Byonics Micro-Trak RTG 30 (Ready-To-Go)

The Micro-Trak RTG 30 is a frequency agile APRS transmitter capable of operating in the 2-meter amateur radio band. 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 30 FA is fundamentally the same product as our MT-RTG FA, but the RTG 30 can produce in excess of 30 Watts of RF power, making it ideal for distant locations, or working space stations.

The MT-RTG 30 is designed to operate from automotive, unregulated power sources, and the device has built in power regulation and filtering. A 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. Unlike the lower power RTG, you should use a 10 Ampere fuse with the RTG 30. If your installation requires removing the cigarette lighter plug and directly wiring your unit into your vehicles' power, use great care to connect the device correctly, with the red wire as 12 Volt Positive, and the black wire as vehicle ground. Do not use the device with the magnetically mounted antenna or any antenna connected to ground on vehicles with positive ground. Reversing polarity, even briefly, is very likely to destroy the transmitter, and it will not be repaired under warranty.

Also note, That Byonics has an Anderson Power Pole version of the power/serial cable, available as an option.

The cable assembly also has a male, DB-9 serial plug, which allows the use of the Byonics GPS2 magnetic mount "hockey puck" GPS module. Power for the GPS is provided through the DB-9 Cable. Virtually any GPS that can provide 4800 Baud, NMEA standard data is compatible with the MT-RTG.

Please note that the wiring of the DB-9 connector is set up for use with a GPS. The unit may be reprogrammed by downloading the free Byonics configuration software from the Byonics website. (www.byonics.com) In order to program the device, the transmitting and receiving serial lines must be reversed in respect to the GPS wiring scheme. Byonics offers a low cost female to female null modem cable for user programming. Ordinarily, the device will be programmed to your specifications prior to shipping.

Operation

WARNING: Do not plug the cigarette lighter plug into your vehicle or apply power to the unit until the system is fully assembled. Operating the MT-RTG 30 without an antenna or dummy load attached may destroy or damage the power amplifier in the unit, which will not be covered under warranty.

Assuming you ordered your Byonics MT-RTG 30 pre-programmed; all that is required is simple "plug and play" operation. Connect the 6 pin mini din plug on the "dongle" cable into the mating receptacle on the MT-RTG, Note that the fit is quite snug, which should prevent unintentional removal. Note that the plug is keyed, and only fits in one way, so make sure you are properly aligning the plug and jack before applying any significant degree of pressure.

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. In the event that you choose to utilize an antenna other that the one utilizing an SMA connector, use the appropriate adapter and a 2 meter antenna capable of handling at least 30 Watts. The antenna should be a vehicular or ground plane antenna designed for two meter operation. Rubber duck or short whip antennas will not work and will probably result in damage to the unit. The unit can be "swamped" with RF power, causing continuous resetting of the MT-RTG 30. This can be observed by watching the red and green LED's visible on the top of the enclosure. Ordinarily, the red/green LEDs will flash briefly on startup, indicating normal operation. If the MT-RTG goes into continuous reset, the LEDs will flash continuously. Unplug the unit and trouble shoot the installation before attempting to re-power the device. The blue LED indicates that the device is currently powered.

Plug the GPS 2 or other GPS device into the MT-RTG 30 and place it in a position to give it the best possible line of sight view of the sky.
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 30 LED will flash green and red, indicating that it is starting properly. The green LED 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.

The red 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 unit’s programming.

