

Features

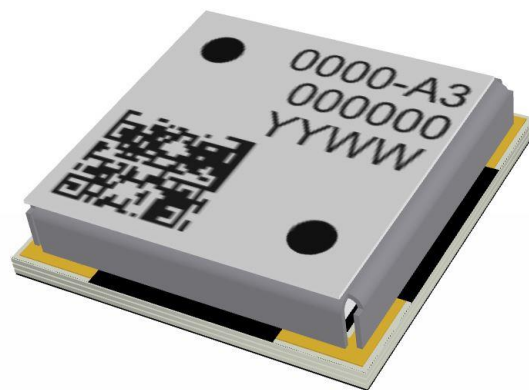
- Simple drop in solution full GNSS receiver (GPS/GLONASS/GALILEO/BEIDOU)
- MediaTek MT3333 flash chip
- Ultra-small SMD package; 9.0 x 9.0 x 1.8mm
- Low current consumption
- AIC, Active Interference Cancellation
- EASY - Internally generated orbit prediction for fast fix times.

Description

A compact GPS module receiver using the MediaTek MT3333 flash chip providing a complete GNSS receiver for optimum performance. The module can run two GNSS systems simultaneously to enhance location and TTFF considerably. The M10578-A3 operates on a versatile 2.8V-4.2V supply with low power consumption and several low power modes for further power savings. An accurate 0.5ppm TXCO ensures short TTFF. Indoor and outdoor multi-path detection and compensation. A second stage GNSS LNA to ensure optimal performance making it suited for small wearable devices.

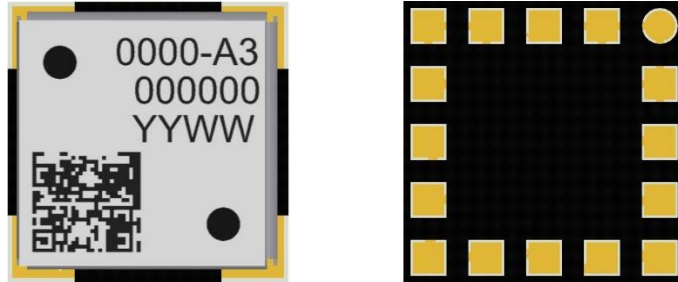
Applications

- **Wearable devices**
- **Portable Devices**
- **Asset Tracking / Personal Safety**
- **Sport Cameras / Equipment**
- **Smart Watches**
- **Navigation devices**

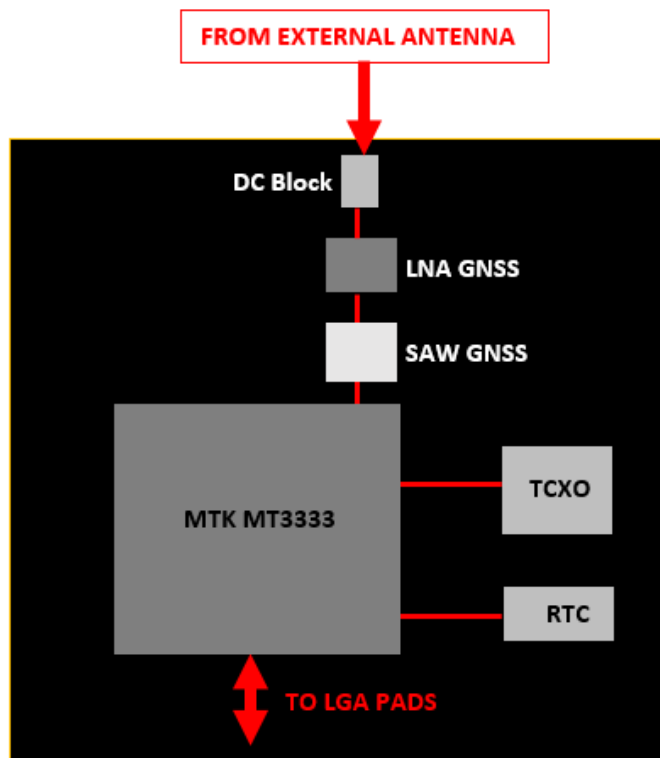


Part number

M10578-A3



Functional Block Diagram



Module Specifications

Absolute Maximum Ratings

| Symbol | Parameter | Min | Max | Unit |
|------------|-------------------------|------|-----|------|
| V_{CC} | Main Supply Voltage | -0.3 | 4.3 | V |
| V_{IO} | Supply voltage I/O ring | -0.3 | 3.6 | V |
| V_{BATT} | VBCKP Supply | -0.3 | 4.3 | V |
| RF_{IN} | Maximum RF Input Power | N/A | +10 | dBm |
| T_{STG} | Storage Temperature | -40 | +85 | °C |
| T_A | Operating Temperature | -40 | +85 | °C |

* Exposure to absolute ratings may adversely affect reliability and may cause permanent damage.

Recommended Operating Conditions

| Symbol | Parameter | Min | Typ | Max | Unit |
|------------|-----------------------|-----|-----|-----|------|
| V_{CC} | Main Supply Voltage | 2.8 | 3.3 | 4.3 | V |
| V_{BATT} | VBCKP Supply | 2.8 | 3.3 | 4.3 | V |
| T_{OP} | Operating Temperature | -40 | - | +85 | °C |

DC Electrical Characteristics

Conditions: $V_{CC} = 3.3V$, $T_{OP} = 25\text{ °C}$

| Symbol | Parameter | Typ | Unit |
|-----------------|-----------------------------------|------|------|
| $I_{CC(PK)}$ | Peak Acquisition Current | 38 | mA |
| $I_{CC(AVG)}$ | Average Tracking Supply Current | 28 | mA |
| $I_{CC(STBY)}$ | Standby (Sleep) Power Supply Mode | <350 | µA |
| $I_{CC(BCKUP)}$ | Backup Mode | <200 | µA |

