

Micro-Trak All-In-One APRS Transmitter

Hardware version 1.3



The MT-AIO is a self-contained, water resistant APRS transmitter/GPS receiver designed for portable use. The MT-AIO is computer –programmable, and frequency agile over the entire 2 Meter ham band. Operation beyond 2 Meter bandwidth limits are not supported, since the device is not FCC approved for use outside the ham bands. Agencies exempt from FCC requirements may contact us about out of band operations. The device is rugged, and intended for operation using conventional

AA batteries or other battery packages available locally that do not exceed 13.2 volts. The MT-AIO is not intended for operation on external power without using a regulated 12 volt power supply, such as the Micro-Volt 12, available from Byonics. The MT-AIO is not designed to be submerged!

The MT-AIO is a transmitter only, and may send packets coincidentally with other transmitters. We recommend using the MIC-E format (default) with this transmitter, since shorter packets tend to have a higher throughput, save power, and minimize potentially high RF exposure levels.

The MT-AIO is controlled by a special version of the TinyTrack 3 chip, and retains most, but not all, of the special functionality of the TT3. Features intended primarily for HF operation have been omitted, for instance. Special features of the MT-AIO include a power saving mode that switches the GPS on and waits for a locked GPS position before sending a transmission. Since the MT-AIO draws only a few milliamperes in the standby mode, battery life can be extended to days or weeks, depending upon the transmission rate selected and other parameters, including the type of data packet sent.

Power output of the Micro-Trak AIO is adjustable, and may be dialed down to a few hundred milliwatts of power or up to as much as 10 Watts. It is shipped set to maximum power.

The MT-AIO has only one, three position control.

Selector Switch

The selector switch, located near the center of the PC board, is a three position switch. In the center position, the MT-AIO is off. Even when left off, the batteries should be removed for extended storage to prevent leakage and damage to the device.

The other two positions are for selecting one of the two configurations stored in the TT3 chip's memory. The two pages of configuration selection allow you to enter different frequencies, icons, transmission rates, FCC call signs, tactical call signs, beacons, and all other programmable features.

The MT-AIO will ordinarily be shipped programmed with the customers requested parameters, allowing instant on-the-air operations; just add batteries.

On moving the switch to the channel 1 or channel 2 positions, the device will send a transmission. This data will not include valid GPS data, since the GPS will not have had time to synchronize. Subsequent transmissions will wait for the GPS to acquire lock, and this may cause transmissions to be sent at intervals different than those programmed into the device. For instance, if you select 2 minute transmission intervals (the default option) and enter a cave, the GPS will not synch up, preventing a transmission. Immediately upon the transmission timing cycle requesting a transmission, the device will verify that the GPS data is valid and hold off transmitting until verified. This allows a tremendous power savings. A transmission can be forced by returning the selector switch to center and switching to channel 1 or channel 2, as desired. Note that the device takes a few seconds to complete a transmission on reset. When the unit is powered off and on, the TT3 PIC re-flashes the stored frequency parameters into the transmitter. This memory is non-volatile, and data will be retained even if the unit loses power for long periods.

Deviation Control

Two small blue trimmer potentiometers are located on the printed circuit board. One is marked “DEV”. This is the deviation control. The deviation control is fixed so that at maximum rotation, deviation does not exceed 4 KHZ, which is well within the range of most digipeaters. Commercial receivers may require a narrower signal, and this control can be used to allow better decoding in these receivers.

Power Control

The power control is the other blue trimmer potentiometer. It is set fully clockwise from the factory for maximum power. This trimmer sets the gate voltage on the amplifier module to allow power control over a wide range, but it is important to remember that this controls' range is all within a few degrees of fully on. Power adjustments are best set using a wattmeter and dummy load. The power adjustment is used when programming your MT-AIO with your computer. Turning the power all the way down will minimize problems in programming caused by RF energy “swamping” your computer or USB to serial adaptor.

Antennas

The Micro-Trak AIO is shipped with a high quality 2 Meter whip antenna. For portable use, this is a great option. Take care not to bend the base of the antenna, as this can result in a cracked enclosure or broken PC board. External antennas may be utilized, but care should be taken to ensure that the SWR is within best practices, and that the antenna is not in too close a proximity to other transmitters or static fields, as this can damage the final amplifier. Operating without an antenna will destroy the final amplifier. For this reason, final amplifiers are not covered under warranty, and repairs will be subject to parts and bench tech costs.