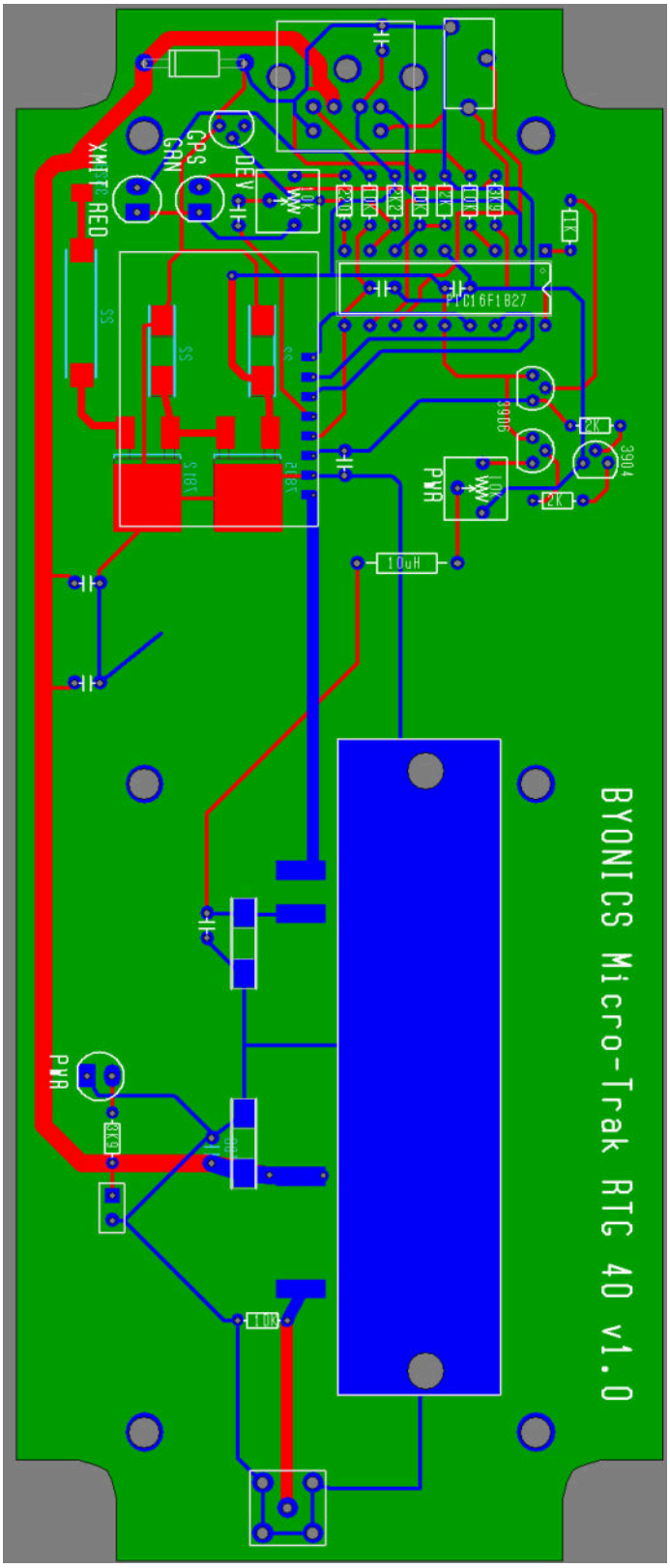
The MT-RTG 30 is a transmitter only. The unit will occasionally send position reports coincidentally with other transmitters. The APRS network is unlike the cellular network, in that the nationwide network of digipeaters may not cover every area of the Country. Since the system is entirely operated by volunteer hams, there is no guarantee that every (or any) position report you send will make it to a digipeater or onto the APRS-IS (sites like openaprs.net or aprs.fi) Although the MT-RTG is much more powerful than handheld radios, it is still relatively low power in comparison to mobile users running potentially hundreds of Watts of power, and we occasionally have to struggle to get a word in edge wise.

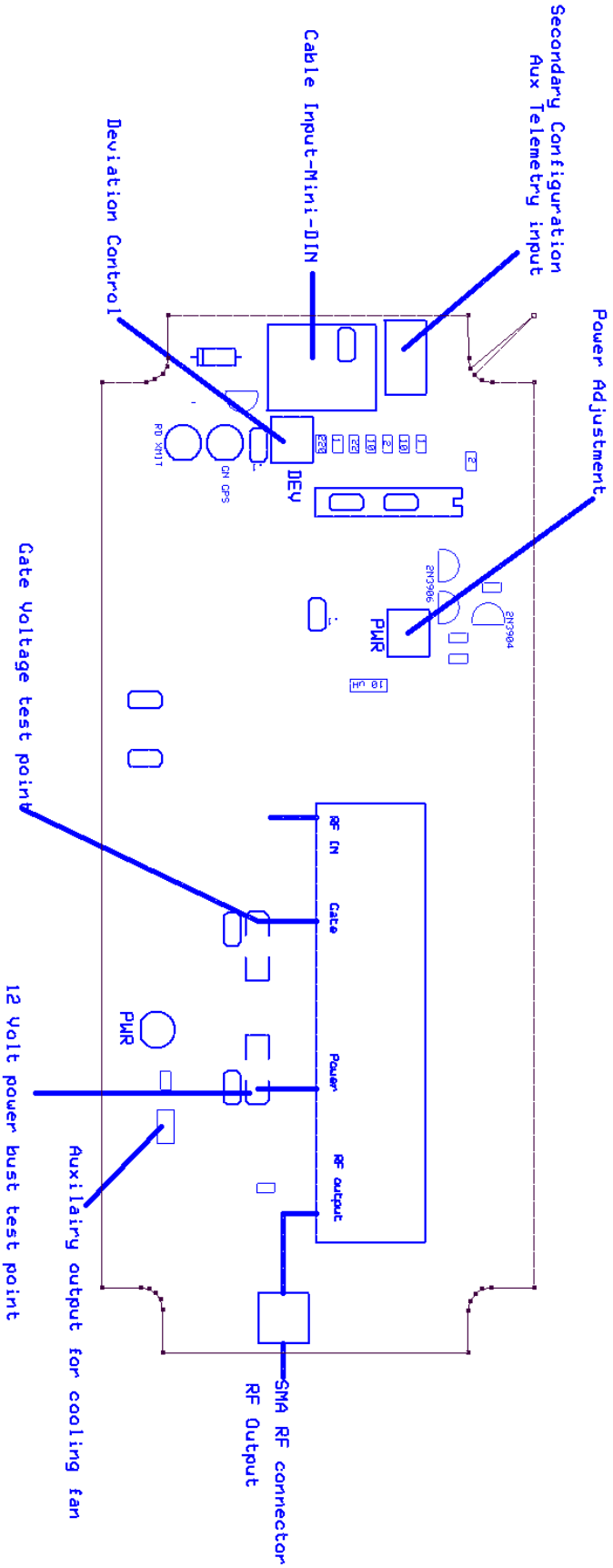
The MT-RTG 30 has internal adjustments for setting power and deviation levels. These should only be adjusted by qualified individuals with proper test equipment. The power and deviation levels are pre-set and fixed at optimal levels for the device. There is no on/off switch: The device is powered and drawing current whenever it is plugged into a “hot” cigarette lighter outlet. The MT-RTG 30 uses a special version of the Byonics TinyTrak3 chip, and requires a version of the TinyTrak3 Configuration program that is different than older versions. The default values included when your unit was shipped are generally optimal.

