

# TACMET II, TRV WEATHER STATION OPERATION MANUAL



## **Met One Instruments, Inc**

Corporate Sales & Service: 1600 NW Washington Blvd. Grants Pass, OR 97526

Tel (541) 471-7111 Fax (541) 471-7116

[www.metone.com](http://www.metone.com) - [service@metone.com](mailto:service@metone.com)

## Technical Support

Should you require support, please consult your printed documentation or our website [www.metone.com](http://www.metone.com) to resolve your problem. If you are still experiencing difficulty, you may contact a Technical Service representative during normal business hours;

Monday – Friday 7:00 a.m. to 4:00 p.m. Pacific Time.

Voice: (541) 471-7111

Fax: (541) 471-7116

E-Mail: [service@metone.com](mailto:service@metone.com)

Mail: Technical Services Department  
Met One Instruments, Inc.  
1600 NW Washington Blvd  
Grants Pass, OR 97526

## Safety Notice

The contents of this manual have been checked against the hardware and software described herein. Since deviations cannot be prevented entirely, we cannot guarantee full agreement. However, the data in this manual is reviewed regularly and any necessary corrections are included in subsequent editions.

Faultless and safe operation of the product presupposes proper transportation, storage, and installation as well as careful operation and maintenance. The seller of this equipment cannot foresee all possible modes of operation in which the user may attempt to utilize this instrumentation. The user assumes all liability associated with the use of this instrumentation. The seller further disclaims any responsibility for consequential damages.

## Electrical & Safety Conformity

The manufacturer certifies that this product operates in compliance with the following standards and regulations:

FDA/CDRH This product is tested and complies with 21 CFR, Subchapter J, of the Health and Safety Act of 1968

US 21 CFR 1040.10

## FCC Notices

Contains FCC ID: OUR-XBEE/OUR-XBEEPRO\*

The enclosed device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (i.) this device may not cause harmful interference and (ii.) this device must accept any interference received, including interference that may cause undesired operation.

**IMPORTANT:** The RF module has been certified for remote and base radio applications. If the module will be used for portable applications, the device must undergo SAR testing.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures: re-orient or relocate the receiving antenna, increase the separation between the equipment and receiver, connect equipment and receiver to outlets on different circuits, or consult the dealer or an experienced radio/TV technician for help.

### **RF Exposure**

**WARNING:** To satisfy FCC RF exposure requirements for mobile transmitting devices, a separation distance of 20 cm or more should be maintained between the antenna of this device and persons during device operation. To ensure compliance, operations at closer than this distance is not recommended. The antenna used for this transmitter must not be co-located in conjunction with any other antenna or transmitter.

### **Warranty**

All instruments are warranted against defects in parts or workmanship for a period of two (2) years from the date of shipment. Should any instrument or part prove to be defective within the warranty period, upon written notice and return of the unit (freight prepaid), Met One Instruments, Inc. will, at its option, repair or replace the defective unit, and return it, transportation prepaid via surface transportation.

Equipment abused, modified, or altered may cause cancellation of this warranty.

The above warranty applies only to items manufactured by Met One Instruments, Inc. Items not manufactured by Met One Instruments, Inc. are warranted only to the extent and in the manner warranted by the manufacturer of such items. Should emergency warranty repair be required at a customer's facility, Met One will provide such repairs and charge only the portal-to-portal Field Service rates and actual expenses in accordance with our published rates then in effect. Expendable supplies and wear items, such as bearings and lightning-related damages, are not covered under this warranty.

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## 1.0 Safety

This manual may include a **CAUTION** and a **WARNING** indication. Familiarize yourself with the following definitions for the meanings of these indicators.

A **CAUTION** indicates a hazard and calls attention to a procedure that if not correctly followed could result in damage to the instrument. Do not proceed beyond a caution indicator without understanding the hazard.

A **WARNING** indicates a hazard to you and calls attention to a procedure that if not correctly followed could result in injury or even death. Do not proceed beyond a warning without understanding the hazard.

