Area Silicon-based Fingerprint Sensor AFS120 Specification

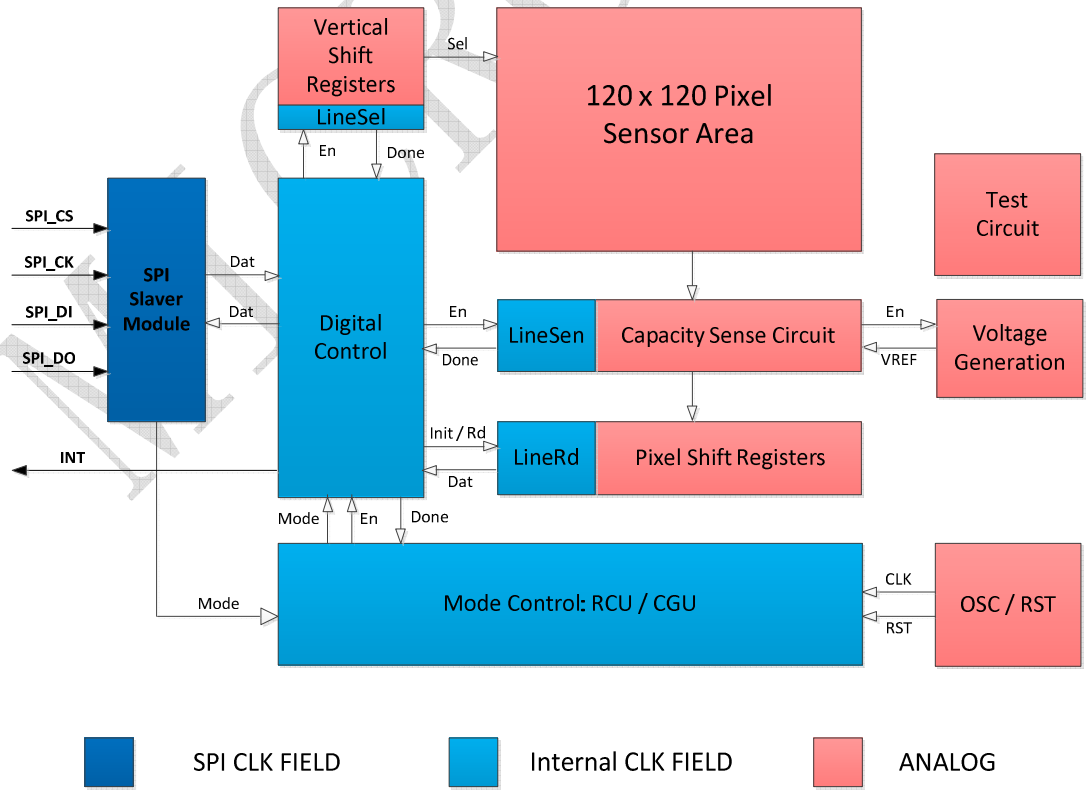
Ver. 1.31

Rev	Date	Author	Description	
V0.9	2014-04-31	Lyy	Modified from AFS128 specification	Document
V0.91	2014-05-03	Lyy	Add CMD 0x78 Add AFS120 Module specification	Document
V1.0	2014-09-26	Alex	Add Package/Module Dimension and Reference Circuit	Document
V1.1	2014-09-30	Alex	Modify the Package Dimension	Document
V1.2	2014-11-20	Alex	Add Module Reference Circuit and Connector Bonding Pad Graph	Document
V1.2.1	2014-12-08	Alex	Modify 1.2.2.1 and 1.2.2.2 FPC side AVDD and DVDD segment	Document
V1.3	2014-12-17	Alex	Add Runway Shape Module and Modify Pin description	Document
V1.3.1	2015-04-28	Alex	Modify SPI CMDs	Document

1. Technical indexes

- 120 x 120 @ 508dpi Sense Array
- 6.0mm x 6.0mm Sensor Size
- 6.58mm x 6.13mm x 0.25mm Package Size
- Φ10.4mm x1.1mm Circular Module Min Size
- 12mm x7.8mm x1.1mm Rectangle Module Min Size
- Each pixel has 8bit grey depth
- SPI Slaver Interface, Maximum baud rate @ 16MHz
- Max frame rate: 100fps (120 x 120@16MHz)
- ±15KV air discharge protection, ±8KV contact discharge protection
- Cover with 200um ceramic
- Internal 12MHz system OSC
- Internal 4KHz low power OSC
- Internal POR/BOR
- 2.7V-3.63V Core Voltage
- 1.62V-3.63V IO Voltage
- 2.6mA typical dynamic power consumption
- 33uA typical power consumption in finger detect mode
- <28uA power consumption in power down mode
- Supports Vision4.0 Fingerprint recognition algorithm, FAR < 1/100000,FRR < 1%

