



i.Report VP3-TMxx Remote Monitoring



i.Report VP3-TM User Guide

1. Safety Notice, Warranty, Required Information

2. Introduction to VP3-TM Remote Monitoring

- 2.1. What Can You Monitor?
- 2.2. What Sort of Notifications Can You Receive?
- 2.3. How Do You Set Up Notifications?
- 2.4. Multi-User Notification Scenarios
- 2.5. Where To Start?
- 2.6. Device Specifications

3. Alarm Examples

- 3.1. Example: Tank Level Percentage
- 3.2. Example: Simple On-Off
- 3.3. Example: Enumerated State
- 3.4. Example: Alarm Escalation

4. Overview of Configuration via Tool Software

5. Overview of Configuration via SMS

6. Configuration Tool: Getting Connected

- 6.1. Connecting, Reconnecting, and Disconnecting
- 6.2. Read All and Write All Configuration
- 6.3. Using the Command Console
- 6.4. Verifying SIM Activation
- 6.5. Using the Toolbar Tools

7. Configuration Tool: Data Objects

- 7.1 Object configuration
- 7.2 Alarm configuration
- 7.3 Alarm message formatting
- 7.4 Protocol configuration

8. Configuration Tool: Protocol Settings

- 8.1. Modbus RTU - VP3-TM10
- 8.2. BACnet MS/TP - VP3-TM30
- 8.3. Modbus TCP - VP3-TM60
- 8.4. BACnet IP - VP3-TM70

9. Configuration Tool: Users

- 9.1. The Phonebook
- 9.2. Password Locking

10. Configuration Tool: User Groups

11. Console Commands and Queries

- 11.1. Site or Device Level Commands and Queries
- 11.2. Data Object Commands and Queries
- 11.3. User Commands and Queries
- 11.4. Group Commands and Queries
- 11.5. Protocol Commands and Queries - Modbus
- 11.6. Protocol Commands and Queries - BACnet

12. Remote Commands and Queries via SMS

- 12.1. Available Commands and Queries
- 12.2. Message STOP
- 12.3. Claiming Ownership of New Device

13. Configuration Script Files

14. CSV File Import/Export

14.1 Using CSV Files to Speed Configuration

14.2. Data Object CSV File Format

14.3. User (Phonebook) CSV File Format

15. Diagnostics and Trouble Shooting

15.1. Sending a Test SMS Message

15.2. Testing Alarms

15.3. Testing Communications - Modbus

15.4. Testing Communications - BACnet

15.5. Diagnostic SMS Queries

15.6. Signal Strength Indication

15.7. Fault Codes

15.7.1. Fault Codes - Modbus

15.7.2. Fault Codes - BACnet

15.8. Restart Codes

15.9. Connection Error Codes

Appendix A. SIM Card Activation

A.1. Activating TracFone Service on AT&T Network

A.2. Activating TracFone Service on Verizon Network

Appendix B. Modbus Slave Register Map

Appendix C. Modbus Protocol Reference

Appendix D. BACnet Object Properties

Appendix E. BACnet Codes

Appendix F. Hardware Details

F.1. LED Indications Common to All Models

F.2. LED Indications for Modbus RTU on VP3-TM10

F.3. LED Indications for BACnet MS/TP on VP3-TM30

F.4. LED Indications for Modbus TCP on VP3-TM60

F.5. LED Indications for BACnet IP on VP3-TM70

F.6. Wiring Connections

F.7. Opening the VP3-TMxx Device

F.8. Jumper Settings

F.9. SIM Card Replacement

Appendix G. Virtual Objects

Appendix H. API Mode

Copyright © 2019 Control Solutions Minnesota, Inc.



**i.Report VP3-TMxx
Remote Monitoring**



CONTROL SOLUTIONS MINNESOTA

1. Safety Notice, Warranty, Required Information

1.1 Important Safety Notice

Proper system design is required for reliable and safe operation of distributed control systems incorporating any Control Solutions product. It is extremely important for the user and system designer to consider the effects of loss of power, loss of communications, and failure of components in the design of any monitoring or control application. This is especially important where the potential for property damage, personal injury, or loss of life may exist. By using ANY Control Solutions, Inc., product, the user has agreed to assume all risk and responsibility for proper system design as well as any consequence for improper system design. Under no circumstances shall any Control Solutions product be used for life safety or life support functions without prior written permission from an authorized executive of Control Solutions, Inc.

1.2 Warranty

Configuration tool software and documentation is provided “as is,” without warranty of any kind, either expressed or implied, including, but not limited to, the implied warranties of fitness or merchantability for a particular purpose. Control Solutions may make improvements and/or changes in this documentation or in the product(s) and/or the program(s) described in this documentation at any time. This product could include software bugs, technical inaccuracies, typographical errors, and the like. Changes are periodically made to the information herein; these changes may be incorporated in new editions of the software.

i.Report Product Warranty: All Control Solutions products are warranted against defects in materials and workmanship for a period of 1 (one) year from date of shipment from factory. Defective units will be repaired or replaced, at manufacturer’s discretion, at no cost to user except when negligence or improper use has resulted in damage. The express warranty stated herein is in lieu of all other warranties, express or implied, including without limitation any warranties of merchantability or fitness for a particular purpose and all other warranties are hereby disclaimed and excluded by Control Solutions, Inc.

1.3 Required License Information

The VP3-TM configuration tool includes the SmartWin library (<http://smartwinlib.org>) under the following terms:

License agreement for SmartWin++ (BSD license)

Copyright (c) 2005, Thomas Hansen All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

- * Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
- * Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
- * Neither the name of the SmartWin++ nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT OWNER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Copyright © 2019 Control Solutions Minnesota, Inc.



i.Report VP3-TMxx Remote Monitoring



CONTROL SOLUTIONS MINNESOTA

2. Introduction to VP3-TM Remote Monitoring

2.1. What Can You Monitor?

The i.Report Text Messenger is a self-contained remote monitoring and alarm notification system that monitors data points in one or more Modbus/BACnet devices and alerts you and others via SMS when an event has been detected that somebody should know about. The i.Report Text Messenger offers simple yet powerful remote monitoring without the need for a monitoring service - no contract required.

You decide what events somebody should know about, and who should know about them. If the event is important, you can require the alarm message recipient to acknowledge the notification. You also have the option of escalating the notification to additional users if the first user (or group of users) did not respond by acknowledging the alarm within the time limit you set.

A single i.Report can monitor up to 100 data points from a single device or from multiple devices on the network. An event can be a level exceeding a threshold high or low, a change in state, change in value, or deviation from a setpoint. The parameters that decide what constitutes an active alarm are set up with an easy to use template. A notification is sent when the alarm transitions to "active", and again

when the alarm transitions to "inactive". If acknowledgement is required but not received within the time you allowed, the active alarm notification is repeated, possibly including additional users each time if you set it up that way.

The notification message consists of whatever text you provided, optionally including template variables. These "variables" are replaced with dynamic data, such as present level, at the time the message is sent to users' mobile phones.

The i.Report Modbus Text Messenger can be Modbus master or slave. As master, it will poll other Modbus slaves, querying the registers you have selected and evaluating register content against alarm criteria. As slave, you can have your PLC or SCADA system write data to the i.Report for alarm evaluation. As a slave, the i.Report will contain up to 100 holding registers addressable by your PLC or SCADA.

Modbus RTU also includes "Sniffer Mode" which means you can monitor Modbus data without any reprogramming of the Modbus devices being monitored. As long as there is traffic on the network between a master and one or more slaves, you can monitor it and receive notifications when your selected registers match the criteria you set. Modbus TCP does not need sniffer mode because you can always have multiple masters on a TCP network. So if you know what register you want to look at, just poll it.



The i.Report is also useful for "non-network" monitoring applications. There are many industrial sensors available with Modbus capability. For mobile applications, a Modbus GPS receiver is available, and a simple geo-fencing implementation can be configured. Control Solutions offers three different models of ValuPoint Programmable I/O which may be used to interface multiple sensors, and even remotely controllable actuators.

The i.Report BACnet Text Messenger can be a BACnet client or server. As a client, it will read properties from objects in other BACnet devices and retain copies of that data for evaluation against alarm criteria. As a server, the i.Report will contain a collection of Analog Value and/or Binary Value objects which other BACnet devices may write data to. Data written to these objects by other BACnet devices will be evaluated against alarm criteria for possible notification.

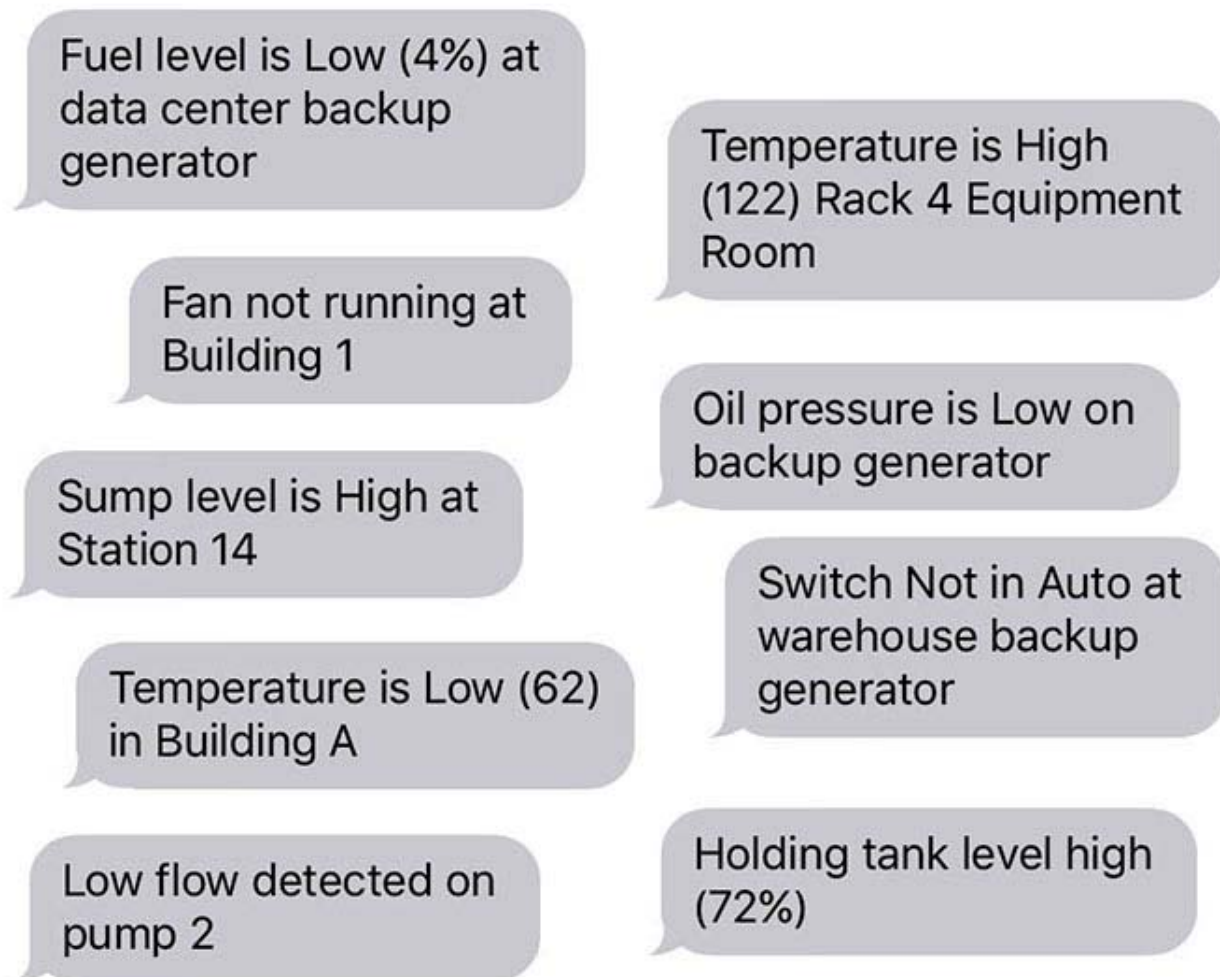
The i.Report BACnet Text Messenger can be used in multiple ways in Building Automation Systems. You can provide alarm monitoring and notification regarding specific equipment such as chillers, compressors, pumps, air handlers, etc., and do this monitoring without reprogramming anything. Because the i.Report represents no network security risk, you can implement monitoring without impacting IT management. This makes i.Report a useful diagnostic tool that can be quickly added without impacting existing BAS programming.