## 2.0 Introduction & Overview

### 2.1 Overview

Met One's TACMET II, TRV Weather Station is designed as a stand-alone weather station to provide accurate measurements of wind speed, wind direction, temperature, relative humidity, and barometric pressure. The TRV Weather Station has a built-in 2.4 GHz spread spectrum radio module with 128-bit data encryption (XBeePro). The unit has no moving parts and is ideally suited for use wherever reliable, maintenance free operation over a wide operating range under adverse operating conditions is required. The unit is built with a metal housing to offer some protection from electromagnetic interference. The TRV Weather Station is painted CARC tan.

### 2.2 Specifications

#### **PERFORMANCE**

##### **Wind Speed**

Range	0-65 m/s (0-145 mph)
Accuracy *	$\pm 0.5$ m/s (1.1 mph) $\pm 5\%$
Resolution	0.1 m/s (0.22 mph)

##### **Wind Direction**

Range	0 to 360°
Accuracy *	$\pm 5^\circ$ @ wind speeds > 2.2 m/s (5 mph)
Resolution	1°

##### **Temperature**

Range	-40° to 60°C (-40° to +140°F)
Accuracy	$\pm 2^\circ\text{C}$ ( $\pm 3.6^\circ\text{F}$ ) @ WS>2.0 m/s (4.5 mph)
Resolution	$\pm 0.1^\circ\text{C}$

##### **Relative Humidity**

Range	0 to 100%
Accuracy	$\pm 3\%$
Resolution	1%

##### **Barometric Pressure**

Range	500 to 1200 hPa (14.75 to 35.50 in Hg)
Accuracy	$\pm 0.40$ hPa ( $\pm 0.01$ in Hg)
Resolution	0.1 in Hg

**MTBF** 80,000 hours

*\* This accuracy is maintained when the sensor is within  $\pm 10$  degrees of vertical.*

## **ELECTRICAL**

Measurement Format	Two orthogonal axis, North-South and East-West
Measurement Rate	Approx. 2 Hz each axis
Operating Frequency	40 kHz
Signal Output	RS232 @19.2 K baud (see section 5.0)
Power Requirements	9 - 36 Vdc: 100 mA draw @ 12 Vdc

## **PHYSICAL**

Size	12.25 inches (31.1 cm) x 4 inches (10.15 cm) dia.
Weight	5.5 lb. (2.5 kg.)
Mounting	MS3106F18-1S Connector
Finish	per MIL-DTL-64159
Color	CARC TAN 686A, 33446

### 3.0 Installation

Be sure to mount the TACMET II, TRV Weather Station in a clear, open area to minimize any turbulent effects caused by local obstructions (e.g., trees, buildings, etc.). The TACMET II, TRV Weather Station is installed on the Met One P/N 102709 pre-wired Quick Mount. The keyway in the connector on the base of the TACMET II, TRV Weather Station is matched to the keyway on the mount.

Attach the TACMET II, TRV Weather Station to the 102709 Quick Mount by inserting it into the top of the mount, aligning the latch springs with the clips on the bottom of the sensor. It may be necessary to rotate the TACMET II, TRV Weather Station 180° to allow the keyway to seat properly. When the sensor is properly seated in the mount, attach the latch springs to the clips on the sensor and snap them down to lock the sensor in place.

The TACMET II, TRV Weather Station is supplied with an internal flux-gate compass to automatically orient the wind direction data to True North. It is not necessary to manually align the TACMET II, TRV Weather Station towards North.

### 4.0 Input/Output Connections

The sensors' pin designations are as follows:

<u>PIN</u>	<u>FUNCTION</u>
A	Power and RS232 Ground
B	+9 to +36 Vdc Power Input
C	N/C
D	N/C
E	N/C
F	N/C
G	RS232 Receive Data
H	RS232 Transmit Data
I	N/C
J	N/C

**Radio Antenna Connector:** TNC Jack

## 5.0 User Interface

The internal serial port works in parallel with the radio. The unit is set for polled operation. The output of the TACMET II is a serial data stream. Typically, the output is set for 19.2k baud (N/8/1) and outputs the data string when polled. The data can be viewed, displayed, and logged using Met One AWeather Software. An example of the output format is shown below:

```
<STX>R S0011 000.6 102 +077.1 055 29.77 63<EOT>
```

The string consists of eight fixed length fields each separated by a space (0x20) character. Each data field contains leading zeros, temperature is preceded by a plus or minus sign.