RF Specifications

Conditions: $V_{CC} = 3.3V$, $T_{OP} = 25\text{ °C}$, Freq = 1575.420MHz

| Symbol | Parameter | TYP | Unit |
|----------------|--|------|------|
| N_{LNA}^F | LNA Noise Figure (MT3333 Integral LNA) | 2.2 | dB |
| N_{LNA1st}^F | 1 st Stage LNA | 0.65 | dB |

Band Rejection

| Frequency | Standard | Typ* | Unit |
|-----------|--------------------|------|------|
| 698-798 | LTE700 | 49 | dB |
| 824-849 | Cellular CDMA | 49 | dB |
| 869-894 | GSM850 | 49 | dB |
| 880-915 | GSM900 | 49 | dB |
| 1710-1785 | GSM1800/DCS | 45 | dB |
| 1850-1910 | GSM1900/PCS | 43 | dB |
| 1920-1980 | WCDMA | 43 | dB |
| 2400-2492 | WLAN, BT and WiMAX | 43 | dB |
| 2500-2690 | LTE2600 | 43 | dB |

*Does not include antenna rejection.

Mechanical Specifications

| Parameter | Typ | Unit |
|--|--|------|
| Module exterior dimensions (L x W x H) | 9.0 (±0.1) x 9.0 (±0.1) x 1.8 (+0.2 / - 0.0) | mm |
| Module support and connection | Surface mounted (SMD) | - |
| Module mass | <1 | g |

System Specifications

| Communication | Specification |
|--------------------------------|--|
| Data Output Protocol | NMEA 0183 |
| Host Interfaces | UART |
| Default data rate on UART | 9600 default rate, modify by input command |
| GPS Engine | |
| Chip | MTK MT3333 Flash Chip |
| Channels | 210 PRN / 66 Acquisition / 22 Tracking |
| TCXO | 0.5ppm |
| Accuracy | |
| Horizontal Position Accuracy | <2.5m CEP |
| Maximum Position Update Rate | 10 Hz |
| Sensitivity | |
| Acquisition (Cold) | -148dBm |
| Acquisition (Hot) | -163dBm |
| Tracking | -165dBm |
| TTF | |
| Hot Start | <1s |
| Warm Start | <25s (typical) |
| Cold Start | <35s (typical) |
| General | |
| Maximum Altitude | <18.000 km |
| Maximum Speed | <514 m/s |
| Active Interference Cancellers | 12 multi tone active cancellers ISSCC2011 award |
| Additional Features | 1PPS Sync, SBAS, WAAS, EGNOS, QRZZ, GAGAN support |
| EPO / EASY | Orbit prediction |

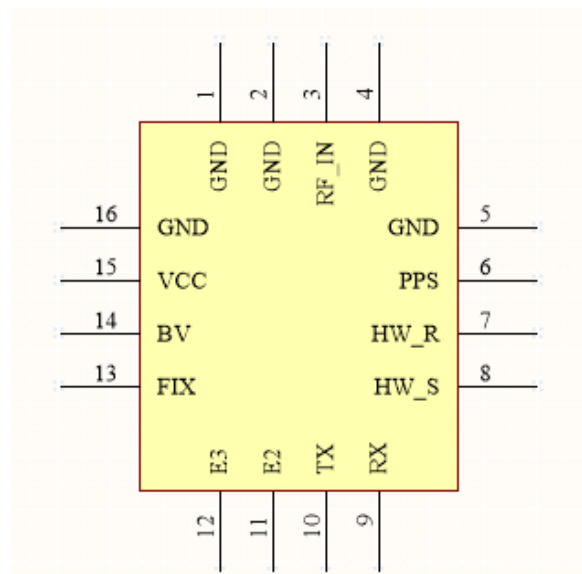
50% CEP, Open-Sky, 24hr Static, -130dBm, good view of the sky

Pin out Description

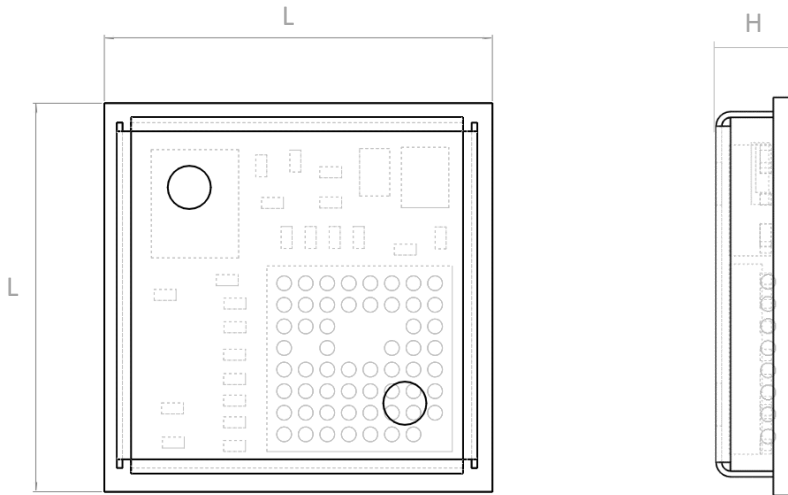
Table shows the designation and function of each pin on the M10578-A3 module.

| Pin | Designator | Description |
|-----|------------|--|
| 1 | GND | Ground connection |
| 2 | GND | Ground connection |
| 3 | RF_IN | RF connection from antenna (50Ω) |
| 4 | GND | Ground connection |
| 5 | GND | Ground connection |
| 6 | 1PPS | Pulse Per Second Output |
| 7 | HW_R | System reset, active low |
| 8 | HW_S | Used to enable standby mode. If not used leave floating. |
| 9 | RX | UART Receive data line |
| 10 | TX | UART Transmit data line |
| 11 | E2 | Not used |
| 12 | E3 | Not used |
| 13 | FIX | Indicates once a GPS fix has been obtained. |
| 14 | BV | Backup Voltage +2.0V to 4.2V |
| 15 | VCC | Main DC supply, +2.8 to +4.2V |
| 16 | GND | Ground connection |

