70°C
Storage Temperature :	-30 ~ +80°C

Note:
*1. For saturated color display content (eg. pure-red, pure-green, pure-blue, or pure-colors-combinations).
*2. For “color scales” display content.
*3. Color tone may slightly change by Temperature and Driving Condition.

1.2 Block Diagram



1.3 Terminal Function

1.3.1 UART Interface Terminal (K1)

Pin No.	Pin Name	I/O	Descriptions
1	VDD	P	Power supply
2	RXD	I	Data Input
3	TXD	O	Data output
4	RTS	O	Request To Send (function as busy BUSY signal) 1：Busy；0：No busy
5	NC	--	NO Connect, leave open
6	VSS	P	Ground, (0V)

Note.
*1. User data and commands transfer through this terminal
*2. HW hand shake is suggested

1.3.2 USB Interface Terminal (K3)

Pin No.	Pin Name	I/O	Descriptions
1	VUSB	P	Power output
2	D-	I/O	USB DATA negative signal
3	D+	I/O	USB DATA positive signal
4	VSS	P	Ground, (0V)

Note.
*1. TML files and image files preload through this terminal

2 Absolute Maximum Ratings

Items	Symbol	Min.	Max.	Unit	Condition
Power Supply voltage	V_{DD}	-0.3	28	V	
Operating Temperature	T_{OP}	-20	70	°C	No Condensation
Storage Temperature	T_{ST}	-30	80	°C	No Condensation

Note:
*1. This rating applies to all parts of the module and should not be exceeded.
*2. The operating temperature only guarantees operation of the circuit. The contrast, response speed, and the other specification related to electro-optical display quality is determined at the room temperature, T_{OP}=25℃
*3. Ambient temperature when the backlight is lit (reference value)
*4. 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

VSS=0V, T_{OP} =25°C

Items	Symbol	MIN.	TYP.	MAX.	Unit	Applicable Pin
Operating Voltage	V_{DD}	6	12.0	26	V	VDD
RxD Input MARK(1)	V_{RxDM}	-3.0	-	-15.0	V	Rx
RxD Input SPACE(0)	V_{RXDS}	+3.0	-	+15.0	V	Rx
TxD Output MARK(1)	V_{TXDM}	-3.0	-	-15.0	V	Tx
TxD Output SPACE(0)	V_{TXDS}	+3.0	-	+15.0	V	Tx
RTS Output High	V_{TXDH}	-3.0	-	-15.0	V	RTS(BUSY)
RTS Output Low	V_{TXDL}	+3.0	-	+15.0	V	RTS(BUSY)
Operating Current	I_{DD}	-	216	-	mA	VDD (*1)
Battery Supply Current	I_{BAT}	-	0.6	-	uA	

Note.
*1. Normal display condition and no usb connect.

3.2 AC Characteristic

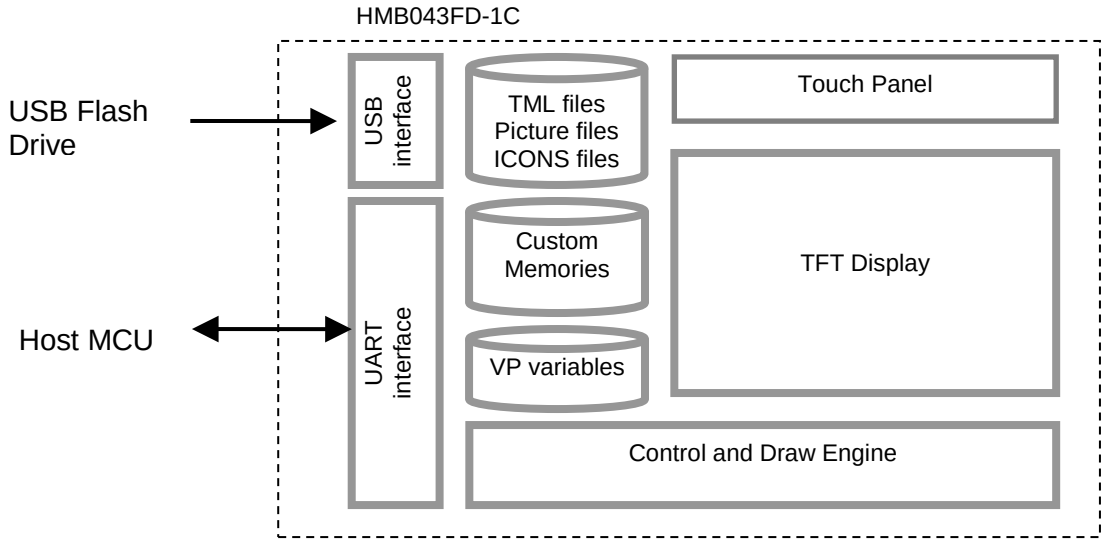
Items	JP6,JP8=close, JP5,JP7=open (factory default)	JP6,JP7=close, JP5,JP8=open	JP6,JP7= open, JP5,JP8= close	JP6,JP8= open, JP5,JP7= close
Start bit	1	1	1	1
Data bit	8	8	8	8
Parity bit	None	None	Even	Odd
Stop bit	1	1	1	1
Baud Rate(*1)	115200 bps	9600 bps	115200 bps	115200 bps

Items	JP10=close, JP9=open (factory default)	JP10= open, JP9=close
Serial Data Flow Control	busy	Xon/Xoff

Note.
*1.Baud Rate (1200bps～115200bps) could be adjusted by software.

4 Function Specifications

4.1 Basic Operation Function Descriptions



- TML files, Picture files, ICON files are stored inside FLASH memory area.
  They are preloaded to HMB043FD-1C for stand alone interface use.
- Those files are preloaded via USB interface by a USB flash Drive.
- All the interface flow are based on the preloaded TML files
- VP variables is inside RAM area,
  it provides real time access via UART by the HOST or display onto the TFT by TML file.
- Custom Memories are inside FLASH memory area
  It can be accessed via UART interface by the HOST.
- Control and Draw Engine executes HOST commands and response respectively
- It also reports the real time Touch Key number to the HOST

4.2 Command Descriptions

Please refer to “TOPWAY HMB043FD-C Command Manual , Protocol V1.00” or later.