The i.Report BACnet Text Messenger can also be an alternate method of generating SMS notifications at the direction of the BAS front end system. The i.Report sends SMS messages directly to the cellular network without the need for passing messages through an external SMS gateway.

2.2. What Sort of Notifications Can You Receive?

The notification message can say almost anything you can dream up. The notification can be triggered by exceeding a threshold high or low, a change in state or value, or deviation from a setpoint.

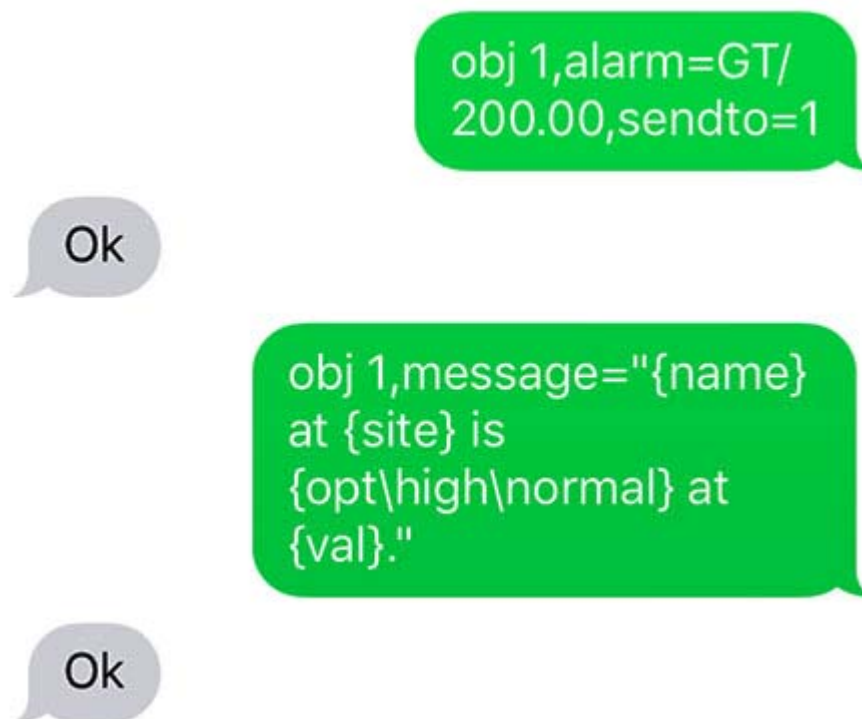


The message can be anything you like. To make the messages more meaningful, there is a set of variable names that can be used to get real time information

when the message is created. For example, if you include "{val}" in your message, the {val} will be replaced by the actual value of that data point as of when the message is created. Other variables include {site} for site name or location of the VP3-TM or {name} for name of this particular data object. Refer to the section about alarm message formatting later in this user guide for the complete list of available variables.

One of the more interesting variables is {opt\a\b}. This means text option. If the alarm is active, then text string "a" is included in the message, otherwise text string "b" is included. An example using "opt" would be "{name} at {site} is {opt\too high\normal}". If the object name is "Tank level" and site name is "Station 1", then the message delivered when the alarm is active would be "Tank level at Station 1 is too high."

2.3. How Do You Set Up Notifications?



You can do everything needed to configure the VP3-TM entirely via SMS. This is most useful for making changes after the remote monitoring is already deployed at some remote location. You will find initial setup is greatly streamlined with the use of the free configuration tool software provided by Control Solutions.

VP3-TMxx Text Messenger Configuration Tool v1.08

Connected: ☒ Sync: ☒

Connect | Object List | Object Edit | Protocol | **Users** | Groups

Object Number: 1 Name: Remote Sensor 1

Data Format: Floating Point

Slope/Scale Factor: 1 Virtual Link: 0 Bit Mask: 00000000

Intercept/Offset: 0 Report Daily: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8

☒ Show Alarm ☐ Show Protocol Map

Alarm Test: GT: Greater Than Threshold: 200.00000 Hysteresis: 0.000000

☐ Require Ack Min On (S): 0 Enabled By: 0

☐ Notify Active Only Min Off (S): 0 Delay: 0

Message: {name} at {site} is {opt\in alarm\normal} at {val}

Report On Alarm: ☒ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8

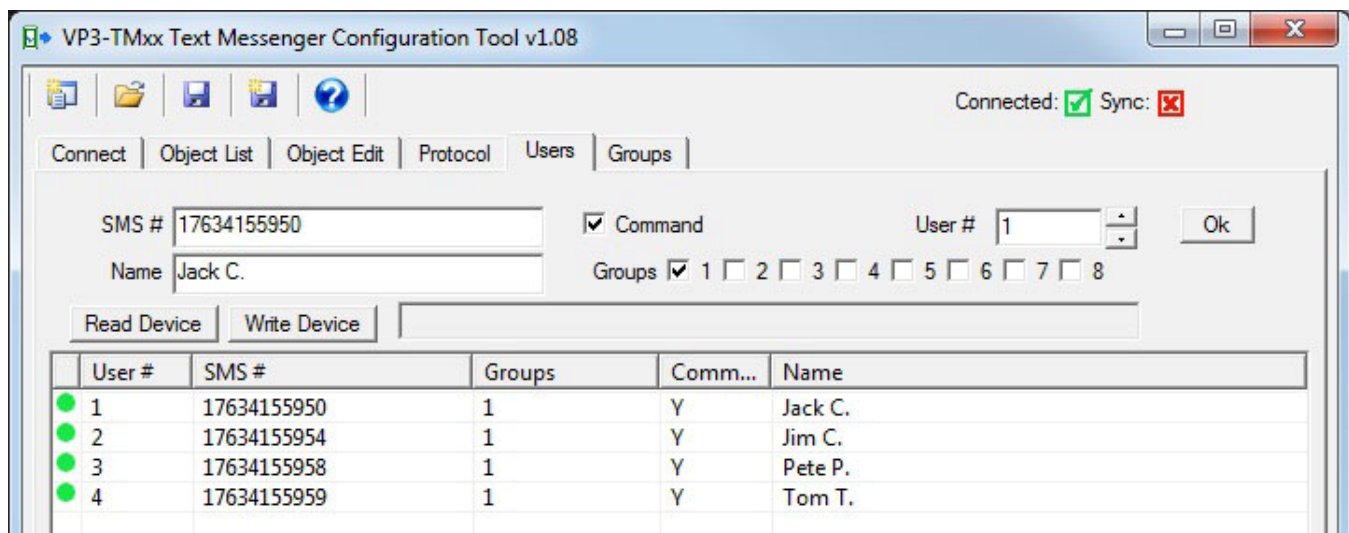
Read Device Write Device

The VP3-TM configuration tool provides easy templates to fill in for configuring data points and their respective alarms, as well as entering users in the phone book. To further speed up the process, you can create a list of data points using a standard spread sheet program (e.g. Excel). Save your data points as a CSV file, and the VP3-TM configuration tool will import your entire list at once. A CSV import may also be used to import your list of users into the phone book.

Once you have created the initial configuration, you can save your entire configuration to a text file as a configuration script. Your data points, alarm settings and messages, and phone book are all included in this file. This is useful both as a backup copy, and for duplicating the same configuration for a second similar site.

2.4. Multi-User Notification Scenarios

The phone book holds up to 50 users. Each user should be included in one of the user groups, and may be included in more than one. There are 8 user groups available. When an alarm notification is sent, it is sent to a user group. All of the users included in that group will be sent the same message at the same time.



User grouping allows certain messages to be sent to one group of users while other messages are sent to other users if desired. Each group also has an optional delay and repeat time. The combination of delay, repeat, and group selection is used to create an alarm escalation scheme whereby if the group initially notified does not acknowledge the alarm within the time limit you provide, then the next group will be notified.

User groups are also assigned attributes determining whether that group receives messages about communication errors and failures, and administrative messages. The admin user will receive messages pertaining to other users. For example, the "admin" user(s) will receive a notification if some other user has replied "stop" to stop receiving messages.

2.5. Where To Start?

Start by creating your configuration. Create some data points and give them some alarm parameters. Create the message that should be sent. Add a user or two to the phone book.

Save all of this to a configuration file, and do this from the Connect page in the configuration tool.

Next, get connected to the VP3-TM. You will need an RS485 connection between the NET terminals on the VP3-TM, and your PC/laptop. Follow directions in the "Getting Connected" section of this user guide.

Once connected and communicating in "configuration mode", write your configuration to the VP3-TM.

