

# Micro-Trak RTG FA V1.8 Manual

## Overview

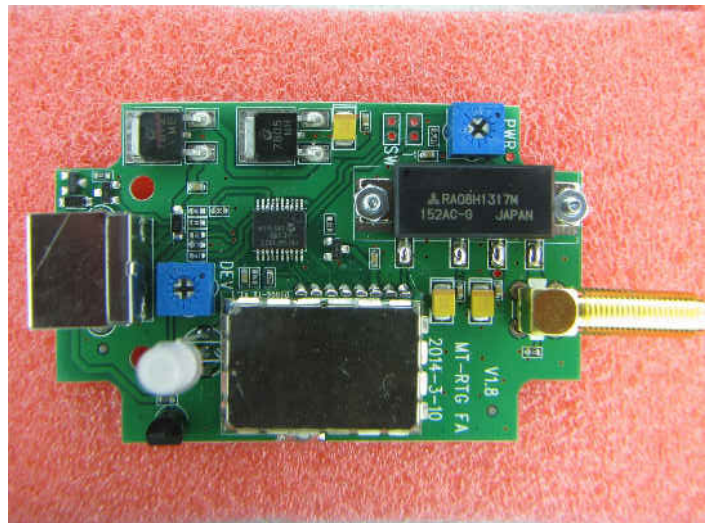
The Micro-Trak RTG is a frequency agile APRS transmitter capable of operating in the 2 meter Amateur band in 5 KHZ channel steps. This permits operation on any of the world-wide Amateur Radio frequencies ordinarily utilized for APRS. The transmitter was designed with the goal of producing a low cost, easy to implement APRS tracker with virtually no technical knowledge prerequisites for operation.

The Micro-Trak RTG is usually sold as a combo which also includes a Byonics serial GPS and a mag-mount 2-meter antenna, as shown to the right.



## Installation

The MT-RTG FA is designed to operate from automotive, unregulated power sources, and the device has built in power regulation and filtering. A special cable is included with your Micro-Trak that allows you to plug it into a cigarette lighter output in your vehicle, boat, aircraft, etc. A fuse is contained in the tip of the cigarette lighter plug, which is easily replaced by unscrewing the tip and removing the burnt out fuse. The RTG power/serial cable is also available unfused, with Anderson PowerPole connectors. Although the RTG has built-in protection against damage from reversed polarity power, it is imprudent to rely on these measures.



If your installation requires removing the cigarette lighter plug and directly wiring your unit into your vehicle's power, use great care to connect the device correctly. The tip of the cigarette lighter cable is connected to the positive supply line in your vehicle, the other line is connected to ground.

## GPS

The RTG power/serial cable assembly also has a male, DB-9 serial plug, which allows the use the Byonics magnetic mount “hockey puck” GPS receivers. Power for the GPS is provided through the DB-9 connector on the power cable. Virtually any 5 Volt GPS that can provide 4800 or 9600 Baud, NMEA standard data is compatible with the MT-RTG. The wiring on the male DB-9 is setup for serial data into the RTG on pin 2, serial data from the RTG on pin 3, +5V to power a GPS on pin 4, and ground on pin 5. Although many GPS receivers equipped with DB-9 cables are wired in the same fashion, not all brands of GPS are so wired, and may require modification.

Unlike previous versions of the RTG, this version is equipped with ability to control the power supply to the GPS. This allows the MT-RTG to draw only a few milliamperes between scheduled transmissions. Before a scheduled transmission, the RTG will turn on the GPS, wait until the GPS has acquired a valid position, send a position report, and then return to the dormant state. This is primarily useful in battery-critical applications, and position reports from GPS receivers awaking from a long “sleep” mode will provide somewhat less accuracy than the ( Generally recommended) GPS “always on” state. If you decide to use the optional “SmartBeaconing” mode ( See configuration manual) The GPS will always remain on. GPS power saving mode should never be used for High Altitude or airborne applications generally; The rapidity and turbulence of flight can make it very difficult or impossible for the GPS to acquire a valid and accurate position fix. By default, the RTG FA is programmed NOT to transmit any packets in the absence of a valid GPS signal. This can be overridden in the Configuration Program ( See Manual)

