

Argent Data Systems Tracker2 model OT2m User's Manual

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Argent Data Systems
PO Box 579
Santa Maria, CA 93455

(800) 274-4076
Fax (866) 302-6890

www.argentdata.com

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Introduction

The Tracker2 fills the gap between a traditional packet radio terminal node controller (TNC) and a transmit-only APRS™ tracker, and adds features not found in either. While it may be used in KISS mode with a PC for general purpose packet radio communications, its feature set is focused on APRS™ applications, including position reporting, messaging, and telemetry.

Firmware updates and enhancements are published frequently, so check the Tracker2 website at <http://www.argentdata.com/tracker2> to make sure you have the latest firmware and documentation.

A Brief Overview of APRS

To understand the Tracker2 and how it can be used, it is important to first understand exactly what APRS is.

APRS stands for Automatic Packet Reporting System. The name is a trademark of its creator, Bob Bruninga, WB4APR. What the name refers to can be a subject of considerable confusion to newcomers.

Primarily, APRS is a communications protocol. It defines how data (including station and map object positions, weather information, radio direction finding readings, text messages, and telemetry) can be communicated among packet radio stations.

APRS can also refer to the network that carries this information. Throughout the United States, Europe, and several other countries, a network of digital repeaters ('digipeaters'), usually on a common nationwide frequency, provides a transport for APRS packets. Most APRS stations operate on one of these common channels, but not all.

The APRS Internet System (APRS-IS) is an Internet-based adjunct to the radio network. Internet gateways (IGates), often simply home PCs with an Internet connection and a radio, pass traffic from the radio network to a shared, worldwide APRS stream. Many IGates will pass at least text message traffic, and sometimes other data, from the Internet back to the radio network. In this way, text messages can be passed from one station to another even when a digipeater path between the two doesn't exist or isn't reliable.

The name APRS is also sometimes used to refer to WB4APR's original MS-DOS APRS mapping program, but it is now properly called APRSdos. Numerous other mapping and messaging programs exist, using either the APRS radio network, the APRS-IS, or both. Some of these programs can function as IGates as well.

Connected to the worldwide APRS-IS stream are a number of database services. These systems (findu.com and aprsworld.net are two of the most popular) process and store all APRS traffic that finds its way to an IGate anywhere in the world, and most provide maps, weather displays, and telemetry graphs based on this traffic. This allows anyone with Internet access to monitor APRS data without needing radio equipment of their own or special software.

Getting data to a web-connected database isn't the only thing APRS is good for, of course. Depending on network coverage and load, it's possible to communicate over a range of hundreds of miles using the radio network alone. However, being a shared network, reliability decreases with each added digipeater hop. APRS is most reliable at the local level, and it's rarely advisable to use more than two or three digipeater hops. Often, a single hop is adequate for local coverage.

The APRS protocol, hardware, and software can be used independently of the national networks, as well. Local or temporary networks may be set up to cover special events or to fill the needs of a particular organization. Some uses may not require digipeaters at all – high altitude balloons, for example, often use APRS to transmit position and telemetry data on a dedicated frequency directly to the chase teams.

Mobile use of APRS can take a number of different forms. The simplest mobile APRS setup is a transmit-only tracker connected to a radio and GPS receiver. These trackers generally have no receive capability, other than to check that the channel is clear before transmitting. They allow the vehicle to be tracked by others, but can't receive messages or positions.

Another option is an APRS-capable radio, like those sold by Kenwood. These radios have a text display, but require a mapping GPS receiver to display the positions of other stations.

An ordinary radio with a TNC can be used in conjunction with a laptop computer or PDA to provide full APRS functionality, including mapping and messaging, although this is usually the most expensive option and may not be practical to operate while driving.

Where the Tracker2 Fits In

The Tracker2 has the capability to fill a number of roles in the APRS system. As the name implies, it's a tracker – it can format and transmit position data from a GPS receiver. It also offers receive capability, though, and in a way that no other device can currently match.

When it receives a position for a station or map object, the Tracker2 can create a GPS waypoint for that position. On a mapping GPS receiver, this allows the user to see the locations of other stations on the map, updated as each new position is received.

