

CD-PA1010D GNSS patch antenna module

Data Sheet V.03

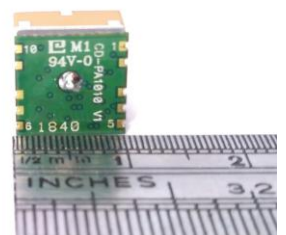
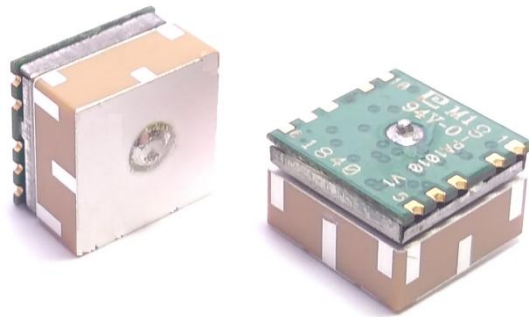


Table of Contents

1. Functional Description	3
1.1 Product description	3
1.2 Features	4
1.3 System Block Diagram	5
1.4 Multi-tone active interference canceller	5
1.5 1PPS	5
1.6 AGPS Support for Fast TTFF (EPO™)	6
1.7 EASY™	6
1.8 Embedded Logger function	7
1.9 Power Management Mode.....	7
1.9.1 Full Power Continuous Mode	7
1.9.2 Power Saving Mode	7
1.9.2.1 Standby Mode	7
1.9.2.2 Periodic Mode	7
1.9.2.3 AlwaysLocate™ (Advance Power Periodic Mode)	8
1.9.3 Backup Mode	9
2. Specifications	10
2.1 Mechanical Dimension	10
2.2 Recommended PCB pad Layout	11
2.3 Pin Configuration	11
2.4 Pin Assignment	12
2.5 Description of I/O Pin	13
2.6 Specification List	14
2.7 Absolute Maximum Ratings.....	15
3. Protocols	16
3.1 NMEA Output Sentences	16
3.2 MTK NMEA Command Protocols	23
4. Reference Design	24
4.1 Reference Design Circuit.....	24
5. Reflow Soldering Note	25
6. Tape Reel Packing Information	26

1. Functional Description

1.1 Product description

The CDTOP CD-PA1010D module utilizes the MediaTek new generation GNSS Chipset MT3333 that support various location and navigation applications, including autonomous GPS, GLONASS, GALILEO, QZSS, SBAS(note) ranging (WAAS, EGNOS, GAGAN, MSAS), QZSS, DGPS and AGPS. It support up to 210 PRN channels with 99 search channels and 33 simultaneous tracking channels.

It is the industry's highest level of sensitivity (-165dBm) and instant Time-to-First Fix (TTFF). Precise GNSS signal processing give the ultra-precise positioning under low receptive, high velocity conditions. Up to 12 multi-tone active interference canceller (ISSCC2011 award), customer can have more flexibility in system design.

World's smallest multi-constellation antenna module enabling high-performance in a variety of application

Power management design makes CD-PA1010D easily integrated into your system without extra voltage regulator. The PA1010D support operational modes that allow them to provide positioning information at reduced overall current consumption. Availability of GNSS signals in the operating environment will also be a factor in choice of power management modes. The designer can choose a mode that provides the best trade-off of performance versus power consumption.

The power management modes are described below, and can be enabled via command:

- Full Power Continuous - for best GNSS performance
- Power saving mode to optimize power consumption:
 - ✓ Standby mode
 - ✓ Periodic mode
 - ✓ AlwaysLocate™ mode
- Backup mode

The excellent low power consumption of CD-PA1010D make it easier to applied to power sensitive devices, especially portable applications, need not worry about operating time anymore and user can get more fun.

It also combined with many advanced features including EASY™, EPO™, and logger function.

Application:

- ✓ Wearable Device
- ✓ Asset management
- ✓ Handheld Device
- ✓ M2M application
- ✓ Security industry
- ✓ Surveillance
- ✓ Tablet PC/PLB/MID

1.2 Features

- Built-in 10x10x4.0mm ceramic patch antenna on the top of module
- Ultra-High Sensitivity: -165dBm (w/o patch antenna), up to 45dB C/N of SVs in open sky reception.
- AlwaysLocate: Intelligent Algorithm (Advance Power Periodic Mode) for power saving
- EASY: Self-Generated Orbit Prediction for instant positioning fix
- GPS Consumption current(@3.3V):
 - Acquisition: 36mA Typical
 - Tracking: 28mA Typical
- High accuracy 1-PPS timing support for Timing Applications (± 20 ns jitter)
- High Update Rate: up to 10Hz^(note1)
- Logger function Embedded^(note2)
- Supports QZSS, SBAS(WAAS, EGNOS, GAGAN, MSAS) ranging
- Ultra-High Sensitivity: -165dBm
- Automatic antenna switching function
- Interface: UART, I2C

Note 1: SBAS can only be enabled when update rate is less than or equal to 5Hz.

Note2: Some features need special firmware or command programmed by customer.

1.3 System Block Diagram

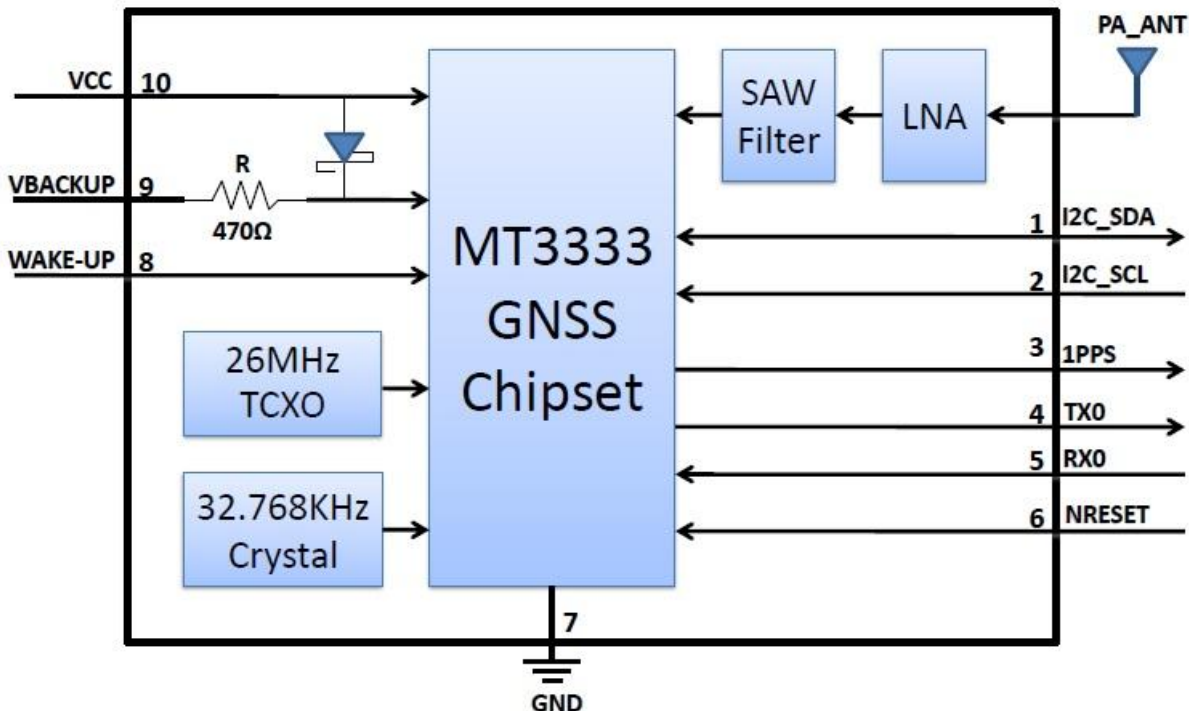


Figure 1-1: System Block Diagram.