5 Optical Characteristics

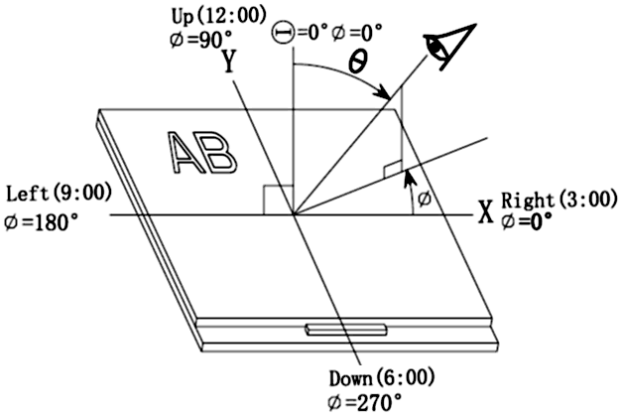
Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
View Angles		θT	CR≧10	60	70	-	Degree	Note2,3
		θB		50	60	-		
		θL		60	70	-		
		θR		60	70	-		
Contrast Ratio		CR	θ =0°	600	800	-		Note 3
Response Time		TON	25℃	-	25	35	ms	Note 4
		TOFF						
Chromaticity	**White**	x	Backlight is on	0.257	0.307	0.357		Note 1,5
		y		0.280	0.330	0.380		
	Red	x		0.532	0.582	0.632		Note 1,5
		y		0.299	0.349	0.399		
	Green	x		0.294	0.344	0.394		Note 1,5
		y		0.538	0.588	0.638		
	Blue	x		0.101	0.151	0.201		Note 1,5
		y		0.049	0.099	0.149		
Uniformity		U			80	-	%	Note 6
NTSC				45	50	-	%	Note 5
Luminance		L		571	708	-	cd/㎡	Note 7

1.IF= **40** mA, and the ambient temperature is 25□ .

2. The test systems refer to Note 1 and Note 2.

Note 1:
The data are measured after LEDs are turned on for 5 minutes. LCM displays full white. The brightness is the average value of 9 measured spots. Measurement equipment SR-3A (1°)
Measuring condition:
- Measuring surroundings: Dark room
- Measuring temperature: Ta=25℃.
- Adjust operating voltage to get optimum contrast at the center of the display.

Note 2:
The definition of viewing angle:
Refer to the graph below marked by θ and Φ

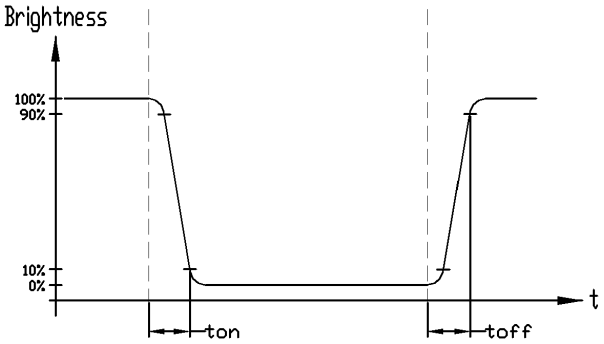


Note 3:
The definition of contrast ratio (Test LCM using SR-3A (1°)):

$$\text{Contrast Ratio(CR)} = \frac{\text{Luminance When LCD is at “White” state}}{\text{Luminance When LCD is at “Black” state}}$$

(Contrast Ratio is measured in optimum common electrode voltage)

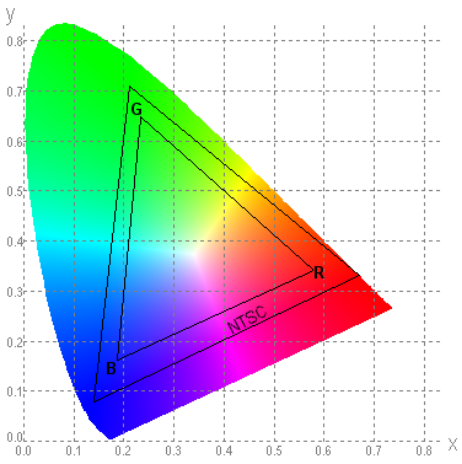
Note 4:
Definition of Response time. (Test LCD using BM-7A(2°)):
The output signals of photo detector are measured when the input signals are changed from “black” to “white”(falling time) and from “white” to “black”(rising time), respectively.
The response time is defined as the time interval between the 10% and 90% of amplitudes.Refer to figure as below.



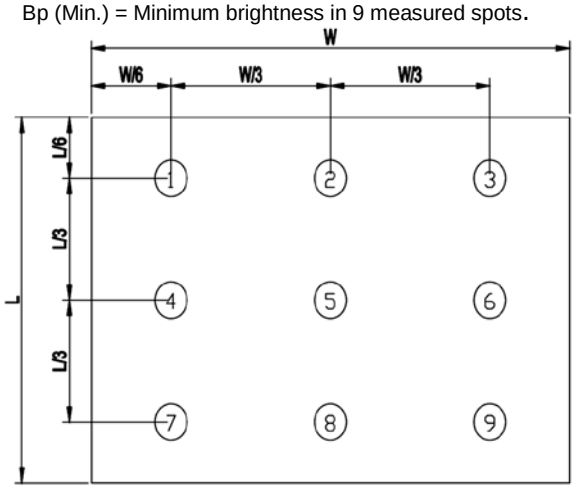
Note 5:
Definition of Color of CIE1931 Coordinate and NTSC Ratio.

Color gamut:

$$S = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}} \times 100\%$$



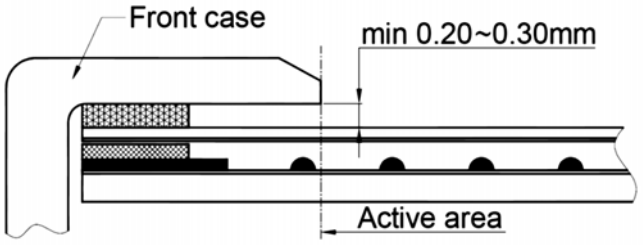
Note 6:
The luminance uniformity is calculated by using following formula.
△Bp = Bp (Min.) / Bp (Max.)×100 (%)
Bp (Max.) = Maximum brightness in 9 measured spots
Bp (Min.) = Minimum brightness in 9 measured spots.