- Field 1: Start of transmission character <STX> immediately followed by an R
- Field 2: Serial number of the sensor (Snnnn)
- Field 3: Wind speed data in miles per hour (nnn.n)
- Field 4: Wind direction data in degrees (nnn)
- Field 5: Temperature data in degrees Fahrenheit (+/-nnn.n)
- Field 6: Relative humidity data in percent (nnn)
- Field 7: Barometric pressure data in inches of mercury (nn.nn)
- Field 8: Two digit Checksum two-digit checksum immediately followed by an end of transmission character (nn<EOT>).

The Checksum is the Twos Complement (Negated) of the 8 bit sum of all the characters in the output including the <STX> character to start the message and the ending <EOT> character (not including the Checksum itself). The Checksum is inserted into the string before transmission.

The polling string must be set up by the user before deploying the system. This string is set up using terminal commands. Please refer to Appendix A for instructions on how to enter the terminal command mode and the “ST” command for details on how to set up the polling string.

## 6.0 Calibration

A zero wind speed check can be done by covering the sensor with a thick plastic bag sealed beneath the sensor. The wind speed should read zero, and the wind direction will bounce around. WS, WD, temperature, relative humidity and pressure should be checked by co-location with a reference sensor. For formal calibration, the unit needs to be returned to the factory. The sensor requires a wind tunnel for WS/WD calibration. Met One Instruments, Inc. can provide NIST traceable calibration in our wind tunnel. Please contact the factory for details.

## 7.0 Maintenance

Because the sensor has no moving parts to wear out, periodic maintenance is not required. In extremely corrosive environments, the condition of the connector used to mount the sensor should be checked.

In harsh environments, the transducer screens should be checked for dust or sand buildup. Should the transducer screens need to be cleaned, with the unit upright, brush the transducer screens with a short, medium to firm bristle brush.

There are no adjustments or user repairable parts located inside the sensor.

## Appendix A Terminal Mode Commands

Connect to a computer running a terminal emulator program like Putty at 19200, N, 8, 1. Power up the TACMET II and hit Ctrl T within 2 seconds of powering the sensor. Terminal mode times-out after 2 minutes of inactivity.

Successful entry into Terminal Mode will return the prompt:

**Command (HE for Help, QU to Quit):**

### HE - Display Help Menu

<b>HE</b>	<p>Display the Help menu Command: HE&lt;cr&gt;</p> <p>HE - This Help Menu            BV - Battery Voltage Printout Toggle On/Off            CV - Compass Heading Printout Toggle On/Off            MD - Set Magnetic Declination            OI - Set Output Interval            PU - Set Pressure Units            QU - Quit command mode and save any changes            SA – SDI Address            SB - Set Baud rate            SP - Sign-on Prompt Toggle On/Off            ST - Set Serial Trigger Address            SU - Set Speed Units            TU - Set Temperature Units            VN - Display Firmware Version Number</p>
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### SU - Wind Speed Units

Read or Set output Units for Wind Speed.

COMMAND	RESULT
SU<cr>	Report Units setting
SU0<cr>	M/S (Default)
SU1<cr>	MPH
SU2<cr>	Knots
SU3<cr>	KPH

### TU - Temperature Units

Read or Set output Units for Temperature.

COMMAND	RESULT
TU<cr>	Report Units setting
TU0<cr>	Celsius (Default)
TU1<cr>	Fahrenheit

### PU - Pressure Units

Read or Set output Units for Pressure

COMMAND	RESULT
PU<cr>	Report Units setting
PU0<cr>	hPa (Default)
PU1<cr>	Inches of Mercury

### SB - Serial Baud Rate

Read or Set Baud Rate

Note: This command is not supported by Tracker Output.

Tracker output is fixed at 9600 Baud.

COMMAND	RESULT
SB<cr>	Report Baud Rate setting
SB1<cr>	1200 baud
SB2<cr>	2400 baud
SB3<cr>	4800 baud
SB4<cr>	9600 baud
SB5<cr>	19200 baud (Default)

Baud rate changes take effect after cycling power to the sensor.