1.4 Multi-tone active interference canceller

Because different application (Wi-Fi, GSM/GPRS, 3G/4G, Bluetooth) are integrated into navigation system, the harmonic of RF signal will influence the GPS reception, the multi-tone active interference canceller (abbr: MTAIC) can reject external RF interference which come from other active components on the main board, to improve the capacity of GPS reception without any needed HW change in the design. CD-PA1010D can cancel up to 12 independent channel interference continuous wave (CW).

1.5 1PPS

A pulse per second (1 PPS) is an electrical signal which precisely indicates the start of a second with the accuracy of ±20ns RMS (Root Mean Square). The PPS signal is provided through a designated output pin for many external applications. The pulse is not only limited to being active every second but is also allowed to set up the required duration, frequency, and active high/low through a programmable user-defined setting.

1PPS (Pulse Per Second) signal output available on configuration:

- At 2D Fix only.
- At 3D Fix only.
- After the first Fix
- Always- default configuration.

1.6 AGPS Support for Fast TTFF (EPO™)

Assisted GPS (or Aided GPS) is a method by which TTFF is reduced using information from a source other than broadcast GPS signals. The necessary ephemeris data is calculated either by the receiver itself (locally-generated ephemeris) or a server (server-generated ephemeris) and stored in the module.

The AGPS (EPO™) supply the predicated Extended Prediction Orbit data to speed TTFF, users can download the EPO data to GPS engine from the FTP server by internet or wireless network, the GPS engine will use the EPO data to assist position calculation when the navigation information of satellites are not enough or weak signal zone .

PA1010D has EASY, EPO to allow for Hot Starts even in weak signal conditions and moving start-ups. EPO (Extended Prediction Orbit) is one of MediaTek’s innovative proprietary off-line server based AGPS solution. Host could use an application to store and load the EPO files into device. With multi-constellation EPO, the user experience will be enhanced by the improved Time To First Fix (TTFF) and better first fix accuracy.

1.7 EASY™

The EASY™ is embedded assist system for quick positioning, the GPS engine will calculate and predict automatically the single ephemeris (Max. up to 3 days)when power on, and save the predict information into the memory, GPS engine will use these information for positioning if no enough information from satellites, so the function will be helpful for positioning and TTFF improvement under indoor or urban condition, the Backup power (VBACKUP) is necessary.

Up to 3 days extension for single received ephemeris:

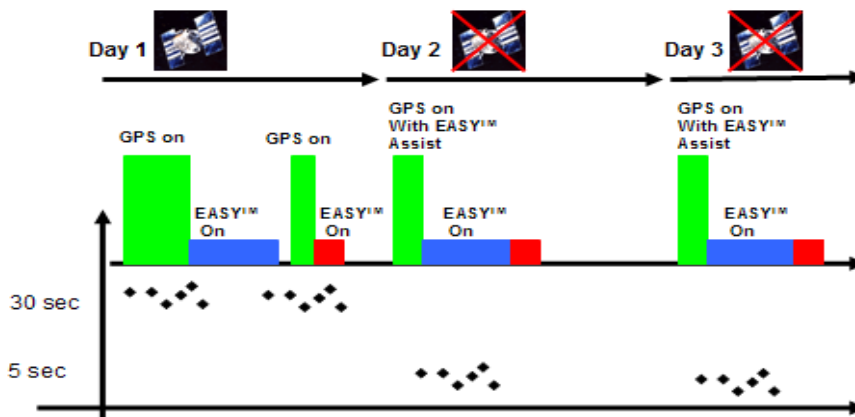


Figure 1-2 EASY System operation

Please refer to the Fig 1-2, When GPS device great the satellite information from GPS satellites, the GPS chip automatically pre-calculate the predict orbit information for 3 days.

The GPS device still can quickly do the positioning with EASY™ function under weak GPS signal.

1.8 Embedded Logger function(LOCUS)

The Embedded Logger function(LOCUS) don't need host CPU (MCU) and external flash to handle the operation, GPS Engine will use internal flash (embedded in GPS chipset) to log the GPS data (Data format : UTC, Latitude, longitude, Valid, Checksum), the maximum log duration is up to two days under AlwaysLocate™.

1.9 Power Management Mode

The PA1010D support operational modes that allow them to provide positioning information at reduced overall current consumption. Availability of GNSS signals in the operating environment will also be a factor in choice of power management modes. The designer can choose a mode that provides the best trade-off of performance versus power consumption.

The power management modes are described below, and can be enabled via command:

- Full Power Continuous for best GNSS performance
- Power saving mode to optimize power consumption:
 - Standby mode
 - Periodic mode
 - AlwaysLocate™ mode
- Backup mode

1.9.1 Full Power Continuous Mode

The modules start up in full power continuous mode. This mode uses the acquisition engine at full performance resulting in the shortest possible TTFF and the highest sensitivity. It searches for all possible satellites. The receiver then switches to the tracking engine to lower the power consumption when:

- A valid GPS/GNSS position is obtained
- The ephemeris for each satellite in view is valid

To return to Full Power mode (from a low power mode), send the following command:
\$PMTK225,0*2B (the module will wakes up from its previous sleep cycle).

1.9.2 Power Saving Mode

1.9.2.1 Standby Mode

In this mode, the receiver stops navigation, the internal processor enters standby state, and the current drain at main supply (Vcc) is reduced. Standby mode is entered by sending the following command: **\$PMTK161,0*28**

The host can then wake up the module from Standby mode to Full Power mode by sending any byte to the serial port.

1.9.2.2 Periodic Mode

This mode allows autonomous power on/off with reduced fix rate to reduce average power consumption. In periodic mode, the main power supply Vcc is still powered, but power distribution to internal circuits is controlled by the receiver.

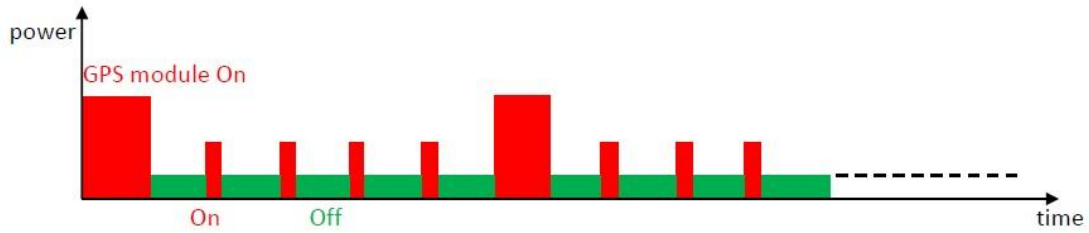


Figure 1-3 Periodic Mode operation

Enter periodic mode by sending the following command:

\$PMTK225,Type, Run_time, Sleep_time,2nd_Run_time,2nd_Sleep_time*checksum

Where:

- Type = 1: Periodic backup mode, Type = 2 : Periodic standby mode
- Run time: Full Power period (ms)
- Sleep time: Standby period (ms)
- 2nd Run time: Full Power period (ms) for extended acquisition if GNSS acquisition fails during Run time.
- 2nd Sleep time: Standby period (ms) for extended sleep if GNSS acquisition fails during Run time.