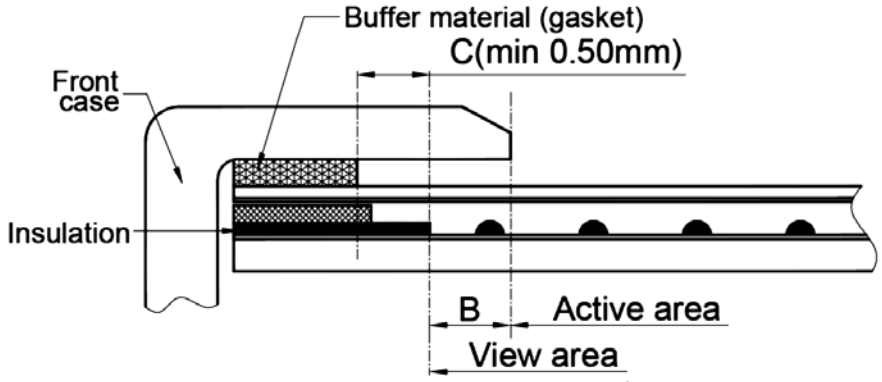
Note 7:
Measured the luminance of white state at center point

附录：Touch panel Design Precautions

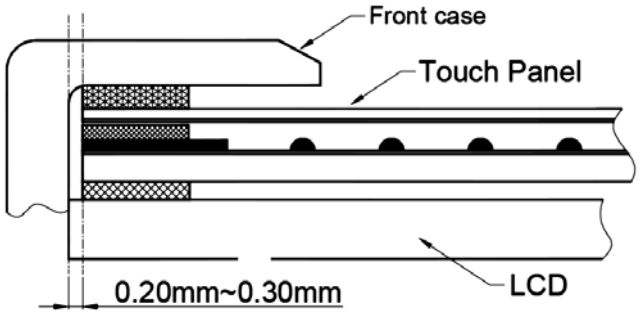
1. It should prevent front case touching the touch panel Active Area (A.A.) to prevent abnormal touch.
   It should left gab (e.g. 0.2~0.3mm) in between.



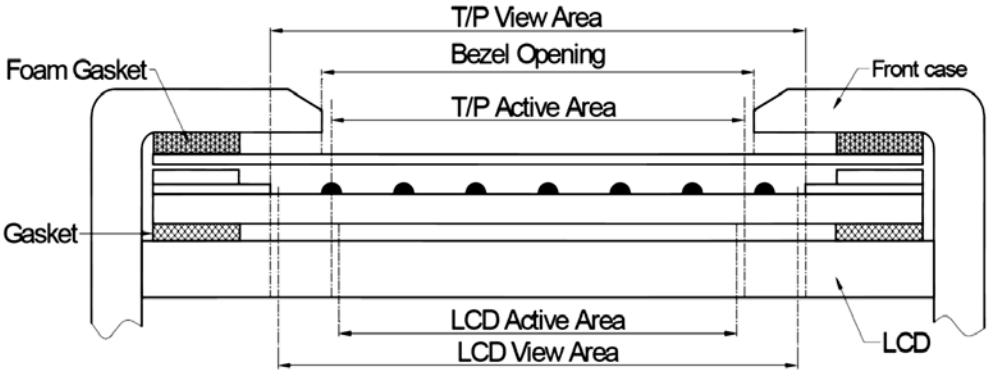
2. Outer case design should take care about the area outside the A.A.
   Those areas contain circuit wires which is having different thickness. Touching those areas could deform the ITO film. As a result case the ITO cold be damaged and shorten its lifetime.
   It is suggested to protect those areas with gasket (between the front case and the touch panel).
   The suggested figures are B≥0.50mm; C≥0.50mm。



3. The front case side wall should keep space (e.g. 0.2 ~ 0.3mm) from the touch panel.



4. In general design,
   touch panel V.A. should be bigger than the LCD V.A.
   and touch panel A.A. should be bigger than the LCD A.A.



6 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 polarizers 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 benzine. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. 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°C and 35°C 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.

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

HMB043FD-C

Command Manual
Protocol V1.00

Prepared by:	Checked by:	Approved by:
chenjian		
Date: 2016-7-1	Date:	Date:

Rev.	Descriptions	Release Date
0.1	- Preliminary Draft release	2016-07-01

Table of Content

1. Basic Specifications

TOPWAY Smart LCD serial command is for real-time control and access. Host machine get the data which input through the Smart LCD interface or provide the data for display.

1.1 Hardware connection

Smart LCD serial UART interface are mainly base on RS232-C standard, by default, config as 8N1 ,115200bps.

2. Command Structure

2.1 Communication Packet Structure

Commands and Response Packet should be format as follow (host→module):

Seq	Code	Code type	Description
1	0xAA	Packet header	Communication packet header specified by the project configuration file, the default is 0xAA, 0x55
2	0x55		
3	0x00 ~ 0xfe	Packet length	1byte (no. of byte of cmd-code & Par-data)
4	Cmd-code	Command code	1byte
5	Par-data	Parameter or Data	No. of Par-data byte = 254-1 = 253 (*1)
:	:	-	-
:	:	-	-
N	0x00~0xFF	CRC MSB Data	CRC is an optional, enabled by project configuration
N+1	0x00~0xFF	CRC LSB Data	

Note.
*1. Unless otherwise specified,all the multi-byte values, data, address' byte sequence are MSB first, LSB last.