Schematic symbol of module



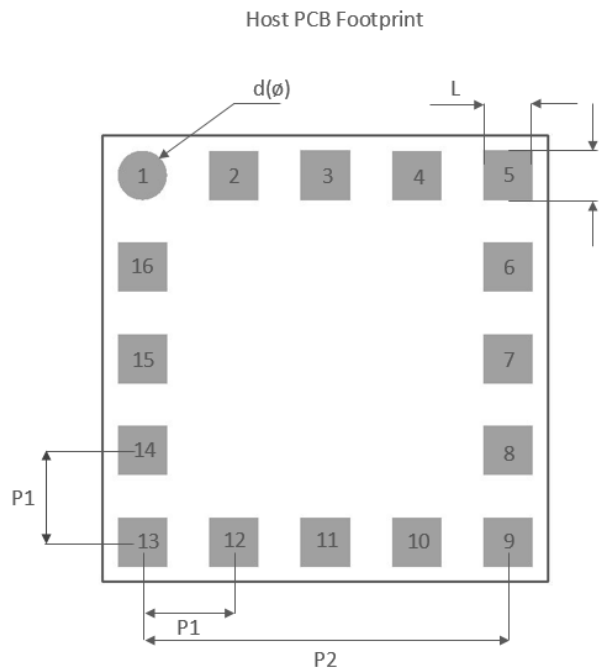
Mechanical



All dimensions in mm

| L | H |
|---------------|------------------|
| Length | Height |
| 9.0 ±0.1 | 1.8 +0.2 / - 0.0 |

Module Footprint



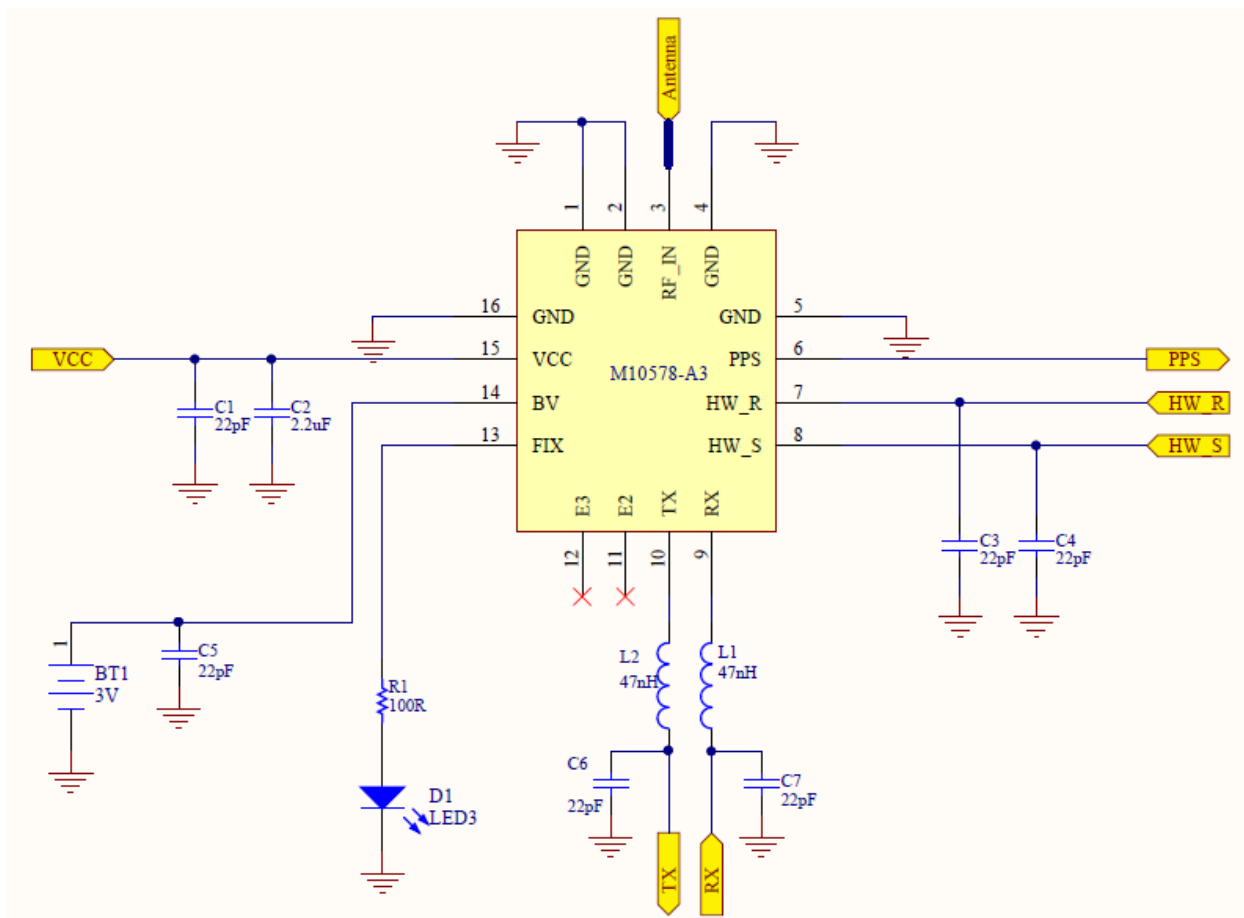
| L | P1 | P2 | d(∅) |
|-----------------|------------------|--------------------|-----------------------|
| Pad Size | Pad pitch | Pitch total | Diameter pad 1 |
| 1.0 | 1.85 | 7.40 | 1.0 |

All dimensions in mm

Application Schematic Example for M10578-A3:

The circuit below shows a basic design for use with the UART interface and configuring the default baud rate to 9600.

