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

HMT028ATB-C

LCD Module User Manual

Prepared by:	Checked by:	Approved by:
Wangxikuan		
Date: 2019-05-10	Date:	Date:

Rev.	Descriptions	Release Date
0.1	- Preliminary Draft release	2019-05-10

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1 Basic Specification

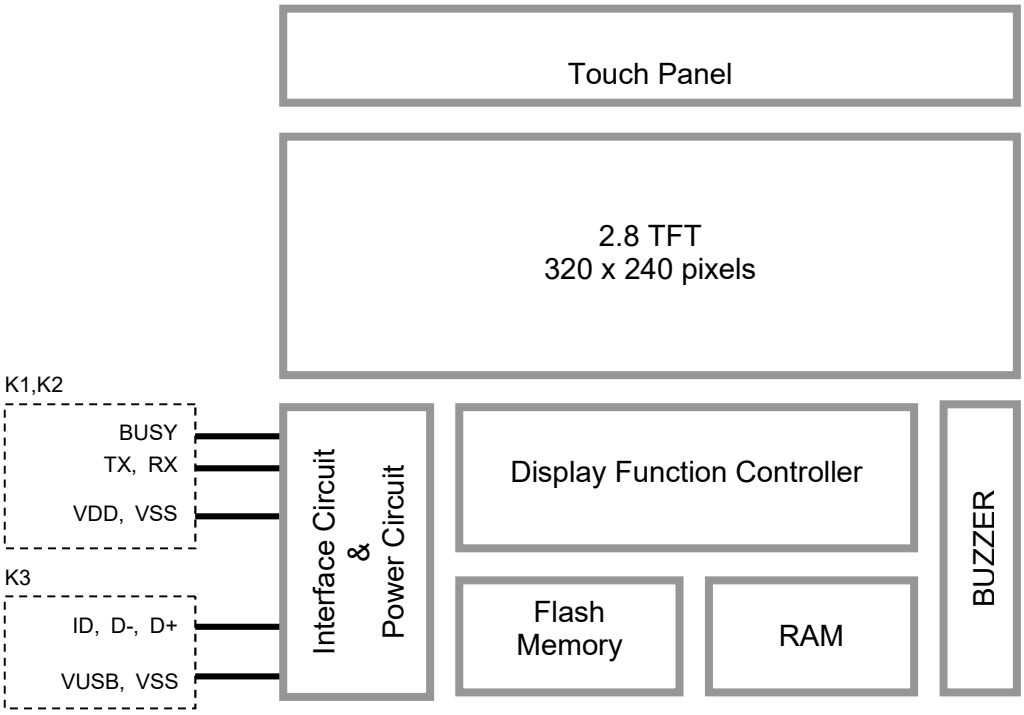
TOPWAY HMT028ATB-C is a Smart TFT Module with 32bit MCU on board. Its graphics engine provides numbers of outstanding features. It supports preload and pre-design display interface that simplify the host operation and development time. Suitable for industry control, instrumentation, medical electronics, power electric equipment applications.

1.1 General Specification

Screen Size(Diagonal) :	2.8”
Resolution :	320 x 240(RGB)
Color Depth :	65k color (16bit)
Pixel Configuration :	RGB Stripe
Display Mode :	Transmissive / Normal White
Viewing Direction :	3H (*1) (gray-scale inverse) 9H (*2)
Outline Dimension :	79.3 x 49.1 x 9.6 (max)(mm) (see attached drawing for details)
Active Area :	57.6 x 43.2 (mm)
Backlight :	LED
Surface Treatment :	Glare Treatment
Command I/F:	UART(3.3V Logic Levels)
Project Download:	by U-Drive (with OTG cable) or by PC (*4)
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.
*4. Seetion 1.3 for configuration.

1.2 Block Diagram



1.3 Terminal Function

UART Interface Terminal (K1)

Pin No.	Pin Name	I/O	Descriptions
1~5	NC	--	No connection, leave open
6,7,8	VDD	P	Power supply (5.0 V)
9	NC	--	No connection, leave open
10	RX	I	Data Input (eg. to Host MCU's UART TXD)
11	TX	O	Data output (eg. to Host MCU's UART RXD)
12	BUSY	O	Request To Send (function as busy BUSY signal) 1:Busy 0:No busy (eg. to Host MCU IO, check before sending data or command>)
13,14,15	VSS	P	Ground, (0V)
16~26	NC	--	No connection, leave open

Note.
*1. User data and commands transfer through this terminal.
*2. HOST using command hand shake during communication is suggested.