3. Data arrangement

3.1 Color Data Value Configuration

16 bit Color value

16 bit color value															
R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B4	B3	B2	B1	B0
High byte (MSB)								Low byte (LSB)							
D7	D6	D5	D4	D3	D2	D1	D0	D7	D6	D5	D4	D3	D2	D1	D0

3.2 Data / Address / Page_ID / Location Values Configuration

64bit value

64 bit number value							
D63…D56	D55…D48	D47…D40	D39...D32	D31…D24	D23…D16	D15…D8	D7…D0
Byte7 (MSB)							Byte0 (LSB)
D7…D0	D7…D0	D7…D0	D7…D0	D7…D0	D7…D0	D7…D0	D7…D0

32bit value

32 bit number value			
D31…D24	D23…D16	D15…D8	D7…D0
Byte3 (MSB)			Byte0 (LSB)
D7…D0	D7…D0	D7…D0	D7…D0

16bit value

16 bit number value	
D15…D8	D7…D0
High Byte (MSB)	Low Byte (LSB)
D7…D0	D7…D0

4. Command Descriptions

4.1 Command Table

Function	Name	Code	Description
Config/Status Functions	hand_shake	0x30	Read a Hand Shake
	read_ver	0x31	Read firmware version
	read_pg_id	0x32	Read Current page ID
	Touch_response	0x78/0x79	Touch Response
	set_sys_config	0xE0	System parameter configuration and Baud Rate
	u_drv_format	0xE2	Format the u_drive
	u_drv_unlock	0xE3	Unlock the u_drive with pre-stored password
	screen_saver	0x5E	Screen saver (backlight dim down time out)
	backlight_ctrl	0x5F	backlight brightness control (64 levels)
	RTC_read	0x9B	Read the RTC values
	RTC_set	0x9C	Set the RTC
	Flash_write	0x90	Write data to the flash
	Flash_read	0x91	Read data from the flash
Display Functions	disp_page	0x70	Display a pre-stored TML file (page)
VP Functions	STR_write	0x42	Write string to VP_STR
	STR_read	0x43	Read string form VP_STR
	STR_fill	0x46	Fill strings to the VP_STR
	N16_write	0x3d	Write 16bit (signed integer) value to VP_N16
	N16_read	0x3e	Read 16bit (signed integer) value from VP_N16
	N16_fill	0x3f	Fill numbers to the VP_N16
	N32_write	0x44	Write 32bit (signed integer) value to VP_N32
	N32_read	0x45	Read 32bit (signed integer) value from VP_N32
	N32_fill	0x47	Fill numbers to the VP_N32
	N64_write	0x48	Write 64bit (signed integer) value to VP_N64
	N64_read	0x49	Read 64bit (signed integer) value from VP_N64
	N64_fill	0x4A	Fill numbers to the VP_N64
	BP1_write	0x4B	Write bit-map (1bpp) data to VP_BP1
	BP1_write_comp	0x4C	Write compressed bit-map (1bpp) data to VP_BP1
	G16_write	0x4D	Write 16bit (signed integer) graphic array to VP_G16
	G16_write_rotate	0x4E	Rotate the VP_G16 array data inside the module and write a 16bit (signed integer) value into end-of-array.
Extended Functions	Ext_Register_write	0x80	Write data to special register
	Ext_Register_read	0x81	Read data form special register
	Ext_Data_write	0x82	Write data to data space
	Ext_Data_read	0x83	Read data form data space

4.2 Config/ Status Function Commands Details

4.2.1 hand_shake (0x30)

seq	Cmd-code / Par-data	Descriptions
1	0x30	Read a Hand Shake

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)

Response code:

Seq.	Content	Byte in Hex	Descriptions
1st	Header	0xAA	Communication packet header
2nd		0x55	
3rd	Packet length	0x12	no. of byte of cmd-code & Par-data to be follow
4th	Command	0x30	Command executed
5th	“T”	0x54	“Topway HMT Ready\0” in ASCII
6th	“o”	0x6f	
7th	“P”	0x70	
8th	“w”	0x77	
9th	“a”	0x61	
10th	“y”	0x79	
11th	“ “	0x20	
12th	“H”	0x48	
13th	“M”	0x4d	
14th	“T”	0x54	
15th	“ “	0x20	
16th	“R”	0x52	
17th	“e”	0x65	
18th	“a”	0x61	
19th	“d”	0x64	
20th	“y”	0x79	
21st	\0	0x00	‘\0’(0x00): string end mark

Note.
*1. The Response code with communication packet format (see Communication Packet Structure Section for details)

4.2.2 read_ver (0x31)

Seq	Cmd-code / Par-data	Descriptions
1	0x31	Read firmware version

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)

Response code:

Seq.	Content	Byte in Hex	Descriptions
1st	Header	0xAA	Communication packet header
2nd		0x55	
3rd	Packet length	0x06	no. of byte of cmd-code & Par-data to be follow
4th	Command	0x31	Command executed
5th	“1”	0x31	“1.06\0” in ASCII Where firmware version is V1.06(example)
6th	“.”	0x2e	
7th	“0”	0x30	
8th	“6”	0x36	
9th	\0	0x00	‘\0’(0x00): string end mark

Note.
*1. The Response code with communication packet format (see Communication Packet Structure Section for details)

4.2.3 read_pg_id (0x32)

Seq	Cmd-code / Par-data	Descriptions
1	0x32	Read Current page ID

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)

Response code:

Seq.	Content	Byte in Hex	Descriptions
1st	Header	0xAA	Communication packet header
2nd		0x55	
3rd	Packet length	0x03	no. of byte of cmd-code & Par-data to be follow
4th	Command	0x32	Command executed
5th	pageIDh	0x00	Current Page ID in 16bit binary value
6th	pageIDl	0x01	

Note.
*1. The Response code with communication packet format (see Communication Packet Structure Section for details)

4.2.4 touch_response (0x78 / 0x79)

seq	Cmd-code / Par-data	Descriptions
1	--	Touch Response

Touch Key ID Response code (0x78):

Seq.	Content	Byte in Hex	Descriptions
1st	Header	0xaa	Communication packet header
2nd		0x55	
3rd	Packet length	0x04	
4th	Command	0x78	Touched release Key_ID defined by TOPWAY TML Graphic Editor will be response to host
5th	Page_ID	Page_IDh	Page_ID = the touch key in page(16bit binary value)
6th		Page_IDl	
7th	Key_ID	Key_ID	Key_ID (8bit binary value)

Note.
*1. The Response code with communication packet format (see Communication Packet Structure Section for details)

Touch Key ID Response code (0x79):

Seq.	Content	Byte in Hex	Descriptions
1st	Header	0xaa	Communication packet header
2nd		0x55	
3rd	Packet length	0x04	
4th	Command	0x79	Touched release Key_ID defined by TOPWAY TML Graphic Editor will be response to host
5th	Page_ID	Page_IDh	Page_ID = the touch key in page(16bit binary value)
6th		Page_IDl	
7th	Key_ID	Key_ID	Key_ID (8bit binary value)

Note.
*1. The Response code with communication packet format (see Communication Packet Structure Section for details)