While still in configuration mode, follow instructions as applicable for activating the SIM in your VP3-TM. If using the pre-installed SIM provided by Control Solutions, instructions for activation are found in Appendix A of this user guide. Verify SIM

activation as noted under "Getting Connected".

You have the option of sending a test SMS message to yourself via the VP3-TM at this point. You also have the option of testing your alarms before connecting the VP3-TM to whatever it will actually be monitoring. Both of these topics are covered in the section titled "Diagnostics and Trouble Shooting".

Finally, connect the VP3-TM to the device(s) it is intended to monitor. Since every application is different, we can't tell you exactly how to verify your device is being monitored, but typically there will be some data points you can look at and come to a satisfactory conclusion. Some suggested diagnostic SMS queries may be found in the section titled "Diagnostics and Trouble Shooting".

2.6. Device Specifications

- Self-contained remote monitoring and alarm notification system
- Monitors data points in one or more Modbus/BACnet devices
- Alerts one or more users via SMS when an event has been detected
- User configurable SMS messages with dynamic content templating
- Up to 100 data objects (Modbus registers or BACnet objects)
- Alarm settings and SMS message content programmable per object
- Up to 50 user phone book, 8 user groups
- Notify multiple users with configurable delay and repeat times per group
- Notification escalation with repeat when not acknowledged (optionally configured)
- Password protected replies accepted from known authorized users
- Unrecognized phone numbers ignored
- Optionally change parameters or command outputs remotely via SMS
- Modbus TCP 10/100BaseT, Modbus RTU 1200 to 38400 baud
- BACnet IP 10/100BaseT, BACnet MS/TP 9600, 19200, 38400, 76800 baud
- Master or slave, client and server
- Up to 20 Modbus TCP devices, up to 100 Modbus RTU devices
- Compatible with AT&T or Verizon 4G LTE
- Operating voltage: 10-30VDC, 24VAC
- Operating current: 0.1A @ 24VDC typical, 0.4A @ 24VDC peak (transmitting, 500mSec duration typical)
- Temperature: -40 to +85°C (SIM card excluded), 95% relative humidity non-condensing
- Mechanical: DIN rail mount, 100mm H x 70mm W x 60mm D

Copyright © 2019 Control Solutions Minnesota, Inc.



i.Report VP3-TMxx Remote Monitoring



3. Alarm Examples

The examples shown in this section illustrate some of the more powerful features of the alarm monitoring and message generation. The configuration tool screen shots have been condensed to call attention to only those parameters necessary to obtain the results illustrated.

3.1. Example: Tank Level Percentage

Fuel level is Low (4%) at data center backup generator

Object Number	1	Name	Fuel level
Data Format	Floating Point		
Alarm Test	LT: Less Than	Threshold	5.000000
		Hysteresis	0.000000
Message	{name} is {opt\Low\Ok} ({%60}) at {site}.		
Site Name	data center backup generator		

Messages may contain “variables”. One of the more interesting variables is {opt\{a}\{b}}. This means text option. If the alarm is active, then text string “a” is included in the message, otherwise text string “b” is included. In this example, the message will say “Low” if the alarm is active, and “Ok” otherwise.

The {val} variable can be used to include the data point or object’s actual value at that point in time. But sometimes the actual number is less meaningful than a relative value. In this example, the {%60} means the message will include a percentage which will be the object’s actual value divided by the number given in the variable. The number following “%” in the variable can be any number. In this example, the object’s actual value would have been 2.4 to generate a message saying 4%. If the fuel level on the backup generator is down to 4%, somebody needs to get moving!

3.2. Example: Simple On-Off

Fan not running at Building 1

Object Number	1	Name	Fan
Data Format	Boolean/Bit		
Alarm Test	NE: Not Equal	Threshold	1
		Hysteresis	0
Message	{name} is {opt\not running\running} at {site}.		
Site Name	Building 1		

Sometimes we don't care about level as a percentage, we just want to know if something is on or off. This example illustrates that. In this example, we want to know about it if our fan stops running. The object is defined as Boolean/bit, and our alarm is active any time that bit is not 1 - a 1 usually implies "on" or running.

3.3. Example: Enumerated State

Switch Not in Auto at warehouse backup generator.

Object Number	1	Name	Switch Not in Auto		
Virtual Link	0	Threshold	0.000000	Hysteresis	0.000000
Alarm Test	EQ: Equal	<input checked="" type="checkbox"/> Notify Active Only			
Message {name} at {site}.					

Object Number	2	Name	Switch is in Auto		
Virtual Link	1	Threshold	1.000000	Hysteresis	0.000000
Alarm Test	EQ: Equal	<input checked="" type="checkbox"/> Notify Active Only			
Message {name} at {site}.					

Object Number	3	Name	Switch is in Override		
Virtual Link	2	Threshold	2.000000	Hysteresis	0.000000
Alarm Test	EQ: Equal	<input checked="" type="checkbox"/> Notify Active Only			
Message {name} at {site}.					

Site Name	warehouse backup generator				
-----------	----------------------------	--	--	--	--

There are times when the notification we desire is not strictly a matter of high/low or on/off. We want to know when something changes state, and there may be multiple states. One example might be a 3-position switch that is on-off-auto. Or a speed setting of off-low-medium-high. It is possible to use a collection of cascaded objects to generate notifications, one per setting. We refer to this type of alarm as an enumerated alarm.

The first object in the sequence will be configured to query some remote device to obtain the present value of the switch setting in question. The remaining objects will simply refer to the previous object using the "virtual link". We also select the option "Notify Active Only". Normally you would receive a message when the alarm transitions to active, and another message with the alarm transitions to inactive. With the "Notify Active Only" selected, you will only receive a notification when the alarm transitions to active. Since we have cascaded the same data point to multiple objects, and each object has its own "alarm" setting, we only want to

know about the active transitions.

In the example illustrated here, you will receive the "Switch Not in Auto" notification when switch transitions to a value of 0, "Switch is in Auto" when the switch object transitions to a value of 1, and "Switch is in Override" when the switch transitions to a value of 2. On startup, the value of zero is treated as a transition for purposes of an "equal to zero" test.

3.4. Example: Alarm Escalation

[1/1] Test Object 1 at My Site is in alarm at 220.00.

Ack 1/1

Ok

Alarm Test Threshold Hysteresis

☒ Require Ack Min On (S) Enabled By

☐ Notify Active Only Min Off (S) Delay

Message

Report On Alarm ☒ 1 ☒ 2 ☒ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8

	Group #	Delay	Repeat	Admin	Fails	Errors	Starts	Daily
<input checked="" type="radio"/>	1	0	300	N	N	N	Y	N
<input checked="" type="radio"/>	2	600	300	N	N	N	Y	N
<input checked="" type="radio"/>	3	1200	300	N	N	N	Y	N
<input checked="" type="radio"/>	4	0	0	N	N	N	N	N
<input checked="" type="radio"/>	5	0	0	N	N	N	N	N
<input checked="" type="radio"/>	6	0	0	N	N	N	N	N
<input checked="" type="radio"/>	7	0	0	N	N	N	N	N
<input checked="" type="radio"/>	8	0	0	N	N	N	N	N

	User #	SMS #	Groups	Comm...	Name
<input checked="" type="radio"/>	1	17634155950	1	Y	Jack C.
<input checked="" type="radio"/>	2	17634155954	2	Y	Jim C.
<input checked="" type="radio"/>	3	17634155958	3	Y	Pete P.
<input checked="" type="radio"/>	4	17634155959	1	Y	Tom T.

The alarm escalation has been mentioned previously. Here we illustrate the settings necessary to implement that escalation. The alarm settings such as test and threshold are made the same as with any other alarm. The only additional requirement in configuring the object's alarm parameters is that you select

“Require Ack”. This means the alarm notification will potentially repeat indefinitely until acknowledged by a user known to the VP3-TM, i.e., found in the phone book.

The more important settings for alarm escalation are found in the group configuration. The Repeat time is a timeout in seconds. If the alarm is not acknowledged within this amount of time, the notification will be sent again to everyone in that group.

The Delay is an optional timeout in seconds that causes this group’s notifications to be delayed. The delay time for a group should always be greater than the repeat time for the previous group. If the alarm has been acknowledged before the delay time expires, then this group is never notified at all.

So here is what is going to happen in this example. When the alarm occurs, Jack and Tom will be notified immediately. They’ve got 10 minutes to acknowledge the alarm. They will get a reminder after 5 minutes. Suppose they don’t acknowledge the alarm. At 10 minutes, Jack and Tom will get another reminder notification, but now Jim is also notified. He’s the supervisor and he’s probably going to be on the phone looking for Jack and Tom. Jim has the option of acknowledging the alarm himself, but he forgets. Another 10 minutes go by and nobody has acknowledged the alarm yet. Now Pete is going to get his first notification while everybody else gets another reminder. Pete is the big boss, and he’s going to be unhappy because he should never have to be notified. But hey, that’s why we have escalation capability in the first place - keep those guys in line.

How do you acknowledge the alarm? It’s easy. If acknowledgement is required, there will be a number in brackets at the start of the message. Simple reply to the text with “Ack a/b” where a/b are the numbers in the message being acknowledged. The acknowledgement must come from a phone number in the phone book, and the a/b numbers must match before the acknowledgement will be registered.

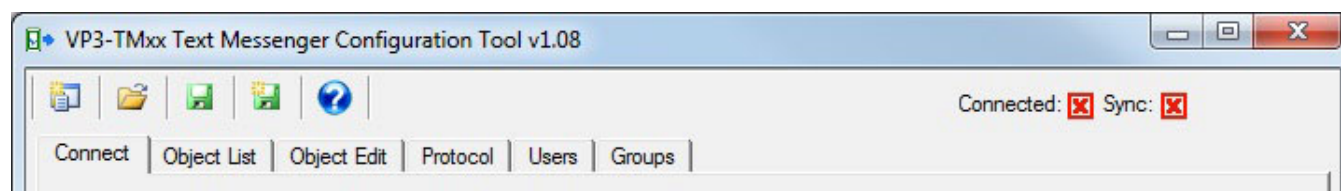
Copyright © 2019 Control Solutions Minnesota, Inc.