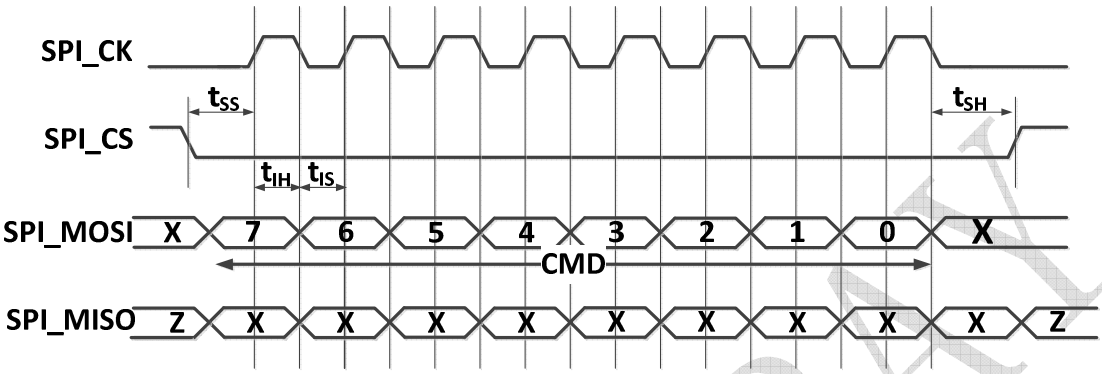
2. Architecture



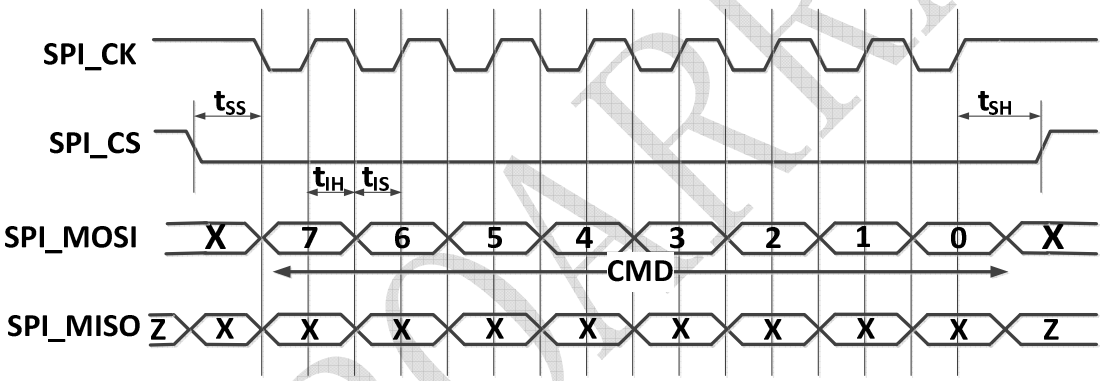
3. SPI Timing

3.1. Mode CMD

SPI_CK initial value is 0, rising edge capture value



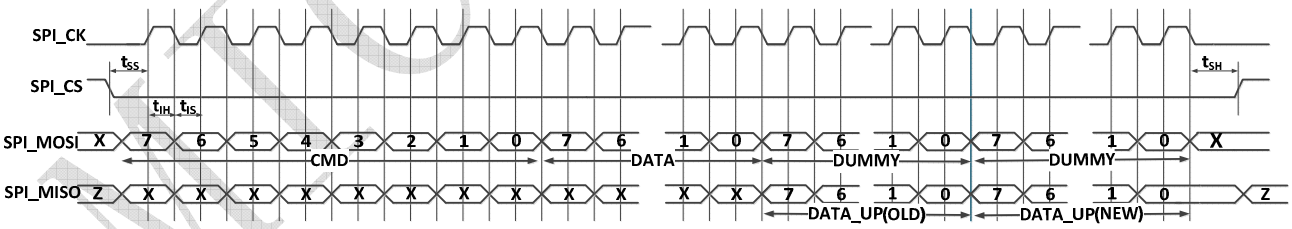
SPI_CK initial value is 1, rising edge capture value



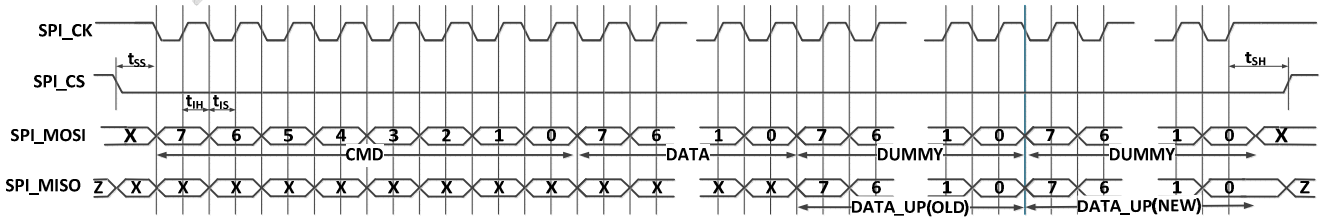
3.2. Register R/W CMD:

CMD + DATA_DOWN + DATA_UP(old) + DATA_UP(new)

SPI_CK initial value is 0, rising edge capture value



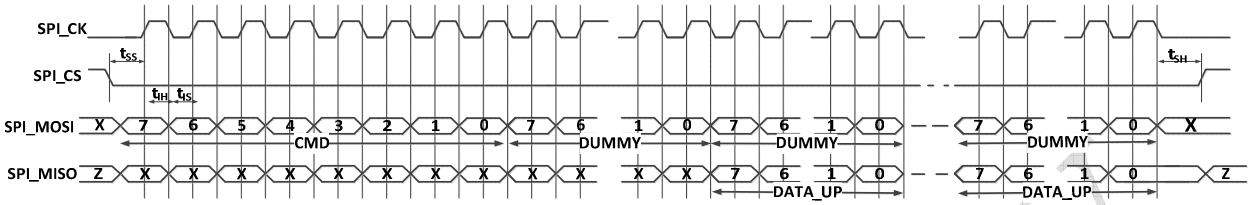
SPI_CK initial value is 1, rising edge capture value



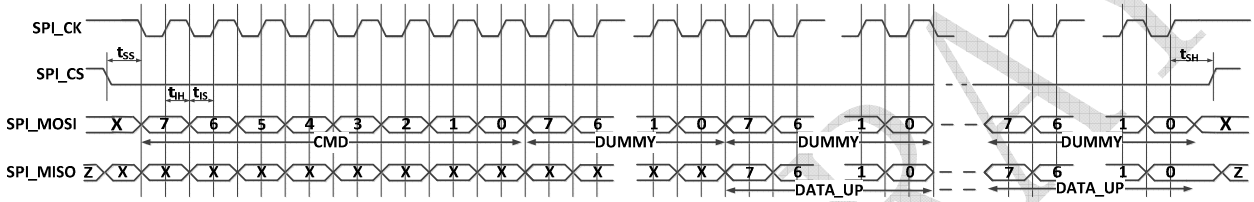
3.3. Read Image CMD:

CMD + DUMMY + DATA_UP * n

SPI_CK initial value is 0, rising edge capture value



SPI_CK initial value is 1, rising edge capture value



3.4 Timing request

parameter	Attribute	min	Max	Unit
t_{SS}	SPI_CS setting time	32	/	ns
t_{SH}	SPI_CS retention time	32	/	ns
t_{IS}	SPI_MOSI setting time	32	/	ns
t_{IH}	SPI_MOSI retention time	32	/	ns

4. SPI CMDs

Production Code, Register R/W CMD(read only)		
CMD	Function	Description
0x00	Production Code 1st Byte 0x41, ASII'A', area sensor	Production Code AFS120, 120x120 pixel matrix, A120
0x04	Production Code 2nd Byte 0x78, 120, AFS120	
0x08	Company Code 1st Byte ASII'M', 0x4d	Company Code MA is short for "MicroArray"
0x0C	Company Code 2nd Byte ASII'A', 0x41	

Mode, Mode CMD		
CMD	Function	Description
0x80	Power Down Mode	Leave Power Down mode by Reset.
0x84	Detect Mode	Detect finger in Detect Mode;
0x88	Capture Mode	Read Image in Capture Mode;
0x8c	Reset	Enter Capture Mode after Reset;

Read Image, Read Image CMD			
CMD	Parameter	Function	Description
0x70	1Byte Dummy 120 Byte Data Dummy	Read 1 line Sense 1 line	Read 1 Line stored in buf1; In the same time, Sense 1 Line and store in buf0; After read & Sense, Copy the new Sensed Line from buf0 to buf1.
0x78	Loop: 1Byte Dummy 120 Byte Data Dummy	Loop: Read 1 line Sense 1 line	Read & Sense & Copy in Loop, for Capturing image.