Example:

\$PMTK225,2,4000,15000,24000,90000*16: periodic mode with 4 second navigation and 15 second sleep.

The acknowledgement response for this command is: **\$PMTK001,225,3*35**

Periodic mode is exited back to Full Power Continuous Mode by sending the command: **\$PMTK225,0*2B** (the module wakes up from a previous sleep cycle).

1.9.2.3 AlwaysLocate Mode(Advance Power Periodic Mode)

AlwaysLocate™ is an intelligent controller of the Periodic mode; the main power supply Vcc is still powered up, but power distribution is internally controlled. Depending on the environment and motion conditions, the module can autonomously and adaptively adjust the parameters of the Periodic mode, the average current can vary based on conditions.

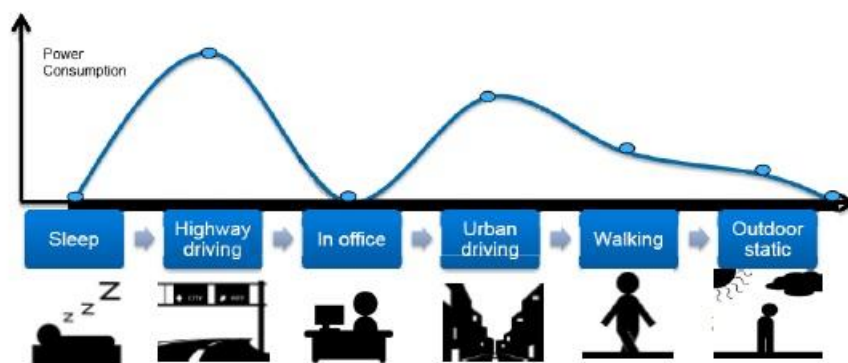


Figure 1-4: Always Locate

Enter AlwaysLocate™ mode by sending the following NMEA command: **\$PMTK225,Type*Checksum**

→ **Type=8: AlwaysLocate™ backup mode, Type=9: AlwaysLocate™ backup mode**

The acknowledgement response for the command is: **\$PMTK001,225,3*35**

The user can exit low power modes to Full Power by sending NMEA command: **\$PMTK225,0*2B**(the module wakes up from its previous sleep cycle).

1.9.3 Backup Mode

Backup Mode means a low quiescent power state where receiver operation is stopped.

The Vcc is powered on but the current consumption is minimal. After waking up, the receiver uses all internal aiding, including GNSS time, Ephemeris, and Last Position, resulting in the fastest possible TTFF in either hot or warm start modes. During Backup State, the I/O block is powered off.

Entering to backup mode is done by a NMEA software command – **\$PMTK225,4*2F**

Important: Before sending the command the WAKE-UP pin(pin 2) must be tied to ground. While in Backup mode, the module will consume 15uA from Vcc. It is not possible to wake up the module from backup mode by software command.

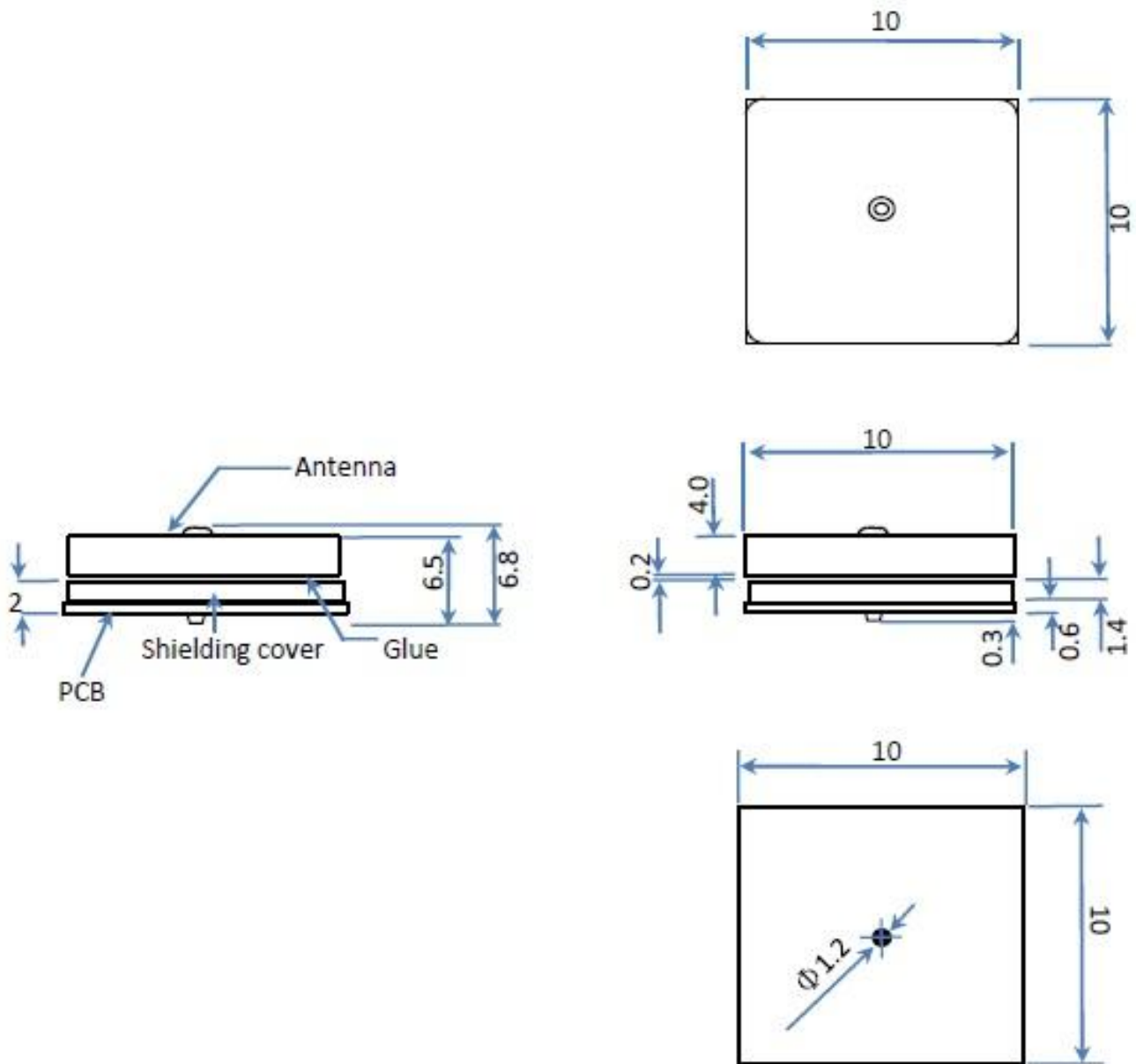
Example: **\$PMTK225,4*2F** Enter backup mode

NMEA Return feedback: **\$PMTK001,225,3*35**

Note: In Periodic backup mode and AlwaysLocate™ backup mode. The user only could let module back to Full Power Continuous Mode by sending the command: **\$PMTK225,0*2B** during the Run time stage. And Periodic standby mode do not have this limitation.