Baud Rate = 9600 (Default)



Bill of Material

| Designator | Value | Description/Comments | Quantity |
|------------------------|-----------------|--|----------|
| C1, C3, C4, C5, C6, C7 | 22pF capacitor | Decoupling cap. Place close to corresponding pin | 6 |
| C2 | 2.2uF capacitor | Decoupling cap. Place close to corresponding pin | 1 |
| L1, L2 | 47nH Inductor | Filter component | 2 |
| BT1 | 3V Battery | 3.0Volt Battery cell for battery backup | 1 |
| D1 | LED | Illuminates when GPS fix | 1 |
| R1 | Resistor | For LED drive | 1 |

Host Baud Rate/Protocol Selection

The baud rate and output protocol can be changed dynamically after start up using the relevant commands. Please contact Antenova for more information about protocol messages.

Host Interface

UART Interface

The UART converts bytes of data to and from asynchronous start-stop bit streams as binary electrical impulses. The port contains a 16-byte FIFO, and 256 bytes of URAM. The bit rates are selectable from 4800, 9600, 38400 and 115200 bps.

The IO level from the UART port are CMOS compatible, however for RS232 compatibility the use of external level shifters will be required. The hardware configuration of the port baud can be changed dynamically by the use of commands. These will be active and saved as long as the VBACKP supply is applied.

Power Supply

The M10458-A3-1 uses two DC supply inputs. VBACKUP to power the RAM and RTC sections of the receiver, and VCC to power the digital and processing sections. VBACKUP is to be applied all the time to keep these sections alive. VCC can be removed to initiate a backup power save mode (See page 10). VBACKUP can be removed if a battery is also used at VBACKUP to maintain this supply. The supply is internally regulated for 2.8V meaning the external supply is versatile for a range of voltage levels.

TM (1PPS)

TM is a one pulse per second output from the receiver providing uses for timing purposes. The pulse is not only limited to being active every second, but also allows the setup to a required duration, frequency and active high/low by programming user defined settings.

HRST (Hardware Reset Pin)

The External reset pin is default high by an internal 75Kohm and should be left floating if not used. To initiate a reset the pin needs to be pulled low. The module also initiates a reset if the VCC drops below the minimum 2.8V supply.

Power Management

The M10578-A3 has three power saving modes.

- Standby mode
- Back up mode
- Periodic mode

Standby Mode

Standby mode is a power saving mode that shuts down the RF section of the module and puts the processor into a standby mode. The RTC is kept alive and the RAM power is maintained to keep the module configuration.

The standby state can be initiated either with a hardware signal to Pin26 or by using a command.

Hardware controlled Standby:

Enable standby mode by a low state to pin 8 (HW_S). To wake the module back to full power a high state needs to be applied to pin 8. If Pin 8 is not to be used then it must be kept floating (not connected).

Standby mode command:

Software on the host needs to send the "PMTK161 command through the UART interface.

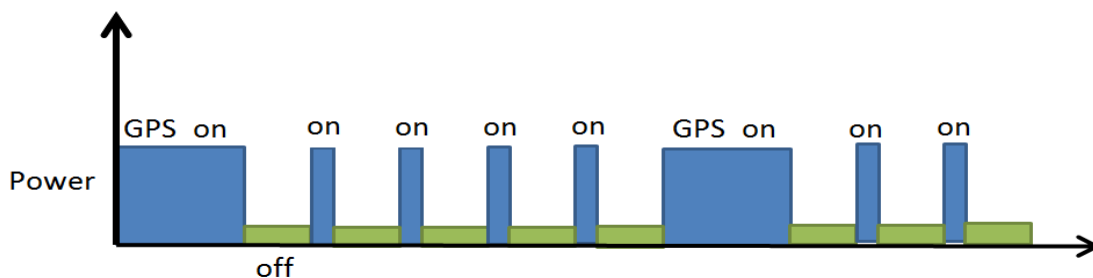
| Command | M10578-A3 standby then wakeup | Current consumption (Typ) |
|----------------|--------------------------------------|---------------------------|
| \$PMTK161,0*28 | M10578-A3 enters standby mode | <200uA |
| Any byte | M10578-A3 wakes up from standby mode | |

Back up mode

To enter backup mode the VCC simply needs to be removed. Once initiated the RTC and all configuration is saved along with any ephemeris data to allow quick TTFF once the VCC is re-applied. BV needs to be applied at all times for backup mode to run correctly.

Periodic mode

Periodic mode is a module controlled mode that reduces current consumption by only waking the module for short periods to maintain fix data. The periodic state is user configured. Contact Antenna for more information and a user command manual.



| PMTK225 setting | M10578-A3 time off/awake | Current usage (Typ) |
|--------------------------------|--|---------------------|
| PMTK225, 2,3000,18000,72000 | Module sleeps for 12secs, then wakes for 3secs periodically. 72000 is for a cold boot condition. | <200uA |

EPO (Extended Prediction Orbit) data service

The EPO allows the use of up to a 30-day orbit predictions that can be used to aid the module for an instant fix solution

- A proxy server on the customer’s side to update EPO files from the MTK server daily.
- Application software to access the proxy server through the internet (optional if host device can access internet)
- Software on host device to send EPO data to M10578-A3 module to allow instant fix by using