CMD	Function	Description
0x60 R/W	Interrupt Default = 0x00 [7] Finger Detect [6:5] N/A [4] reserved [3] reserved [2:0] N/A	Interrupt CMD reset IO_INT; Each reset will set IO_INT; See detailed “Finger Detect” in 0x4x registers

CMD	Function	Description
0x50 R/W	Default 0x00 Current Line	The ID of the line captured in next Read Line CMD.

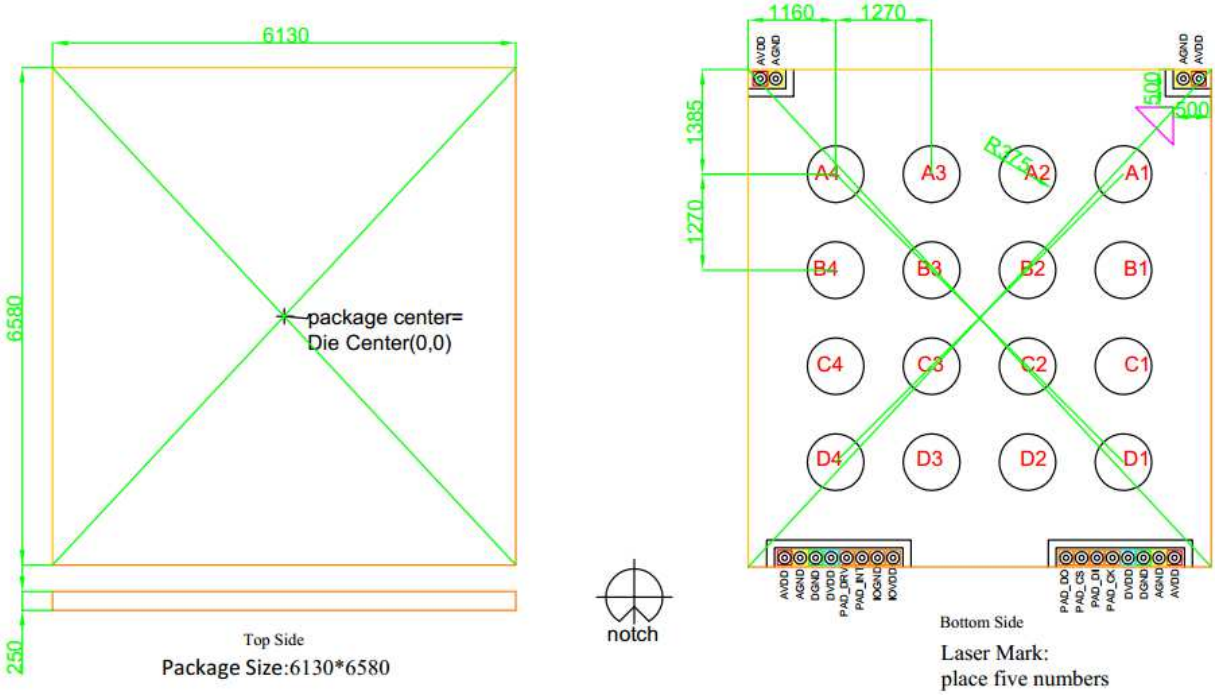
CMD	Function	Description
0x10 R/W	Enable Default = 0x00 [7] Grey Expansion En [6] Finger Detect En [5] Window En [4] CurLine Set En [3:0] reserved	See Grey Expansion in 0x2x registers; See Finger Detect in 0x4x registers; See Window in 0x3x registers; When CurLine Set disable, 0x50 is read only.
0x14 R/W	Ref Voltage Default = 0xf0	0x00: lowest 0xff: highest
0x18 R/W	Ref Capacity Default = 0x3f [7:2] reserved [1:0] Cref	
0x1c R/W	Period Default = 0x00 [7:6] N/A [5:4] reserved [3:0] Period	Finger Detect once in 1 period under Detect Mode: 0x0 1*64 Clk@4KHz 0x1 2*64 Clk@4KHz 0xf 16*64 Clk@4KHz

CMD	Function	Description
0x28	Offset Default = 0x00 unit(8)	Mid = 255 - (Ori – Offset) / Step; Mid = min(Mid, 0xff); Mid = max(Mid, 0x00).
0x2c	Step Default = 0x10 Fixed(4.4)	

CMD	Function	Description
0x30 R/W	Default 0x00 Start line	Automate update Current Line after each Read Line CMD: If CurrentLn + Step <= endLn CurrentLn = CurrentLn + Step Else Current = StartLn
0x34 R/W	Default 0x77 End line	
0x38 R/W	Default 0x01 Line Step	

CMD	Function	Description
0x40 R/W	Detect Parameter T Default = 0x00 Int(8)	Threshold Cross: If the amount of “greater-than-T grey value” of pixels is greater than C, send a finger detect Interrupt.
0x44 R/W	Detect Parameter C Default = 0x00 Int(8) * 4	

