



## **T3 – Tiny Telematics Tracker System User Manual - v1.01**

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### **Overview**

The T3 Tiny Telematics Tracker System is a small, integrated 900-MHz GPS-based telemetry and location system designed for autonomous rocket tracking and landing zone location identification. The heart of the T3 system is built around the uBlox 7 PAM-7Q GPS module which has a highly sensitive GPS satellite receiver system.

In addition to this highly capable GPS engine, the T3 system communicates from your rocket to its associated base unit using the license-free 900 MHz ISM radio band (902-928 MHz). The radio modules employ a proprietary FHSS (Frequency Hopping Spread Spectrum) technology and operate with a proprietary networking feature which provides virtual interference-free operation.

The T3 base unit communicates the real time NMEA GPS data to a paired device using its integral Bluetooth module. Users can choose Android or PC apps that provide a fully functional HMI (Human Machine Interface) providing navigational support using the GPS coordinates received from the T3 rocket unit.

### **Primary Features**

Long-range, license-free and interference-free radio operations  
Live GPS data streaming via Bluetooth to Android platform apps or Windows PC's

### **Specifications**

GPS Operational Ranges

Altitude: 50,000 meters / 160,042 feet

Velocity: 500 meters/sec / 1640 feet/sec

Radio Operational Ranges	902 to 928 MHZ (software selected channels) Range up to 9 miles (with 2.1dB dipole antennas)
Operational Voltage	3.5 volts to 7.4V (3.7V 1S Lipo recommended)
Operational Current	@ 3.7 V / ~175ma (Rocket) / ~70ma (base)
Dimensions	28.5mm x 114.3mm (1" x 2.075" / 25.4mm x 52.7mm)
Weight (Rocket Board)	0.68 oz / 19.5 grams
Radio Network Addressing	XBee Pro 900HP Preamble ID: 5 / Net Address 0 thru 7FFF

### Radio Network ID's

Network ID's are managed by Missile Works to ensure each T3 System has a unique, interference-free address. Contact us for radio replacement or T3 radio expansion. T3 Systems operate in a "one-to-many" multicast network mode (one BASE unit to one or more ROCKET units).

### Handling Precautions

- Always handle the T3 in a static-free, grounded environment.
- Allow the T3 to adjust to ambient conditions prior to flying.
- Prepare your rocket with the T3 powered off for maximum battery life.
- Don't cycle the T3 power off, then immediately back on (allow a few seconds).

### Installation

The T3 System comes with two boards:

- The Rocket unit (this unit has the GPS Module ceramic "patch" antenna)
- The Base unit (this unit has the HC-06 Bluetooth Module)

### Rocket Unit Mounting

The T3 does not have an "up" orientation and can be mounted in any convenient orientation. It is important to mount the T3 securely, preventing it from suffering damage during flight. It can be affixed rigidly to a sled or foam/bubble packed to cushion the board.

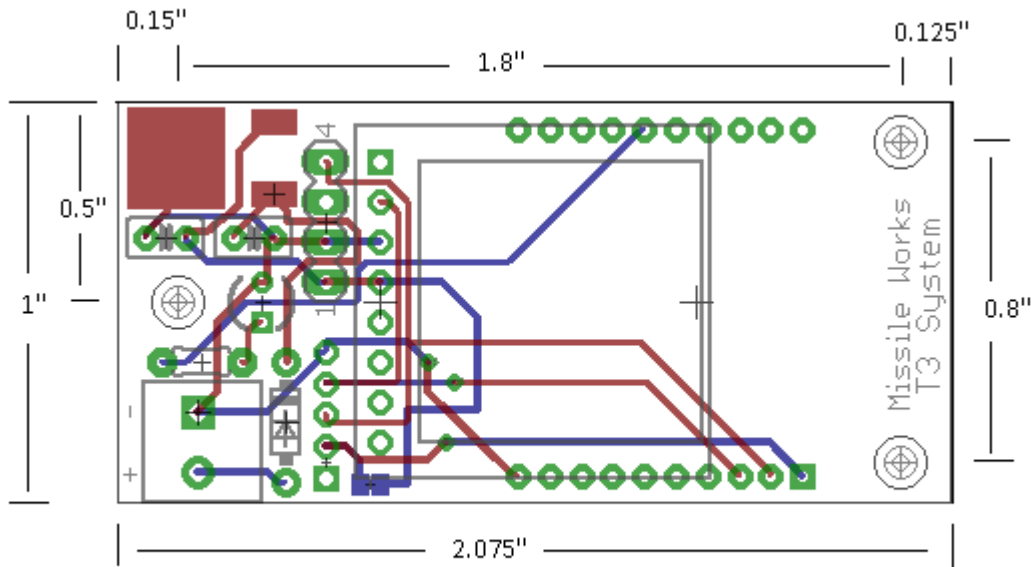
When planning the mounting layout of your T3 system, be sure to provide secure mounting for the battery. An unsecured battery can break free during recovery events, resulting in damage to the board.