Status LED

A single bi-color LED is used to show the status of the unit. Immediately upon start up, the LED will flash a pattern of red and green, indicating that the unit is starting up and internally resetting. If this pattern continues without stopping, this is an indication that something is wrong, such as a low battery state or excessive SWR. The single pulse of a red signal indicates that the unit is sending a transmission. A blinking green indicates that the unit has switched on the GPS and is waiting for it to lock onto the GPS satellites. When the GPS locks on solidly, the TT3 brain will allow the transmitter to send its data out over the air, causing the GPS green indicator to switch off. In some cases, the GPS LED will remain lit until the next timing cycle. This is normal, and is an attempt by the TT3 to verify good GPS data.

Programming

Ordinarily, the MT-AIO is shipped pre-programmed with the user's information. In the event that a user needs to reprogram the MT-AIO, this can be accomplished in several ways. A Kenwood compatible cable is available through Byonics for this device. **Please note that the programming cable wiring is different than Version 1.1 of the MT-AIO, and now uses the Kenwood wiring scheme.**

To program the device, the power amplifier control should be turned all the way counter-clockwise (off)

The Micro-Trak AIO software may be downloaded from the Byonics website. Additional information on programming parameters may be found in the regular TT3 manual. Note that not all functions available in the standard TT3 configuration are available for use on the MT-AIO.

Alternatively, the PIC may be removed and plugged into a regular TT3 for programming, using a null modem cable and a gender changer. Note that there is a difference in the chips, and the TT3 should not be connected to a radio while programming! Use only the programming software designed for the MT-AIO.

Battery operation

The MT-AIO includes a standard 8 pack AA holder. This connects to the PCB using a standard 9 volt style battery clip. This clip notwithstanding, the device will not satisfactorily run on a 9 volt transistor radio battery! Battery connections are notoriously common points of failure for battery powered devices. The MT-AIO was designed to allow end-users to replace the battery clip using nothing more than a small screwdriver. The MT-AIO will run well from 9 to 13.2 volts DC (do not use unregulated automotive or aircraft supplies!) This allows a wide variety of options for power if needed, including ganged 9 volt lithium or alkaline batteries, AA LiPo, NICAD, NIMH, or alkaline batteries. It is possible that batteries going into the last segment of their lives will exhibit erratic behavior, and cause the MT-AIO to continuously recycle. Naturally, these batteries should be removed and disposed of. (Or recharged) **Please note that connecting the battery connector backwards may damage the MT-AIO.** A polarity protection steering diode has been installed in this transmitter, as opposed to the last version of the MT-AIO, which had a “crowbar” protection circuit. To operate the MT-AIO from external power, use a fused line, and a regulated power supply, like the Micro-Volt 12, available from Byonics. Please be careful not to install the battery cartridge in a way that allows its snap connectors to short across the PC Board. This can cause the battery case to melt and the batteries to explode or leak.

Operation

The internal GPS antenna is horizontally oriented. In general use, this does not present a problem using the unit in upright operation. It is recommended that the unit be powered on initially after a long period without being powered, or after having relocated the unit to a distant location from the last general area of operation. Allowing the unit to face upright during this time will allow the GPS to more easily view multiple satellites and locate itself in the universe quickly.