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, and other modes) an external 2.5mm jack is included for those hams with the skills to add an external switch. Additionally, the third conductor in this jack may be used as an auxiliary telemetry input. 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 degree of flexibility.

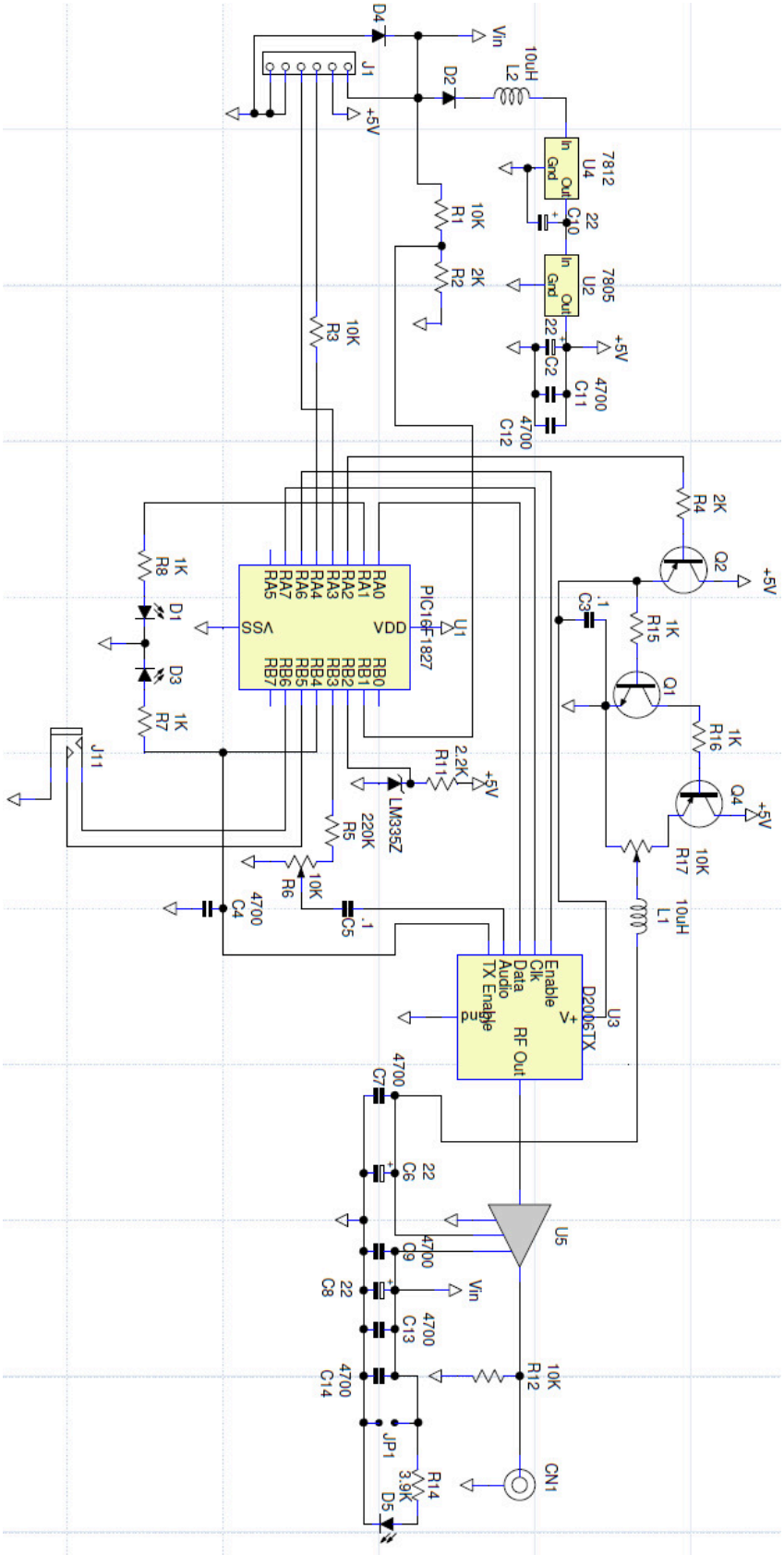
The MT-RTG 30 has two built in telemetry channels, one that reports the supply voltage to the RTG, another, which reports the temperature inside the RTG enclosure. If your application calls for a more accurate external temperature reading, you may remove the lid from the enclosure to allow better access to ambient air temperatures. If necessary, the temperature sensor may be removed and remotely-mounted.
Voltage and Temperature graphs from the MT-RTG 30 will be available on aprs.fi. Further information regarding setting up all MT-RTG parameters can be found in the Micro-Trak Configuration Program manual.