4.2.5 Set_sys_config(0xE0)

seq	Cmd-code / Par-data	Descriptions
1	0xE0	Baud Rate and system parameter configuration
2	0x55	
3	0xAA	
4	0x5A	
5	0xA5	
6	Baud_Set	Baud_Set= 0x00 : 1200bps; 0x01 : 2400bps; 0x02 : 4800bps; 0x03 : 9600bps; 0x04 : 19200bps; 0x05 : 38400bps; 0x06 : 57600bps; 0x07 : 115200bps;
7	sys_par1	Reserved
8	sys_par2	Reserved

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)

4.2.6 U_drv_format (0xE2)

seq	Cmd-code / Par-data	Descriptions
1	0xE2	Format the USB drive. All the files (include the security lock file) will be erased.
2	0x55	
3	0xAA	
4	0x5A	
5	0xA5	

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)

4.2.7 U_drv_unlock (0xE3)

seq	Cmd-code / Par-data	Descriptions
1	0xE3	Unlock the USB drive of file read/write with pre-stored password.
2	PW	PW: password in ASCII length=127max. '\0'(0x00): string end mark
:	:	
:	:	
:	'\0'	

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)

4.2.8 screen_saver (0x5E)

seq	Cmd-code / Par-data	Descriptions
1	0x5E	Screen saver
2	Time1h	time out time in seconds, range: 0x0000~0xffff (0x0000: disable screen saver function) (*2)
3	Time1l	
4	PWM_LE	PWM_LE=0~0x3F (default 0x19 in dim down), the backlight dimmed level in screen saving mode (*2)

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)
*2. default value defined by TML graphic editor configuration

4.2.9 backlight_ctrl(0x5F)

seq	Cmd-code / Par-data	Descriptions
1	0x5F	backlight brightness control
2	PWM_LE	PWM_LE=0x00~0x3F (*2)

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)
*2. default value defined by TML graphic editor configuration

4.2.10 RTC_read(0x9B)

seq	Cmd-code / Par-data	Descriptions
1	0x9B	Read the current RTC value

Response code:

Seq.	Content	Byte in Hex	Descriptions
1st	Header	0xAA	Communication packet header
2nd		0x55	
3rd	Packet length	0x04	no. of byte of cmd-code & Par-data to be follow
4th	Command	0x78	Touched release Key_ID defined by TOPWAY TML Graphic Editor will be response to host
5th	Page_ID	Page_IDh	Page_ID = the touch key in page(16bit binary value)
6th		Page_IDl	
7th	Y coordinate	Key_ID	Key_ID (8bit binary value)

Response code:

Seq.	Content	Byte in Hex	Descriptions
1st	Header	0xAA	Communication packet header
2nd		0x55	
3rd	Packet length	0x07	no. of byte of cmd-code & Par-data to be follow
4th	Command	0x9B	Command executed
5th	Date	Year	Year: 00~99 (00=year2000) (8bit binary value)
6th		Month	Month: 01~12 (8bit binary value)
7th		Day	Day: 01~31 (8bit binary value)
8th	Time	Hour	Hour 00~23 (24hr format)(8bit binary value)
9th		Minute	Minutes 00~59 (8bit binary value)
10th		Second	Second 00~59 (8bit binary value)

Note.
*1. The Response code with communication packet format (see Communication Packet Structure Section for details)

4.2.11 RTC_set(0x9C)

seq	Cmd-code / Par-data	Descriptions
1	0x9C	Set the RTC
2	Year	Year = 00~99(2000~2099) Month = 00~12 Date = 00~31 Hour =00~23 Minute =00~59 Second =00~59
3	Month	
4	Date	
5	Hour	
6	Minute	
7	Second	

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)

4.2.12 Flash_write(0x90)

seq	Cmd-code / Par-data	Descriptions
1	0x90	Write data to the flash at specified address
2	Address3(MSB)	the specified start address to write Address range =0x00 000~0x3F FFF
3	Address2	
4	Address1	
5	Address0(LSB)	
6	0x00	Reserved
7	0x00	
8	Data	data to write. (247 byte MAX) (*2)
:	:	
:	:	
:	:	

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)
*2. No. of byte limited by package structure

4.2.13 Flash_read(0x91)

seq	Cmd-code / Par-data	Descriptions
1	0x91	Read data from the flash at specified address
2	Address3(MSB)	the specified start address to write Address range =0x00 000~0x3F FFF
3	Address2	
4	Address1	
5	Address0(LSB)	
6	Data_Lengthh	The no. of data byte to read Length =1~254
7	Data_Lengthl	

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)

Response code:

Seq.	Content	Byte in Hex	Descriptions
1st	Header	0xAA	Communication packet header
2nd		0x55	
3rd	Packet length	0x00~0xff	no. of byte of cmd-code & Par-data to be follow
4th	Command	0x91	Command executed
5th	Data	data	Read back data
:		:	

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)

4.3 Display Functions Commands Details

4.3.1 disp_page(0x70)

seq	Cmd-code / Par-data	Descriptions
1	0x70	Display a pre-stored TML file(page)
2	Page_IDh	Page_ID = 0~999
3	Page_IDl	

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)

4.4 VP Function Commands Details

4.4.1 STR_write(0x42)

Seq	Cmd-code / Par-data	Descriptions
1	0x42	Write string to VP_STR
2	Add3(MSB)	the VP_STR Address = 0x000000 ~ 0x01DFFF (each VP_STR = 128 bytes) (address value must be divisible by 128)
3	Add2	
4	Add1	
5	Add0(LSB)	
6	data	String to write Total no. of byte in string ≤128
:	:	
:	:	
:	'\0'	'\0'(0x00): string end mark

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)

4.4.2 STR_read(0x43)

Seq	Cmd-code / Par-data	Descriptions
1	0x43	Read string from VP_STR
2	Add3(MSB)	the VP_STR Address = 0x000000 ~ 0x01DFFF (each VP_STR = 128 bytes) (address value must be divisible by 128)
3	Add2	
4	Add1	
5	Add0(LSB)	

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)

Response code:

Seq.	Content	Byte in Hex	Descriptions
1st	Header	0xAA	Communication packet header
2nd		0x55	
3rd	Packet length	0x00~0xff	no. of byte of cmd-code & Par-data to be follow
4th	Command	0x43	Command executed
5th	String data	data	String code
:		:	
:		:	
:	\0	0x00	''\0'(0x00): string end mark