## The APRS Network

The APRS network is supported entirely by volunteers, and although the infrastructure to receive and forward your packets to the Internet is widespread, there are certainly major “holes” in coverage. It is also important to remember that the APRS network is somewhat of a “free-for-all”. That is to say, there is no real method of preventing one transmitter from sending coincidental reports with any other(s), and this can cause all or some of the packets from “getting through” to such sites as aprs.fi or open aprs.net. In short, it is unrealistic to expect that all of your packets will be digipeated and I-gated and show up on the Internet. The RTG will be set for the best mobile “digipath” ( The instructions for how many times and under what conditions your received packets will be re-transmitted by Digipeaters) If you live or operate in an area that does not have adequate digipeater coverage, Byonics has many solutions, including the TT4 TNC, and the MTT4B 10 Watt Transceiver that will allow you to easily add to your own local infrastructure.

## Configuration

Ordinarily the RTG FA will be shipped to you already programmed with your desired information, i.e. Call Sign, APRS Icon, optional SSID, etc. By default, the transmitter is programmed to display as a vehicle Icon on APRS mapping programs, and set to send a transmission every 120 seconds.

The unit may be reconfigured by downloading the free configuration software from the Byonics website. Connection to your PC is best accomplished using the Byonics TT USB cable. This cable is optimum because it provides a low voltage source for the RTG sufficient to program the device. When using the TT USB cable, you should not connect the cigarette lighter plug into a power supply. The transmitter may also be programmed using a gender-changing, serial null modem cable, although this will require applying external power (A nine Volt “transistor radio” battery is sufficient for programming) If you need to connect the RTG to a higher-current source for programming, the unit should be programmed while connected to a dummy load, or at the least, a good mobile antenna

## Antenna

Please note that the MT-RTG FA was designed as an automobile tracker, and due to its low mass and high power, a well matched mobile antenna is necessary to achieve stable operation. The V3 antenna included with the RTG standard combo is adequate for areas with good digipeater and I-gate coverage, but significantly increased range and performance can be achieved with a high gain mobile antenna or high gain magnetic mount antennas like the Byonics V8 or V9.

For applications requiring a portable antenna, a low SWR antenna providing its own ground plane is needed. The RTG will not operate properly into a rubber duck whip antenna under any circumstances. Although most users will use a mobile antenna ( Like the magnet mount antenna provided in the standard Combo,) it is possible to use well matched antennae like wire J-Pole antennas or  $\frac{1}{4}$  wave ground plane antenna with radials. Do not use the RTG with any antenna connected to ground on vehicles with positive ground.

In the event that you choose to use an antenna without an SMA connector, use the appropriate adapter and a 2 meter antenna capable of handling at least 10 Watts. The antenna should be a vehicular or ground plane antenna designed for VHF or dual band operation. Poor antennae with high SWR or leaky cable may cause the RTG to become “swamped” with RF power, causing continuous resetting of the MT-RTG.

## Installation

Assuming you ordered your Byonics MT-RTG FA pre-programmed; all that is required is simple “plug and play” operation. Connect the 6-pin mini-DIN plug on the cable into the mating receptacle on the MT-RTG, Note that the fit is quite snug, which should prevent unintentional removal. The plug is keyed, and only fits in one way, so make sure you are properly aligning the plug and jack properly before pushing the plug into place. Install or locate the RTG in a manner that does not place any stress of the Mini-DIN connector. Avoid frequent removal and reinsertion of the mini-din plug to prevent premature wear. Mounting tabs on the case are in place for more permanent installations.

Connect the SMA antenna connector to the mating SMA connector on the MT-RTG. Place the magnetically mounted antenna as close to the center of the vehicle roof as possible. Non-metallic roofs may require metal foil or other improvised ground planes. Avoid placing the antenna near other transmitting antennas on the vehicle. Plug the GPS into the MT-RTG, and place it in a position to give

it the best possible line of sight view of the sky. In most cases, it is not necessary to mount the GPS on the outside of the vehicle.

## Operations

After all connections are made, plug the cigarette lighter plug into the power jack, and switch the vehicle to whichever position allows the cigarette lighter jack to provide power. The MT-RTG LED will flash both colors indicating that it is starting properly. The green LED section should begin to flash at a rate of about once per second. This indicates that the unit is receiving serial data from the GPS, but the GPS is not “locked” onto the satellites. When the GPS is providing “good” data, the green LED will stay lit continuously.