Printed Circuit Board and Parts Placement





Schematic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Vin
J1
D2
10uH
L2
+5V
7812
U4
In
Gnd
Out
C10
22
10K
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2K
R2
7805
U2
10K
R3
C2
C11
4700
C12
2K
R4
Q2
1K
R8
D1
D3
1K
R7
J11
SSA
VDD
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RA0
RA1
RA2
RA3
RA4
RA5
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RA7
RB0
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RB3
RB4
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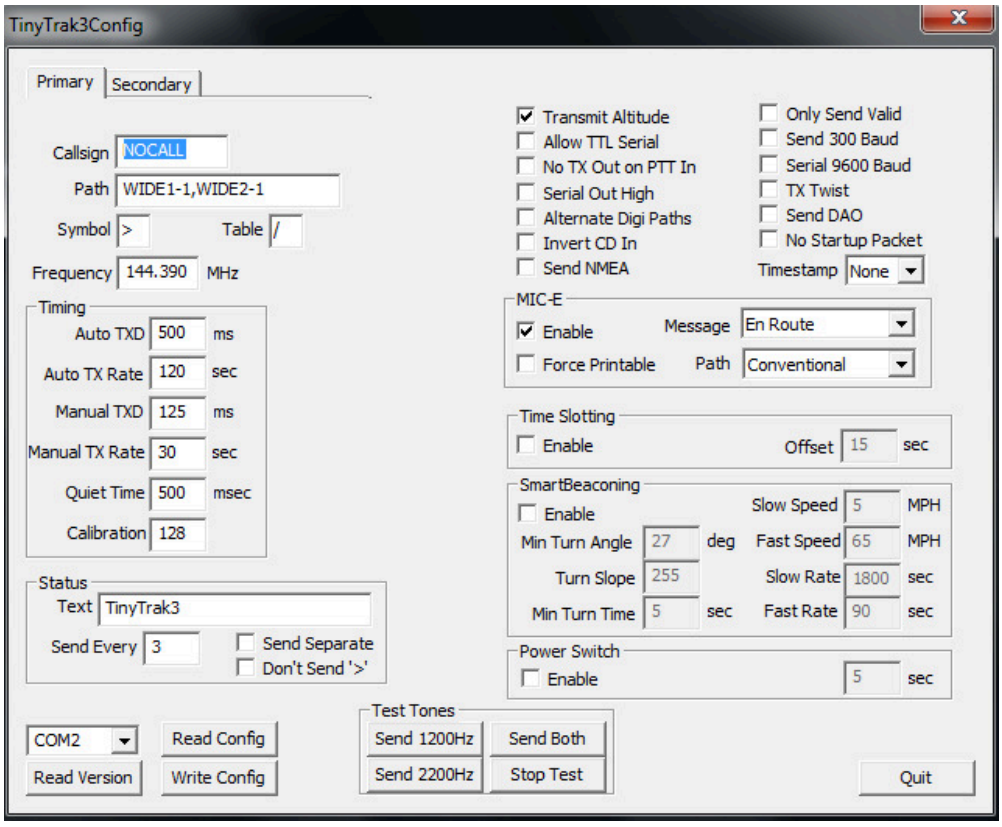
RB6
RB7
2.2K
R11
LM335Z
220K
R5
10K
R6
4700
C4
.1
C5
C3
1K
R15
Q1
1K
R16
Q4
10K
R17
10uH
L1
Enable
Clk
Data
Audio
TX Enable
RF Out
V+
D2006TX
U3
4700
C7
22
C6
U5
4700
C9
22
C8
Vin
4700
C13
4700
C14
10K
R12
JP1
R14
3.9K
D5
CN1