5. Package Mechanical Drawing and Package Dimension



6. Module Reference Circuit

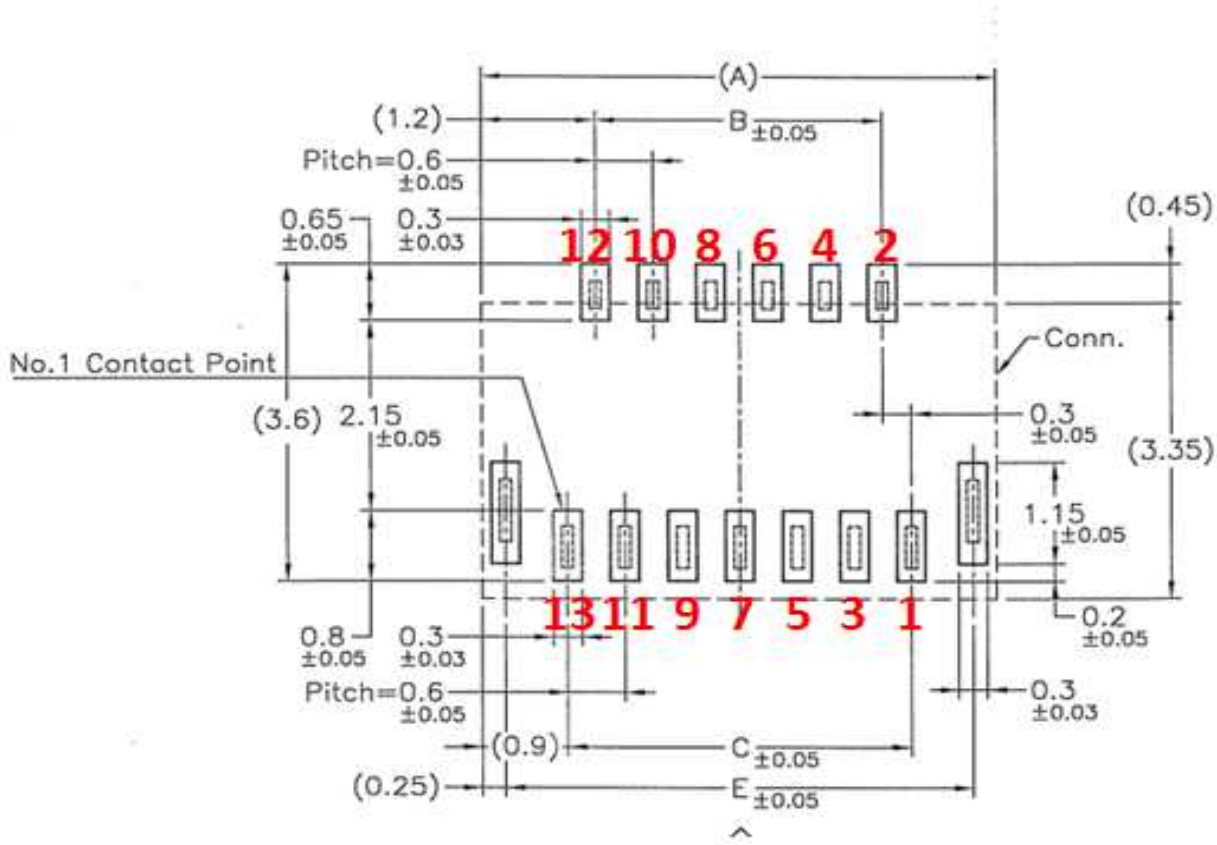
6.1 Pin List for 13 Pin Module

Pin Index	Pin Name	Description
1	KEY	In different version may become NC
2	DRV_IN	Drive Connection
3	DRV_OUT	Drive Connection
4	VCC_1.8V	IO power supply pin(1.62V-3.63V)
5	SPI_MISO	SPI MISO pin, Sensor Output
6	INT	Interrupt
7	GND	Signal GND pin.
8	SPI_MOSI	SPI MOSI pin, Sensor Input
9	VCC_3.3V	Analog power Pin(2.7V—3.63V)
10	SPI_CK	SPI clock pin.
11	GNG_ESD	In different version may become NC
12	SPI_CS	SPI Chip Select pin.
13	VCC_3.3V	Digital power Pin (2.7V—3.63V)

6.2 Connector Bonding Pad Graph for 13 Pin Module

0.3 mm Pitch, 1.0 mm Height FPC Connector for Main board,

Connector Part No: FH26-13S-0.3SHW or BL125-13RL-TAGF



6.3 Specification each version for 13 pin module

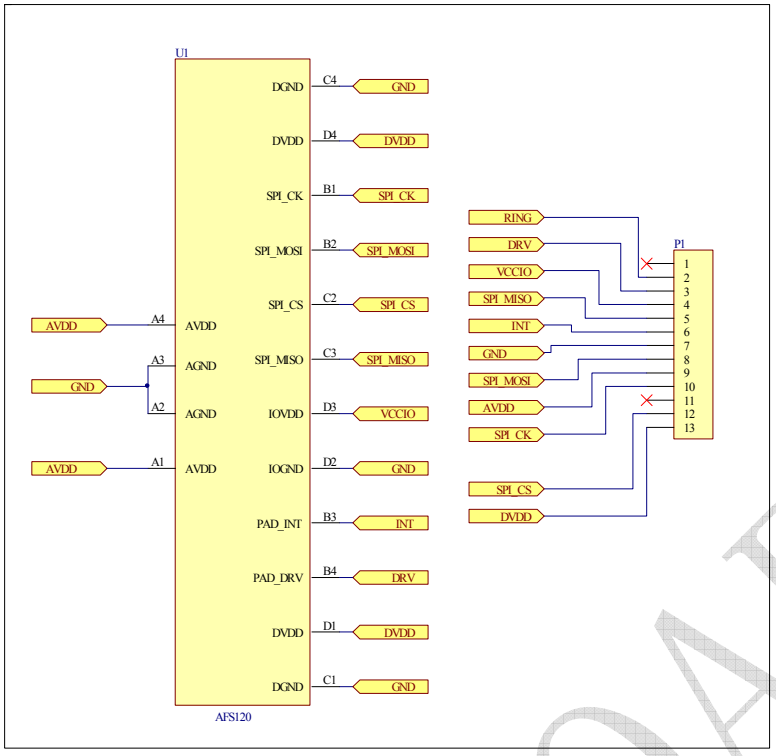
Higher thickness of surface medium needs higher version of reference circuit

Version	Remark			
1.2.2.1	13Pin	Active type	1.8V drive Voltage	1.8V IO Voltage
1.2.2.2	13Pin	Active type	3.3V drive Voltage	3.3V IO Voltage