Use 4/40 screw hardware to mount the T3 onto a "sled" of the rocket. Nylon standoffs or insulated washers are also recommended to provide clearance for the bottom-side components of the circuit board and components.

Isolate the T3 electronics from the ejection-charge heat, residue, and over-pressure during recovery events.

***IMPORTANT: Inadequate sealing of the electronics bay or exposure of the electronics to ejection charge heat or BP residue can cause the T3 to malfunction. Black powder residue is extremely corrosive to the circuit board and its components. Always immediately clean off any incidental residue.***

**IMPORTANT: Ensure your T3 is oriented in your rocket or av-bay to avoid having the patch antenna placed near or against your launch pad rail or tower rails. This proximity will block all satellite reception and prevent acquisition of a GPS coordinate fix.**



**NOTE: All mounting holes are 0.125" diameter (for #4 hardware)**

### **Power and Wiring Considerations for the Rocket Unit**

The T3 is designed to operate optimally using LiPo battery types. 1S LiPo batteries are the preferred battery choice; however, a 2S battery can be used. Due to the power overhead of the Rocket unit, a 2S battery will dissipate a lot of heat across the linear regulator. If a 2S battery is used, it's much better suited for use on the Base unit as it has much lower power demands.

Bench testing with a 750ma 1S LiPo operated the T3 Rocket unit for just under 4 hours continuously, whereas a Base unit ran for more than 10 hours continuously running with a live -inked Bluetooth HMI.

It is important to pay attention to battery polarity. The positive pole of the battery must be connected to the positive terminal (marked with a + sign) on the board. Connecting the battery backwards will not damage the unit, however, the unit will not operate.

### **Power Switch Considerations**

In addition to providing a power source, a power switch should be connected between the battery and the T3. The switch used can be as simple as a pair of wires which are twisted together prior to flight (i.e., "twist and tape"), a snap action toggle, push on/off or rotary style, or as complex as a magnetically activated solid-state switch.

### **Base Unit Mounting Considerations**

Similar to the requirements for mounting the Rocket unit, you'll need a power source and a power switch connected between the battery and the T3. Likewise you should mount the Base unit in a suitable box or on a

sled for integrity and protection. We offer a general purpose 3D printed case for use in conjunction with a typical Android Smartphone.

Always take care to not stress the RPSMA antenna connection on the Base unit radio module. Consider using the nut and lock washer through a hole in a case or a bracket to hold the RPSMA jack flush and rigid against a chassis. Excessive stress on this antenna jack (especially when the base antenna is mounted onto the RPSMA jack) can result in the cracking and breaking of the antenna connection which will render your system unusable.

### **HMI (Human Machine Interface) Considerations**

The T3 system supports two HMI options:

- Streaming Bluetooth to an Android device running a Bluetooth-enabled GPS app
- Streaming Bluetooth to a Windows PC running a serial GPS app (PC must have Bluetooth)

### **Recommended Android Apps (in the Google Play Store)**

*Bluetooth GPS*

<https://play.google.com/store/apps/details?id=googoo.android.btgps>

*GPS Rocket Locator*

<https://play.google.com/store/apps/details?id=com.frankdev.rocketlocator>

### **Recommended PC Apps (available for download)**

*u-center Windows*

<https://www.u-blox.com/en/product/u-center-windows>

*Visual GPS*

<http://www.visualgps.net/>

### **Operating the T3 System**

The T3 requires no setup or programming. Simply power up both units, pair up to the HC-06 Bluetooth module with your Android or PC (PIN Code 1234), then launch the GPS app of your choice. When paired correctly, the LED on the HC-06 module transitions from a flashing display to a solid display.