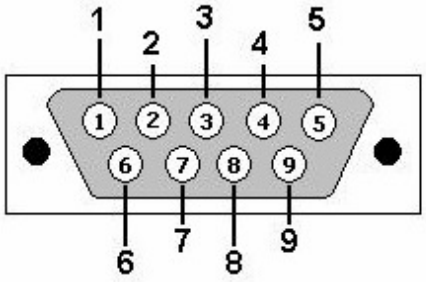
Configuration Software

This is a screen shot of the programming software



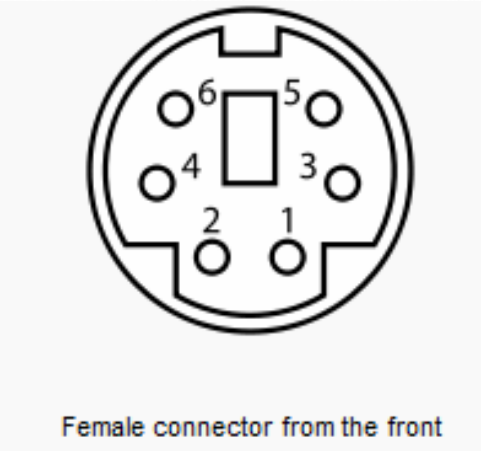
This configuration program is designed for use with multiple variations of the Micro-Trak product line, and not all settings will be used with the MT-RTG 30. The MT-RTG 30 will ordinarily be shipped with information you provide at the time of your order. If you need to reprogram the MT-RTG 30 or other Micro-Trak products, you may download a free copy of this configuration software from the Byonics website.

Connect your MT-RTG FA to the wiring harness provided with your RTG, through a null modem F-F gender changer adapter or cable (also available from Byonics) Your RTG must be powered during programming, and an antenna or dummy load (preferable) must be connected to the antenna output to prevent damage to the unit. You must have a serial port or USB to Serial adapter to program the RTG FA.



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)

Installation and Trouble Shooting

Configuration

The MT-RTG 30 generally ships to you pre-programmed. In the event that you would like to change the programming, you will need the following:

1) A free copy of the Byonics Configuration program, Version 1.4.3 or later. Note that older copies of the Byonics Configuration program are product-specific and may or may not work with this device.
2) A serial, gender-changing, null modem cable. Byonics sells these inexpensively. A GPS device has pins 2 and 3 reversed respective to a standard serial DB-9 connection, so a null modem cable is required in order for the RTG 30 to communicate with your PC
3) An IBM PC compatible computer with a "true" serial port or a USB-to Serial adapter.

Programming is accomplished by connecting the RTG 30 to your computer with the null modem/gender changing cable, and opening the configuration software. Note that the RTG must be powered during transmissions, which can cause difficulties with some computers, due to high RF fields. Ideally, the power setting on the RTG 30 should be turned all the way clockwise to turn off the power amplifier, or failing that, a dummy load capable of handling 30 Watts of RF power. In some cases, powering the transmitter with a nine volt "transistor radio" battery provides enough current to program the unit, without generating particularly high RF fields. Note that high RF fields can swamp your computer, and cause USB devices to turn off, so taking these precautions is wise. For detailed information on individual programming parameters, download the TT3 manual from the Byonics website

Connecting to a computer

Standard serial ports are becoming increasingly rare on computers. This means that you will probably have to configure the RTG with a USB to Serial adapter and the programming cable. Most computers will not automatically carry the drivers for any individual USB/Serial adapter, and it is important that you know you have the adapter installed and running properly prior to attempting programming. Please make sure you have installed the current drivers for your adapter. Remember that a USB adapter may show up in your Windows devices list without actually being available for use. If you encounter difficulties with being able to read or write to the RTG, the problem is almost certainly an improperly loaded driver.

We have found that turning off the FIFO buffers will sometimes help with faulty serial communications. You can find this in Windows Device Manager. Open Ports, right click the desired COM port and select properties, select the Port Settings tab, select Advanced, and uncheck the Use FIFO buffers option.

To confirm that your RTG is capable of recognizing serial data, just plugging in the GPS should result in a flashing or solid green light.