While this concept isn't new – APRS-capable radios have been doing it for years – the Tracker2 takes it a step further. While other devices output only a position and name, the Tracker2 will, when used with a compatible Garmin or Magellan GPS receiver, pick the most appropriate symbol for the waypoint (including custom APRS symbols if available), extract the altitude, and insert the status text (often including course and speed) into the waypoint details. For many applications, this allows a GPS receiver to be used in place of a PC or PDA.

Aside from its tracking capabilities, the Tracker2 can also function as a digipeater. Its remote control capabilities allow it to be reconfigured remotely, and even through IGates, and its path limiting features let the sysop reduce the amount of extraneous traffic carried by the network.

In KISS mode, the Tracker2 can also function as part of an IGate, when connected to a PC with an Internet connection and appropriate software.

With few exceptions, the Tracker2 can perform all of its functions concurrently. For example, a mountaintop installation could function simultaneously as a digipeater, weather station, site monitor (reporting voltage and temperature), and TNC for an IGate.

Major Features

APRS Tracker - The Tracker2 is first and foremost a full-featured APRS tracker. It works with GPS receivers using either the industry-standard NMEA format (\$GPRMC, \$GPGGA, and \$GPGLL sentences) or the proprietary Garmin binary protocol. In addition to transmitting its own position, it can also decode incoming positions and plot them as waypoints on the screen of a GPS receiver, selecting appropriate symbols and setting comment text and other waypoint details if supported by the receiver.

KISS Mode - The KISS protocol defines an interface between a TNC and its host, typically a PC. This mode allows the Tracker2 to be used with PC-based APRS programs like Xastir, WinAPRS, and UI-View32. It can also be used with non-APRS applications, subject to the limitations of the Tracker2's transmit and receive buffers.

Digipeater - A digipeater acts as a simplex digital repeater, receiving packets and retransmitting them, typically on the same radio channel. The Tracker2's digipeater function is designed specifically for APRS use, and supports advanced features such as WIDEn-N operation, hop count limiting, duplicate elimination, preemptive digipeating, and multiple aliases.

Weather Station – The Tracker2 can be connected to several models of weather station, including the Peet Bros. Ultimeter 2000 series, Dallas/AAG 1-Wire Weather Station, and LaCrosse WS-2310 wireless weather station, to provide remote weather telemetry.

Command Console – While the Tracker2 comes with a Windows-based configuration program, it can also be configured, tuned, and upgraded through a traditional console interface with command syntax similar to that of the classic TNC2 and its clones. Keyboard-to-keyboard QSOs are supported through a 'converse' mode as well as APRS messaging commands.

Power Control – The Tracker2 includes an integrated solid-state relay that may be used to control an external DC load. Typically, this is used to control power to a transceiver to conserve power in applications like solar-powered weather stations; the radio can be automatically powered on just prior to a transmission,

and turned off again when the transmission is complete. The power output can also be controlled manually through APRS messages.

Hardware Description

The Tracker2 model OT2m features a heavy-duty steel enclosure and measures approximately 4.2" by 3.2" by 1". The circuit is built with surface mount technology and includes over-voltage and over-current protection, as well as RFI filtering on external connections.

Front Panel

The front panel has three indicator LEDs, marked ACT (activity), TX (transmit), and RX (receive). The 6-pin modular jack is an accessory port that provides a Dallas 1-wire data bus, 5 volt power, a counter/transmit trigger input, and a profile select input.

Rear Panel

The rear panel has a female 9-pin d-sub connector for connection to a radio. A male 9-pin d-sub connector provides, depending on software configuration, a single RS-232 port with hardware flow control or dual independent RS-232 ports. A standard 2.1x5.5mm center-positive power connector accepts from 7 to 28 volts, and an access hole is provided to allow heavy gauge power cables to be connected to the appropriate pads on the circuit board for control of an external DC load.

Connections

SERIAL Connector

- | | |
|----|--------------------------|
| 2: | Data in (port A) |
| 3: | Data out (port A) |
| 4: | Power output for GPS |
| 5: | Ground |
| 7: | Data out (port B) or CTS |
| 8: | Data in (port B) or RTS |

Note: The serial interface is configured as DTE (data terminal equipment) to allow direct connection to a GPS receiver. Connection to a PC requires a null-modem cable.