Note.
*1. The Response code with communication packet format (see Communication Packet Structure Section for details)

4.4.3 STR_fill(0x46)

Seq	Cmd-code / Par-data	Descriptions
1	0x46	Write string to VP_STR
2	Add3(MSB)	he VP_STR Address = 0x000000 ~ 0x01DFFF (each VP_STR = 128 bytes) (address value must be divisible by 128)
3	Add2	
4	Add1	
5	Add0(LSB)	
6	Lengthh	the number of VP_STR (including the start address) to be filled Length = 1~512
7	Lengthl	
8	data	String to write Total no. of byte in string ≤128
:	:	
:	:	
:	'\0'	'\0'(0x00): string end mark

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)

4.4.4 N16_write(0x3D)

Seq	Cmd-code / Par-data	Descriptions
1	0x3D	Write 16bit number to VP_N16
2	Add3(MSB)	VP_N16 Address = 0x080000 ~ 0x08FFFF (each VP_N16 = 2 byte) (address value must be divisible by 2)
3	Add2	
4	Add1	
5	Add0(LSB)	
6	High Byte	The 16 bit value to write
7	Low Byte	

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)

4.4.5 N16_read(0x3E)

Seq	Cmd-code / Par-data	Descriptions
1	0x3E	Read 16bit number from VP_N16
2	Add3(MSB)	VP_N16 Address = 0x080000 ~ 0x08FFFF (each VP_N16 = 2 byte) (address value must be divisible by 2)
3	Add2	
4	Add1	
5	Add0(LSB)	

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details

Response code:

Seq.	Content	Byte in Hex	Descriptions
1st	Header	0xAA	Communication packet header
2nd		0x55	
3rd	Packet length	0x03	no. of byte of cmd-code & Par-data to be follow
4th	Command	0x3e	Command executed
5th	N16 value	High Byte	16 bit value
6th		Low Byte	

Note.
*1. The Response code with communication packet format (see Communication Packet Structure Section for details)

4.4.6 N16_fill(0x3F)

Seq	Cmd-code / Par-data	Descriptions
1	0x3F	Fill 16bit number to the VP_N16
2	Add3(MSB)	VP_N16 Address = 0x080000 ~ 0x08FFFF (each VP_N16 = 2 byte) (address value must be divisible by 2)
3	Add2	
4	Add1	
5	Add0(LSB)	
6	Lengthh	the number of VP_N16 (including the start address) to be filled Length = 1~32768
7	Lengthl	
8	High Byte	the 16 bit value to fill
9	Low Byte	

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)

4.4.7 N32_write(0x44)

Seq	Cmd-code / Par-data	Descriptions
1	0x44	Write 32bit number to VP_N32
2	Add3(MSB)	VP_N32 Address = 0x020000 ~ 0x02FFFF (each VP_N32 = 4 byte) (address value must be divisible by 4)
3	Add2	
4	Add1	
5	Add0(LSB)	
6	Data3(MSB)	the 32 bit value to write.
7	Data2	
8	Data1	
9	Data0(LSB)	

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)

4.4.8 N32_read(0x45)

Seq	Cmd-code / Par-data	Descriptions
1	0x45	Read 32bit number from VP_N32
2	Add3(MSB)	VP_N32 Address = 0x020000 ~ 0x02FFFF (each VP_N32 = 4 byte) (address value must be divisible by 4)
3	Add2	
4	Add1	
5	Add0(LSB)	

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details

Response code:

Seq.	Content	Byte in Hex	Descriptions
1st	Header	0xAA	Communication packet header
2nd		0x55	
3rd	Packet length	0x05	no. of byte of cmd-code & Par-data to be follow
4th	Command	0x45	Command executed
5th	N32 value	Data3(MSB)	32 bit value
6th		Data2	
7th		Data1	
8th		Data0(LSB)	

Note.
*1. The Response code with communication packet format (see Communication Packet Structure Section for details)

4.4.9 N32_fill(0x47)

Seq	Cmd-code / Par-data	Descriptions
1	0x47	Fill 32bit number to the VP_N32
2	Add3(MSB)	VP_N32 Address = 0x020000 ~ 0x02FFFF (each VP_N32 = 4 byte) (address value must be divisible by 4)
3	Add2	
4	Add1	
5	Add0(LSB)	
6	Lengthh	the number of VP_N32 (including the start address) to be filled Length = 1~8192
7	Lengthl	
8	Data3(MSB)	the 32 bit value to fill
9	Data2	
10	Data1	
11	Data0(LSB)	

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)

4.4.10 N64_write(0x48)

Seq	Cmd-code / Par-data	Descriptions
1	0x48	Write 64bit number to VP_N64
2	Add3(MSB)	VP_N64 Address= 0x030000 ~ 0x03DFFF (each VP_N64 = 8 byte) (address value must be divisible by 8)
3	Add2	
4	Add1	
5	Add0(LSB)	
6	Data7(MSB)	the 64bit value to write.
7	Data6	
:	:	
:	:	
12	Data1	
13	Data0(LSB)	

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)

4.4.11 N64_read(0x49)

Seq	Cmd-code / Par-data	Descriptions
1	0x49	Read 64bit number from VP_N64
2	Add3(MSB)	VP_N64 Address= 0x030000 ~ 0x03DFFF (each VP_N64 = 8 byte) (address value must be divisible by 8)
3	Add2	
4	Add1	
5	Add0(LSB)	

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details

Response code:

Seq.	Content	Byte in Hex	Descriptions
1st	Header	0xAA	Communication packet header
2nd		0x55	
3rd	Packet length	0x09	no. of byte of cmd-code & Par-data to be follow
4th	Command	0x49	Command executed
5th	N64 value	Data7(MSB)	64 bit value
6th		Data6	
:		:	
11th		Data1	
12th		Data0(LSB)	

Note.
*1. The Response code with communication packet format (see Communication Packet Structure Section for details)

4.4.12 N64_fill(0x4A)

Seq	Cmd-code / Par-data	Descriptions
1	0x4A	Fill 64bit number to the VP_N64
2	Add3(MSB)	VP_N64 Address= 0x030000 ~ 0x03DFFF (each VP_N64 = 8 byte) (address value must be divisible by 8)
3	Add2	
4	Add1	
5	Add0(LSB)	
6	Lengthh	the number of VP_N64 (including the start address) to be filled Length = 1~4096
7	Lengthl	
8	Data7(MSB)	the 64 bit value to fill
9	Data6	
:	:	
14	Data1	
15	Data0(LSB)	