Ordinarily, the red/green LED will flash briefly on startup, indicating normal operation. If the MT-RTG goes into continuous reset, the LED will flash red/green continuously. Unplug the unit and troubleshoot the installation before attempting to re-power the device.

The red section of the LED will flash briefly indicating a transmission is taking place. APRS transmissions are very short, and may last from about 1/3 of a second to a second, depending on the units’ programming. A position report is typically quite short, even though it includes substantial amounts of information. The RTG can be programmed to send telemetry reports at a defined rate ( See configuration manual) and these packets are somewhat longer in duration. Sending position and telemetry packets too frequently can overload the local APRS system, and is impolite.

## Telemetry

The MT-RTG FA has two built in telemetry channels, one that reports the supply voltage to the RTG, another which reports the temperature inside the RTG enclosure. If your application calls for a more accurate external temperature reading, you may remove the lid from the enclosure to allow better access to ambient air. If necessary, the temperature sensor may be removed and remotely-mounted.

Voltage and Temperature graphs from the MT-RTG will be available on [aprs.fi](http://aprs.fi). Further information regarding setting up all MT-RTG parameters can be found in the Micro-Trak Configuration Program manual.

Although it is possible to set the telemetry definitions in the configuration program, there is an easier way to do this. Essentially, you send an message with a set of instructions to the APRS network letting it know how your data should be handled and displayed. Using the Configuration program, under the Telemetry setup menu, just enter the number “2” as the number of channels ( Voltage and Temperature).

## Setting telemetry values using Messaging

The data transmitted in a telemetry packet is a “raw” analog number, and websites like aprs.fi need to know how to interpret these values as Voltage or temperature. You can “teach” the aprs network to interpret these values, and here’s how:

- Go to <http://www.findu.com/cgi-bin/entermmsg.cgi>
- Enter your callsign as it appears in your RTG’s configuration, in both the “Your callsign” and the “send message to” fields, and then enter each of the following lines, one at a time, as a separate message in the message text:
- PARM.Battery,Temp
- UNIT.Volts,Deg.F
- EQNS.0,0.0293,0,0,0.879,-459.67

(Notice that this last line has lots of Zeros and commas, so check them twice!)

You can change the last two lines to the two below to use Celsius instead of Farenheit.