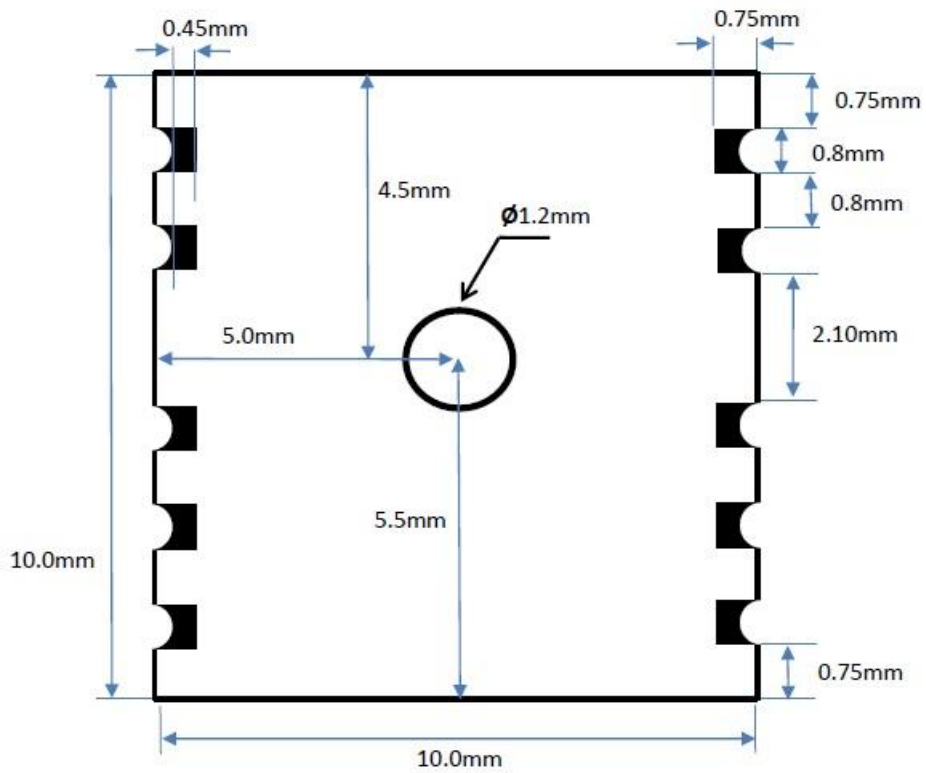
2. Specification

2.1 Mechanical Dimension



Dimension: (Unit: mm, Tolerance: +/- 0.2mm)

2.2 Recommended PCB pad Layout



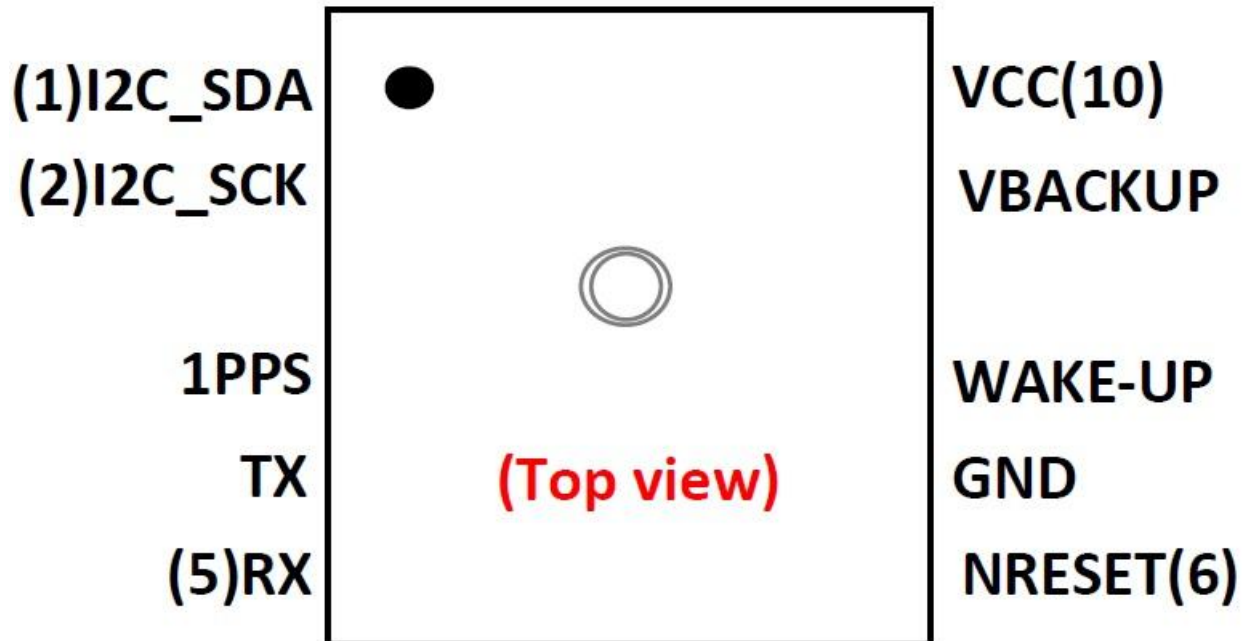
(Unit: mm, Tolerance: $\pm 0.1\text{mm}$)

Note:

Place one hole(diameter=3.0mm)
under this module for antenna pad,
avoid trace or VIAs pass this area



2.3 Pin Configuration



2.4 Pin Assignment

Pin	Name	I/O	Description & Note
1	I2C_SDA	I/O	I2C Serial data(in slave mode)
2	I2C_SCL	I	I2C Serial clock(in slave mode)
3	1PPS	O	1PPS Time Mark Output 2.8V CMOS Level
4	TX	O	Serial Data Output for NMEA Output (UART TTL)
5	RX	I	Serial Data Input for Firmware Update (UART TTL)
6	NRESET	I	Reset Input, Low Active
7	GND	P	Ground
8	WAKE-UP	I	Wake up from Backup Mode (power saving), High Active
9	VBACKUP	PI	Backup Power Input for RTC & Navigation Data Retention
10	VCC	PI	Main DC power input

2.5 Description of I/O Pin

Pin1(I2C_SDA)

This pin is defined to I2C_SDA, it outputs GPS information for I2C application. Keep floating if not used.

Pin2, (I2C_SCL)

This pin is defined to I2C_SCL, it is used to received the clock for I2C application. Keep floating if not used.

Pin3 (1PPS)

This pin provides one pulse-per-second output from the module and synchronizes to GPS time. Keep floating if not used.

Pin4, (TX)

This is the UART transmitter of the module.

Pin5, (RX)

This is the UART receiver of the module.

Pin6 (NRESET)

With a low level, it causes the module to reset. If not used, keep floating.

Pin 7(GND)

Ground

Pin8, (WAKE-UP)

Entering into BACKUP mode by sending SW command and tied to ground the WAKE-UP pin with 10K Ohm. Module will stay in BACKUP mode while WAKE-UP is 10K tied to ground for input pull down. To exit from BACKUP mode, Active High level will wake up the module. Keep floating if not used.