### BV - Toggle Battery Voltage Printout in data string

Read or Set the Battery Voltage output option

COMMAND	RESULT
BV<cr>	Report option setting
BV0<cr>	Battery Voltage printout Disabled (Default)
BV1<cr>	Battery Voltage printout Enabled

### CV - Toggle Compass Heading Printout in data string

Read or Set the Compass Heading output option

COMMAND	RESULT
CV<cr>	Report option setting
CV0<cr>	Compass Heading printout Disabled (Default)
CV1<cr>	Compass Heading printout Enabled

### MD - Magnetic Declination

Read or Set the Magnetic Declination

COMMAND	RESULT
MD<cr>	Report Magnetic Declination setting
MDXX.X<cr>	Set Declination to XX.X Degrees

Note: West declination values are entered and reported as negative values.

### ST - Serial Trigger

Read or Set the Serial Trigger character string (Poll command). This can be any alpha numeric value, limited to six digits. The serial trigger is case sensitive.

Note: ST must be immediately followed by the serial trigger string. Do not add a space between the command and trigger.

COMMAND	RESULT
ST<cr>	Report Serial Trigger string setting
STXXXXXX<cr>	Set Serial Trigger

### VN - Software Version Number

Report the current Software Version Number

COMMAND	RESULT
VN<cr>	Report current Software Version

### OI - Output Interval

Read or Set the Output Interval

Note: This command is not supported by CAMEO/ALOHA or Tracker Output.

COMMAND	RESULT
OI<cr>	Report Output Interval setting
OI1<cr>	Sensor Output every 1 second (Default)
OI2<cr>	Sensor Output every 2 seconds
OI3<cr>	Sensor Output every 5 seconds
OI4<cr>	Sensor Output every 15 seconds
OI5<cr>	Sensor Output every 30 seconds
OI6<cr>	Sensor Output every 60 seconds

### SA – SDI Address

Read or Set the SDI Address

COMMAND	RESULT
SA<cr>	Report SDI-12 Address
SAX<cr>	Set SDI-12 Address (X may be [0-9], [A-Z], or [a-z]; case sensitive)

### SP - Sign-On Prompt

Read or Set the Sign-On Prompt output option at power-up

COMMAND	RESULT
SP<cr>	Report option setting
SP0<cr>	Sign-On Prompt Disabled (Default)
SP1<cr>	Sign-On Prompt Enabled

### QU - Quit

**Exit the command mode and query to save any changes.**

Command (HE for Help, QU to Quit): QU<cr>

To save changes type 'Y' : N<cr>

Restarting

## **Appendix B**

### **Theory of Operation**

#### **Winds**

Met One's sonic anemometer operates on the principal that the speed of the wind effects the time it takes for sound to travel from one point to a second point. If the sound is traveling in the direction of the wind, the transit time is decreased. If the sound is traveling in a direction opposite the wind, the transit time is increased. This principal is well known and is the basis of most sonic anemometers.

#### **Temperature / Humidity**

The temperature sensor in the P/N 102760-1 TACMET II uses a precision single-element thermistor. This provides a highly accurate and stable temperature reading. The resistance value is 10K ohms at 25°C. This allows the TACMET II to directly interface with the temperature sensor without additional electronics; sensor compensation is handled through software.

The relative humidity sensor is a capacitive element sensor. It has a linear voltage output connected directly to the TACMET II microprocessor. The humidity sensor element's construction provides excellent resistance to wetting, dust, dirt, oils, and common environmental chemicals. A heavy contaminant layer of dirt will slow down the sensor's response time because it will take longer for water vapor to equilibrate in the sensor.

#### **Barometric Pressure**

The P/N 102555 barometer uses proven silicon sensor technology with microprocessor-based signal compensation, eliminating the need to insulate or thermally regulate the barometer. The P/N 102555 has a pressure range of 14.75 to 35.50 in Hg (500 to 1200 hPa). The P/N 102555 has a TTL output that reduces the power consumption of the barometer to 33 mW. The accuracy of the sensor is  $\pm 0.4$  hPa (0.01 in Hg)