In the Configuration program, you will have a drop down menu of all available com ports on your P.C. This is helpful if you don't know which port your adapter is connected to. Going through these ports one by one, you can click on the "read version" button in the configuration software to verify you are connected to the correct Com port. Alternatively, you can use the "send tone" button, which will cause the transmitter to send a continuous tone (note: this should only be down with the power control to the unit turned all the way down, or quickly turned off with the configuration button to stop tones- excessive tone broadcasting jams the channel and may over-heat and destroy the amplifier, which is designed for low duty cycle operation)

Every product has been confirmed to be able to read and write serial data in manufacturing, and in most cases, revalidated by pre-programming the unit before it ships to you. A failure to read or write to the device may

result in a error message from your computer's operating system. In some cases, your computer may actually be programming the Micro-Trak's PIC, but timing issues in your PC may be preventing reading the data back. You can test this by setting the device to another frequency and monitoring the transmission, or by using the "send tone" command to verify that your computer can "talk" but not "hear" the received programming data.

Note that the transmitter is not capable of loading a new configuration while it is transmitting. If you observe a red LED lighting during loading a new configuration, you will have to retry loading the configuration afterwards. This can be especially problematic if you set your transmitter to transmit once per second. Besides overheating the power amplifier and destroying the transmitter if the power is set for more than a few hundred milliwatts, you will never be able to get "a word in edgewise" to reprogram the transmitter's PIC (programmable Integrated Circuit) and the PIC may have to have the firmware reloaded or replaced. The default and polite transmission interval is two minutes, which will give you plenty of time to find a window to program the device.

Operating the transmitter at rates faster than once every thirty seconds may overheat and damage the amplifier if operated at full power. Operating the transmitter more frequently is possible, and in many cases (Especially when operating off the National APRS frequency) desirable. Depending on the input voltage and frequency of transmissions, as well as the ambient air temperature, your transmitter's amplifier could potentially over heat. If you find that it is warm to the touch, or smells likes it burning, Turn the transmitter off, allow it to cool, and try again at a lower power setting.

Setting the RF power output level.

The best way to set the power output level of the transmitter is to connect the RF Output (SMA Connector) to a Wattmeter and Dummy load. Power output is directly related to voltage and current capabilities of your power supply. You may operate the RTG 30 at voltages as high as 17 Volts maximum, which can cause the unit to operate as high as 45 Watts.

The instantaneous power output of an APRS transmitter may be too fast for many Wattmeters to reach the peak, leaving you with the impression that the power output is lower than it actually is. Ideally, use the configuration program to cause a force-send transmission at your intended voltage of operation. (Please remember that automobile voltage will vary dramatically depending upon the engine speed.) Adjust the power level trimmer potentiometer to your desired power level. As shipped, the unit will be set for maximum power. Power output should be measured with the transmitter operating continuously, but do not operate the transmitter for more than 5-10 seconds at a time, since this can cause it to overheat and self destruct.

Note that the trimmer control for power is not set up like a volume control; with all the way counterclockwise off and all the way clockwise at maximum. Most of the power adjustment is in the last half (or less) of the power trimmer rotation.

Alternative power adjustment methods.

Current Draw
The amperage drawn by the transmitter will of course change as a function of supply voltage and the power output of the transmitter. Typically, the unit will draw approximately 8 Amperes during the peak of a transmission. This will roughly correlate to 30 Watts of output power. Turning the power control down will result in decreased current. A supply current of 1 Ampere during transmission indicates about 5 Watts output. These are very rough estimates, since the actual power the unit generates has a wide number of variables, but they are good enough for a WAG.

Gate Voltage

The easiest way to set the power absent a Wattmeter and dummy load is to set the gate voltage to the amplifier. The test point for the amplifier gate voltage is shown above under “parts placement”. Optimally, this power setting should be carried out with a dummy load. Since RF fields can wreak havoc on your voltmeters accuracy. In a pinch, you can desolder and temporarily lift the input pin on the amplifier to prevent generating high RF fields. This should be done by de-soldering with solder wick and gently lifting the input pin off the PC board. Be careful not to strain the pin. If it breaks off, its an expensive part to replace.

Measure the voltage during transmissions from between circuit ground (the screws on the amplifier mounting is a good ground) and the amplifier gate (second pin from left, indicated above) The amplifier will be essentially off at voltages below 3 Volts, and will generate maximum power at 5 Volts. This relationship is fairly linear.

Installation

The vast majority of RTG users do not permanently install the tracker in their vehicle, instead keeping it transportable from vehicle to vehicle. In this case, the basic magnet mount antenna may suffice for your needs. I strongly recommend that you consider a permanently mounted and higher gain, 2 meter antenna.