Pin9 (VBACKUP)

This connects to the backup power of the GPS module. Power source (such as battery) connected to this pin will help the GPS chipset in keeping its internal RTC running when the main power source is removed. The voltage should be kept between 2.0V~4.3V, Typical 3.0V.

If VBACKUP power was not reserved, the GPS module will perform a lengthy cold start every time it is powered-on because previous satellite information is not retained and needs to be re- transmitted.

If not used, keep floating.

Pin10, (VCC)

The main DC power supply of the module, the voltage should be kept between from 3.0V to 4.3V. The Vcc ripple must be controlled under 50mVpp (Typical: 3.3V)

2.6 Specification List

Item	Description
GNSS Solution	MTK MT3333
Frequency	GPS L1, 1575.42MHz GLONASS L1, 1598.0625~1605.375MHz Galileo E1, 1575.42MHz
Sensitivity(GPS portion)	Acquisition: -148dBm, cold start Reacquisition: -163dBm Hot start Tracking: -165dBm
SV Number	#1~32 for GPS #65~96 for GLONASS #1~36 for Galileo #193~195 for QZSS #33~51 for SBAS
TTFB (No. of SVs>4, C/N>40dB, PDop<1.5)	Hot start: 1 second typical Warm start: 33 seconds typical Cold start: 35 seconds typical, 60 seconds Max
Update Rate	1Hz (default), maximum 10Hz
Baud Rate	9600 bps (default)
Position Accuracy	Without aid:3.0m (50% CEP) DGPS(SBAS(WAAS,EGNOS,MSAS)):2.5m (50% CEP)
Velocity Accuracy	Without aid : 0.1m/s DGPS(SBAS(WAAS,EGNOS,MSAS,GAGAN)):0.05m/s
Timing Accuracy(1PPS Output)	±20 ns RMS within 100ms in one pulse
Altitude	Maximum 18,000m (60,000 feet)
Velocity	Maximum 515m/s (1000 knots)
Acceleration	Maximum 4G
DGPS	SBAS(default) [WAAS, EGNOS, MSAS,GAGAN]
Power Supply	VCC : 3.0V to 4.3V ; VBACKUP : 2.0V to 4.3V
Current Consumption @ 3.3V,1Hz Update Rate	Acquisition: 36mA, Tracking: 28mA
Working Temperature	-40 °C to +85 °C
Dimension	10 x 10 x 6.8 mm, LCC
Weight	2.75 g

Note:

The number range 65~96 of GLONASS satellite is shown in GLGSV sentence

The number range 1~36 of Galileo satellite is shown in GAGSV sentence

The number range 33~51 of SBAS and 193~195 of QZSS satellite is shown in GPGSV sentence

2.7 Absolute Maximum Ratings

The voltage applied for VCC should not exceed 4.3VDC.

	Symbol	Min.	Typ.	Max.	Unit
Power Supply Voltage	VCC	3.0	3.3	4.3	V
Backup battery Voltage	VBACKUP	2.0	3.0	4.3	V

2.8 Operating Condition

	Condition	Min.	Typ.	Max.	Unit
Operation supply Ripple Voltage	—	—	—	50	mVpp
RX0 TTL H Level	Vcc=3.0~4.3V	2.0	—	Vcc	V
RX0 TTL L Level	Vcc=3.0~4.3V	0	—	0.8	V
TX0 TTL H Level	Vcc=3.0~4.3V	2.4	—	2.8	V
TX0 TTL L Level	Vcc=3.0~4.3V	0	—	0.4	V
Current consumption @3.3V, 1Hz update rate	Acquisition	—	36	—	mA
	Tracking	—	28	—	mA
Backup power consumption @ 3V	25 ⁰ C	—	18	—	uA

3. Protocols

3.1 NMEA Output Sentences

Table-1 lists each of the NMEA output sentences specifically developed and defined by MTK for use within MTK products

Table-1: Each of the NMEA output sentences	
Option	Description
GGA	Time, position and fix type data.
GSA	GNSS receiver operating mode, active satellites used in the position solution and DOP values.
GSV	The number of GNSS satellites in view satellite ID numbers, elevation, azimuth, and SNR values.
RMC	Time, date, position, course and speed data. Recommended Minimum Navigation Information.
VTG	Course and speed information relative to the ground.

Table-2: NMEA Output Sentence for GPS and GNSS					
System	GGA	GSA	GSV	RMC	VTG
GPS	GPGGA	GPGSA	GPGSV	GPRMC	GPVTG
GNSS (GPS+GLONASS)	GNGGA	GPGSA GLGSA	GPGSV GLGSV	GNRMC	GNVTG
GNSS (GPS+GLONASS+Galileo)	GNGG	GPGSA GLGSA GAGSA	GPGSV GLGSV GAGSV	GNRMC	GNVTG

Note: GP is a short term of “GPS”; GL is “GLONASS”; GA is “Galileo” and GN is “multi-system”
 Default setting: GPS+GLONASS, GPS+GLONASS+Galileo need custom firmware and suggest work baud rate is 115,200bps.

GGA—Global Positioning System Fixed Data. Time, Position and fix related data

Table-3 contains the values for the following example :

*\$GNGGA,165006.000,2241.9107,N,12017.2383,E,1,14,0.79,22.6,M,18.5,M,,*42*

Table-3: GGA Data Format			
Name	Example	Units	Description
Message ID	\$GNGGA		GGA protocol header
UTC Time	165006.000		hhmmss.sss
Latitude	2241.9107		ddmm.mmmm
N/S Indicator	N		N→North or S→South
Longitude	12017.2383		dddmm.mmmm
E/W Indicator	E		E→East or W→West
Position Fix Indicator	1		See Table-4
Satellites Used	14		Range 0 to 14
HDOP	0.79		Horizontal Dilution of Precision
MSL Altitude	22.6	meters	Antenna Altitude above/below mean-sea-level
Units	M	meters	Units of antenna altitude
Geoidal Separation	18.5	meters	
Units	M	meters	Units of geoids separation
Age of Diff. Corr.		second	Null fields when DGPS is not used
Checksum	*42		
<CR> <LF>			End of message termination

Table-4: Position Fix Indicator	
Value	Description
0	Fix not available
1	GPS fix
2	Differential GPS fix

Note:

When inputting the command \$PMTK353,0,1,0,0,0*2A, \$GNGGA will change to \$GLGGA (For GLONASS).
 When inputting the command \$PMTK353,1,0,0,0,0*2A, \$GNGGA will change to \$GPGGA (For GPS)
 User could refer to PMTK353 command for more detail

GSA—GNSS DOP and Active Satellites

Table-5 contains the values for the following example :

*\$GPGSA,A,3,06,02,05,17,19,09,12,193,194,195,,,1.19,0.66,0.99*34*

*\$GLGSA,A,3,65,66,88,87,81,67,,,,,,1.19,0.66,0.99*13*

*\$GAGSA,A,3,19,04,11,12,,,,,,1.19,0.66,0.99*15*

Table-5: GSA Data Format			
Name	Example	Units	Description
Message ID	\$GPGSA or \$GLGSA or \$GAGSA		GSA protocol header
Mode 1	A		See Table-6
Mode 2	3		See Table-7
Satellite Used	06		SV on Channel 1
Satellite Used	02		SV on Channel 2
....
Satellite Used			SV on Channel 12
QZSS satellite	193		Range 193 ~ 195
PDOP	1.19		Position Dilution of Precision
HDOP	0.66		Horizontal Dilution of Precision
VDOP	0.99		Vertical Dilution of Precision
Checksum	*34		
<CR> <LF>			End of message termination

Table-6: Mode 1	
Value	Description
M	Manual—forced to operate in 2D or 3D mode
A	2D Automatic—allowed to automatically switch 2D/3D

Table-7: Mode 2	
Value	Description
1	Fix not available
2	2D (< 4 SVs used)
3	3D (≥ 4 SVs used)

Note:

It supports several header ID of GSA sentence for different satellite system like: GPxxx for GPS system, GLxxx for GLONASS system and GAXxx for Galileo system.