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)

4.4.13 BP1_write(0x4B)

Seq	Cmd-code / Par-data	Descriptions
1	0x4B	Write raw bit-map data to the VP_BP1
2	Add3(MSB)	VP_BP1 Address = 0x040000 ~ 0x05DFFF
3	Add2	
4	Add1	
5	Add0(LSB)	
6	Length3(MSB)	the number of data Length =1~ 98304
7	Length2	
8	Length1	
9	Length0(LSB)	

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)
*2. After the above command issued, it follow with the raw data byte with out communication packet structure.
*3. over all command flow

HOST	Flow	module
BP1_write Command (in communication packet structure)	→	Instruct to wait for data….
Raw 1bpp image data (without communication packet structure)	→	Store the data into VP_BP1

4.4.14 BP1_write_compress(0x4C)

Seq	Cmd-code / Par-data	Descriptions
1	0x4C	Write compressed bit-map data to the VP_BP1
2	Add3(MSB)	VP_BP1 Address = 0x040000 ~ 0x05DFFF
3	Add2	
4	Add1	
5	Add0(LSB)	
6	Length3(MSB)	the number of data Length = 1~ 98304
7	Length2	
8	Length1	
9	Length0(LSB)	

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)
*2. After the above command issued, it follow with the compressed data byte with out communication packet structure.
*3. over all command flow

HOST	Flow	module
BP1_write Command (in communication packet structure)	→	Instruct to wait for data….
compressed 1bpp image data (without communication packet structure)	→	Store the data into VP_BP1

4.4.15 G16_write(0x4D)

Seq	Cmd-code / Par-data	Descriptions
1	0x4D	Write graph values to the VP_G16 array
2	Addr1h	VP_G16 Address = 0x060000 ~ 0x06EFFF
3	Addr1l	
4	Addr2h	
5	Addr2l	
6	0x00	reserved
7	0x00	
8	Data(MSB)	16 bit data array (*2, *3) (no. of byte = 2x array-size) (246 byte MAX) (*4)
9	Data(LSB)	
10	Data(MSB)	
11	Data(LSB)	
:	:	
:	:	
:	:	
:	:	
:	:	

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)
*2. Array-size = no. of 16bit values
*3. Array-size suggest to be same at the size value defined in TML editor
*4. No. of byte limited by package structure

4.4.16 G16_write_rotate(0x4E)

Seq	Cmd-code / Par-data	Descriptions
1	0x4E	Write graph values to the last position of VP_G16 array with rotation effect
2	Addr1h	VP_G16 Address = 0x060000 ~ 0x06EFFF
3	Addr1l	
4	Addr2h	
5	Addr2l	
6	Sizeh	Array-size to be rotate = 1~32767 (*2. *3)
7	Sizel	
8	Data(MSB)	16 bit data value to be add to the end-of-array
9	Data(LSB)	

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)
*2. Array-size = no. of 16bit values
*3. Array-size suggest to be same at the value defined in TML editor

4.5 Extended Function Commands Details

4.5.1 Ext_Register_write(0x80)

Seq	Cmd-code / Par-data	Descriptions
1	0x80	Write value to Ext_Register
2	Address	1st Ext_Register Address = 0x00 ~ 0xFF
3	Value	Ext_Register Values (252 byte MAX) (*3)
:	:	
:	:	

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)
*2. Number of continues Ext_Register to be written is defined by Packet length value
*3. No. of byte limited by package structure

Ext_Register Address List:

Register Address	Register Name	Function Descriptions
0x00	VER	Version
0x01	BL	Set Bright light level
0x02	BZ_TIME	Buzzer Time
0x03	Page_ID_H	Write: Switch to a page with this Page_ID
0x04	Page_ID_L	Read: Current page's Page_ID
0x06	--	Reserved
:	:	:
0x1e	BL_Now	Read Current Bright light level
0x1f	RTC_set	Write 0x5a to assign RTC_xx's value to RTC module, clear to 0 after set.
0x20	RTC_YY	Year (BCD format)
0x21	RTC_MM	Month (BCD format)
0x22	RTC_DD	Day (BCD format)
0x23	RTC_WW	Week (BCD format), Value will be ignored in write
0x24	RTC_HH	Hour (BCD format)
0x25	RTC_MM	Minutes (BCD format)
0x26	RTC_SS	Seconds (BCD format)
0x27	--	Reserved
:	:	:
0x4f	keycode	User keycode, Trigger VPK(when keycode = ID)
0x50	Play_music	0x5A:Play_Strat:Play_Num (3 Byte)
0x53	Volume_adj	0x5A:VOL(2 Byte) VOL:0~63
:	:	:
0xff	--	Reserved

4.5.2 Ext_Register_read(0x81)

Seq	Cmd-code / Par-data	Descriptions
1	0x81	Read Ext_Register values
2	Address	1st Ext_Register Address = 0x00 ~ 0xFF
3	No_of_byte	No. of byte of Ext_Register values to read (0~252)

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details

Response code:

Seq.	Content	Byte in Hex	Descriptions
	Header	0xAA	Communication packet header
		0x55	
1st	0x00 ~ 0xfe	Packet length	1byte (no. of byte of cmd-code & Par-data)
2nd	Command	0x81	Command executed
3rd	Address	0x00 ~ 0xFF	Ext_Register (start) Address
4th	No_of_byte	No_of_byte	No. of byte to read
5th	Value	Value	Ext_Register values
6th	Value	Value	
7th	:	:	
8th	:	:	

Note.
*1. The Response code with communication packet format (see Communication Packet Structure Section for details)

4.5.3 Ext_Data_write(0x82)

Seq	Cmd-code / Par-data	Descriptions
1	0x82	Write data to Ext_Data space
2	Add (High)	1st Ext_Data Address 0x0000 ~ 0x6FFF This address will be convert to corresponded VP_N16 and VP_STR
3	Add (Low)	
4	Value	Data Values (251 byte MAX) (*3)
:	:	

Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details)
*2. Number of continues Ext_Data space to be written is defined by Packet length value
*3. No. of byte limited by package structure