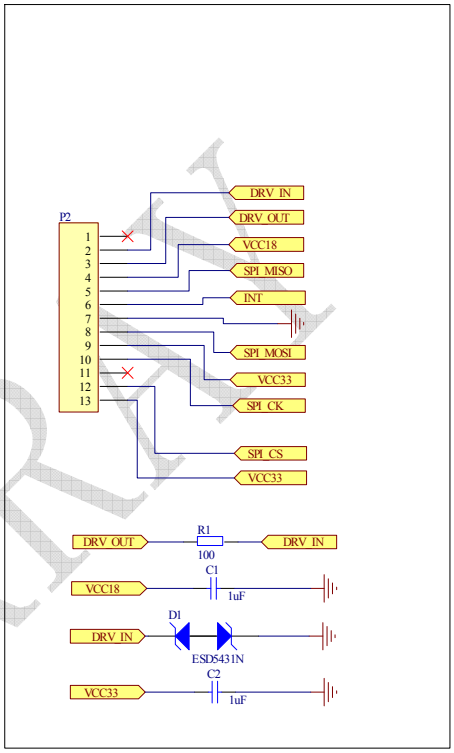
6.4 Reference Circuit for 13 pin module

6.4.1 Version 1.2.2.1

FPC circuit V1.2

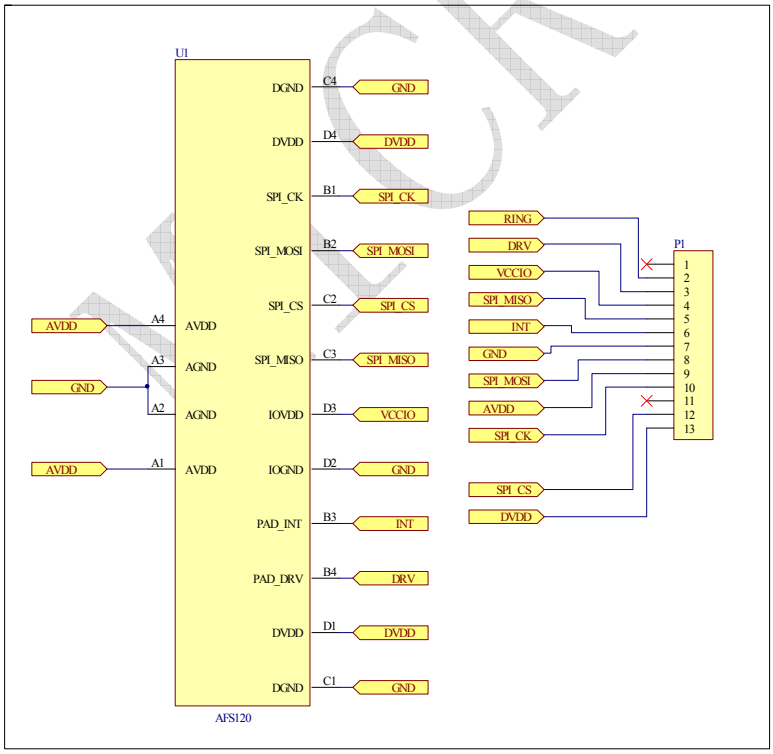


Board circuit V1.*.2.1

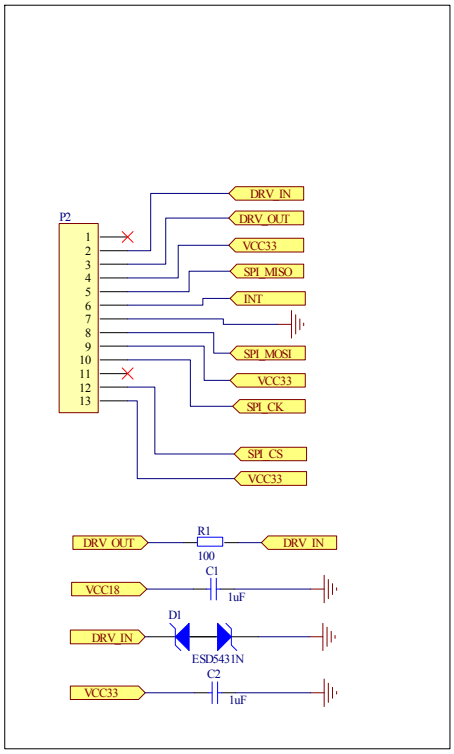


6.4.4 Version 1.2.2.2

FPC circuit V1.2



Board circuit V1.*.2.2

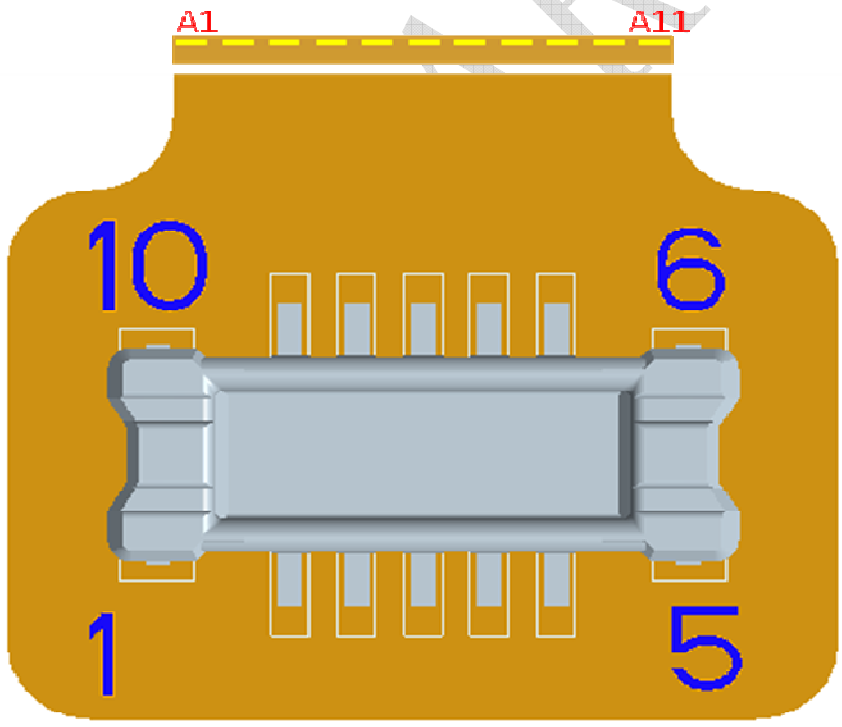


6.5 Pin List for 10 Pin Module

Pin Map.			FPC Profile（A）	
Pin Index	Pin Name	Description	Pin Index	Segment
1	SPI_CS	SPI Chip Select pin.	1	SPI_CS
2	INT	Device interrupt pin.	2	AVDD
3	SPI_MISO	SPIMISO pin, Sensor data Output.	3	INT
4	SPI_CLK	SPI clock pin.	4	GND
5	SPI_MOSI	SPIMOSI pin, Sensor Data input.	5	SPI_MISO
6	Vbat	In different version may become NC.	6	VDDIO
7	KEY	In different version may become NC.	7	SPI_CLK
8	VDDIO	IO power supply pin(1.62V-3.63V).	8	KEY
9	GND	Signal GND pin.	9	SPI_MOSI
10	AVDD	Core power supply pin (2.7V—3.63V).	10	Vbat
			11	DVDD

AVDD was power supply to sensor's AVDD(A2) and DVDD(A11),

6.6 BTB Bonding Pad Graph and FPC Profile



6.7 Specification each version for 10 Pin Module

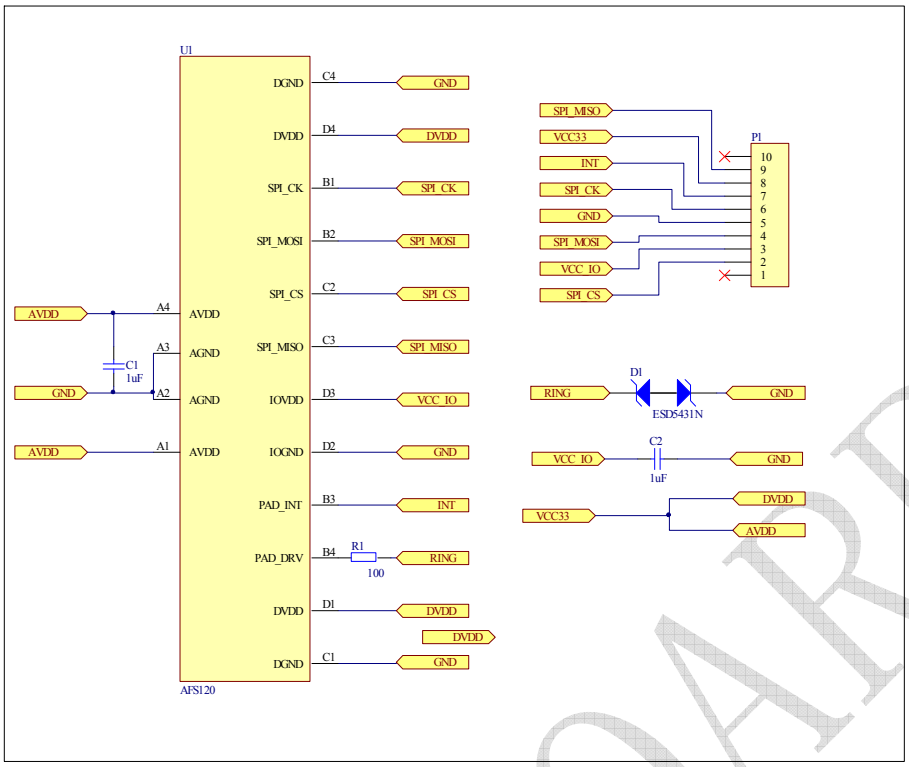
Higher thickness of surface medium needs higher version of reference circuit