UART Interface Terminal (K2)

Pin No.	Pin Name	I/O	Descriptions
1,2,3	VDD	P	Power supply (5.0 V)
4	NC	--	No connection, leave open
5	RX	I	Data Input (eg. to Host MCU's UART TXD)
6	TX	O	Data output (eg. to Host MCU's UART RXD)
7	BUSY	O	Request To Send (function as busy BUSY signal) 1:Busy 0:No busy (eg. to Host MCU IO, check before sending data or command>)
8,9,10	VSS	P	Ground, (0V)

Note.
*1. User data and commands transfer through this terminal.
*2. HOST using command hand shake during communication is suggested.

USB Interface Terminal (K3)

Pin No.	Pin Name	I/O	Descriptions
1	VUSB	P	Power supply (5.0 V)
2	D-	I/O	USB DATA negative signal
3	D+	I/O	USB DATA positive signal
4	ID	I	USB_ID, 1:Client, 0:HOST
5	VSS	P	Ground, (0V)

Note.
*1. Display files preload through this terminal.
*2. Connect to U-Drive (with OTG cable), for files transfer
*3. For U-Drive to download project: R22=27R, R23=27R, R24=NC, R25=NC.(default)
For PC direct download project: R22=NC, R23=NC, R24=27R, R25=27R.

2 Absolute Maximum Ratings

Items	Symbol	Min.	Max.	Unit	Condition
Power Supply voltage	V_{dd}	-0.3	5.5	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

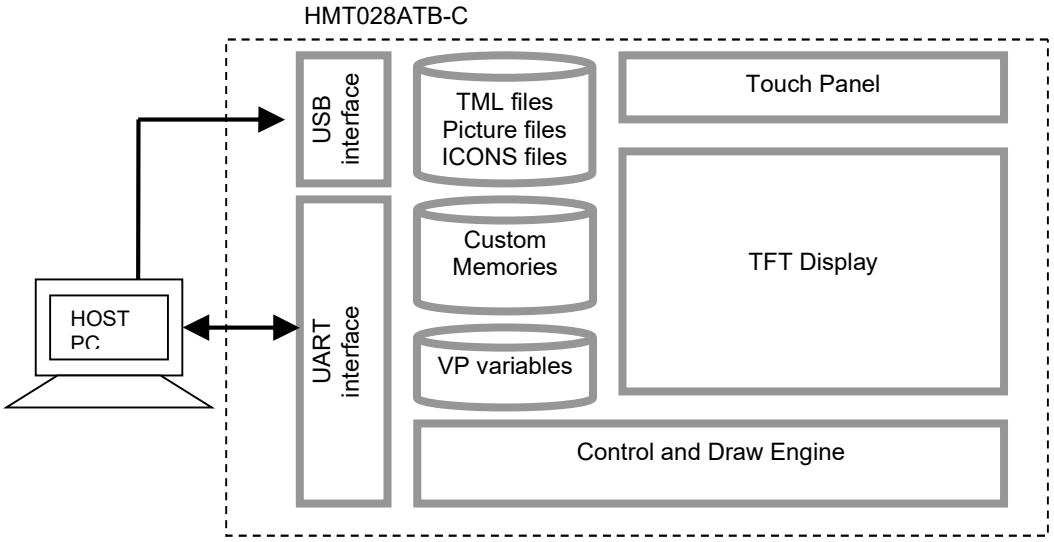
VSS=0V, V_{IO} =3.3V, T_{OP} =25°C

Items	Symbol	MIN.	TYP.	MAX.	Unit	Applicable Pin/FUNC
Operating Voltage	V_{DD}	4.8	5.0	5.2	V	VDD
Rx Input Hi	V_{RxH}	0.8V_{IO}	-	V_{IO}	V	Rx
Rx Input Lo	V_{RXL}	0	-	0.2 V_{IO}	V	Rx
Tx Output Hi	V_{TXH}	0.7V_{IO}	-	V_{IO}	V	Tx
Tx Output Lo	V_{TXL}	0	-	0.3V_{IO}	V	Tx
Operating Current	I_{DD}	-	TBD	-	mA	VDD (*1)
Operating Current (USB)	I_{VUSB}	-	TBD	-	mA	VUSB