RADIO Connector

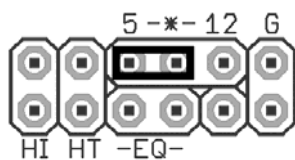
- 1: Audio out
- 2: COR / Squelch input
- 3: PTT out
- 5: Audio in
- 6: Ground
- 7: Power in
- 8: PTT in

ACCESSORY Connector

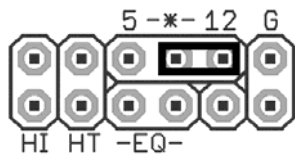
- 1: Counter / Transmit input
- 2: Ground
- 3: Ground
- 4: 1-Wire data bus
- 5: +5 Volt power output
- 6: Profile select input

Note: Pin 1 is the left-most pin as seen from the front of the connector.

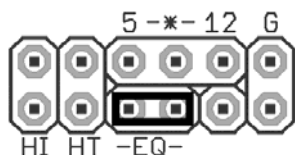
Jumper Settings



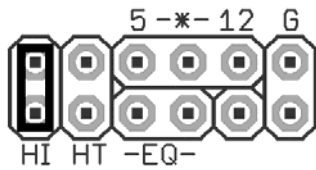
Voltage select – ‘5’. Connects pin 4 of the serial connector to the output of the 5-volt regulator. Use this setting to supply power to a 5-volt GPS receiver or other external device.



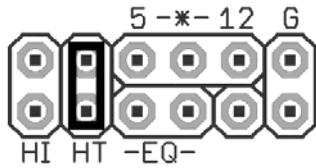
Voltage select – ‘12’. Connects pin 4 of the serial connector to the input of the 5-volt regulator. Use this setting to supply unregulated power from the radio connector to a GPS receiver, or to supply power to the tracker from the serial connector.



‘EQ’ – Enables RX equalization.



‘HI’ – This jumper sets the audio output level to the high range. This is needed mostly for mobile radios, especially some commercial models.



‘HT’ – Selects if push-to-talk signaling through the audio output line is enabled. Use this jumper with most HTs by Icom, Yaesu, and Alinco handhelds, but not Kenwood.

Setup and Configuration

Once installed, you can use a PC to connect to the Tracker2 either the Windows configuration program (otwincfg.exe) or a terminal emulation program of your choice, such as HyperTerminal, SecureCRT, or Minicom.

To use the command console, connect at the proper baud rate (4800 baud is the default) and press enter several times until you see a command prompt. To use the Windows configuration program, simply start the program, select the COM port, and power up the device.

The only setting absolutely required for normal APRS tracker operation is the callsign. The defaults for all other settings should be reasonable, but you should check on locally recommended settings, particularly for the digipeater path.

Port Modes

The Tracker2 has two serial ports that share the same physical connector. A ‘Y’ adapter is available to separate the ports if needed. Both ports can operate in multiple modes:

AUTO – In this mode, the device will automatically detect NMEA GPS data, Peet Bros weather data, or (for port A only) command console input. Note that while both ports can be configured in AUTO mode, only one should be used for a given function at any time. For example, port A can accept NMEA data while

port B accepts weather data, but providing NMEA data to both ports simultaneously will cause unpredictable operation.

GARMIN – This mode forces the selected port to 9600 baud, ignoring any manual setting, and starts Garmin binary communications.

KISS – In KISS mode, a PC or other host device sends and receives raw AX.25 packets. Keep in mind that even with one or both ports in KISS mode, the Tracker2 will continue to perform its other functions, including messaging and digipeating. The host should use a different callsign/SSID combination to avoid interference.

WS2300 – Supports LaCrosse WS-2300 series weather stations at 2400 baud, again ignoring manual baud rate settings.

FLOW – Valid only for port B, this setting causes the port B pins to function as CTS/RTS flow control signals for port A.

Remote Access

Commands can be issued to the Tracker2 remotely via APRS messages. The originating station's callsign must appear in the device's security authorization list (see AUTHLIST command.) Commands are prefixed with 'CMD', and the results of the command, if any, will be send back as an APRS message to the sending station.

For example, 'CMD VERSION', sent from an APRS client, will cause the target device to reply with its firmware version.

In response to a RESET command, the device will attempt to send one acknowledgement before resetting. This is intended to prevent message retries from causing multiple resets, but especially if the channel is busy there is a possibility that the acknowledgement will not be sent before the reset is executed. A RESET command should be cancelled after a few retries with no response received to check if the device has indeed been reset.