Version	Remark			
2.2.1.1	10Pin	Active type	1.8V drive Voltage	1.8V IO Voltage
2.2.1.2	10Pin	Active type	3.3V drive Voltage	3.3V IO Voltage

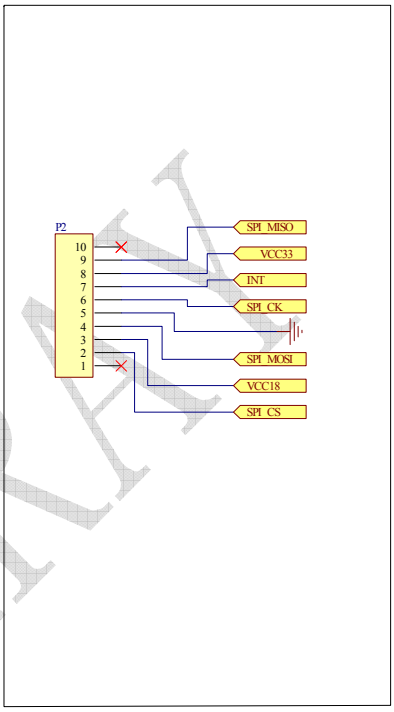
6.8 Reference Circuit for 10 pin module

6.8.1 Version 2.2.1.1

FPC circuit V2.2

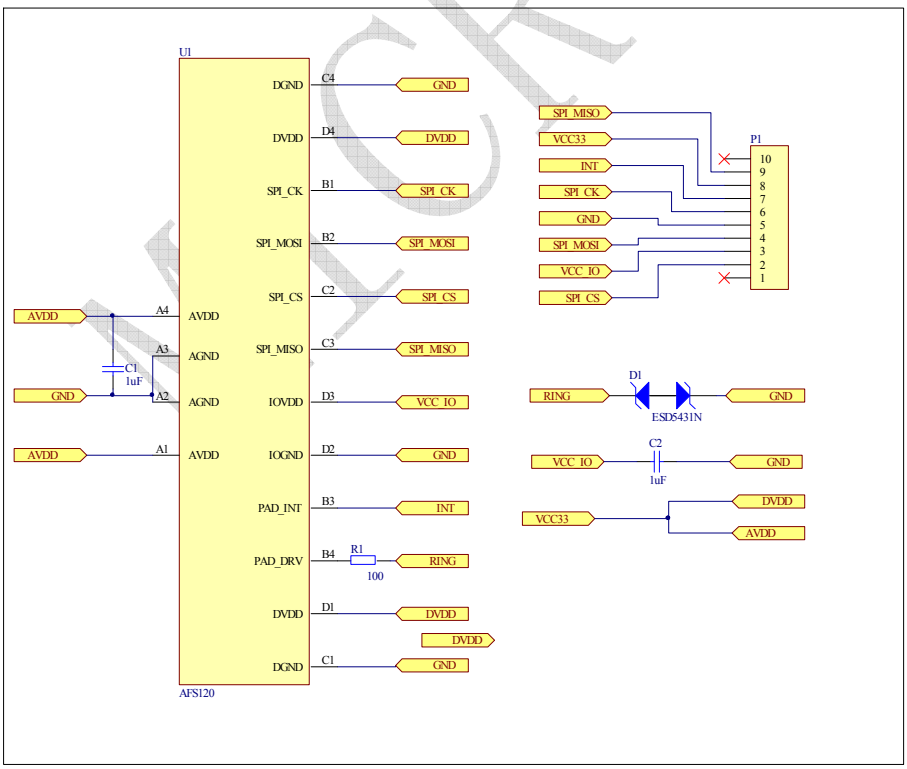