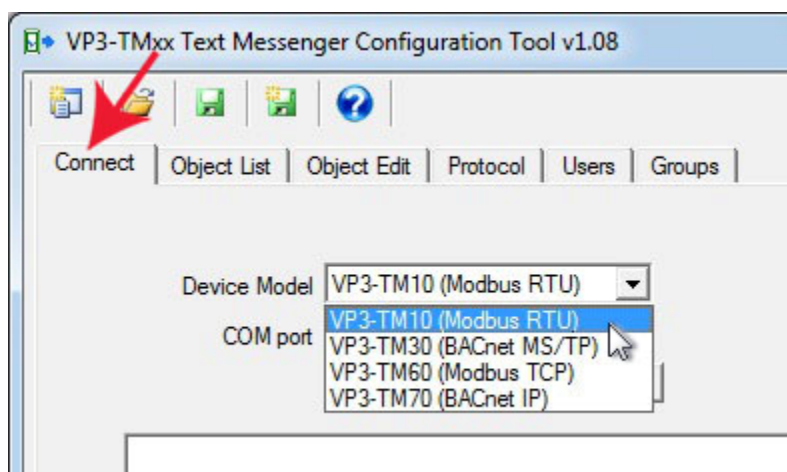
i.Report VP3-TMxx Remote Monitoring



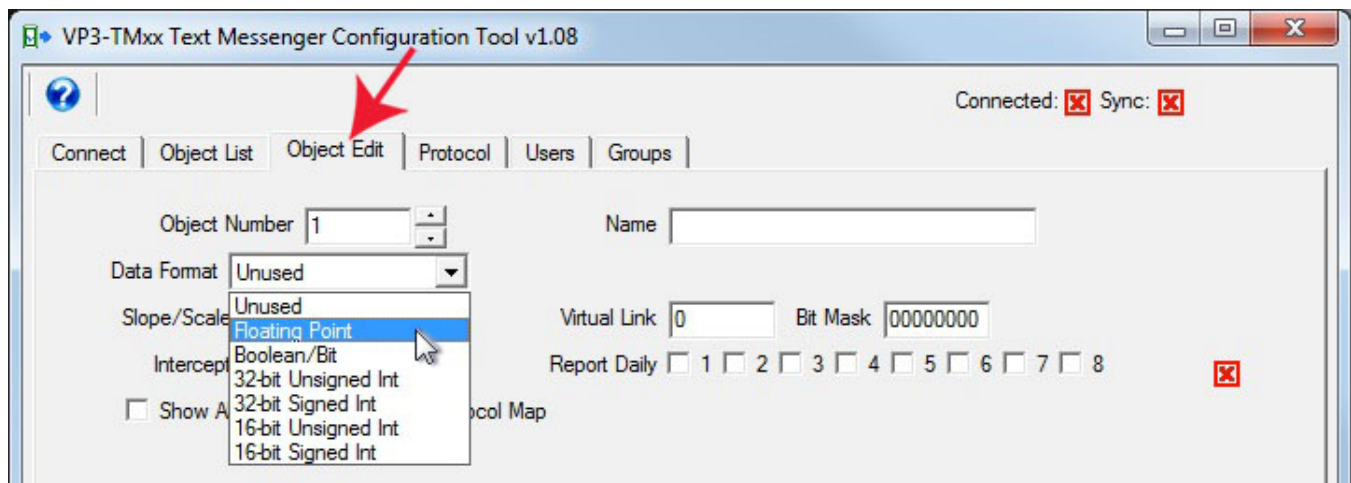
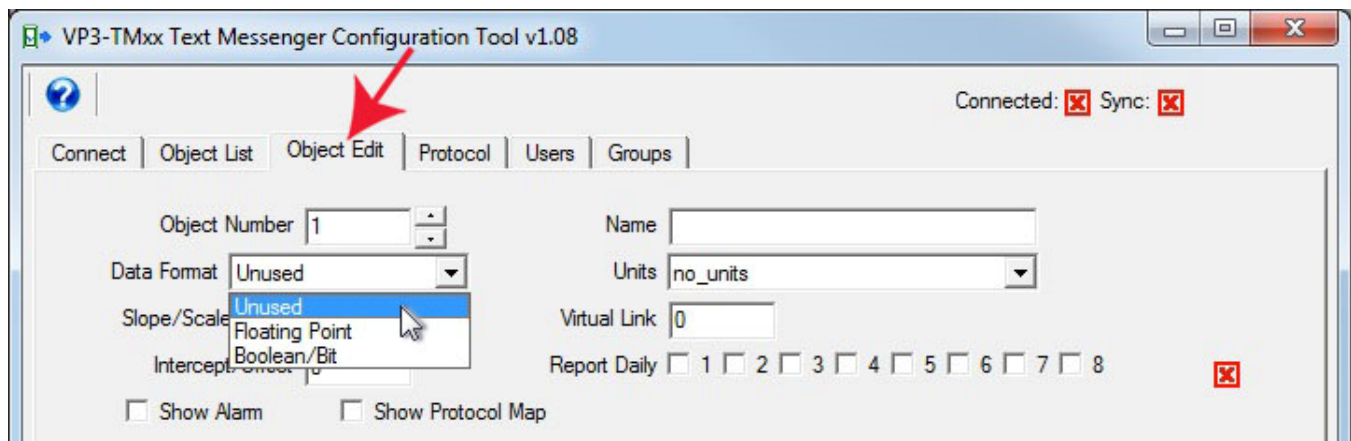
4. Overview of Configuration via Tool Software



The VP3-TM configuration tool is free software you may run on any Windows PC. It streamlines the process of configuring the VP3-TM. When you open the tool, you will see a tabbed set of pages that are organized mostly in order of how you will typically use them. In this section, we will run through a quick overview of setting up the VP3-TM for the first time.

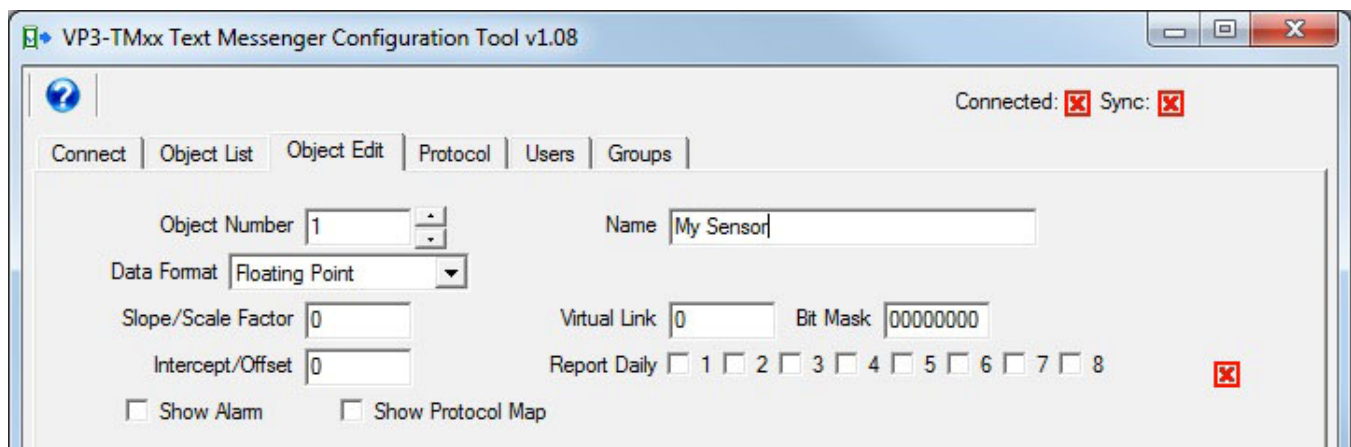


We are going to start by creating a simple configuration with a single alarm, and create that configuration “off-line” before connecting to the VP3-TM. To do this, start by selecting your VP3-TM model number from the device model list on the Connect page.

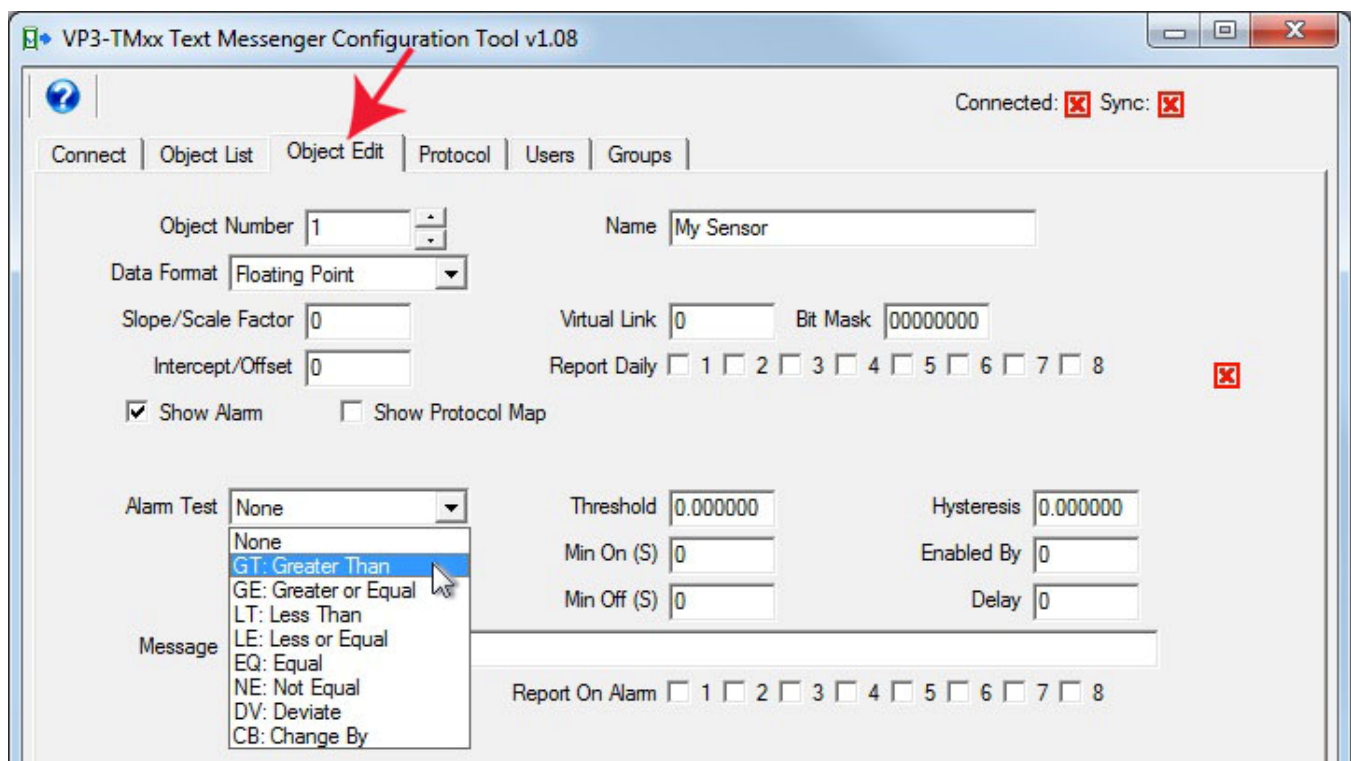


Next, go to the Object Edit page. The VP3-TM has data “objects” that it maintains internally. The data value held by the object is compared against the alarm threshold to determine if there is an alarm. The data value was obtained by the VP3-TM reading it from another device on the network, or by some other device on the network writing to the VP3-TM. The data can be floating point or Boolean (on/off), or in the case of Modbus can also be integer.