Garmin Fleet Management Interface

Some Garmin navigation systems, including the nüvi 300 and 600 series and StreetPilot 7000 series, provide a Fleet Management Interface (FMI) that can be used with the Tracker2 with the proper cable.

To use the FMI features, set one of the Tracker2's serial ports to GARMIN mode and connect the FMI cable. The Tracker2 will automatically place the navigation system in fleet management mode, which adds a 'Dispatch' menu item and may change the layout of other menus. This mode change can only be reversed by erasing all user data on the navigation system

If the waypoint output option is enabled, the Tracker2 will attempt to create points of interest (POIs) on the navigation system for every station, object, or item received. This feature is not part of the documented FMI protocol and does not work properly on all devices; many will create duplicate POIs every time a station moves. Until Garmin adds this feature to the official protocol, only the nüvi 350 is known to display moving POIs properly.

Incoming APRS messages will display a message icon on the navigation system's screen and will be stored in the inbox. Outgoing messages can be addressed to a specific station by starting the message with a dash ('-') and the destination callsign, followed by a space and the message text. If no station is specified, the message will be sent to the sender of the last message received. This allows conversations to be carried on without having to constantly re-enter callsigns.

To send a configuration command to the Tracker2, start a message with '!'. For example, '!VERSION' will cause the Tracker2 to respond with a message stating its firmware version.

Command Reference

Most commands can be issued through the serial console, APRS message, or fleet management message. Some commands make sense only when used from the local console and are not available for remote access.

1WIREWX

Enables 1-Wire Weather Station mode. The TAI8515 weather station should be connected to the front-panel modular jack.

ABAUD 1200 | 2400 | 4800 | 9600 | 19200 | 38400 | 57600 | 115200

Sets baud rate for the primary serial port. Default is 4800 baud.

ALIAS <n> <callsign>

Sets digipeater alias for slot <n>, where n is between 1 and 8. This will typically be a generic alias like 'WIDE'. No SSID is allowed in this field.

ALTITUDE on|off

Report altitude in position packet.

AMODE AUTO | GARMIN | KISS | WS2300

Sets mode for primary serial port. See 'Port Modes' above for more information.

AUTHLIST +/-<callsign>

Displays or changes the list of callsigns authorized for remote access. +callsign adds a callsign to the list, -callsign removes a callsign from the list, and 'none' erases the entire list. Up to six callsigns can be stored.

AUTOBAUD on|off

Enables automatic baud rate detection. When a baud rate mismatch is detected, the unit will attempt to automatically select the proper baud rate.

AUTOSAVE on|off

When enabled, the tracker will save its last-known GPS position as a permanent fixed position if the GPS fix is lost. This may be used in the

case of a temporary digipeater or weather station where a GPS receiver is installed only during setup and is removed to conserve power. The system must remain powered on for 30 seconds after GPS fix loss before the position is saved.

BBAUD 1200 | 2400 | 4800 | 9600 | 19200 | 38400 | 57600 | 115200

Sets baud rate for the secondary serial port. Default is 4800 baud.

BEACON [text] (local only)

If no beacon text is specified, a position beacon (and weather beacon, if applicable) will be queued for immediate transmission. If a text string is entered, that text will be transmitted as an AX.25 text packet.

BMODE AUTO | GARMIN | KISS | WS2300 | FLOW

Sets mode for secondary serial port. See 'Port Modes' above.

CALIBRATE LOW | HIGH | ALT | PACKET (local only)

Calibration functions to set demodulator tuning and transmitter deviation. 'Low' transmits a 1200 hz tone, 'high' transmits a 2200 hz tone, 'alt' transmits alternating 1200 and 2200 hz tones, 'packet' sends a test packet repeatedly, and 'tune' displays a tuning indicator for adjustment of the demodulator. Use the '[' and ']' keys for coarse adjustment of the transmit audio level, and '-' and '+' for fine adjustment. Press any other key to exit calibration mode.

CDINVERT on|off

Inverts carrier detect input polarity.

CLIMB on|off

Enables rate-of-climb indication. Climb rate is reported in feet per minute, positive or negative, immediately following the altitude. Available only in Garmin binary mode.

CNTRESET on|off

Causes counter to reset with each transmission. See accessory port information.

COMMENT <string>

Sets beacon text / comment string, up to 64 characters.