- Always pretest your system as COMPLETELY as possible prior to every flight. This includes a quick run of both rocket and base units together to ensure GPS lock and Radio Telemetry integrity.
- Always charge and measure your batteries before each flight and ensure they have adequate power capacity for the anticipated worst case flight profile, including unplanned "on-the-pad" waiting time.

### **Additional notes on T3 communication**

Depending on the overall velocity or peak velocity of your rocket flight, your Base unit may experience radio packet loss due to Doppler effects and/or timing shifts caused by inertial forces to crystal components within the airborne radio module. Once the rocket starts its coast and deceleration phase, the radio data should be reacquired.

Likewise, the GPS module itself has operational limits on both altitude and velocity (Altitude limit = 50,000 meters / 160,042 feet – Velocity limit = 500 meters/sec / 1640 feet/sec.). Should you approach these extremes during your flight, expect the GPS data to drop out and not update.

You may also experience packet dropout due to the sheer distance between Rocket and Base unit. This distance can be affected by attenuation due to metallic items in your rocket that are in proximity to your antenna, other metallic airframe components, or the airframe itself.

Also note that when a descending rocket dips below your line-of-sight (visible or not), the radio packets will drop out and you'll lose packet sync. It's also a recommended practice to write down the last received Lat/Lon coordinates on paper prior to powering down your BASE unit

## FAQ's

Q: My T3 is on the pad, I'm receiving radio data packets but there's NO GPS Fix

A: It's likely that your GPS patch antenna is adjacent or flush to your pad or tower rail and satellite signals are being blocked. If you've allowed adequate time for a GPS fix, pull your rocket from the pad and inspect the patch antenna position relative to your rail(s).

Q: The T3 is powered up but I'm not getting GPS data?

A: No packet data may be a case of a poor or failed antenna connection, so double check to ensure that everything is tightened and intact. It might also be a case where your radio module may have failed, there's heavy radio overload, or an elevated noise floor in the ISM band. Also ensure your HMI device is paired and linked to the HC-06 Bluetooth module (the LED will be ON SOLID). Battery power may also be a culprit here, too, so ensure your battery is up to par. Don't fly without an operational radio link and Bluetooth.

## Radio Operations and Networking

Each ISM Radio Module is assigned a unique data packet "preamble" and belongs to unique network ID. There are over 30,000 Network ID's, so you never need worry about someone else's T3 or RTx System being on your network while at a large launch. Missile Works maintains a list of all sold units and their ID's.

You can have several Rocket units networked with one Base unit; however, only ONE Rocket unit can be operational and in use at any given time. Be sure that if you have multiple Rocket units in different rockets, you shut down the units NOT being flown and recover/power down a Rocket unit prior to flying another rocket.

### **Product Warranty**

Missile Works Corporation has exercised reasonable care in the design and manufacture of this product and warrants the original purchaser that the T3 is free of defects and that it will operate at a satisfactory level of performance for a period of one year from the original date of purchase. If the system fails to operate as specified, return the unit (or units) within the warranty period for repair or replacement (at our discretion). The system must be returned by the original purchaser and be free of modification or any other physical damage which renders the system inoperable. Upon repair or replacement of the unit, Missile Works Corporation will return the unit postage-paid to the original purchaser.

### **Product Disclaimer and Limit of Liability**

Because the use and application of this equipment are beyond our control, the purchaser or user agrees to hold harmless Missile Works Corporation and their agents from any and all claims, demands, actions, debts, liabilities, judgments, costs, and attorney fees arising out of, claimed on account of, or in any manner predicated upon, loss or damage to property of, or injuries to or the death of, any and all persons arising out of the use of this equipment. Due to the nature of electronic devices -- and the application and environments for those devices -- the possibility of failure can never be totally ruled out. It is the responsibility of the purchaser or user of this equipment to properly test and simulate the actual conditions under which the device is intended to be used to ensure the highest degree of reliability and success.