- UNIT.Volts,Deg.C
- EQNS.0,0.0293,0,0,0.489,-273.15

## Modifications

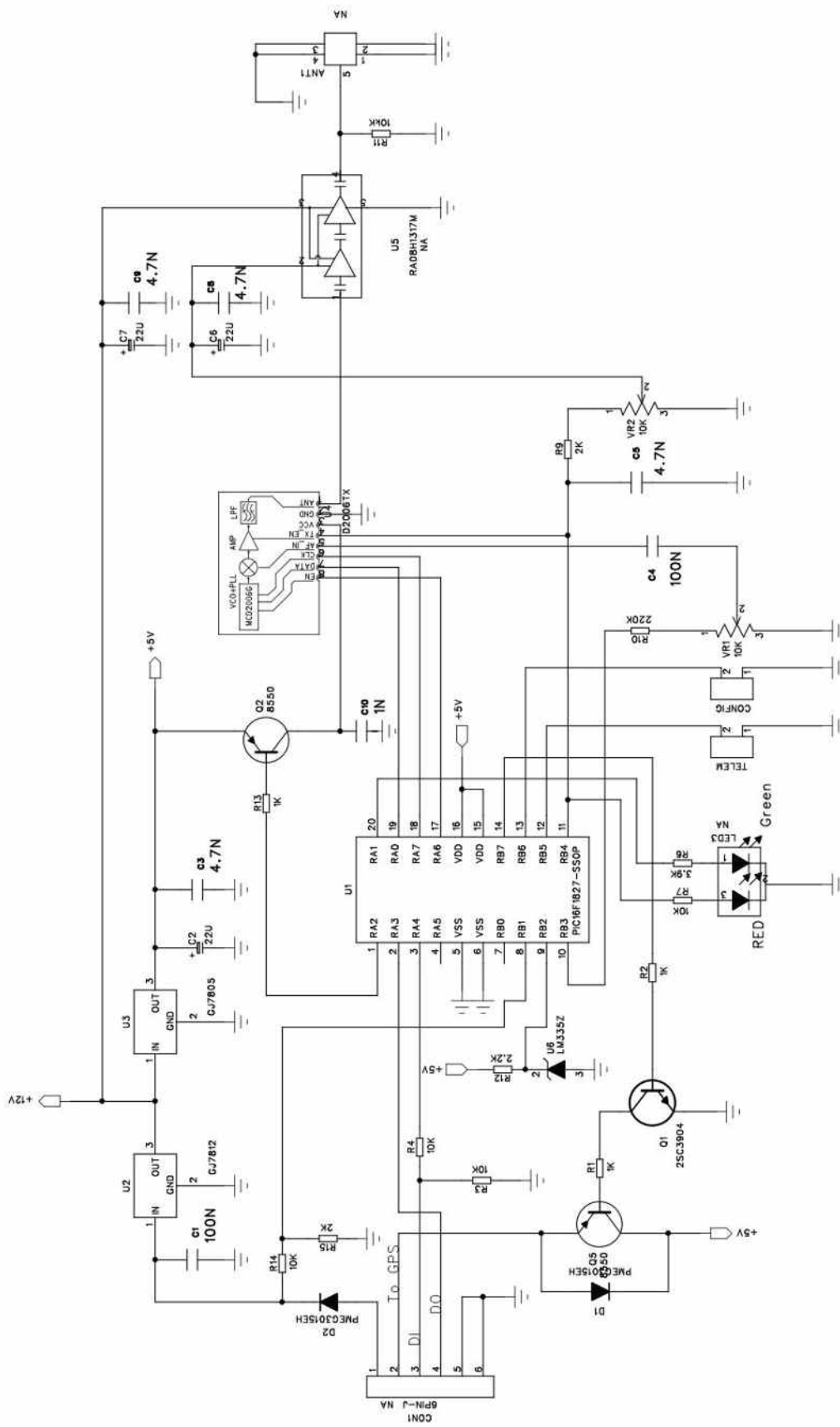
The MT-RTG FA has internal adjustments for setting power and deviation levels. These should only be adjusted by qualified individuals with proper test equipment. The power and deviation levels are preset at the factory and fixed at optimal levels for the device. There is no on/off switch: The device is powered and drawing current whenever it is plugged into a “hot” cigarette lighter outlet.

Because the TT3 chip is capable of storing two entirely separate configurations (containing your FCC call sign, frequency, APRS Icon, tactical call sign, digipath, SmartBeaconing settings, and other modes) a pair of holes on the printed circuit board marked “SW” (Switch) has been provided for those hams with the skills to add an external switch. One side of the two-hole pairs is Ground, and switching the Config SW to ground will cause the second profile set up in the TT3 Configuration program to be active. Note that this is a SPST switch, not a momentary button. Most hams will generally only run one configuration, but as these units may be used in a car one day, and in a boat the next, the option to select multiple configurations creates a high degree of flexibility.

The RTG also has an additional set of holes on the board next to the “SW” input. This is an optional input for an analog telemetry channel, which can be transmitted and displayed on aprs.fi in graphic form. Consult the Configuration Software manual for more information about using telemetry.

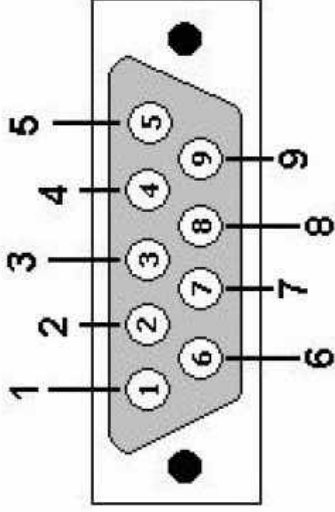
(NOTE: On the version of the MT-RTG V1.8 shown with the date code 2014-3-10, the “SW” and “T” markings are reversed. “T” is the secondary configuration switch input, and “SW” is the analog telemetry input.)