Note.
*1. Normal display condition

4 Function Specifications

4.1 Basic Operation Function Descriptions



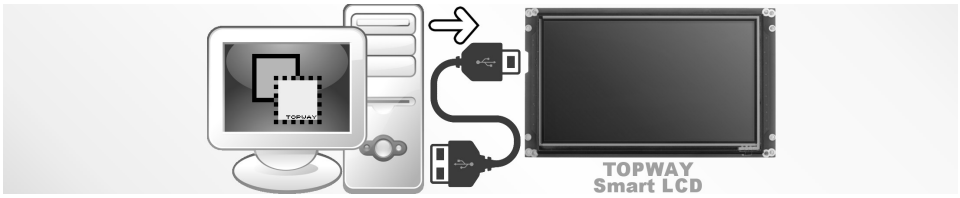
- Display files are stored inside FLASH memory area.
  They are preloaded to HMT028ATB-C for stand alone interface use.
- Those files are preloaded via USB interface (U-Drive or PC download).
- All the interface flow and the touch response are based on the preloaded files
- VP variables memory is inside RAM area,
  it provides real time access via UART by the HOST or display onto the TFT.
- 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 Quick Start Guide

1. Install TOPWAY Graphics Editor

2. Import pictures design UI flow

3. Download to Smart LCD



4. power on & display

5. Connect to host Show real time data

4.3 Command Descriptions

Please refer to “SMART LCD Command Manual ”

5 Optical Characteristics

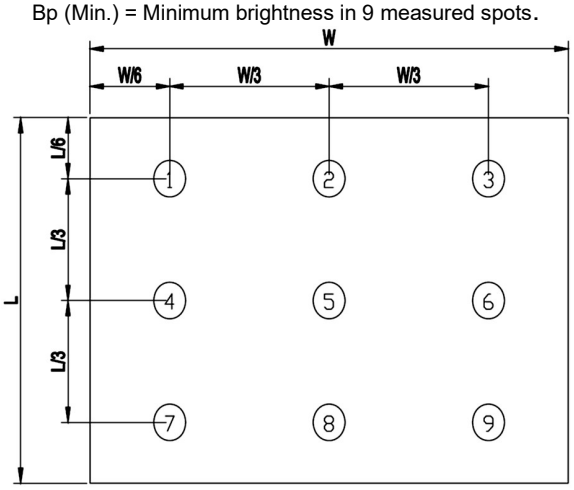
Item	Symbol		Condition	Min.	Typ.	Max.	Unit	Note
Brightness	Bp		θ=0° Φ=0°	-	200	-	Cd/m^2	1
Uniformity	△Bp			80%	-	-		1,2
Viewing Angle	θ1 (Φ=90° or270°)		Cr≥10	-25～+60			Deg	3
	θ2 (Φ=0° or 180°)			-45～+45				
Contrast Ratio	Cr		θ=0° Φ=0°	-	300	-	-	4
Response Time	T_r			-	25	40	ms	5
	T_f			-	25	40	ms	
Color of CIE Coordinate	W	x	θ=0° Φ=0°	-	0.29	-	-	1,6
		y		-	0.31	-	-	
	R	x		-	0.60	-	-	
		y		-	0.37	-	-	
	G	x		-	0.34	-	-	
		y		-	0.57	-	-	
	B	x		-	0.15	-	-	
		y		-	0.09	-	-	
NTSC Ratio	S			50	-		%	

Note：The parameter is slightly changed by temperature, driving voltage and materiel.

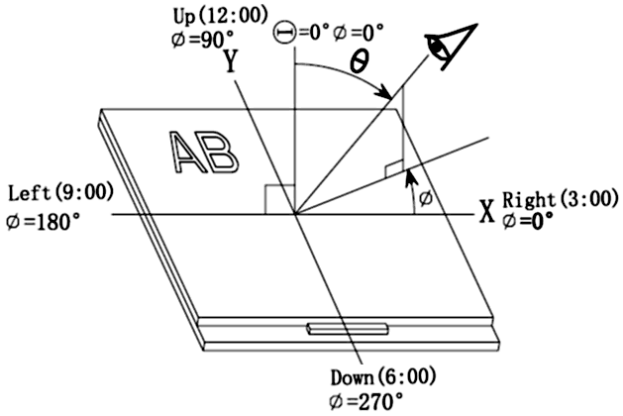
Note 1:
The data are measured after LEDs are turned on for 5 minutes. LCM displays full white. The brightness is the average value of 9 measured spots. Measurement equipment PR-705 (Φ8mm)
Measuring condition:
- Measuring surroundings: Dark room
- Measuring temperature: Ta=25℃.
- Adjust operating voltage to get optimum contrast at the center of the display.