GSV— Satellites in View, includes GPS(GPGSV),GLONASS(GLGSV) and Galileo(GAGSV)

Table-8 contains the values for the following example :

\$GPGSV,4,1,15,195,59,162,39,05,53,288,45,42,51,129,36,02,49,348,41*4E
 \$GPGSV,4,2,15,19,49,149,42,06,42,065,43,13,29,187,37,12,24,254,33*75
 \$GPGSV,4,3,15,17,23,149,50,09,14,041,32,25,09,294,37,30,08,119,36*7E
 \$GPGSV,4,4,15,07,05,090,29,193,,,40,194,,,38*45

Table-8: GPGSV Data Format			
Name	Example	Units	Description
Message ID	\$GPGSV		GSV protocol header
Number of Messages	4		Range 1 to 4 <i>(Depending on the number of satellites tracked, multiple messages of GSV data may be required.)</i>
Message Number1	1		Range 1 to 4
Satellites in View	15		
Satellite ID	195		Channel 1 (Range 1 to 32) Note: 193~ 195 for QZSS
Elevation	59	degrees	Channel 1 (Maximum 90)
Azimuth	162	degrees	Channel 1 (True, Range 0 to 359)
SNR (C/No)	39	dBHz	Range 0 to 99,(null when not tracking)
....
Satellite ID	07		Channel 4 (Range 1 to 32)
Elevation	05	degrees	Channel 4 (Maximum 90)
Azimuth	090	degrees	Channel 4 (True, Range 0 to 359)
SNR (C/No)	29	dBHz	Range 0 to 99, (null when not tracking)
Checksum	*4E		
<CR> <LF>			End of message termination

Table-9 contains the values for the following example :

\$GLGSV,2,1,07,66,65,356,38,81,57,004,36,88,52,108,34,67,48,235,36*66

\$GLGSV,2,2,07,82,13,332,,87,11,134,26,65,10,029,19*54

Table-9: GLGSV Data Format			
Name	Example	Units	Description
Message ID	\$GLGSV		GSV protocol header
Number of Messages	2		Range 1 to 4 (<i>Depending on the number of satellites tracked, multiple messages of GSV data may be required.</i>)
Message Number1	1		Range 1 to 4
Satellites in View	07		
Satellite ID	66		Channel 1 (Range 65 to 96)
Elevation	65	degrees	Channel 1 (Maximum 90)
Azimuth	356	degrees	Channel 1 (True, Range 0 to 359)
SNR (C/No)	38	dBHz	Range 0 to 99,(null when not tracking)
....
Satellite ID	65		Channel 4 (Range 65 to 96)
Elevation	10	degrees	Channel 4 (Maximum 90)
Azimuth	029	degrees	Channel 4 (True, Range 0 to 359)
SNR (C/No)	19	dBHz	Range 0 to 99,(null when not tracking)
Checksum	*54		
<CR> <LF>			End of message termination

\$GAGSV,2,1,06,04,79,161,42,12,59,058,38,11,38,332,35,19,36,042,32*6B

\$GAGSV,2,2,06,24,10,226,,25,06,272,*69

Table-9: GAGSV Data Format

Name	Example	Units	Description
Message ID	\$GAGSV		GSV protocol header
Number of Messages	2		Range 1 to 4 (<i>Depending on the number of satellites tracked, multiple messages of GSV data may be required.</i>)
Message Number1	1		Range 1 to 4
Satellites in View	06		
Satellite ID	04		Channel 1 (Range 1 to 36)
Elevation	79	degrees	Channel 1 (Maximum 90)
Azimuth	161	degrees	Channel 1 (True, Range 0 to 359)
SNR (C/No)	42	dBHz	Range 0 to 99,(null when not tracking)
....
Satellite ID	25		Channel 4 (Range 1 to 36)
Elevation	06	degrees	Channel 4 (Maximum 90)
Azimuth	272	degrees	Channel 4 (True, Range 0 to 359)
SNR (C/No)		dBHz	Range 0 to 99,(null when not tracking)
Checksum	*6D		
<CR> <LF>			End of message termination

RMC—Recommended Minimum Navigation Information

Table-10 contains the values for the following example :

*\$GNRMC,064951.000,A,2307.1256,N,12016.4438,E,0.03,165.48,260406,3.05,W,A*2C*

*\$GNRMC,155503.000,A,5606.1725,N,01404.0622,E,0.04,0.00,110918,,,D*75*

Table-10: RMC Data Format

Name	Example	Units	Description
Message ID	\$GNRMC		RMC protocol header
UTC Time	155503.000		hhmmss.sss
Status	A		A → data valid or V → data not valid
Latitude	5606.1725		ddmm.mmmm
N/S Indicator	N		N → North or S → South
Longitude	01404.0622		dddmm.mmmm
E/W Indicator	E		E → East or W → West
Speed over Ground	0.04	knots	
Course over Ground	165.48	degrees	True
Date	260406		ddmmyy
Magnetic Variation	3.05, W	degrees	E → East or W → West
Mode	A		A → Autonomous mode D → Differential mode E → Estimated mode
Checksum	*2C		
<CR> <LF>			End of message termination

Note:

When inputting the commend \$PMTK353,0,1,0,0,0*2A , \$GNRMC will change to \$GLRMC (for GLONASS).

When inputting the commend \$PMTK353,1,0,0,0,0*2A : \$GNRMC will change to \$GPRMC (for GPS).

User could refer to PMTK353 command for more details

VTG—Course and speed information relative to the ground

Table-10 contains the values for the following example:

`$GNVTG,352.70,T,,M,0.07,N,0.13,K,A*25`

Table-10: VTG Data Format			
Name	Example	Units	Description
Message ID	\$GNVTG		VTG protocol header
Course	352.70	degrees	Measured heading
Reference	T		True
Course		degrees	Measured heading
Reference	M		Magnetic
Speed	0.07	knots	Measured horizontal speed
Units	N		Knots
Speed	0.13	km/hr	Measured horizontal speed
Units	K		Kilometers per hour
Mode	A		A → Autonomous mode D → Differential mode E → Estimated mode
Checksum	*25		
<CR> <LF>			End of message termination

Note:

When inputting the command `$PMTK353,0,1,0,0,0*2A` , `$GNVTG` will change to `$GLVTG`(For GLONASS). When inputting the command `$PMTK353,1,0,0,0,0*2A` : `$GNVTG` will change to `$GPVTG` (For GPS).

3.2 MTK NMEA Command Protocols

Packet Type:

103 PMTK_CMD_COLD_START

Packet Meaning:

Cold Start : Don't use Time, Position, Almanacs and Ephemeris data at re-start.