# MT-RTG FA Version 1.8 Schematic





# Connectors

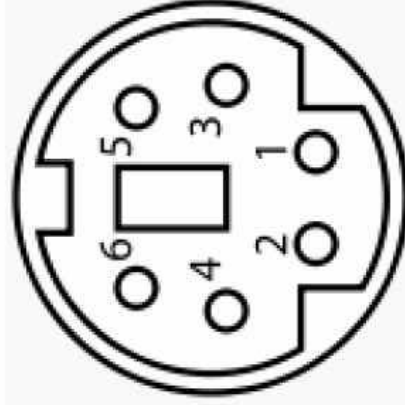


**DB9: View looking into male connector**

Pin No.	Dir	Notes/Description
1	-	No Connection
2	IN	Serial Input - From GPS RS-232 TX or PC
3	OUT	Serial Output - (Only used during programming)
4	OUT	+5 volts output to power GPS
5	OUT	Ground

## Pin assignment for Mini-DIN 6 Connector

- 5-6 Ground
- 4 Serial out (From Transmitter)
- 3 Serial in (To Transmitter)
- 2 +5 regulated output (to GPS)
- 1 Unregulated 12 VDC input (Power Supply)



**Female connector from the front**



## Optional Firmware

Although the Byonics RTG was initially designed as a vehicle tracker, various types of optional firmware may be downloaded and installed from the Byonics webpage. These currently include the WxTrak, a program for use with APRS Weather reporting Stations, TinyPack, a serial data packet transmission firmware for special applications and Weather Stations incompatible with the WxTrak, and the Micro-Fox Firmware, all of which are available from the Byonics website. Because the RTG is designed for a very low duty cycle, using the Micro-Fox firmware is discouraged for any user without significant experience and test equipment, as well as configuration-specific knowledge to prevent overheating and destroying the MT-RTG. Additionally, new versions of the basic firmware for the Micro-Trak may be made available for free download and installation.

Installation of new firmware versions requires an IBM PC compatible and the appropriate programming cable. We recommend using the Byonics TT USB cable for reasons previously discussed. You may download and install the USB driver for your PC from the Byonics website. Additionally, you will need a Terminal Program to communicate with the Micro-Trak. We recommend TeraTerm Pro, a freeware simple terminal program that can be downloaded freely from the internet.

### Instructions for updating the FA firmware

- Obtain a copy of TeraTerm Pro
- Connect the Micro-Trak to the computer serial port with a programming cable.
- Start TeraTerm Pro, and under Serial Port..., select the connected COM port, 19200 baud, and a transmit delay of 1 msec/char
- In the terminal program, press and hold the 'b' key
- Apply power to the Micro-Trak (Omit if using the USB-TT3 cable)
- The terminal should display "ø\_1" or "\_1". If it doesn't, reset power to try again, keeping the 'b' key held.
- Release the 'b' key
- Press (and release) the "s" key. Nothing will be changed in the terminal.
- Choose File, Send File..., check the binary box, and select the desired .t3f file you have previously downloaded for upgrade
- During the upload, nothing should be displayed on the terminal
- After the upload was successful, the terminal should display a '\*'. If it does not, repeat from the press and hold 'b' step. There may be a few second delay after the Send File dialog closes and the '\*' appears.
- Quit Tera Term Pro
- Cycle power on the Micro-Trak
- Run the new config program to set the desired options. (Do not read current settings first, they may be bad)

Some computers may experience communications difficulties with the USB cable. If this occurs, you may often resolve the problem by going into your PC's Device Settings, and in the Prolifics USB device settings, disable the FIFO setting.

## RTG FA High Altitude Combination

Although the MT-RTG was originally designed for vehicular use, many of our clients have found that its low cost, high power, and built in telemetry features are useful in meteorological, High Altitude Balloon experiments. Consequently, Byonics offers the RTG High Altitude combination package. This includes a high altitude GPS (most GPS receivers will not work above 60,000 feet) and a high gain, center-fed half wave dipole antenna with a one meter coaxial cable. When the package is ordered in this form, the RTG is generally pre-programmed using the most common and polite high altitude values. A transmitter operating at 100,000 feet may activate digipeaters many hundreds of miles away if the optimal “mobile” pathway is used, which can over-tax the local APRS network.