Board circuit V2.*.1.1

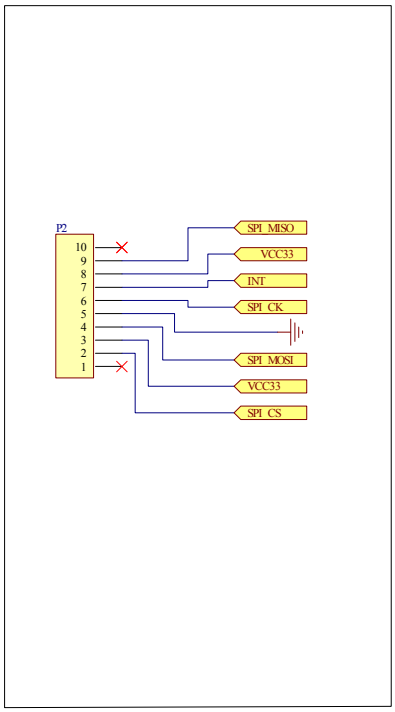


6.8.2 Version 2.2.1.2

FPC circuit V2.2

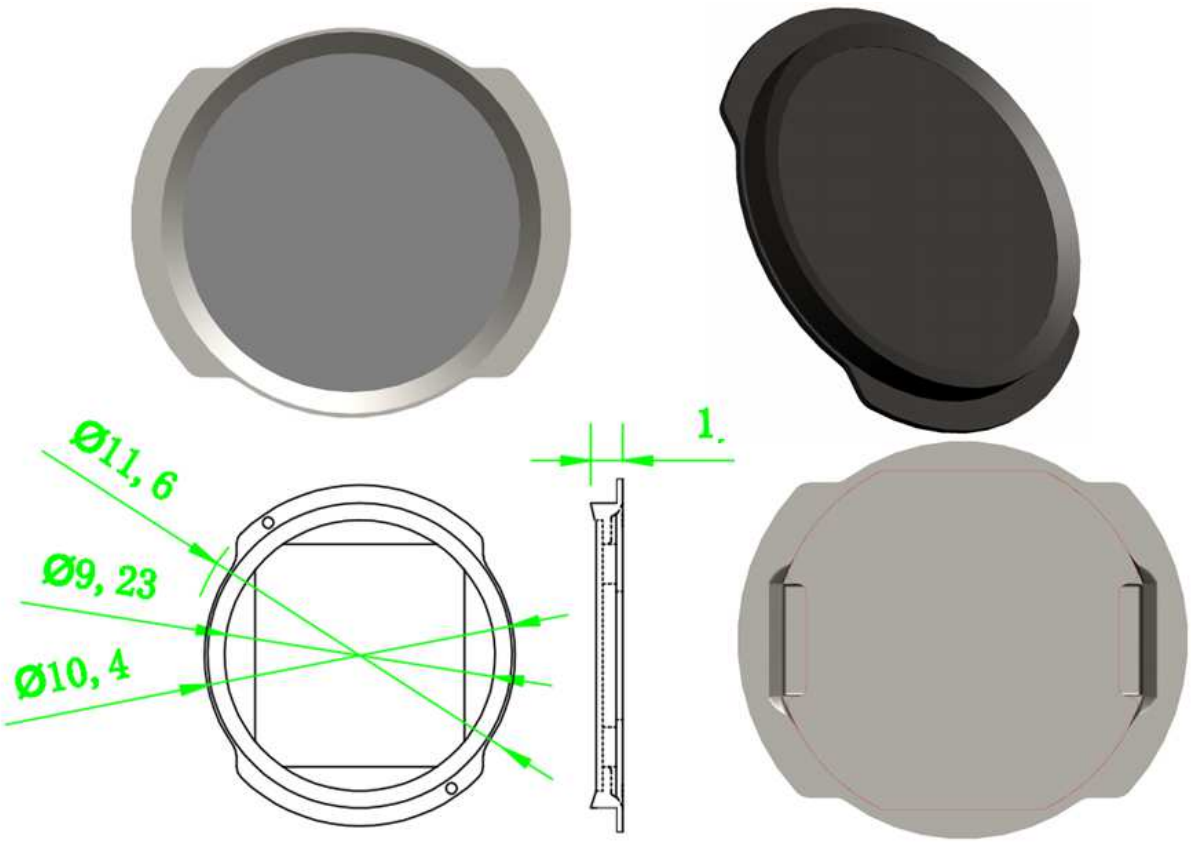


Board circuit V2.*.1.2

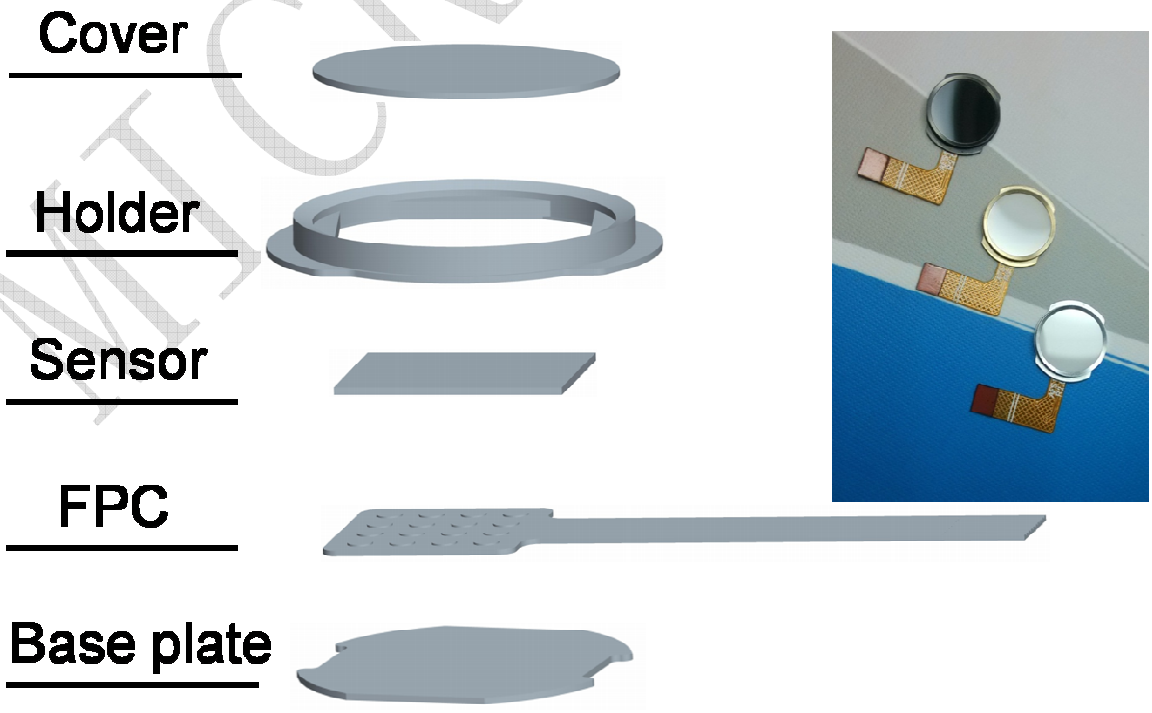


7. Module Dimension

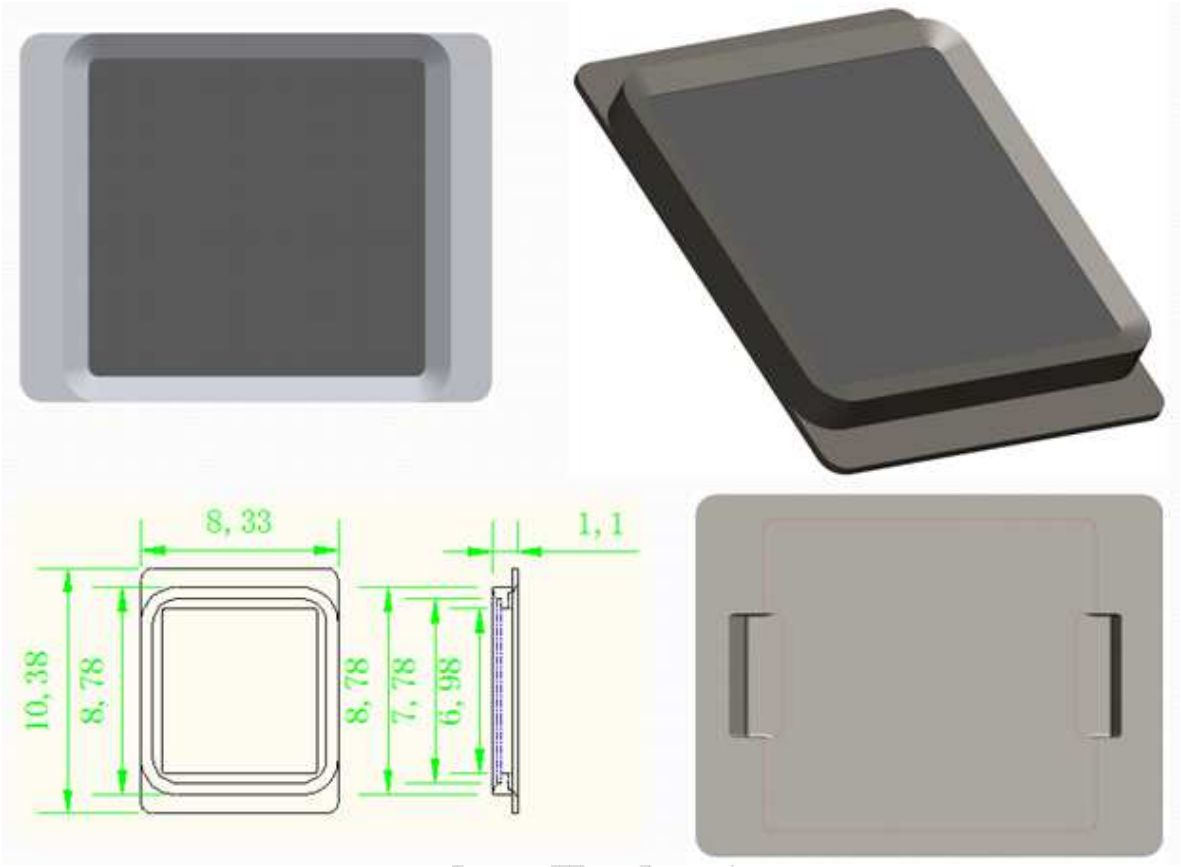