Measured value at the center point of LCD panel after more than 5 minutes while backlight turning on.

Note 2:
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 3:
The definition of viewing angle:
Refer to the graph below marked by θ and Φ

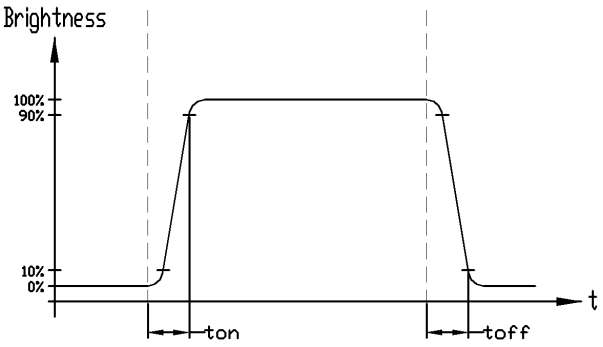


Note 4:
The definition of contrast ratio (Test LCM using PR-705):

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

(Contrast Ratio is measured in optimum common electrode voltage)

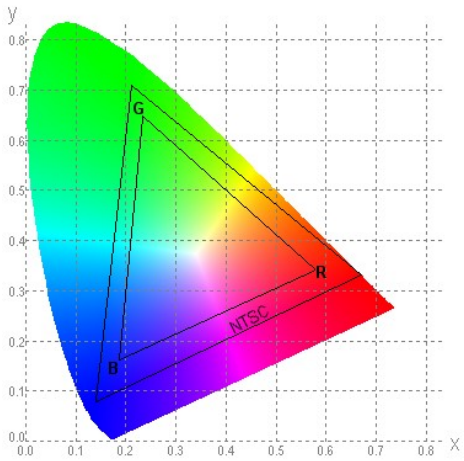
Note 5:
Definition of Response time. (Test LCD using DMS501):
The output signals of photo detector are measured when the input signals are changed from "black" to "white"(falling time) and from "white" to "black"(rising time), respectively.
The response time is defined as the time interval between the 10% and 90% of amplitudes.Refer to figure as below.



Note 6:
Definition of Color of CIE Coordinate and NTSC Ratio.

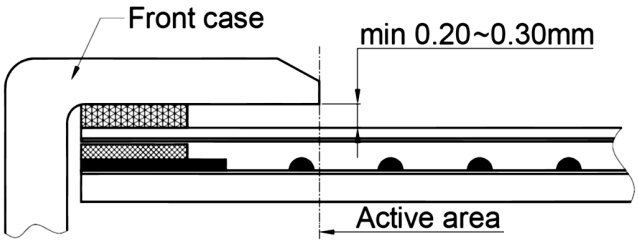
Color gamut:

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

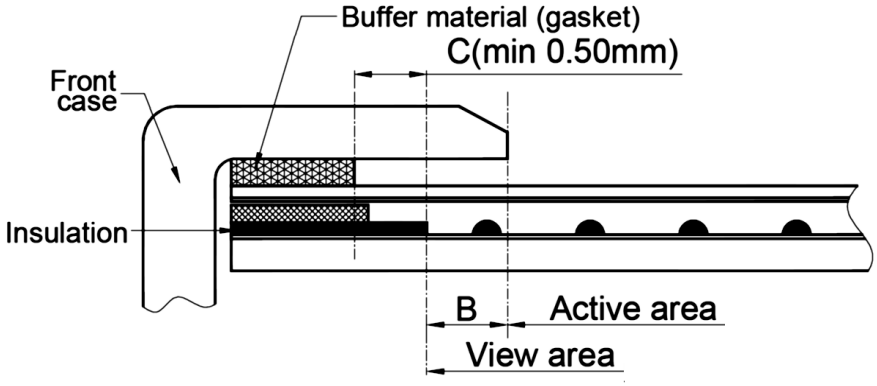


6 Touch panel Design Precautions

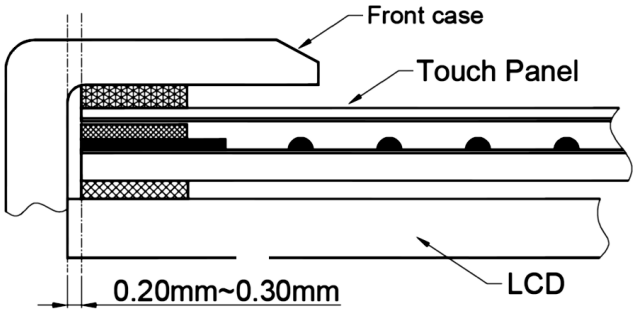
1. It should prevent front case touching the touch panel Active Area (A.A.) to prevent abnormal touch.
   It should left gab (e.g. 0.2~0.3mm) in between.



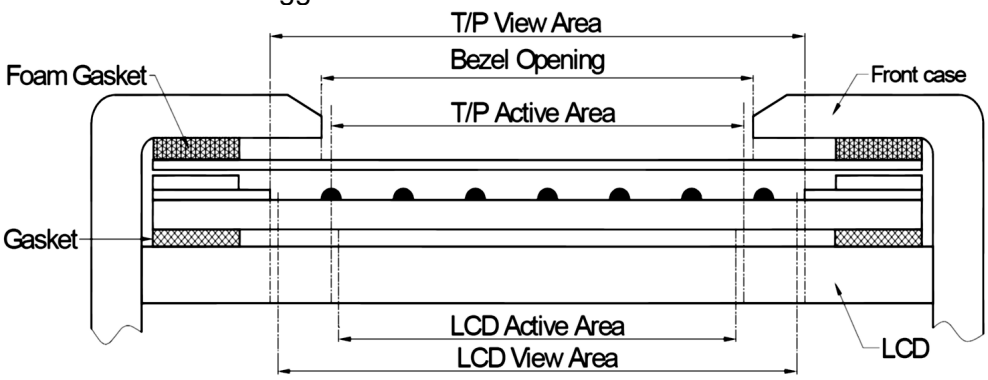
2. Outer case design should take care about the area outside the A.A.
   Those areas contain circuit wires which is having different thickness. Touching those areas could deform the ITO film. As a result case the ITO cold be damaged and shorten its lifetime.
   It is suggested to protect those areas 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.