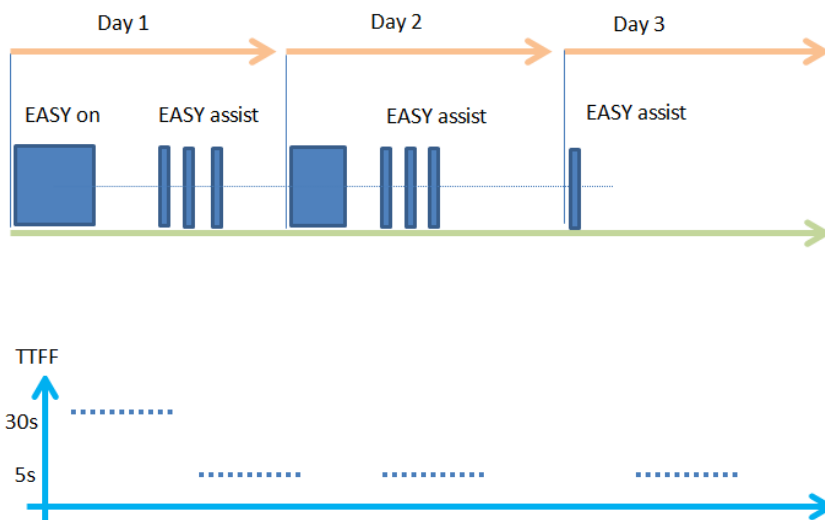
EE data. Please contact Antenova for more information. Requires permission from MTK to use service.

EASY (Self-Generated Orbit prediction)

The module supports EASY™ (Embedded Assisted System) is a Self-Generated Orbit Prediction feature. It provides up to 3 days GPS orbit prediction ability without the need for any host CPU porting or internet connection requirements.

EASY works as embedded software which accelerates TTFF by predicting satellite navigation messages from received ephemeris. EASY is a fully automated receiver task that is efficiently scheduled and computed in free time of every second after a GNSS navigation solution.

EASY is default off and can be enabled by a PMTK command.



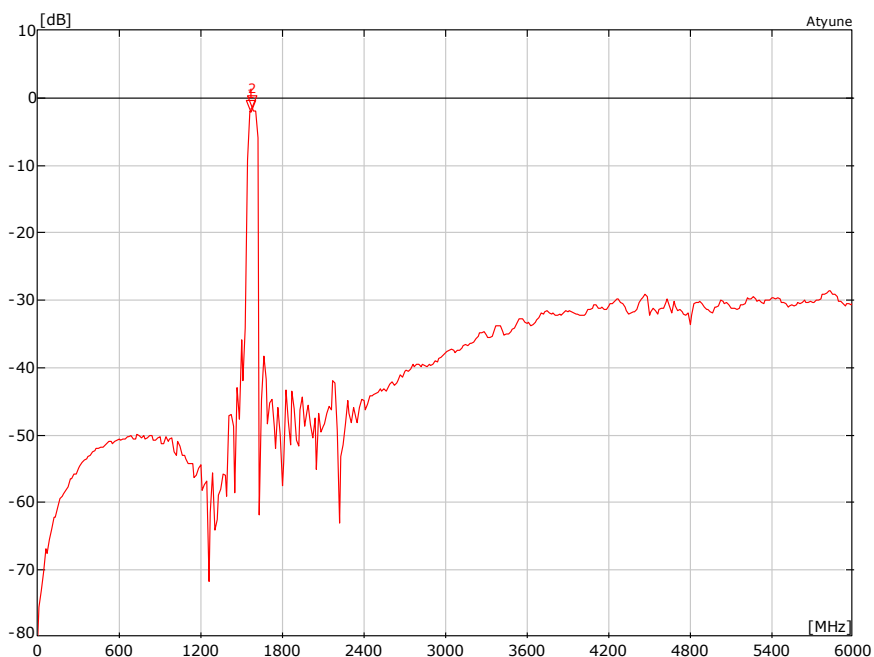
AIC (Active Interference Cancellation)

The AIC feature provides effective narrow-band interference and jamming elimination. The GPS signal can be recovered from the jammed signal and allows users to obtain better navigation quality. This can be beneficial since many of today’s devices have more and more functionality with regards to transmitters with many on-board antennas

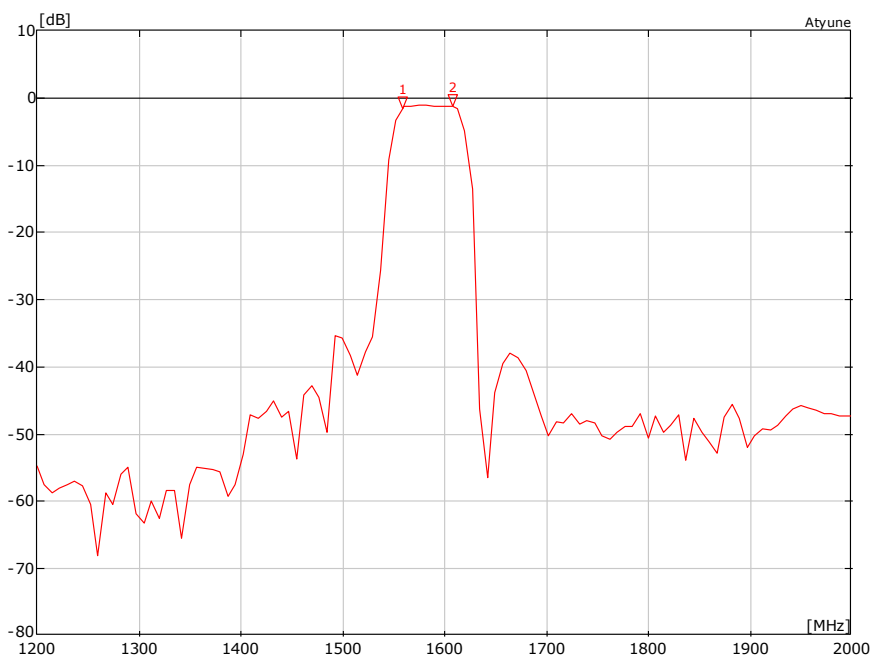
Front-end Rejection

The figure below shows the rejection for the input SAW filter after the 1st stage LNA, including the effect of pads, tracks. The plot can be useful to calculate the isolation required from adjacent transmitters in order to avoid the saturation of the LNA.