For edge-of-space experiments, the RTG should be enclosed within the insulated payload. If the enclosure is not foil lined, the GPS should be installed inside the payload as well. If your payload has a metallic film lining, the GPS will need to be mounted externally. The end-user will need to make provision for battery power for the tracker. We recommend an 8 pack cartridge of Energizer brand, “Ultimate Lithium” batteries. These non-rechargeable batteries are lighter than batteries of other chemistries, offer higher energy density and lower effective series resistance, and most importantly, offer the best tolerance to extreme cold of any commercial battery. An 8 pack of these batteries will typically provide approximately 24 hours of run time, with power output decreasing with decreased supply voltage. Although this may be more than you need for a typical, five hour flight, the recovery phase of your experiment may be longer than you initially expect.

The V6 antenna can be mounted or suspended outside the payload. The elements should be oriented vertically. The extra coaxial cable should be rolled into a small coil loop and located as close to the antenna’s SMA connector as possible. It should be taped or zip-tied. This forms a “balun” or current transformer, which helps keep the SWR down, and aids in reducing any chance of RF interference to other devices within your payload. Do not tie the antenna to the parachute shroud lines; these can twist and unscrew or tear the coaxial cable away from the antenna. The half-wave dipole is a “free-space” antenna. It will not work inside of a car! For testing, I recommend mounting the antenna on a boom or at least holding it at arm’s length. Be careful not to touch the antenna elements during transmissions. In addition to attenuating the signal, the energy may cause RF burns at the point of finger contact.

The “WIDE2-1” digipath used in high altitude balloons may be less than optimal for payloads laying in the mud... If you have difficulty in hitting digipeaters with the RTG in ground testing, you may want to use a Digipath of “WIDE1-1,WIDE2-1” for ground testing only.

## Frequently Asked Questions

### **Q: I have installed my RTG, but I am not showing up on the Internet**

A: Verify that the RTG is assembled and installed correctly, and that none of the power or coaxial cables are bundled together. If possible, use a receiver tuned to the APRS frequency in your area to verify that the RTG is transmitting during the time the LED on the RTG is flashing green, typically, every two minutes.

### **Q: My RTG is not transmitting**

A: Do you see a green indicator light on the RTG, indicating that the RTG is recognizing the presence of a GPS? Is it flashing green, or is it solid green? If it is flashing green, the GPS has not acquired a valid position fix; relocate the GPS to obtain a better view of the sky.

### **Q: My RTG is transmitting, but I still don't show up on the Internet**

A: Go to [aprs.fi](http://aprs.fi) and see if any other traffic is showing up in your area map. If there are no other trackers showing in your area, it is possible that there are no digipeaters or I-gates functioning in your area. Contact your local Ham Radio club and ask them if there is an operational APRS infrastructure in your area.

### **Q: My RTG's bi-color LED flashes red/green continuously and never stops as long as power is applied, or it just occasionally flashes red/green continuously and eventually stops.**

A: This is a condition in which the RTG continually resets. This is usually due to a defective antenna, an antenna with a high SWR, poor installation, especially in wire and cable routing, or in some cases, inadequate power supply voltage and current. Check your installation and power connections.