Physical Mounting
The RTG 30 has screw mounting tabs on both ends, which can be screwed directly to your vehicle. These are electrically isolated from ground. This is a very powerful transmitter, and to avoid interference to your radios, avionics, or other electronic devices, try to avoid locating the RTG 30 too close to any other electronic devices. The trunk of a vehicle is an excellent choice.

DC Power
Connect the supplied cable (cigarette lighter or power pole) to your automotive power. Note that you probably can't draw 8 amperes of current from sources such as your interior light circuit without blowing the fuse(s) in your car. You may need to run a large power wire directly from the battery for best results. Note that whether you use the cigarette lighter cable or the power pole cable, a 10 Amp fuse should be in the power line.

GPS
The RTG 30 will work with any GPS capable of providing true serial NMEA data at 4800 baud with a 5 volt swing. If you have a TTL GPS, you may still be able to use it by selecting the "allow TTL" option in the configuration menu. Note that the connector on the RTG-30 includes a 5 volt power supply pin, which is plug-and-play compatible with all Byonics, and many other brand GPS receivers. Place the receiver where is has a clear view of the sky. For trunk operation, there may be perforation in the rear deck sheet metal where the GPS can be mounted without metal in the way of its view of the sky. Rear decks made solely of plastic or fiberboard will not interfere with GPS reception. Byonics GPS receivers are equipped with magnets, and may be mounted outside the vehicle, or inside the vehicle. To keep the top side of the GPS upright and facing the sky, you can fabricate a mount or connect the GPS to the underside of the rear deck or dashboard with permanent double sided foam tape. Byonics makes no representation that any GPS other than those sold by Byonics are compatible with this device.

Antennae
Byonics includes a very basic magnet mount antenna with the RTG 30 kit. This is fine for transportability, but it's not a great performance option. I strongly urge you to use a high gain antenna with RG-58 cable for critical applications. Don't even THINK about using a rubber duck with this transmitter except at the minimal power setting

Cable Routing

The RTG 30 can become "swamped" by high energy fields, which will generally cause continuous resetting of the transmitter. This condition can be prevented by carefully routing the power, GPS, and antenna cables away from each other. Do not bundle the cables together.

Problems

1. *"I connected my unit to reverse polarity current and it no longer works".*

If you installed the Amp fuse, you simply need to replace the fuse. If you did not install a fuse, you may have blown traces off the printed circuit board, destroyed the "crowbar" polarity protection diode, and destroyed the amplifier module. In the worst case, you may have destroyed the entire board, although this unlikely. The transmitter should be shipped to **VHS Special Services** for non-warranty repair.

2. *"I operated my transmitter without an antenna, into a cut off cable, or a paper clip antenna and now it does not produce any power".*

You may have blown out the power amplifier, as above, this a non-warranty repair, and you will be charged the costs of parts and shipping (not shop time) assuming your transmitter is repairable.

3. *"The green LED never comes on except at start-up"*

This signifies that the unit is not receiving valid GPS data. If you have a Byonics GPS, you can tell if the GPS is receiving power because the GPS has its own LED. The GPS 2 has red light that flashes at about once per second while it is in acquisition mode, and lights solidly when it has acquired a valid signal.

On initially powering the RTG 30, the blue LED will light indicating power on. The green LED will flash several time and the red LED will flash on briefly. This indicates that an initial transmission has occurred. Note that this transmission will not contain a valid position report. The green LED should begin to flash, indicating the recognition of invalid GPS data. The green LED will light solidly when the GPS provides valid data. Depending on how long it has been since the unit has been operated, and how far away from the last place it recognized a valid signal, the GPS may take longer periods to acquire a position.

The green LED on the RTG 30 will flash at about once per second (although not synchronized to the flashing of the GPS) while the GPS is acquiring a position fix. The green LED should light solidly as soon as the GPS has acquired a valid signal. A transmission should occur as soon as the GPS has a solid position. (Note: The Byonics GPS 4 LED works "backwards", that is to say, it lights solidly while seeking, and flashes when it has acquisition; the green LED on the RTG works the same as in the GPS 2)

a) Check your connectors to make sure they are fully seated
b) Verify that the LED on the GPS indicates its getting power
c) If there is no LED lighting on the GPS, it is either dead or their has been a failure of the power/serial cable. Contact Byonics about getting a replacement GPS
d) Verify your RTG has not gone bad by attempting communications with it via a computer. You should be able to use the "send tone" command if your serial port is set up properly, and the RTG is working.