Input SAW Rejection – Wideband



Input SAW Rejection - Narrowband



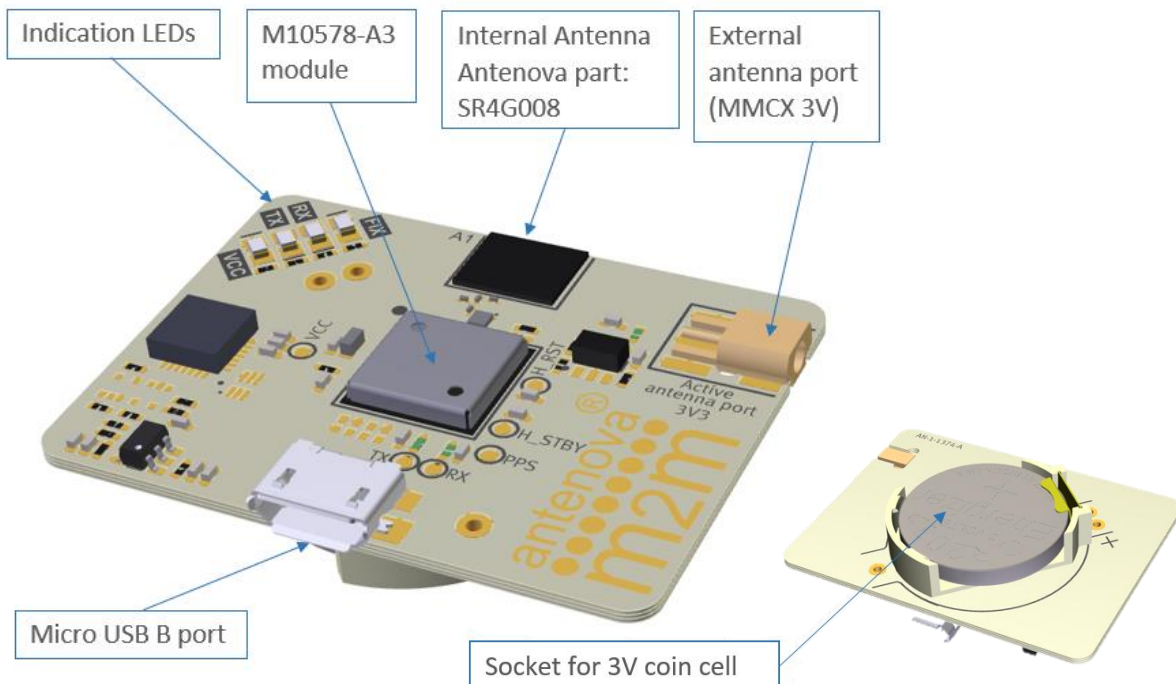
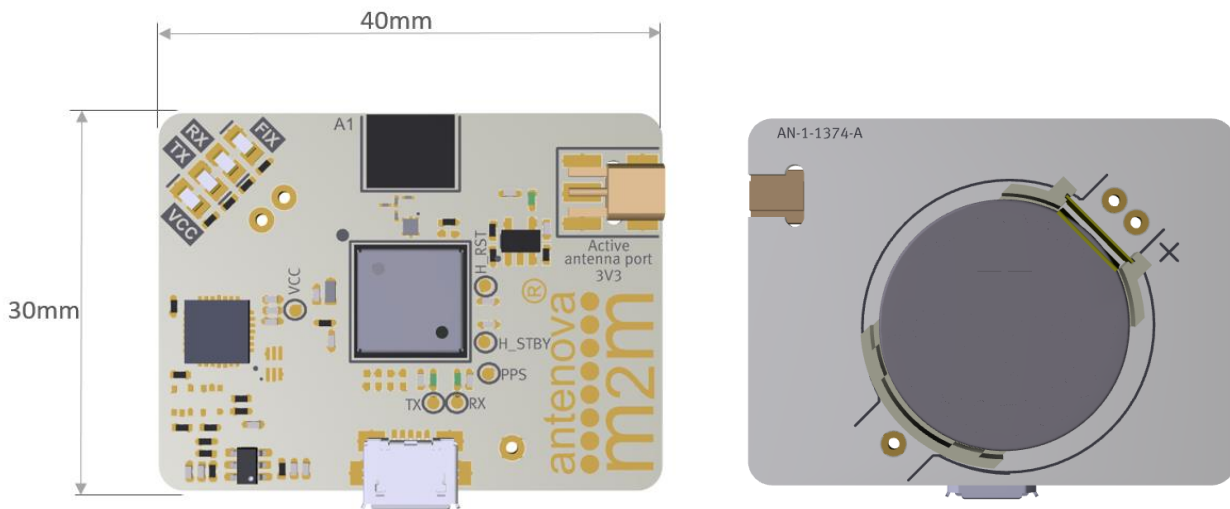
Evaluation Kit

The EVK is a single PCB that contains the module and required components to run on a PC via a USB cable and Antenna software. Evaluation kits are available on request. Please contact Antenna for more information.