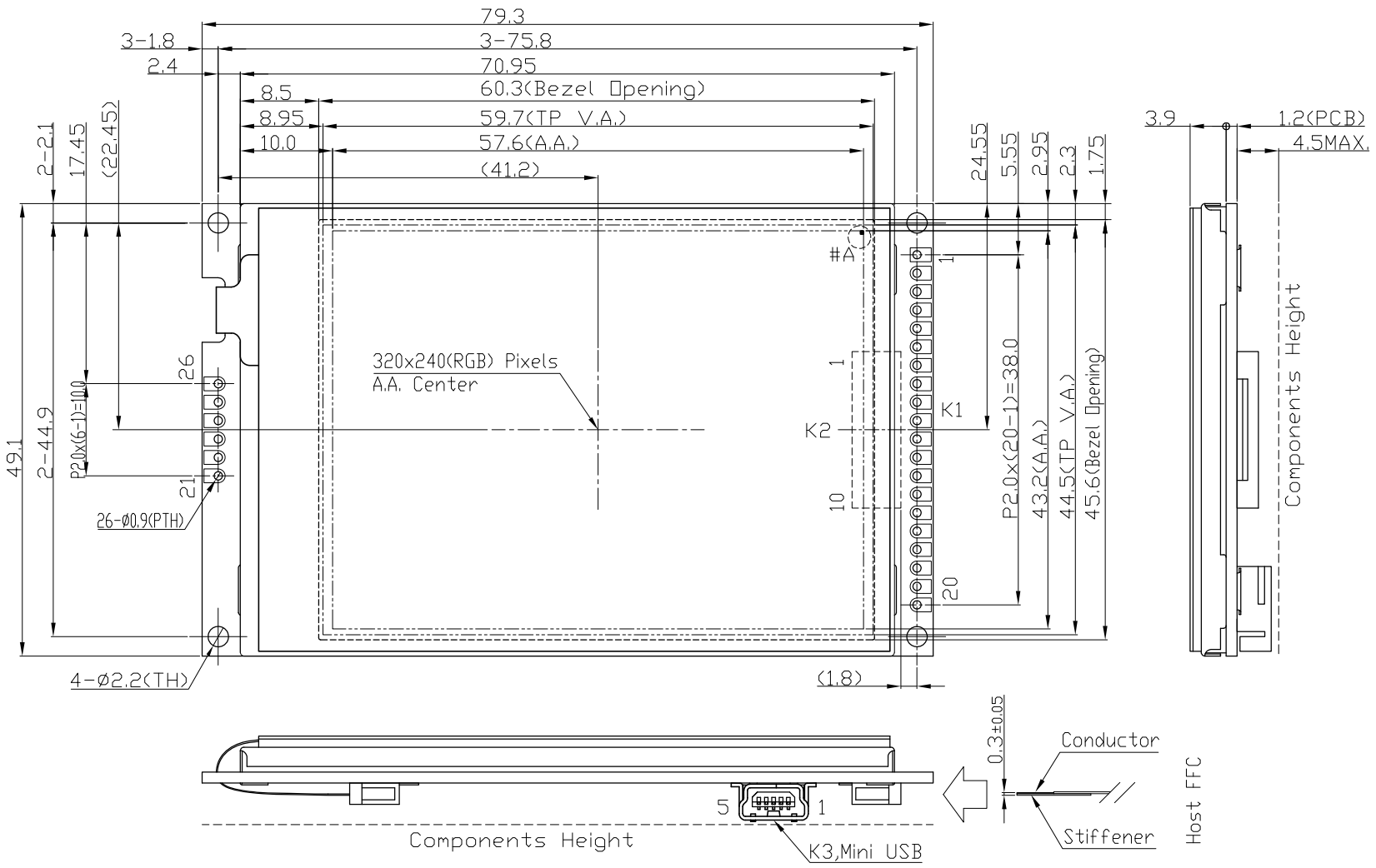


4. In general design,
   touch panel V.A. should be bigger than the LCD V.A.
   and touch panel A.A. should be bigger than the LCD A.A.



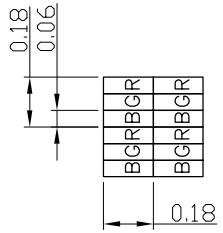
7 Precautions of using LCD Modules

Please refer to "LCD-Module-Design-Handling-Precaution.pdf".



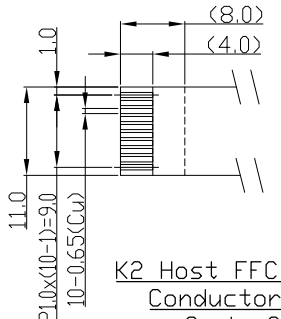
K1 Terminal	
No	Pin Name
1	NC
2	NC
3	NC
4	NC
5	NC
6	VDD
7	VDD
8	VDD
9	NC
10	RX
11	TX
12	BUSY
13	VSS
14	VSS
15	VSS
16	NC
17	NC
:	:
:	:
26	NC

K2 Terminal	
No	Pin Name
1	VDD
2	VDD
3	VDD
4	NC
5	RX
6	TX
7	BUSY
8	VSS
9	VSS
10	VSS



#A Details
Scale=50/1

Note:
*1. LCD Display Type : TFT, Transmissive
*2. Operating Voltage : 5.0V, Logic Voltage : 3.3V
*3. Backlight : White LEDs
*4. Pixel Arrangment : RGB-STRIPE
*5. Color Depth : 65k Colors
*6. Signal Interface : UART
*7. Touch Panel Type : Resistive Touch Panel
*8. Connector:
K1: P2.0,1x20+1x6 PCB Pad
K2: 10Pin P1.0 FFC Socket Or Equivalent
K3: Mini USB
*9. Operating Temperature : -20°C~70°C
*10. Storage Temperature : -30°C~80°C
*11. Foam Gasket must be assemble outside RTP VA by 0.5mm



K2 Host FFC Details
Conductor Side
Scale=3/2

Rev	Note	Date
C		
B		
A		

Dwg Title	HMT028ATB-C Outline Dwg			
Dwg No.	MK-006612-1-1			Date 2019-04-15
Scale 2/1	Tol. ±0.5	Unit mm	Paper Size A3	
Approved		Checked	Drawn Luo Lin	

TOPWAY