4. *"The green LED flashes, but never lights solid"*

Generally, a GPS that sends an invalid signal for a long period has been off for a long time, and moved a long way, and can take awhile to download new information from the GPS satellite system and to recharge its internal memory battery. Normally, a GPS memory battery or supercapacitor will outlive the GPS, but since the units are sealed, there is no practical way to repair them. Try leaving the unit powered for as long as it takes to recharge the memory battery and download new data. Note that we ship the units with a default setting that will prevent transmissions (except on initial power-up) unless the RTG detects a valid signal, so you won't be jamming the APRS network. IF these steps fail, you may need a replacement GPS.

5. *" The red and green LED's on my unit flash continuously and never stop!"*

This condition is called "continuous reset" and can be caused by several things.

a) High SWR. A bad antenna, bad connection, having the antenna laying on metal, or the cables or devices routed too closely can cause the RTG 30 PIC to become "swamped with RF power. Make sure you have not crushed or cut your antenna cable in the window or door of your car. Any antenna with an abnormally high SWR can cause this problem as well. If everything seems shipshape, you can try turning the power trimmer on the RTG 30 board down somewhat until the condition stabilizes. It's important to remember that while this resetting occurs, you may be transmitting brief bursts of noise, that will jam and irritate our fellow APRS users. It may also damage the amplifier by causing over-heating.
b) Excessive power conditions. Low voltage or current may cause the unit to operate normally until it attempts a transmission. With nearly dead batteries, too light power cables, etc, the current demand may be too much for the source, causing the unit to become locked into a fatal loop of transmission retries. Similarly, excessively high voltage may cause the transmitter to develop more power than the particular installation can tolerate. An antenna with a marginal SWR for instance, may run on your hand-talkie, but at 30 Watts, the reflected power is too high for the RTG 30 to tolerate. Higher power settings can become issues with identical conditions to low power operations. A GPS mounted right next to an antenna may be fine at 8 Watts, but a fatal condition at >30 Watts. Check your antenna, transmission path, cable routing, mounting, power supply as above. Turn the power down if required to stabilize. Did I mention to buy a good antenna?

6. *"My unit does not transmit!"*

If your unit truly does not transmit, then it is broken and needs to go back for service. However, experience leads me to believe that when someone tells me this, it generally means that they are not showing up on aprs.fi or other APRS-IS fed page. Assuming your transmitter was programmed with the default settings, you should see the transmitter's red LED flash briefly every two minutes. If you requested Smart Beaconing as part of your configuration, and you are stationary, you may only see a brief transmission every 1800 seconds. In any case, your transmitter should send a start-up beacon on initial power-up. If you have a two meter receiver, you can listen to the device to make sure it is actually transmitting. Measuring the current draw (Anything in excess of an Ampere indicates its transmitting power) Ideally, you will find a ham with a radio that can decode APRS transmissions.

Now that we have confirmed the unit is transmitting, we need to know if there are digipeaters or I-gates within range, and that the transmissions you are sending are valid and decodable. I suggest downloading a free copy of AGWPE (http://www.sv2agw.com/ham/agwpe.htm) which when connected to your two meter receiver and the sound card on your PC, allows you to directly monitor over the air transmissions. This will show you in clear terms if your transmitter is sending data, and what, if any, digipeaters are locally receiving your transmissions.

The deviation control on your transmitter is ordinarily set to about the 3:00 position, which should be deviating at 3 KHZ. Depending on the local digipeaters, and what they are made from, (Commercial narrow band, old ham junk, scanners, etc) they may prefer wider or narrower deviation. While watching AGWPE and seeing real time transmissions, you might try increasing (Clockwise-be gentle on the control) or decreasing (CCW) your deviation and unpower/power your transmitter to force a transmission. With any luck, you will find the sweet spot that your local Digi prefers.

7. *"I am not showing up on APRS.Fi!"*

I have to confess, Byonics did not invent or install the infrastructure for APRS…There are many areas where there is no coverage, or the digipeater has been taken off the air, destroyed by fire, mudslides, power loss, etc., or temporarily switched over to another frequency for a public service event. We built the RTG 30 to help people in areas where coverage is sparse by "brute forcing" the transmissions. Keep in mind that we are still "competing" to get into digipeaters with high power mobile and base stations with better antennae then us. We can tell you with certainty if your transmitter is operating properly, but we can't guarantee the network: we have no control over what Hams put up, if it works, if they allow us access to it, etc.

I suggest checking out your zip code on Aprs.fi and see if there are any active digipeaters or I-gates. If you live in a radio "black hole", no amount of power is going to work. Contact us about setting up your own fill-in or high level digipeater. The AGWPE website also has everything you need to set up an I-gate; all you need is a receiver, an IBM PC compatible, and an always-on internet connection.

8. *"Can I operate the RTG 30 in a high altitude balloon?"*

Sure, you just need a balloon big enough to carry a car battery and at least a quarter wave ground plane antenna.