The first step in configuring a data object is to select a data format that best matches what you anticipate the source of data to be. An exact match is not an absolute requirement since data will be automatically converted as necessary by the VP3-TM. But if you know the only options are on and off, then floating point level does not make a lot of sense as a way of representing that. Conversely, a single bit (Boolean) is not going to be capable of representing a temperature reading.



The other thing you will want to do for each data object is give them a unique name. Beyond that, all other parameters are optional. If scale factor is left at zero, that will be interpreted as “none” and be mathematically treated as 1.



It is possible to configure an object with no alarm just to get a daily report of its value. But alarm monitoring generally isn't going to be useful without defining an alarm. Start by checking the box marked “Show Alarm” to make the alarm settings visible.

The first step in defining an alarm is to select an alarm test, such as “greater than”. If the test is “greater than”, then the alarm will be considered active any time the present value of the object is greater than the threshold value. (Refer to section 7.2 for further details on all of the alarm test types.)

Alarm Test: Threshold: Hysteresis:

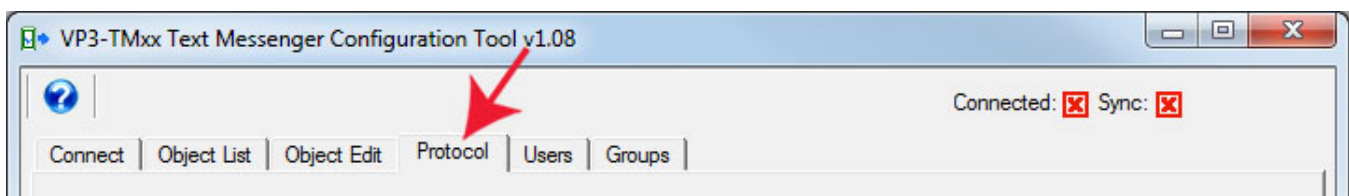
☐ Require Ack Min On (S): Enabled By:

☐ Notify Active Only Min Off (S): Delay:

Message:

Report On Alarm: ☒ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8

There are three additional settings beyond alarm test that need to be entered in order to make the alarm useful: (1) Enter a value for the threshold. (2) Enter a text string for alarm message. (3) Select at least one user group to report to. The check boxes after "Report On Alarm" represent the user groups that the message should be sent to. Message content is further discussed in section 7.3 of this user guide.



The VP3-TM will be communicating with one or more other devices to monitor those devices. This will require protocol settings that will vary by protocol, and in turn vary by VP3-TM model number. Refer to the applicable protocol settings discussed later in this user guide. We are at this point only calling your attention to the fact that something here will most likely need to be set.

The one setting on the Protocol page that does not vary is the Site Name. Be sure to give your VP3-TM a site name as this will often be used in generating messages.

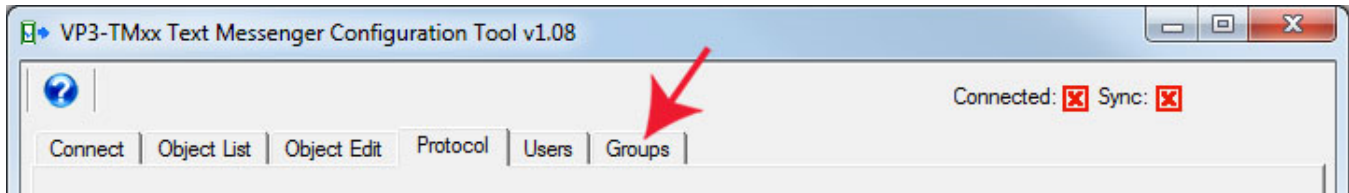
SMS #: ☒ Command User #:

Name: Groups: ☒ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8

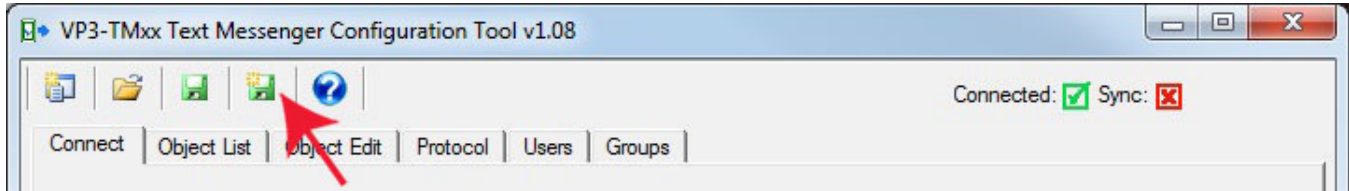
User #	SMS #	Groups	Comm...	Name
1	17634155950	1	Y	Jack C.

The alarm messages will not go anywhere until you enter at least one user - most importantly that user's mobile phone number - in the phone book. The user's name does not get used anywhere other than to be displayed in the configuration tool. What matters is the phone number, and selecting at least one user group for

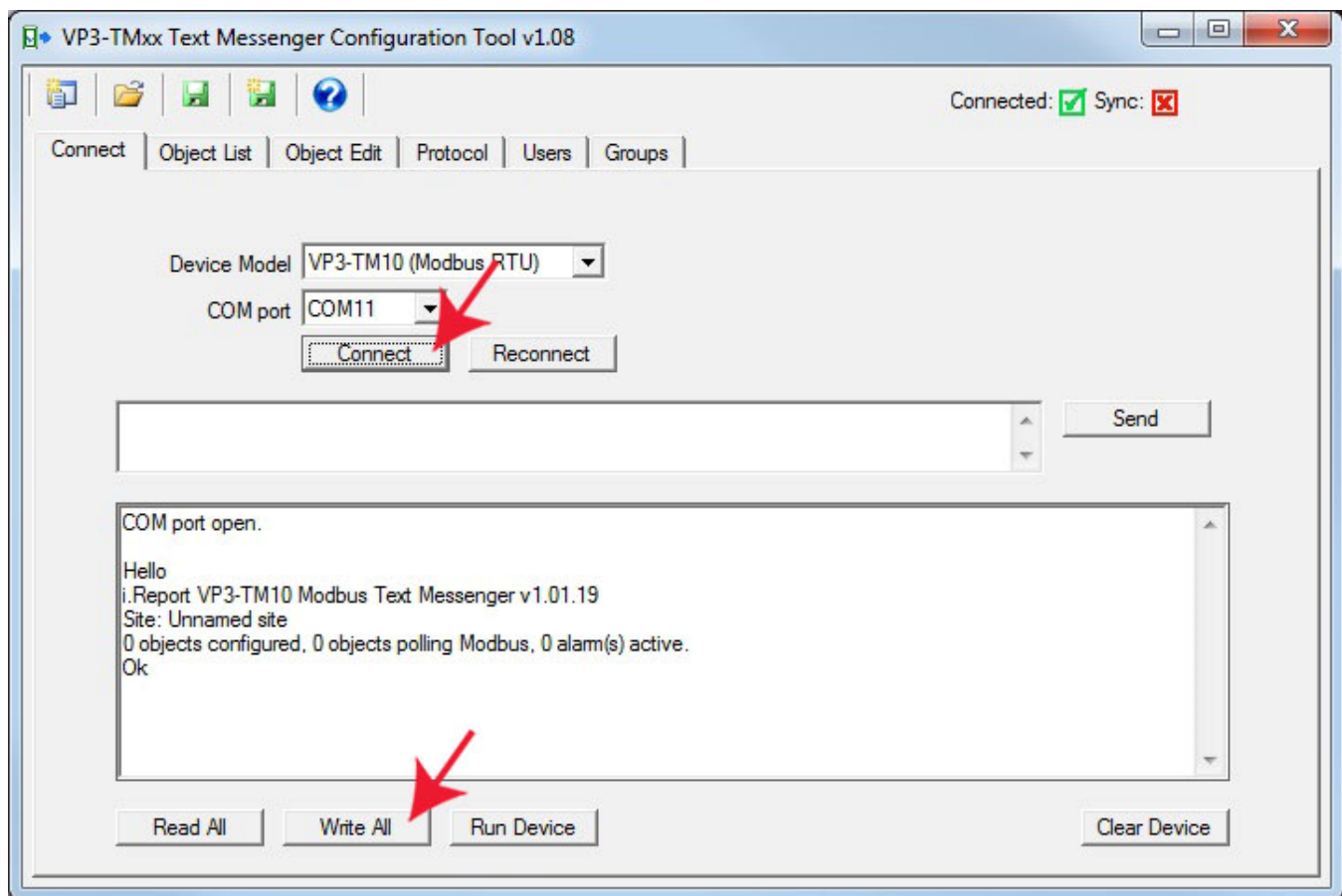
that user to be a member of.



The groups tab is where you configure the user groups. Assigning users to group #1 and not configuring anything on the groups page will work just fine. All groups are always active. The only thing configured on the groups page is additional qualifiers for each group. With no qualifiers set and both delay and repeat times left at zero, users in the group will receive all normal alarm notifications immediately. The only thing not received with no qualifiers set will be error and failure messages, and admin messages. Error messages are not user configurable - you only have the choice of whether to receive them or who is to receive them.



Now that you have your initial configuration set up, you should save it. Go back to the Connect page and click the new file icon. You will be prompted with the usual Windows dialog to provide a file name to save.



At this point, you should be ready to send your configuration to the VP3-TM. You will want to connect by selecting the applicable COM port and then clicking Connect, after which you should power up the VP3-TM that is connected via an RS485 adapter.

Once you see the initial Hello message, you can click Write All to send your entire configuration to the VP3-TM. If this is not the first time you have sent any configuration to the VP3-TM, the Hello message will indicate that objects are configured. In this case, you should click the Clear Device button first, and wait a few seconds for it to indicate it is finished. Then proceed with Write All.