COMPRESS on|off

Enables Base91 compressed format for position transmissions.

CONFIG 1|2

(local only)

Selects configuration profile to modify.

CONVERSE

(local only)

In converse mode, text entered at the console is transmitted when the ENTER key is pressed. Hit CTRL-C to exit.

COUNTER on|off

Transmits counter value in status text.

CUSTSYM on|off

Enables the use of custom symbols if they have been uploaded to a compatible Garmin GPS receiver (using the Garmin xImage utility).

CWBEACON <text>

(local only)

Sends <text> as a Morse code beacon.

DAO on|off

Enables transmission of the !DAO! extended-precision construct. This provides an extra digit of precision over the standard APRS position format, but results in a longer packet and may not be supported by all APRS clients.

DEVLIST

(local only)

Lists addresses of all connected 1-wire devices.

DIGI on|off

When enabled, the tracker will digipeat packets having its own callsign (MYCALL) in the next digipeater address field.

DIGIID <n> on|off

Enables callsign substitution for digipeater alias <n> (1 to 8). This should normally be enabled.

DISPLAY

(local only)

Lists all configuration parameters.

DUPETIME <0-255> (seconds)

Sets digipeating duplicate suppression period.

EXTSQL on | off

Enables external squelch input.

FAHRENHT on | off

Reports temperatures in Fahrenheit when temperature output in the status text is enabled.

GPSDATA on | off

Reports GPS quality data in status text: Horizontal dilution of precision and number of satellites for NMEA mode, or estimated position error for Garmin mode.

HBAUD 1200 | 300

Selects transmission baud rate. Note that the reception baud rate is fixed at 1200 baud.

HEADERLN on | off

Breaks MONITOR packets into two lines, with header and payload separated.

HOPLIMIT <n> <hops>

For digipeater alias <n> (1-8), sets the maximum number of digipeater hops allowed. This can be used to limit excessively long paths that may cause network degradation.

INFO

Displays general system and diagnostic data, including number of packets heard, packets digipeated, and frame check sequence errors detected.

INTERVAL <0-65535> (seconds)

Sets the interval between automatic transmissions.

LOADFIRMW

(local only)

Loads firmware image using XMODEM protocol. The firmware file is provided in a binary (.bin) format. The tracker will reset when the firmware load is complete.

LVINHIBIT <0-255> (* 0.0784 volts)

Sets the low-voltage inhibit threshold. When the supply voltage drops below this level, the unit will cease transmitting. Each unit is 0.0784 volts, so a setting of 100 equals 7.84 volts.

MAXRANGE <0-255> (miles)

When set to a non-zero value, waypoints will only be created for stations and objects within the specified range.

MONITOR on|off

Displays incoming packets on the console as they are received.

MYCALL <xxxxxx-nn>

Sets the unit's callsign and optional SSID.

NICE <n>

When the tracker hears one of its own packets digipeated, it will skip the following <n> transmissions. This allows a faster beacon rate to be used in areas with poor coverage, without increasing the load on the network in areas with better coverage.

OUTPUT1 on|off

Not currently implemented.

PATCH <hex string>

The patch command allows direct modification of the contents of the Tracker2's flash memory. This command should only be used as directed by the manufacturer. Improper use of this command may render the Tracker2 inoperable.

POSITION <hhmm.mmx hhhmm.mmx> | GPS

Sets fixed position or enable GPS. Position must be entered in degrees and decimal minutes, including leading zeros. Setting position to 'GPS' reverts to GPS tracking mode.

Example: POSITION 4851.49N 00217.66E

POWER on|off|<0-255> (seconds)

ON or OFF will manually set the state of the power output. Specifying a value in seconds will enable automatic power control mode, where the

power output is turned on for the specified number of seconds prior to transmission, and turned off immediately after transmission.

PREEMPT <n> on|off

Enables digipeater preemption for alias <n> (1-8). If preemption is enabled, packets will be digipeated on this alias even if it isn't the next address in the packet's digipeater list.

PTTINPUT on|off

Enables PTT input for mic encoder operation. A position packet will be transmitted when the mic PTT is released.

PATH <call1,call2,...>

Comma-separated digipeater path list, containing up to three digipeater addresses.

PULSE <0-255> (seconds)

Activates power output for specified duration.

QUIET <0-255>

Time channel must be free before transmission can occur.