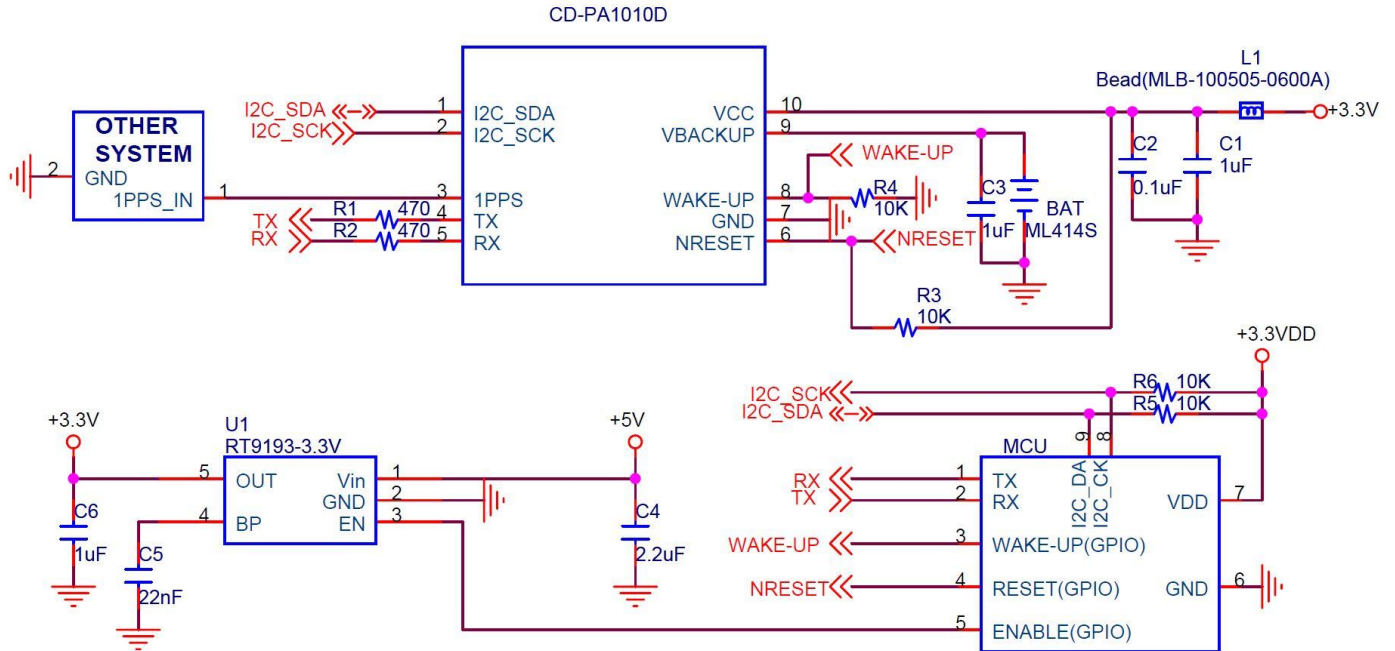
Example:

`$PMTK103*30<CR><LF>`

4. Reference Design

This chapter introduces the reference schematic design for the best performance. Additional tips and cautions on design are well documented on Application Note, which is available upon request.

4.1 Reference Design Circuit



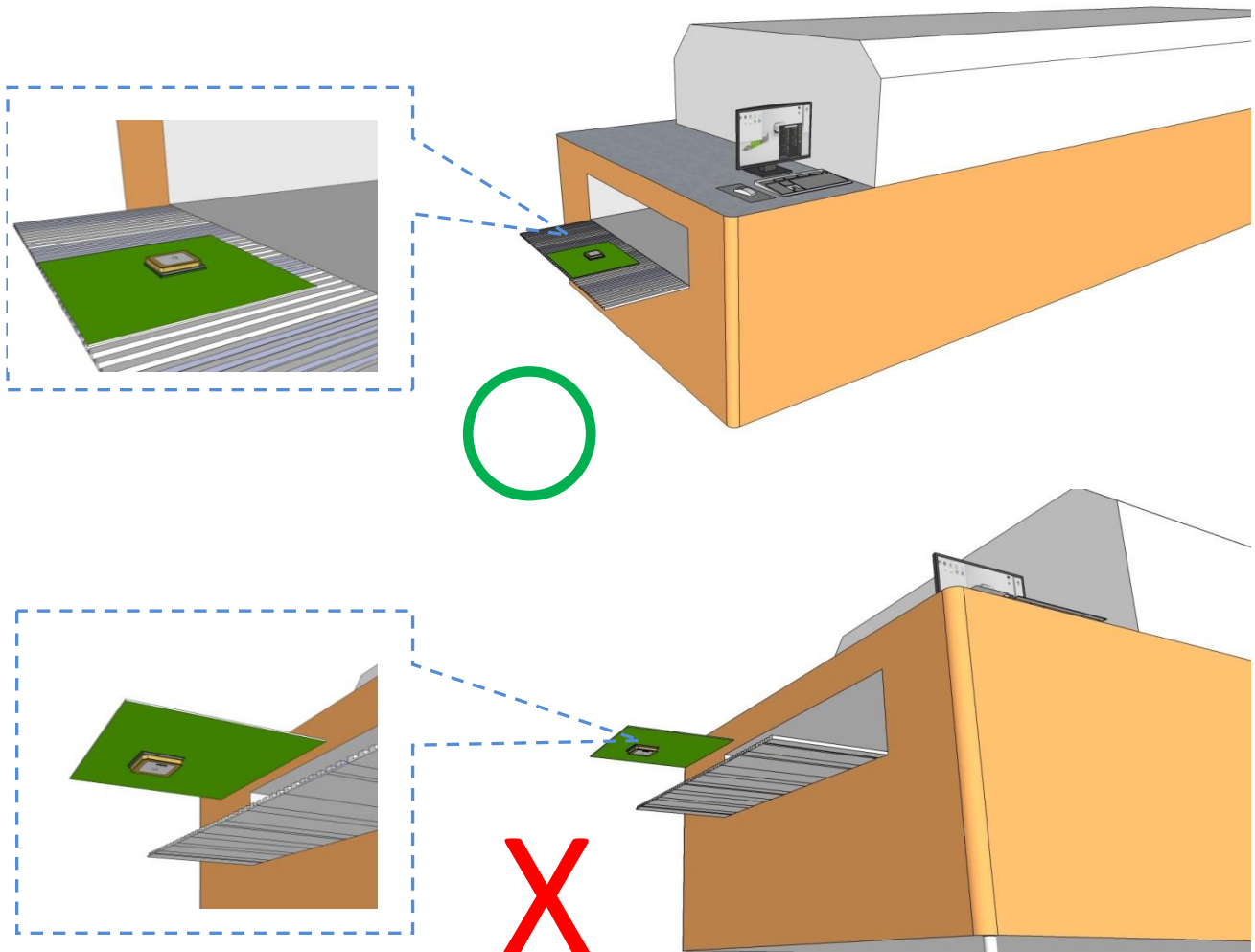
Note:

1. Ferrite bead L1 is added for power noise reduction.
2. C1 and C2 bypass should be put near the module.
3. Damping resistors R1, R2 could be modified based on system application for EMI.