PCB Layout

Antenna

GPS

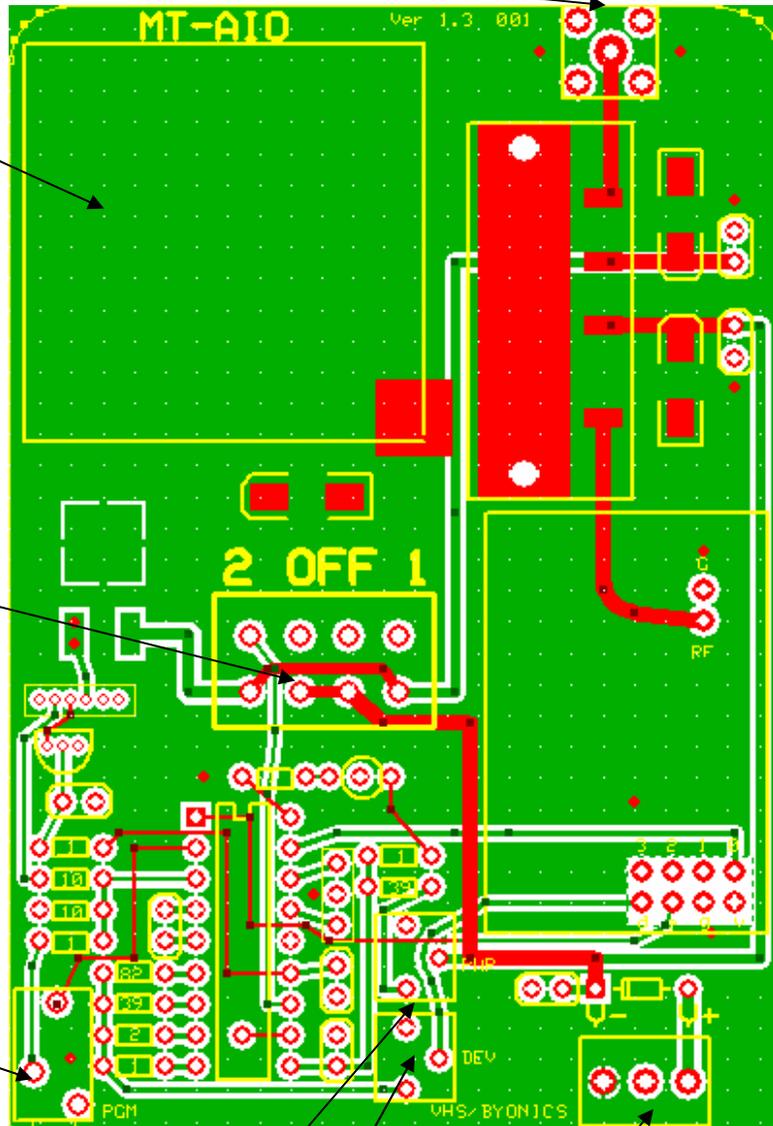
Selector Switch

Programming

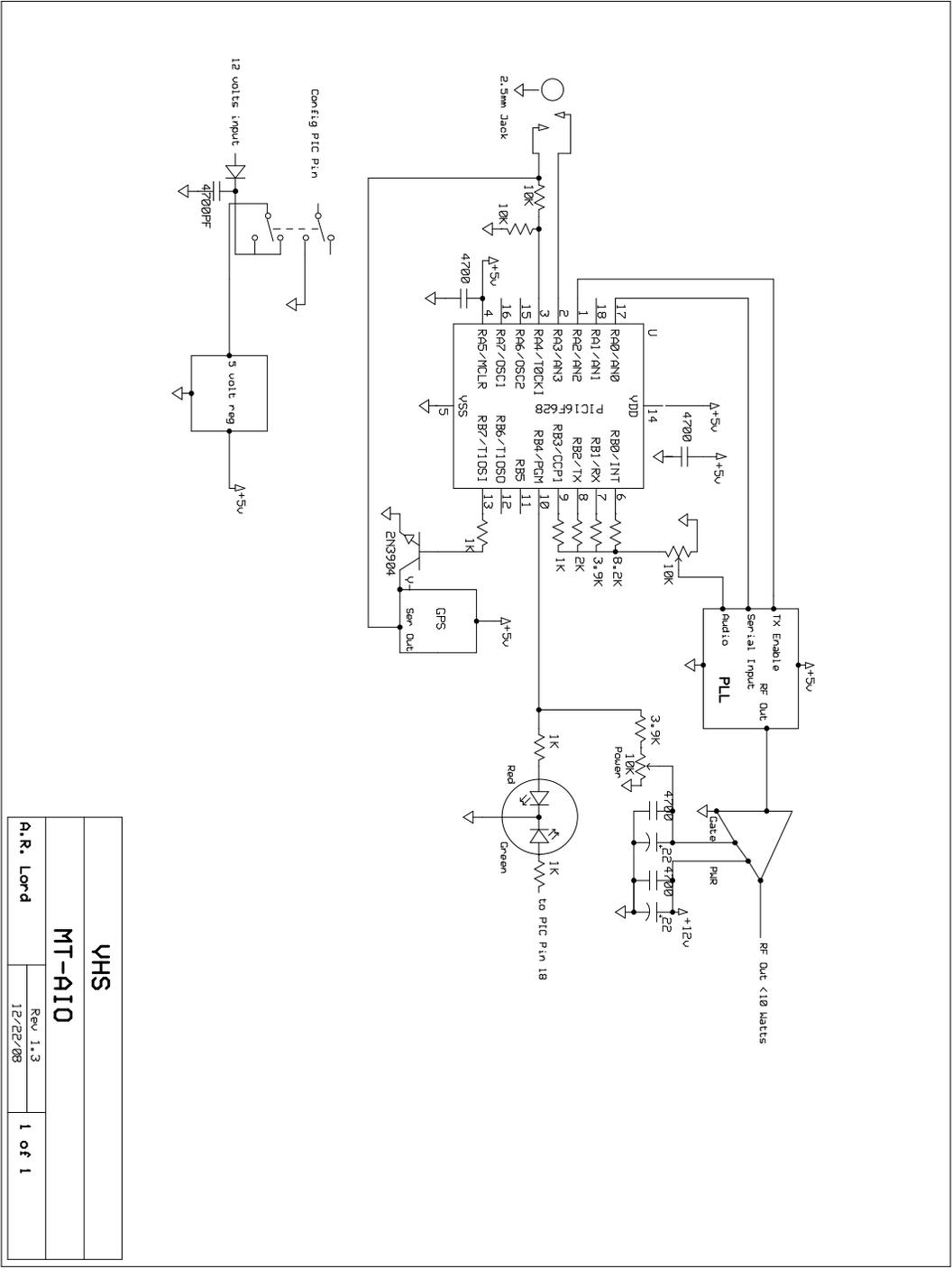
Power Control

Deviation Control

12 VDC



MT-AIO Schematic



VHS	
MT-AIO	
Rev 1.3	12/22/08
A.R. Lord	
1 of 1	

Specifications

Dimensions	6.37 X 2.62 X 2.06 inches (case dimensions)
Weight	14 ounces, batteries not included
Power supply	8 AA alkaline batteries of equivalent
Antenna	15" 2 Meter whip antenna
Output connector	SMA Male
Frequency range	144 to 148 MHz 2 Meter ham band
Output power	Maximum 10 Watts at 13.2 volts DC, adjustable
Deviation	3.5 KHz, factory set, adjustable
Estimated operation	8 Days, @ 2min Check-ins using MIC-E Data
Frequency Stability	+/- 1.5 KHZ
Operating temperature	-20 to +70 Centigrade
Spurious radiations	ETSI EN 300 220-3 and ETSI-301 489-3
Adjacent Channel spurs	<-40 dBm