Once the configuration has been written, click Run Device to exit configuration mode, close the tool software, disconnect the RS485 adapter, and connect the VP3-TM to the device(s) it should be monitoring.

Copyright © 2019 Control Solutions Minnesota, Inc.



5. Overview of Configuration via SMS

You have the option of starting from scratch with a totally blank VP3-TM device and configuring it entirely via SMS messages. Normally, commands including configuration changes can only be sent by a known user in the phone book whose credentials include commands allowed. But if the device is brand new and totally blank, then there are no known users. There is a special command usable one time only when there are no known users.



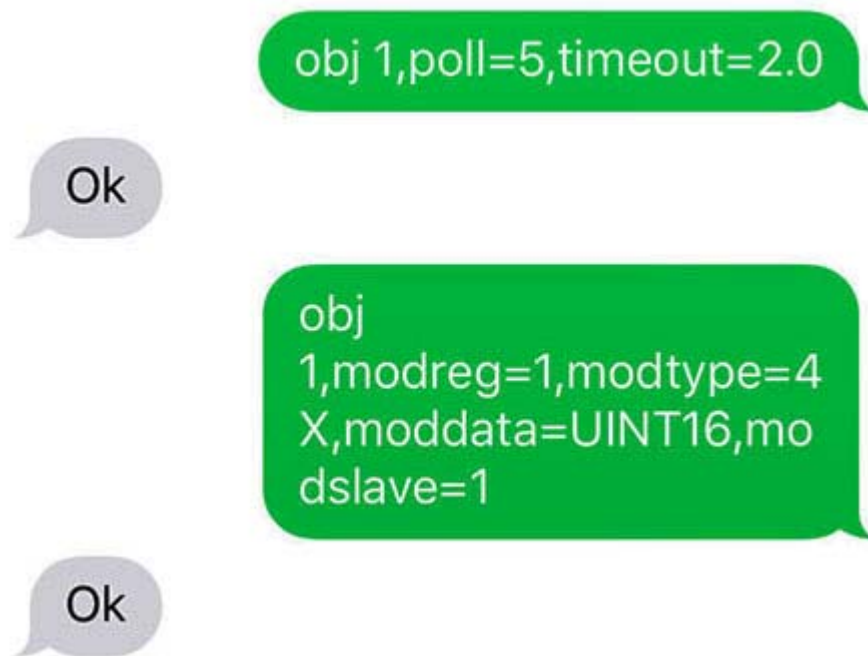
The command Owner="My Name" is used to claim ownership of the VP3-TM. The name must be enclosed in quotes when sent to the VP3-TM's phone number. If recognized, the reply will be "Welcome". At this point, the phone number from which the owner command was sent is automatically entered in the phone book with the command qualification set to "yes". This user may then proceed to send additional commands.



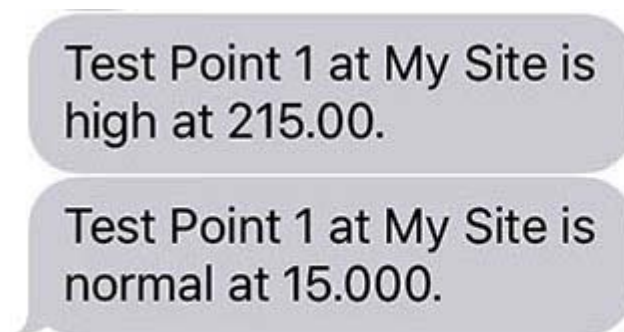
One of the important settings that should be sent early on is the site name.



Objects may be defined, and alarms configured for those objects, entirely via SMS. The various commands for doing so are detailed later in this user guide.



Protocol settings will also need to be made. In this case, protocol settings for polling a Modbus holding register are illustrated. The means of setting protocol parameters for BACnet is similar.



And with that, this i.Report is up and running.

Copyright © 2019 Control Solutions Minnesota, Inc.

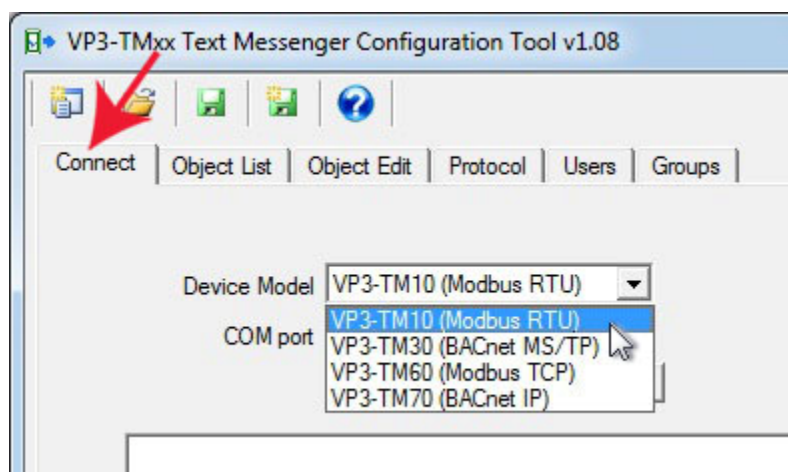


i.Report VP3-TMxx Remote Monitoring

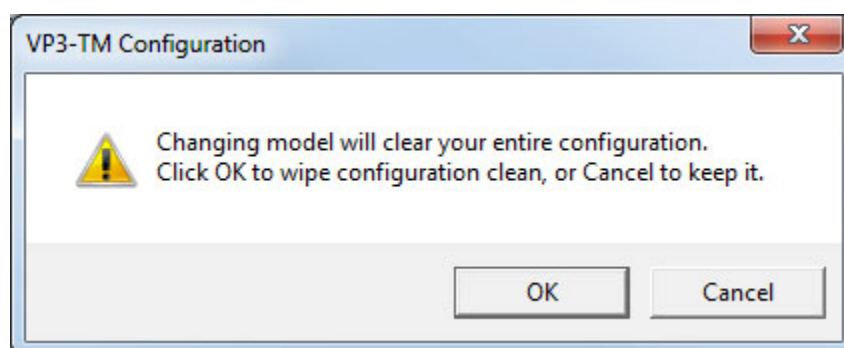


6. Configuration Tool: Getting Connected

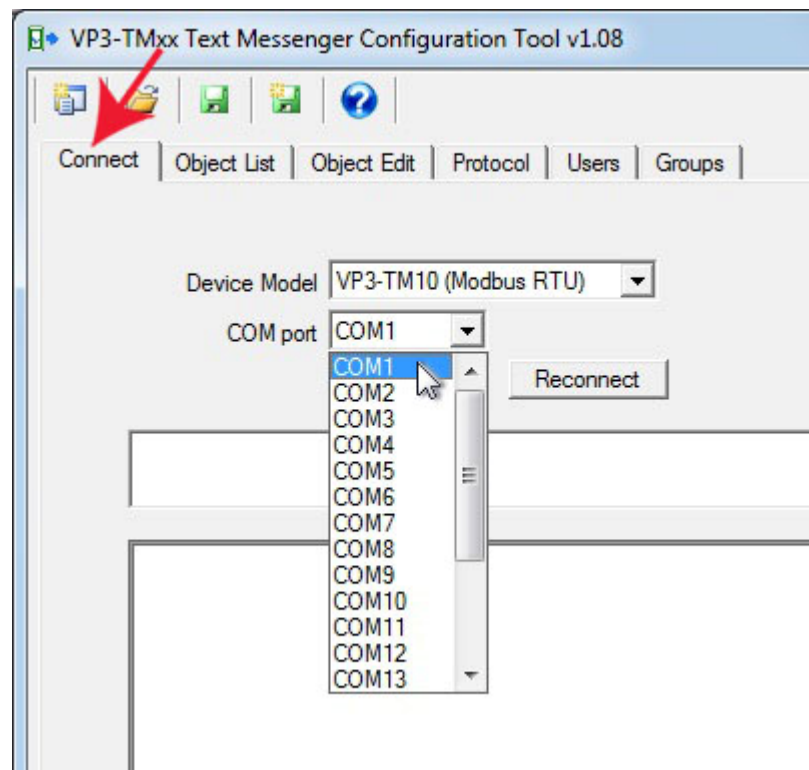
6.1. Connecting, Reconnecting, and Disconnecting



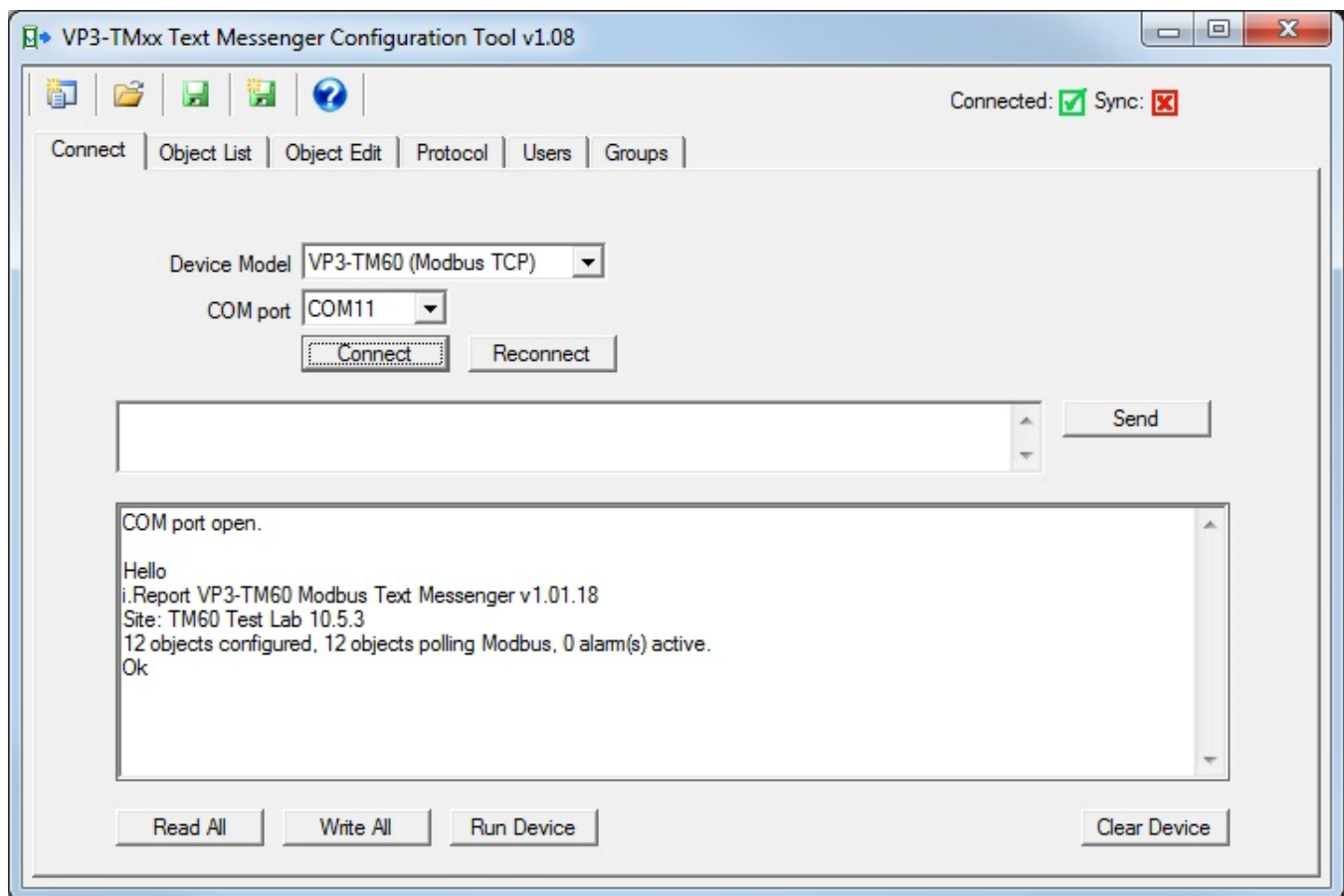
Selecting your i.Report model from the Device Model list is only necessary when you are working with configuration off-line, i.e. not actually connected to the VP3-TM. When you connect to a device, the model will be automatically selected for you.