5. Reflow Soldering Note

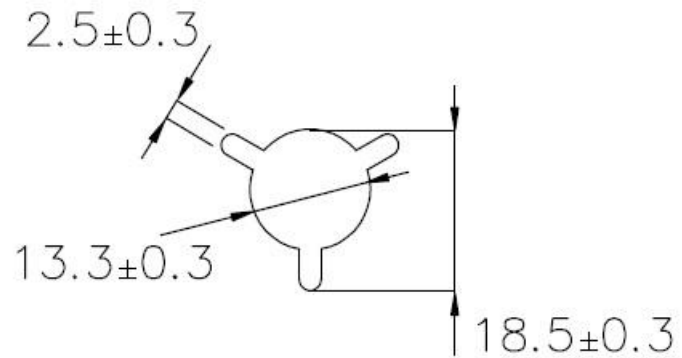
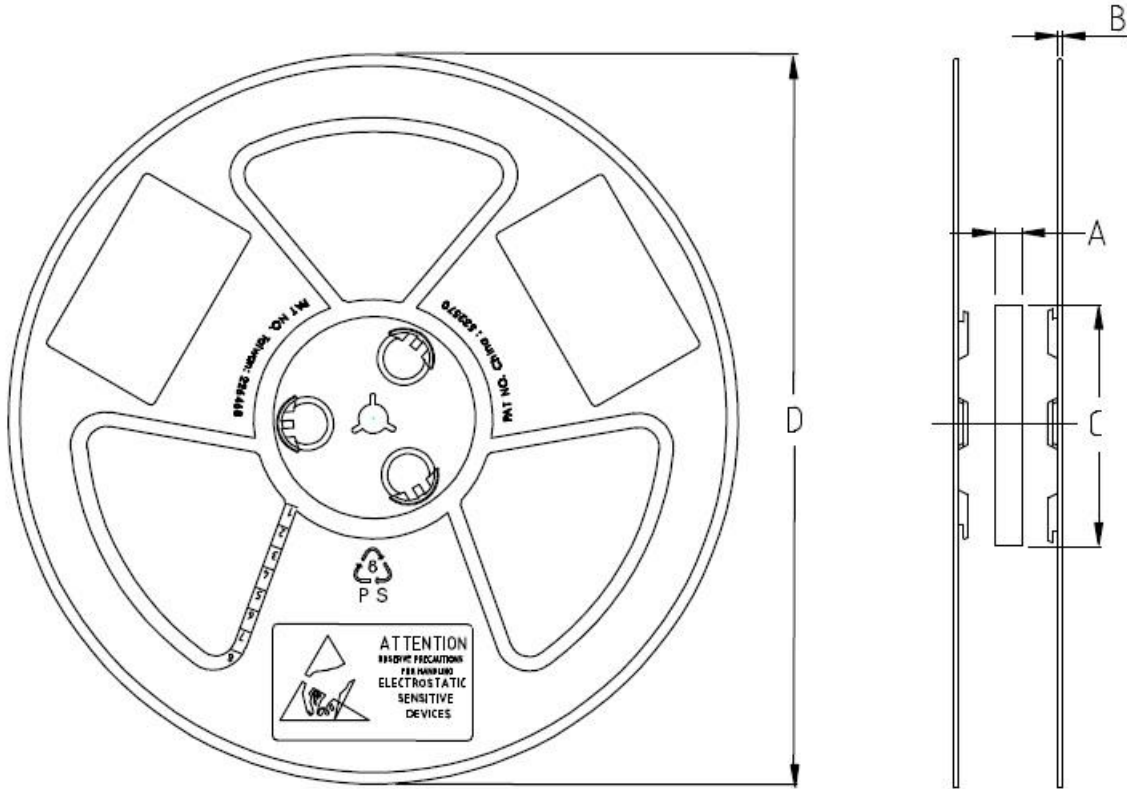
Cautionary Notes on Reflow-Soldering Process:

1. Module must be pre-baked **before** going through SMT solder reflow process.
2. The usage of solder paste should follow “First-in-First out” principle. Opened solder paste needs to be monitored and recorded in a timely manner (refer to IPQC standards for related documentation and examples).
3. Temperature and humidity must be controlled within SMT production line and storage area. Temperature of 23°C, 60±5% RH humidity is recommended. (please refer to IPQC standards for related documentation and examples)
4. When performing solder paste printing, please notice if the amount of solder paste is in excess or insufficient, as both conditions may lead to defects such as electrical shortage, empty solder and etc.
5. Make sure the vacuum mouthpiece is able to bear the weight of the GNSS module to prevent positional shift during the loading process.
6. Before the PCBA is going through the reflow-soldering process, the operators should check with his/her own eyes to see if there are positional offset to the module.
7. The reflow temperature and its profile data must be measured before the SMT process and match the levels and guidelines set by IPQC.
8. If SMT protection line is running a double-sided process for PCBA, please process GNSS module during the second pass only to avoid repeated reflow exposures of the GNSS module. Please contact CDTop beforehand if you must process GNSS module during the 1st pass of double-side process.

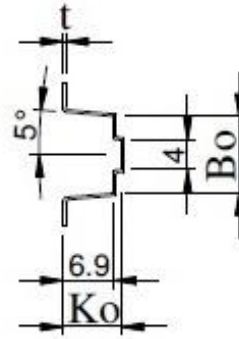
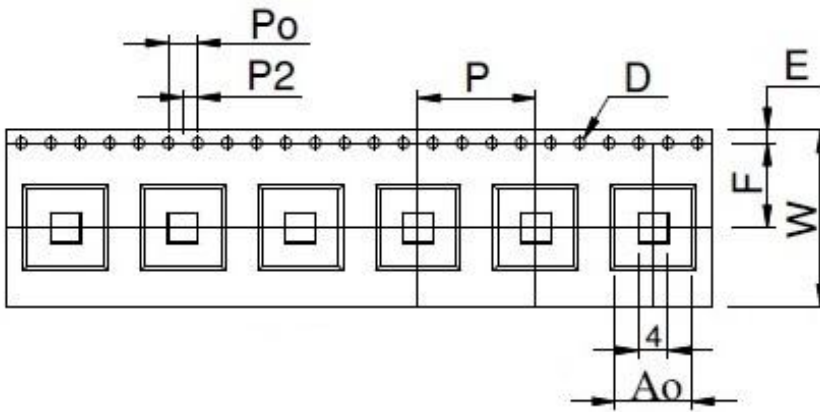


6. Tape Reel Packing Information

One Reel : 500pcs



SPEC	13" REEL W: 24 mm				
	Material: HIPS				
ITEM	A	B	C	D	Surface Resistivity
DIM	24.5 ± $\begin{matrix} +1.0 \\ -0.1 \end{matrix}$ mm	2.2 ± 0.2mm	100 ± 1.0 mm	330 ± 1.5mm	< 10 ¹¹ Ω/□
ALTERNATE					



ITEM	SPEC
W	+0.30 24.0 -0.30
Ao	+0.10 10.4 -0.10
Bo	+0.10 10.4 -0.10
Ko	+0.10 7.90 -0.10
P	+0.10 16.0 -0.10
F	+0.10 11.5 -0.10
E	+0.10 1.75 -0.10
D	+0.10 1.50 -0.00
D1	+0.10 0.00 -0.10
Po	+0.10 4.00 -0.10
P2	+0.10 2.00 -0.10
t	+0.05 0.35 -0.05