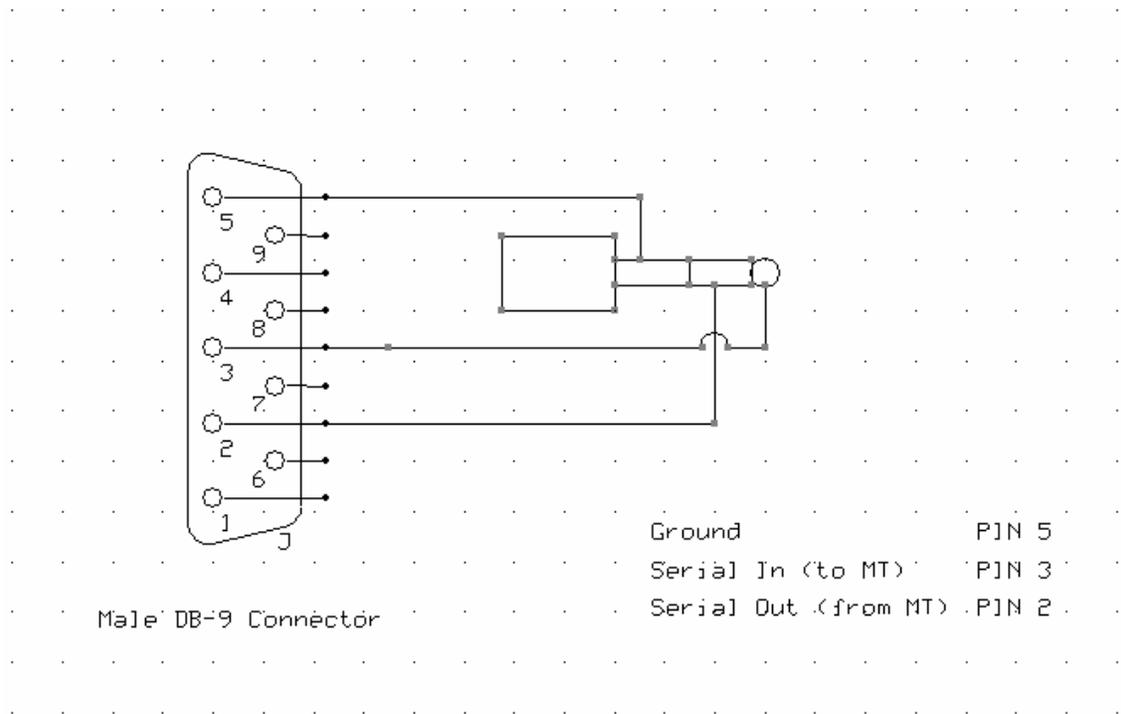
GPS Data

General	Tracking up to 20 satellites L1, 1575.42 MHz, C/A code
Accuracy	Position: 2DRMS approximately 5m, WAAS support Velocity: 0.1 m/s without SA imposed Time: $\pm 1\mu\text{s}$
Acquisition Time	Cold Start: 42s (Average) Warm Start: 38s (Average) Hot Start: 1s (Minimum)
Sensitivity	Acquisition: -148dBm Tracking: -159dBm
Dynamics	Max Altitude: 18000m Max Velocity: 500m/s Max Acceleration: $\pm 4\text{g}$
Navigation Update Rate	Once per second
Serial Port	TTL, RS-232
Baud Rate	4800 bps (Optional 9600,19300,38400 bps)
Output Message	NMEA0283 V2.2 GGA, GSV, GSA, RMC (optional VTG, GLL)
Datum	WGS 84
Power Supply	DC 3.3~5V
Power Consumption	Typical 80mA @5V
LED Indicator	Power On/Off Navigation
Operating Temperature	-40°C ~ +85°C
Storage Temperature	-40°C ~ +100°C
Humidity	5%~95%
Antenna Type	Built-in patch antenna

A word about using the Smart Beaconsing Feature

The MT-AIO was initially designed for portable, hand-held uses. Many Byonics/VHS customers requested that the Smart Beaconsing capabilities available in other Byonics products be made available in the MT-AIO. The Smart Beaconsing parameters require the GPS to provide a constant source of data to the processor. This means that when Smart Beaconsing is selected, the GPS will automatically be switched on. Depending upon the battery type and transmission interval, this will shorten battery life to about 2 days at best.

Programming Cable Version 1.2



MISUSE



An MT-AIO, carried as rocket payload, after auguring in from 12000 feet.

Using the MT-AIO with External Power

The Micro-Trak AIO was designed primarily for battery powered operation using the internal battery pack. The Micro-Trak can be operated off an external source of DC voltage, but care must be taken not to exceed the rated input voltage of 13.2 volts, which will destroy the amplifier module. For automotive or aircraft operation, a regulated power supply should be used to run the MT-AIO.

MICRO-VOLT 12

The Micro-Volt is a 12 volt regulated power supply intended for use with Micro-Trak products. The supply measure 1 X 1 inches, and has a three terminal input/output connector. The Micro-Volt will supply the short duration 2 Ampere pulses required by 8-10 Watt Micro-Trak transmitters, and may be used to power any Micro-Trak from automotive or 24 Volt aircraft power busses. The power supply should be installed on a fused power bus. Note that the power supply uses a common ground for input and output. In an automobile with negative ground, the center connection should be connected to chassis ground. Unlike many power supplies, the voltage regulator tab on the Micro-Volt is not connected to ground, so use care in your installation not to short the tab to chassis ground. Do not install a screw through the board to fasten the tab to the board, as this could cause a short. If required, the voltage regulator may be bent upwards and attached to an accessory heat sink.