4.5.4 Ext_Data_read(0x83)

Seq	Cmd-code / Par-data	Descriptions
1	0x83	Read data from Ext_Data space
2	Add (High)	1st Ext_Data Address 0x0000 ~ 0x6FFF This address will be convert to corresponded VP_N16 and VP_STR
3	Add (Low)	
4	No_of_word	No. of word of Ext_Data values to read (0~125)

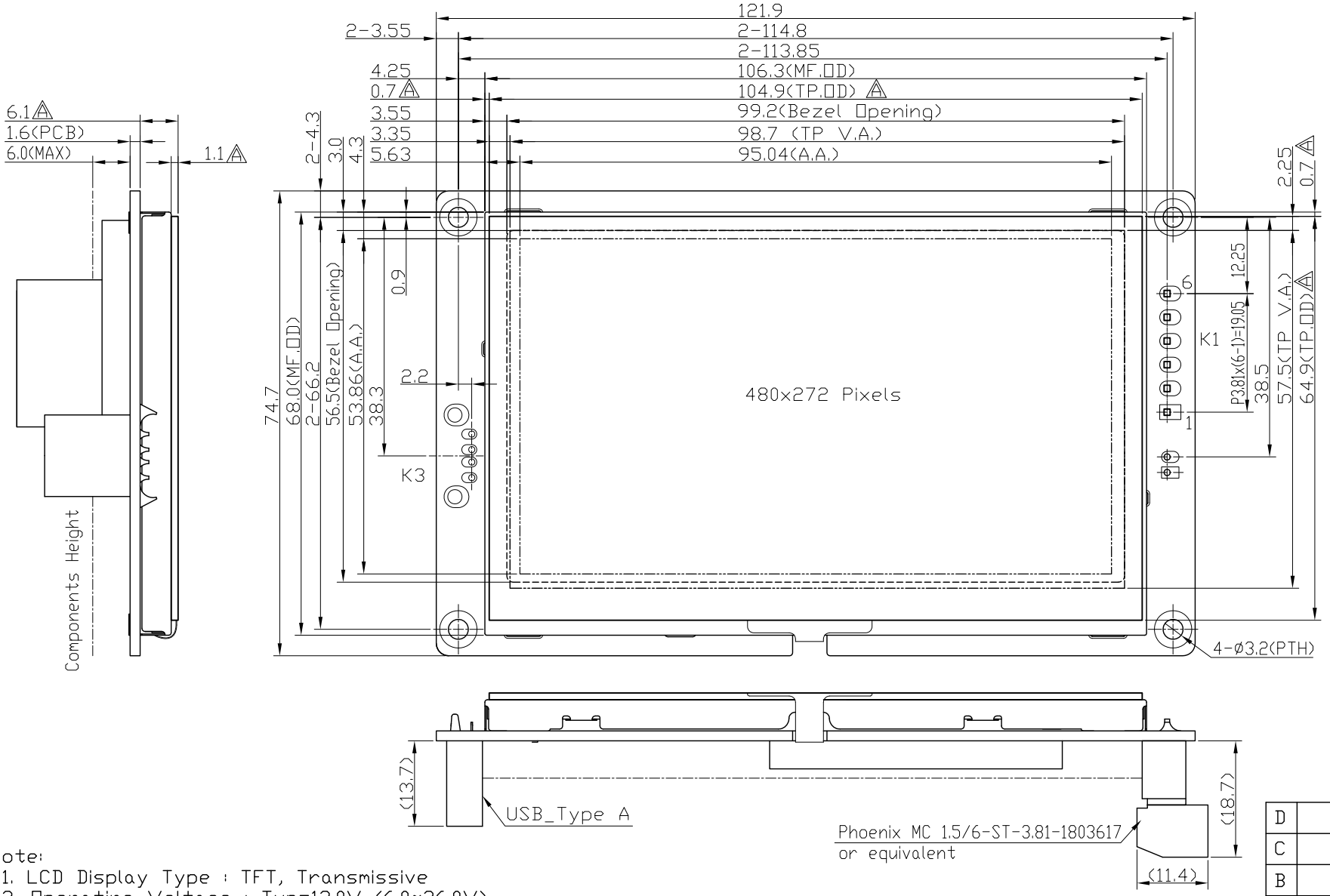
Note.
*1. Command should be transferred in communication packet structure (see Communication Packet Structure Section for details

Response code:

Seq.	Content	Byte in Hex	Descriptions
1st	Header	0xAA	Communication packet header
2nd		0x55	
3rd	0x00 ~ 0xfe	Packet length	1byte (no. of byte of cmd-code & Par-data)
4th	Command	0x83	Command executed
5th	Address	0x0000 ~ 0x6FFF	Ext_Data (start) Address
6th			
7th	No_of_word	0~125	No. of word to read
8th	Value	Value	Ext_Data values
9th	Value	Value	
:	:	:	
:	:	:	

Note.
*1. The Response code with communication packet format (see Communication Packet Structure Section for details)

Teriminal K1	
No.	Pin Name
1	VDD
2	RXD
3	TXD
4	RTS(BUSY)
5	NC
6	VSS



Note:

*1. LCD Display Type : TFT, Transmissive
*2. □perating Voltage : Typ=12.0V (6.0~26.0V)
*3. Backlight Color : White LEDs
*4. Pixel Arrangment : RGB-STRIPE
*5. Color Depth : 65K Colors
*6. Interface : K1 RS-232C (P3.81x6pin Phoenix MC 1.5/6-ST-3.81-1803617 or equivalent)
K3 USB_Type A
*7. Touch Panel Type : Resistive Touch Panel
*8. Touch Panel Loop Resistance : X:400~900Ω;Y:200~500Ω
*9. □perating Temperature : -20°C~70°C
*10. Storage Temperature : -30°C~80°C
*11. Foam Gasket must be assemble outside TP VA by 0.5mm

Rev	Note	Date
D		
C		
B		
A	Revise TP	Wei Guangy 2017-12-22

Dwg Title	HMB043FD-1C □utline Dwg
Dwg No.	MK-006240a-1-1
Date	2017-12-19
Scale	3/2
Tol.	±0.5
Unit	mm
Paper Size	A3
Approved	
Checked	
Drawn	Wei Guangyang

TOPWAY