M10578-A3-U1

Top Side

Bottom Side



Reflow Soldering

Placement

Typical placement systems used for any BGA/LGA package are acceptable. Recommended nozzle diameter for placement: 5mm

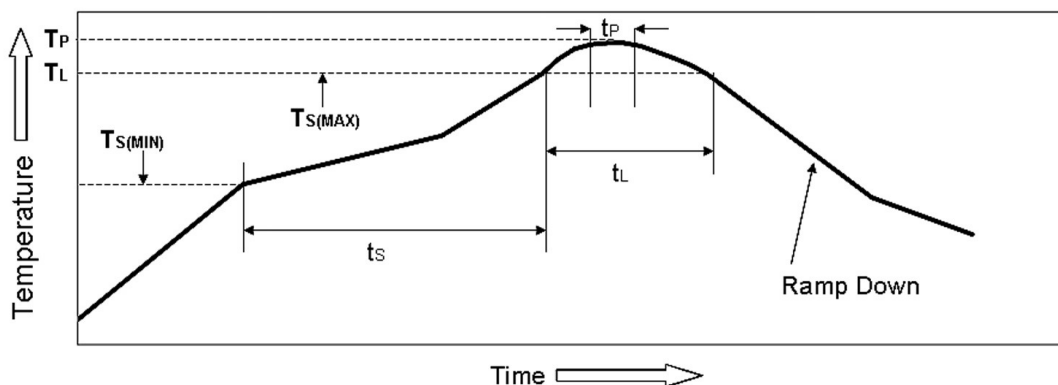
Soldering Paste

Use of “No Clean” soldering paste is strongly recommended, as it does not require cleaning after the soldering process has taken place. An example of suitable soldering paste is Alpha OM350.

Soldering

The recommended soldering profile for M10578-A3 is shown below. However, it is the responsibility of the Contract Manufacturer to determine the exact reflow profile used, taking into consideration the parameters of the host PCB, solder paste used, etc.

| Profile Feature | | Pb-Free Solder |
|---|----------------------------------|----------------|
| Pre-Heat | Temperature (T_s) Min | 130°C |
| | Temperature (T_s) Max | 220°C |
| | Time (t_s) | <150s |
| Reflow | Liquidus Temperature - (T_l) | 220°C |
| | Time (t_l) | 45-90s |
| Peak Package Body Temperature (T_p) | | 245°C |
| Time within 5°C of peak temp (t_p) | | 30s |
| Average Ramp up rate - $T_s(\text{max})$ to (T_p) | | 3°C/s |
| Ramp Down Rate | | 6°C/s max |



Example Reflow profile

The Pb Free Process-Package Peak Reflow Temperature is 260°C.

Exceeding the maximum soldering temperature could permanently damage the module.

Multiple Soldering

The M10578-A3 module can be submitted up to 2 reflow soldering processes.

Upside-down soldering is acceptable but it is recommended that the Contract Manufacturer qualify the process before mass production. The second reflow must take place within the recommended floor life limit (MSL3). Please contact Antenova for further information.

Hand Soldering

Hand-soldering and rework of the M10578-A3 module is acceptable, however care must be taken to avoid short circuits due to the small size of the module pads.

Quality and Environmental Specifications

| Test | Standard | Parameters |
|-----------------------------|--|---|
| PCB Inspection | IPC-6012B, Class 2. Qualification and Performance Specification for Rigid Printed Boards - Jan 2007 | |
| Assembly Inspection | IPC-A-610-D, Class 2 "Acceptability of electronic assemblies" | |
| Temperature Range | ETSI EN 300 019-2-7 specification T 7.3 | -30 °C, +25 °C, +85 °C, operating |
| Damp Heat | ETSI EN 300 019-2-7 specification T 7.3 | +70 °C, 80% RH, 96 hrs, non-operating |
| Thermal Shock | ETSI EN 300 019-2-7 specification T 7.3 E | -40 °C ... +85 °C, 200 cycles |
| Vibration | ISO16750-3 | Random vibration, 10~1000Hz, 27.8m/s ² , 8hrs/axis, X, Y, Z 8hrs for each 3 axis non-operating |
| Shock | ISO16750-3 | Half-sinusoidal 50g, 6ms, 10time/face, ±X, ±Y and ±Z non-operating |
| Free Fall | ISO16750-3 | 1m height, 2 drops on opposite side |
| ESD Sensitivity | JEDEC, JESD22-A114 ESD Sensitivity Testing Human Body Model (HBM), Class 2 JEDEC, JESD22-A115 ESD Sensitivity Testing Machine Model (MM), Class B | +2000V - Human hand assembly +200V - Machine automatic final assembly |
| Shear | IEC 60068-2-21, Test Ue3: Shear | Force of 5N applied to the side of the PCB |
| Moisture/Reflow Sensitivity | IPC/JEDEC J-STD-020D.1 | MSL3 |
| Storage (Dry Pack) | IPC/JEDEC J-STD-033C | MSL3 |
| Solderability | EN/IEC 60068-2-58 Test Td | More than 90% of the electrode should be covered by solder. Solder temperature 245 °C ± 5 °C |

Moisture Sensitivity

Antenova ships all devices dry packed in tape on reel with desiccant and moisture level indicator sealed in an airtight package. If on receiving the goods the moisture indicator is pink in colour or a puncture of the airtight seal packaging is observed, then follow J-STD-033 "Handling and Use of Moisture/Reflow Sensitive Surface Mount Devices".