REARM <0-255> (milliseconds)

Specifies minimum time between counter inputs. May be used for switch de-bouncing.

REPLY <message>

(local only)

Sends a text message to the last person who sent a message addressed to this unit's callsign

RETRIES <0-255>

Number of times to retransmit an outgoing message.

RETRYTIME <0-255> (seconds)

Time between message retry attempts - interval increases by this value with each transmission.

REQALL on|off

Require all configuration switch parameters to be met before switching profiles.

RESET

Perform software reset. Saved settings are unaffected.

RING on|off

Sends a bell character whenever an incoming message arrives.

SEND <callsign> <message> (local only)

Sends a text message to the designated recipient.

SHAREDPTT on|off

Controls PTT line behavior for mic encoder mode. If enabled, PTT output is not asserted until the PTT input is released.

SLOT <0-65535>

Time slot for transmission (if TIMESLOT is on). Slot position is counted in seconds from the start of the hour.

SMARTBCON <low speed> <high speed> <low rate> <angle> <time>

Configures SmartBeaconing. The SmartBeaconing algorithm allows the tracker to operate more efficiently by changing how often it transmits depending on its speed and turn rate.

When stopped or moving at a speed below the low speed setting, the tracker will transmit at a fixed rate determined by the lower rate setting. Above the specified high-speed threshold, the higher rate setting is used. Between these two extremes, the interval varies between the low rate and high rate (specified separately with the INTERVAL command) depending on the speed.

The <low speed> and <high speed> settings define these two limits. For storage efficiency, the speeds are represented in units of 32 centimeters/second. To convert from miles per hour, multiply by 1.397. To convert from kilometers per hour, divide by 1.152.

Setting	MPH	Km/h
5	3.6	5.7
10	7.2	11.5
15	10.7	17
25	17.9	29
40	28.6	46
60	43	69
80	57	92

<low rate> and <high rate> are specified in seconds. <angle> indicates the change of direction, in degrees, that will cause an immediate transmission. <time> specifies, in seconds, the minimum time required between transmissions, regardless of speed or turns.

SQUAWK <0-255> (seconds)

Transmits alternating tones for specified number of seconds. May be used for testing or direction finding.

SWDCD on|off

ON selects software data carrier detect mode, providing a channel busy indication only when data is present. OFF selects energy detect mode, which will provide a busy indication for any signal, including static or voice. Use the ON setting for digipeater operation with open squelch for fastest signal acquisition.

STATUS <0-255>

Status packets are sent every *n* transmissions, or if set to 0, status text is sent as part of the position packet.

SYMBOL <1-2 characters>

APRS symbol character, optionally preceded by symbol table or overlay identifier.

TELEMETRY on|off

Enables transmission of telemetry packets.

TEMP on|off

Enables transmission of temperature readings from the on-board temperature sensor.

TEMPADJ <-128 to 127> (degrees C)

Offset for temperature sensor in degrees C.

TIMEHMS on|off

Sets timestamp mode to hour/minute/second when enabled. Default is day/hour/minute. Applies only to NMEA mode – hour/minute/second format is always used in Garmin binary mode.

TIMESLOT on|off

Force position packets to be transmitted only in designated time slots, expressed as the number of seconds from the start of the hour to the first transmission.

TIMESTAMP on|off

Report time information in the position packet.

TXDELAY <0-255>

Delay between start of transmission and start of data. This setting should be set to the minimum value that allows reliable reception of transmitted packets. An excessively high TXDELAY setting wastes channel capacity.

TXLEVEL <1-255>

Sets transmission audio level. This value should be selected to provide an appropriate FM deviation level, typically about 3.5 kHz.

TXNOFIX on|off

Allows transmission of last position if GPS fix is lost for more than 30 seconds. Default behavior is to cease transmitting the position in the absence of a valid GPS signal.

TXONCHG on|off

Causes an immediate transmission when switching configuration profiles.

USEALIAS <n> on|off

Enables digipeating for alias *n*.

VELOCITY on|off

Enables transmission of velocity (course and speed) information in the position packet.

VERSION

Displays firmware version number.

VOLTAGE on|off

Enables reporting of supply voltage in status text.

WAYPOINTS on|off

Enables output of waypoints from received positions.

WPTLEN <6-9>

Sets maximum waypoint name length.

WXINFO

Displays weather information from attached station.