When you select a different model from the Device Model list, you will be prompted to continue. Changing model clears configuration in tool memory. The device, if any is connected, will not be affected. The device model change only clears configuration tool memory (to avoid trying to re-cast Modbus parameters as BACnet for example).



You will need an RS485 connection between the NET terminals on the VP3-TM, and your PC/laptop. Most often, you will be using a USB to RS485 adapter. Follow the installation instructions for that adapter as applicable. From your PC's device manager, find out what COM port it was installed as, and select that port on the Connect page. If you are using a RS232 to RS485 adapter on an older style COM port on the PC, select that COM port number from the list, usually COM1.



The Connect and power-up sequence is important. Select your COM port from the list, and then click the Connect button. After clicking the Connect button, apply power to the VP3-TM. The configuration tool will wait about a minute to see the startup "Hello" from the VP3-TM. The tool will then send the "show" command to the VP3-TM, which results in displaying the summary information as illustrated above.

Here is why timing is important: If the VP3-TM does not see a command from the tool console within 10 seconds after power-up, it will automatically exit configuration mode and attempt to begin normal operation. Once it begins normal operation, you will be unable to configure it. Therefore, clicking the Connect button and then applying power will let the tool send the "show" command immediately upon seeing the startup "Hello", and you have now "locked" the VP3-TM in configuration mode.

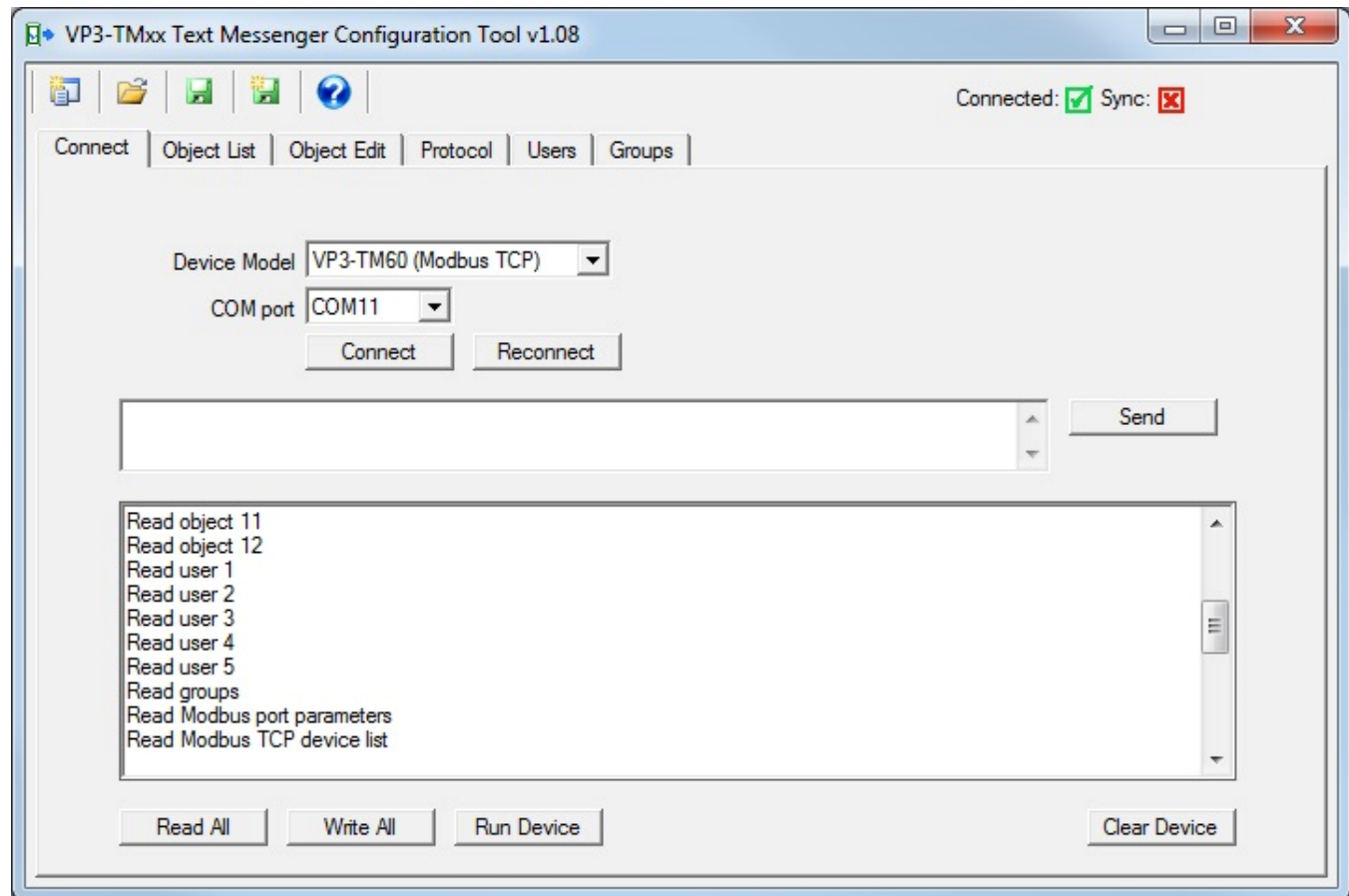
The fact that you are in configuration mode will be indicated by the LED labeled "STA" remaining on solid amber. In normal operation, this LED will be off, or flashing. If on solid amber, you are in configuration mode.

If you have disconnected and reconnected your serial port for any reason, and want to reconnect to a VP3-TM that is already in configuration mode as indicated by the STA LED, click the Reconnect button instead of Connect. The Connect button will wait to see "Hello", while the Reconnect button will simply go ahead

and send "show".

When you are done configuring your i.Report and want to proceed with normal operation, click the Run Device button. This will cause the VP3-TM to exit configuration mode and start running as configured.

6.2. Read All and Write All Configuration

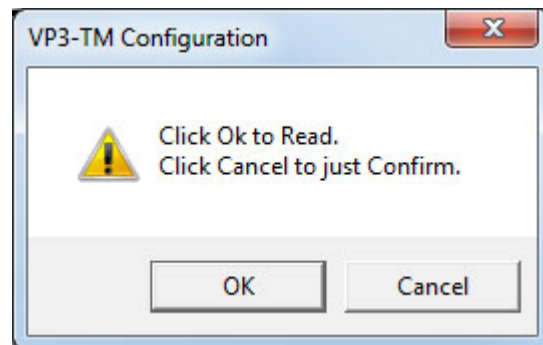


While you are in configuration mode, you can read and write various individual parameters from other tabs or pages in the tool. But if you want to read or write everything known to the VP3-TM, click the Read All or Write All buttons.

If you want to retrieve the entire configuration from a VP3-TM that has been previously configured, click Read All. However, what is read will simply be "added" to whatever is already stored within the tool's tables. Therefore, to get a clean representation of only what is in the device, click the "New" icon (very top left corner) first. This will clear everything from the tool's memory. Now proceed with the Read All.