### **Q: The configuration program shows two independent configurations, how can I select which one is used?**

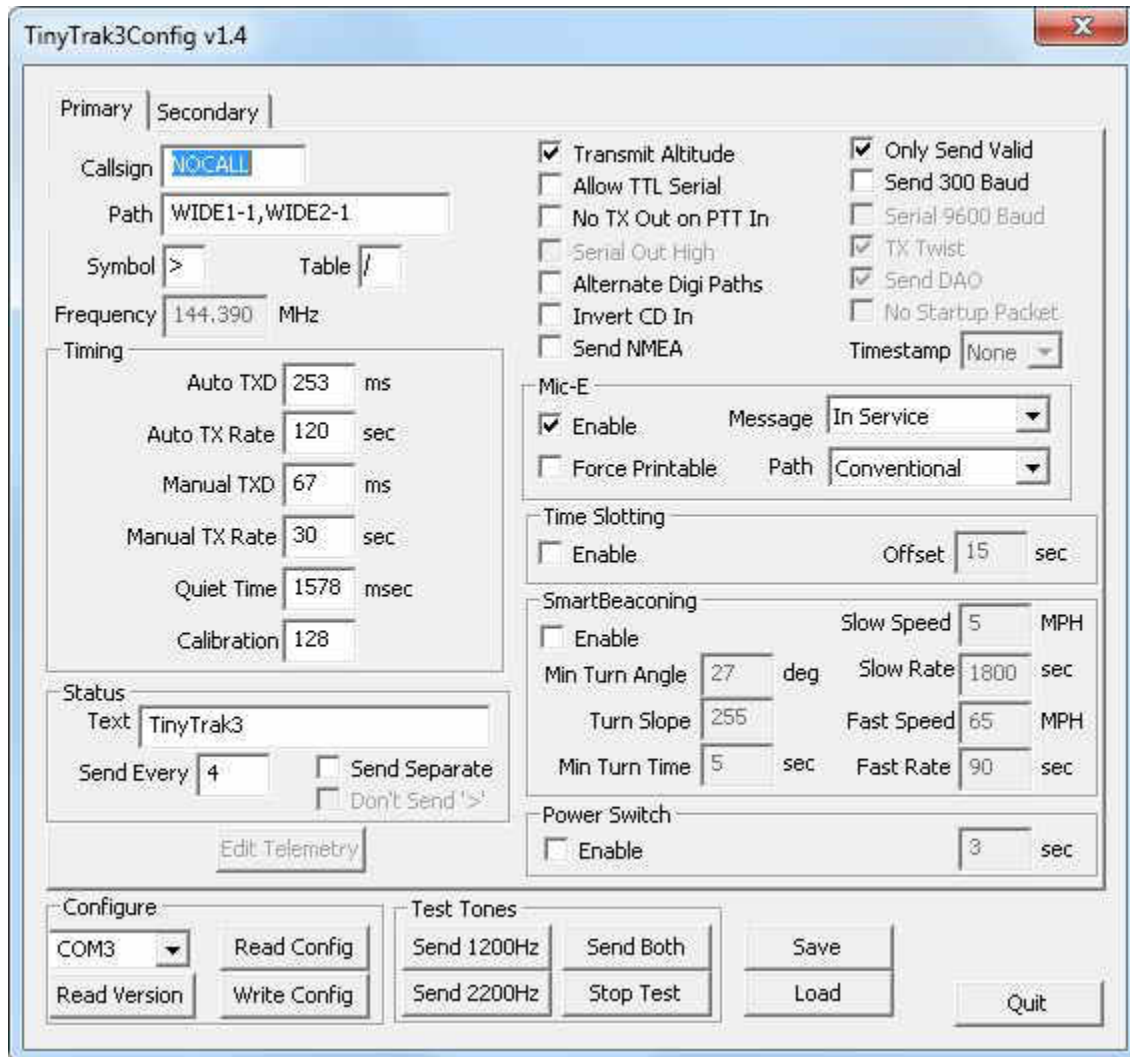
A: The RTG is most often used with just one profile, however, you may connect an external SPST switch to the external switch connection on the RTG PC board. When this connection is brought to ground, the RTG will operate in the secondary configuration.

### **Q: I can't get my computer to communicate with the RTG.**

A: First, verify that your computer will work with a GPS, if it does, we will know that the RTG is recognizing incoming serial data. If you are using the Byonics TT USB cable, you must first install the Prolific USB drivers, which you can download from the internet. In your Window's device manager, make sure that the Prolific USB device is showing up and marked as working normally. In many cases, it is helpful to select the advanced options menu in the Windows device manager, and disable the FIFO buffer setting. Make a note of which Com Port the device manager has the Prolific USB programming cable assigned to.

When you download and install the TinyTrack3 Configuration Program, version 1.4.6, the lower left hand corner of the Configuration Program screen will show a drop-down box with a list of available

Com Ports on your computer. You should select the Com Port previously assigned to the Prolifics USB cable in the Device Manager. If your COM port doesn't appear, you can type it. Clicking the "Read Version" button while connected to the RTG should identify the type and version of Byonics product you are connected to. Some areas of the screen that had been Grayed-out will now be available for selection.



In the rare event that your computer has assigned the Prolifics USB cable to a Com Port not available in the Configuration program, you can re-enter the device manager in Windows and manually reassign the USB device to one of the Com Ports available in the drop-down box in the Byonics Configuration program.