7.1 Circular Module



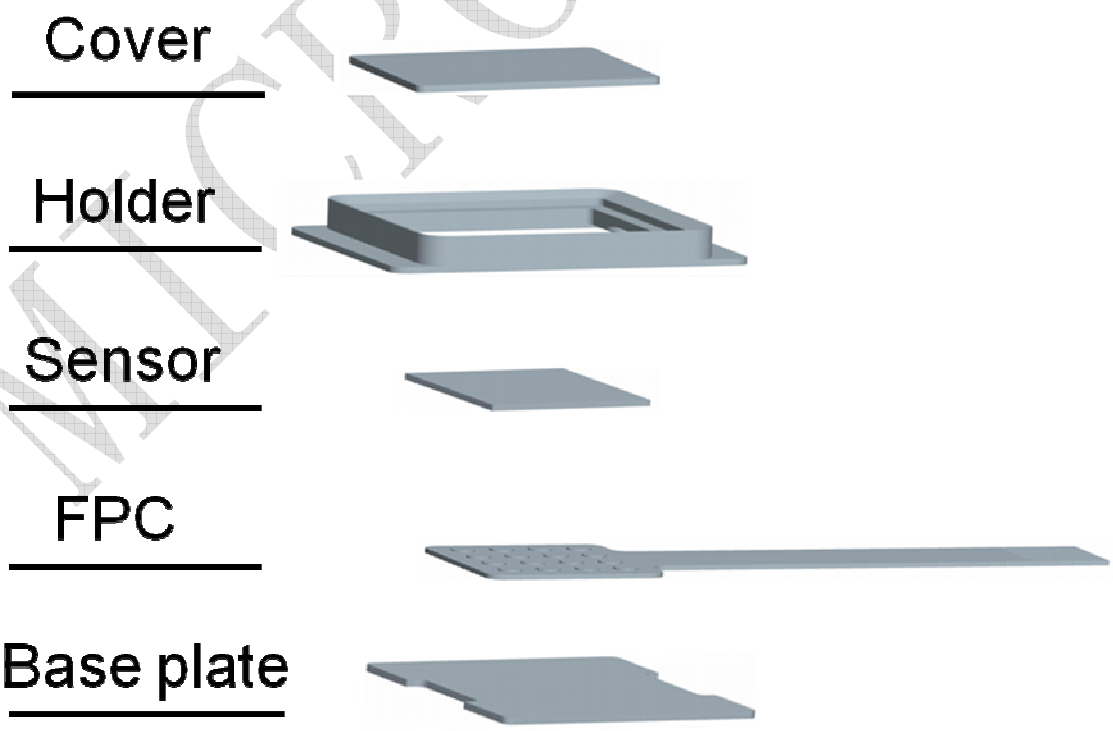
7.2 Circular Module Structure Diagram



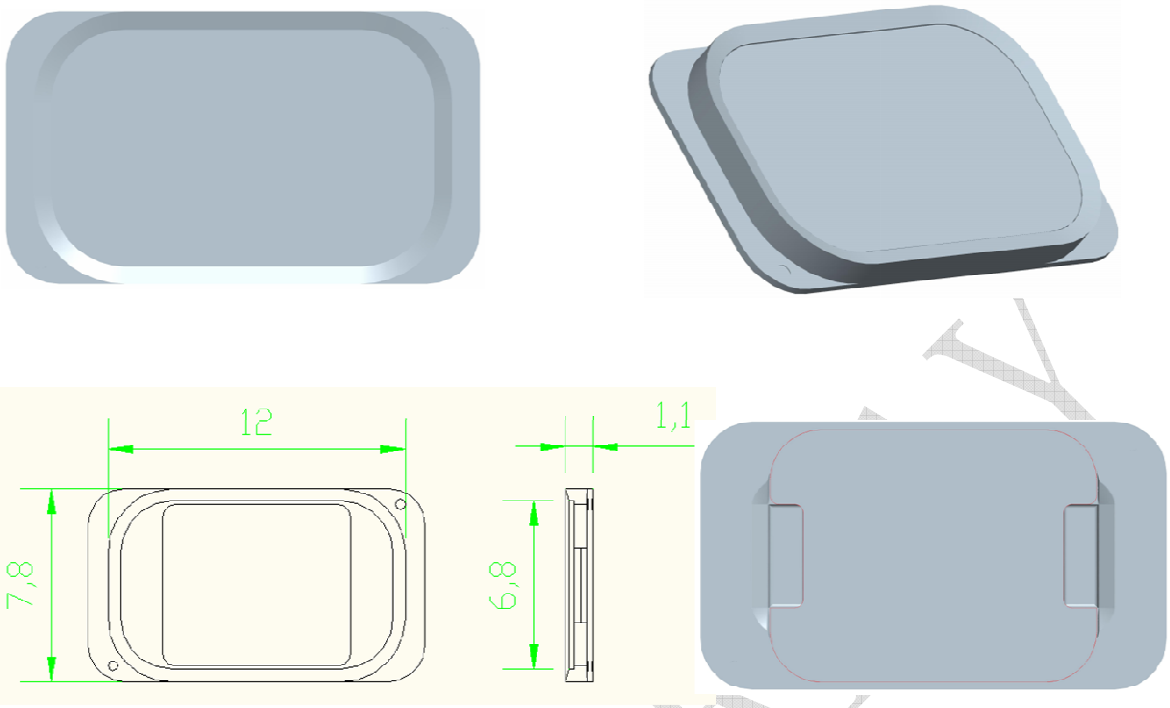
7.3 Rectangle Module



7.4 Rectangle Module Structure Diagram



7.5 Racetrack Module



7.6 Racetrack Module Structure Diagram