Storage (Out of Bag)

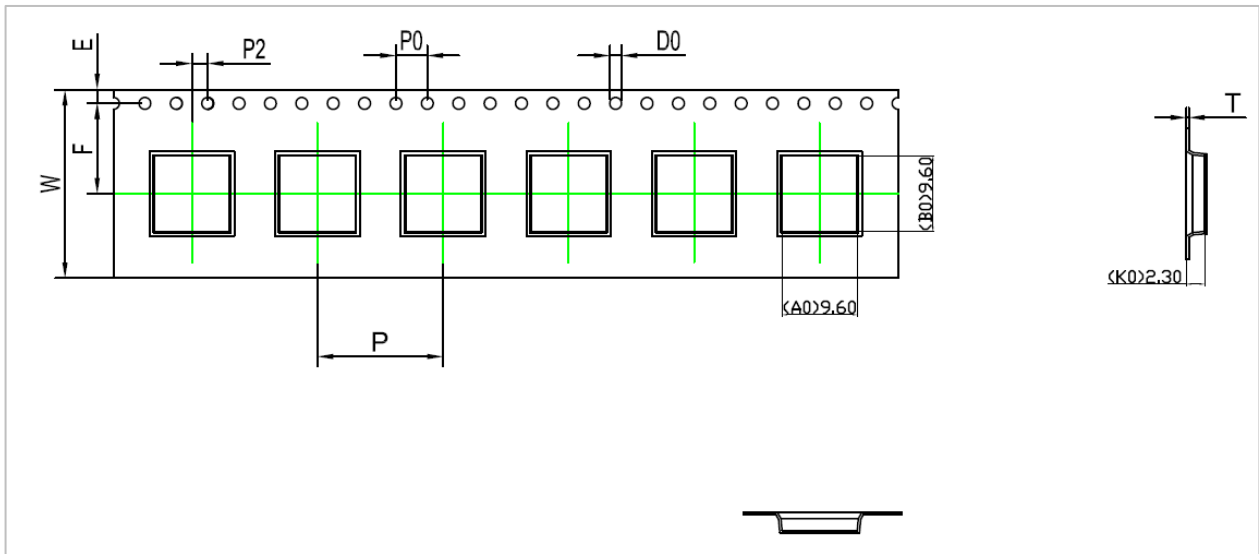
The M10578-A3 modules meet MSL Level 3 of the JEDEC specification J-STD-020D - 168 hours Floor Life (out of bag) ≤30 °C/60% RH. If the stated floor life expires prior to reflow process then follow J-STD-033 "Handling and Use of Moisture/Reflow Sensitive Surface Mount Devices".

Hazardous material regulation conformance

The RF antenna module meets RoHS requirements.

Packaging

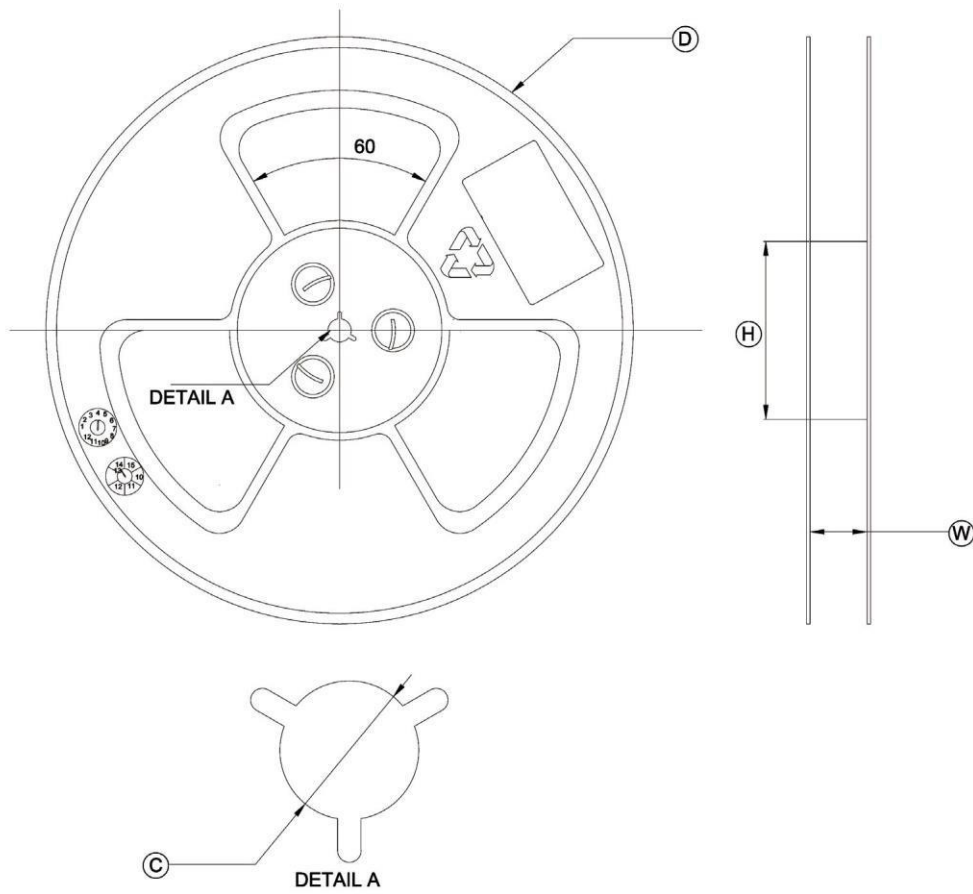
Tape Characteristics



| | | | | | |
|------------|------------|------------|-----------|-----------|-----------|
| W | F | E | P0 | P | P2 |
| 24.00 ±0.3 | 11.50 ±0.1 | 1.75 ±0.1 | 4.00 ±0.1 | 16 ±0.1 | 2.00 ±0.1 |
| D0 | B0 | T | K0 | A0 | |
| 1.55 ±0.1 | 9.60 ±0.1 | 0.30 ±0.05 | 2.30 ±0.1 | 9.60 ±0.1 | |

Dimensions in mm

| Quantity | Leading Space | Trailing Space |
|-----------------|-------------------------|-------------------------|
| 1000 pcs / reel | 50 blank module holders | 50 blank module holders |



| Width (W) | Reel Diameter (D) | Hub Diameter (H) | Shaft Diameter (C) |
|------------------|----------------------|---------------------|-----------------------|
| 24.4mm +0.2/-0.2 | 330.0mm +0.0/-2.0 | 100.0mm +3.0/-3.0 | 13.3mm +0.3/-0.3 |



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Antennas for Wireless M2M Applications