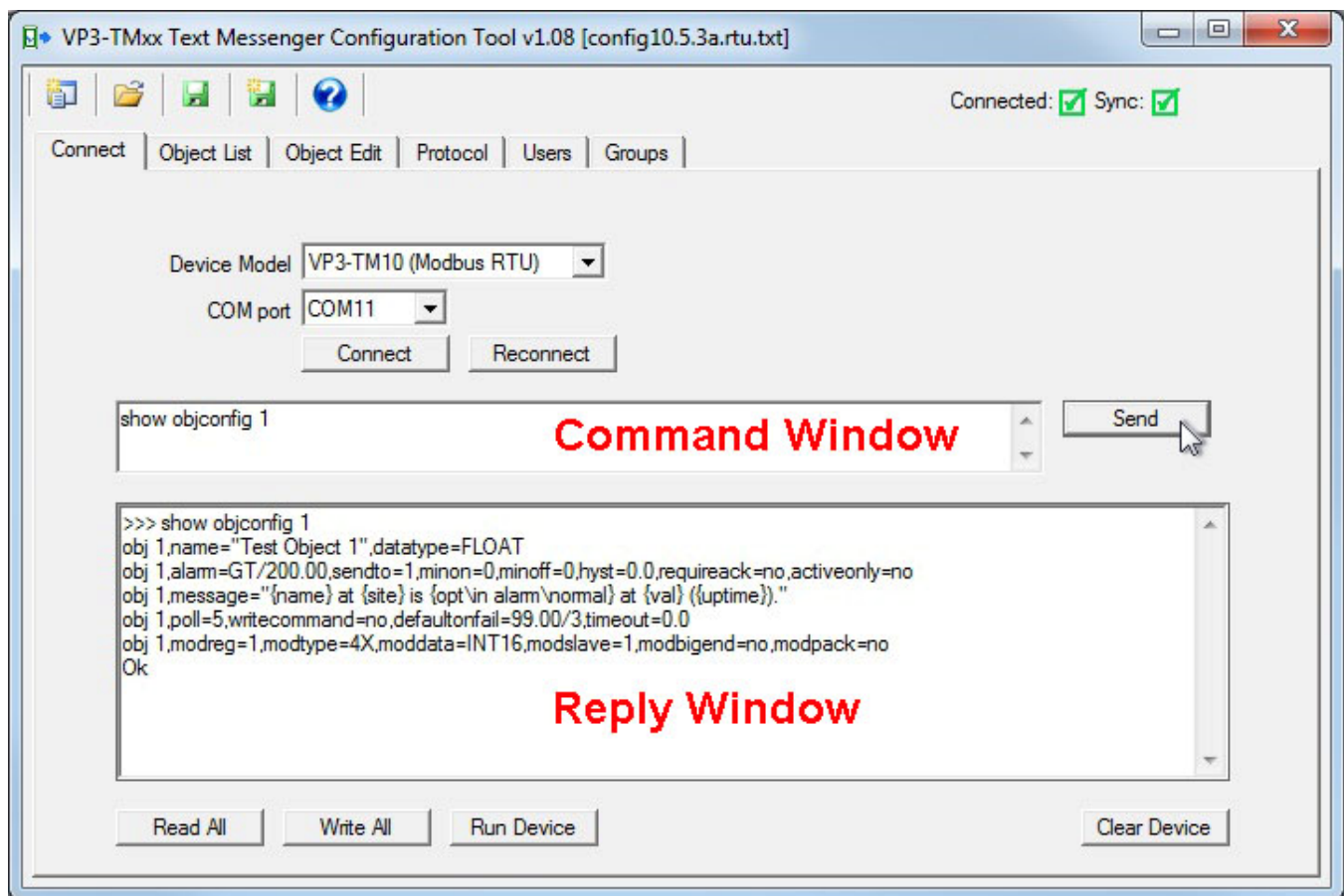
If you want to send every bit of configuration currently in the tools memory to the connected VP3-TM device, click Write All. However, what is written will simply be "added" to whatever is already in the device's memory. This will be suitable for modifying an existing configuration, but if any part of the configuration being sent

is intended to replace existing configuration, you should start by first clearing the device. Click the Clear Device to completely erase all configuration currently stored in the VP3-TM device. Wait several seconds for this process to complete - a message will be displayed indicating completion. Now proceed with the Write All.



When you click Read All, or any Read Device button anywhere else in the configuration tool, you will be prompted to Read or Confirm. If you click Ok on this dialog, the tool will proceed to read configuration from the connected device and save everything it finds in the configuration tool memory as noted above. However, if you click Cancel indicating you want to just Confirm, then the tool will read configuration from the device but only compare what it finds to what it already had in configuration tool memory. If the configuration does not match, the "in sync" icons will turn to a red X where applicable.

6.3. Using the Command Console

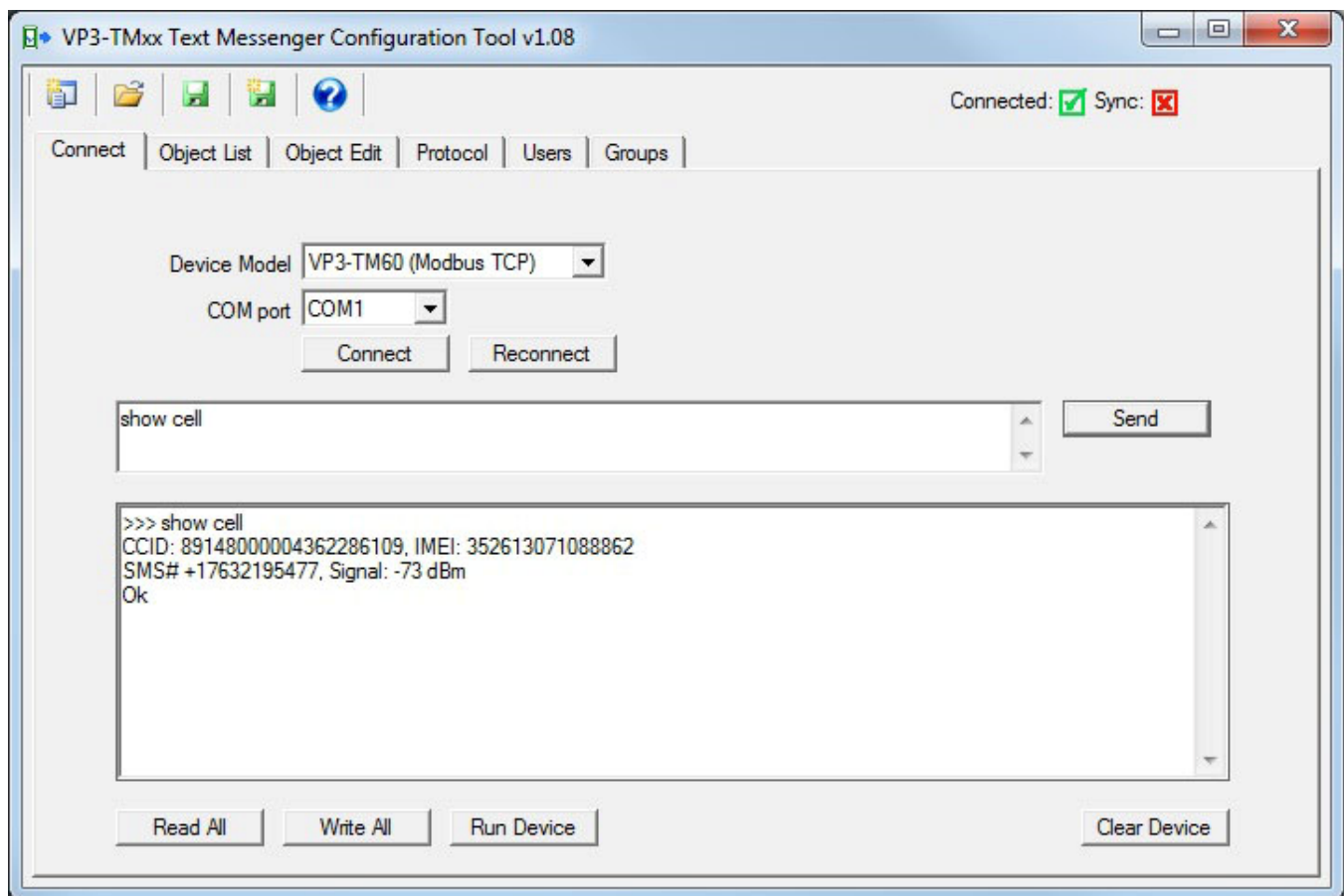


The Connect page doubles as a command console while in configuration mode. You can type any command into the command window, click Send, and wait for the response in the reply window. Any of the commands documented throughout this user guide can be entered here.

There is really no magic going on behind the scenes of the various tabs or pages in the configuration tool. It simply provides templates for creating the configuration script you see displayed when you enter a command like "show objconfig 1". You could turn around and type any of this right back into the command window and reconfigure the object right here. You actually don't even need the configuration tool software. Any generic serial terminal emulator such as PuTTY or HyperTerminal could be used to type the same commands and configure or query the connected VP3-TM.

If you wish to use a generic terminal emulator, connect to the NET terminals of the VP3-TM using an RS485 adapter, and open the COM port at 19200 baud, N81. Then simply type "show" (and return) as soon as you see "Hello" upon power-up. You will now be in configuration mode.

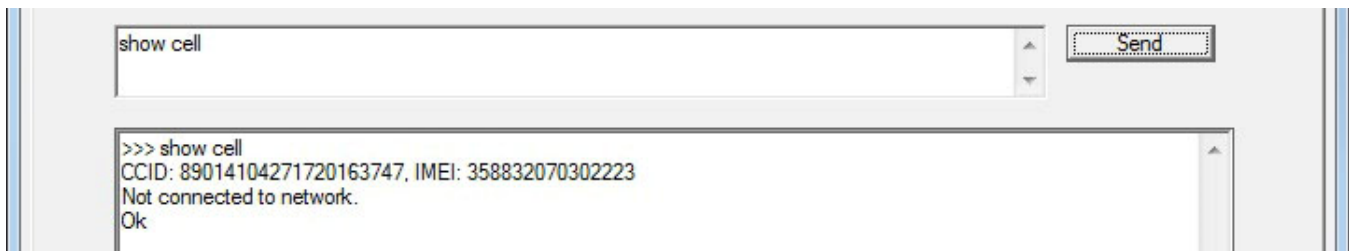
6.4. Verifying SIM Activation



Type “show cell” in the command window and click Send. Provided the VP3-TM has been up long enough for the cellular modem to connect to the network, the response to the “show cell” command will be a display of the CCID (SIM card number), IMEI (cellular device identifier), phone number assigned by the carrier, and signal strength. Signal strength will be indicated as a number in the range of -51 dBm to -113 dBm with -51 being a perfect signal and -113 being call-dropping bad.



If you send the “show cell” command right after power-up, you will get no CCID indication because the modem is still in the process of waking up. It takes typically 30 to 45 seconds before you will see the CCID indication.



The CCID and IMEI numbers will be displayed even if the modem has not managed to connect to the network yet. Under normal conditions, the modem will connect within 1 to 2 minutes after power-up. If the VP3-TM has been off for a long time, the initial network connection sometimes takes a bit longer. If the antenna is disconnected or you have a poor signal for some other reason, including location or being inside a metal building, it might never connect. Of course the other potential reason for not connecting is that your SIM is not active.

6.5. Using the Toolbar Tools



Referred to as the "New" icon, click this to clear configuration stored within the tool.



Open a configuration file and load it into the configuration tool. From the Connect page, this opens and loads a configuration script (text) file. From the Object List page, it imports a CSV list of objects. From the Users page, it imports a CSV list of users into the phone book.



Saves configuration to a file already opened for reading or writing.



Saves (creates) a new configuration file, writing all configuration currently saved within the tool memory into the new file.



Saves a CSV file already opened for reading or writing.



Saves (creates) a new CSV file with content relevant to the page where used. This will create a CSV list of objects from the Object List page, or a CSV list of users from the Users page.



Used to access the user guide from within the configuration tool.



The Connected icon will be red if the tool is not connected to a VP3-TM, and green if it is connected via the serial port.

The Sync icon will be red any time configuration changes made in the tool are not in sync with configuration in the device. The Sync icon will become green after

Read All or Write All. If changes are made to an individual object, the Sync icon will become red, but will return to green when that one object is written to the VP3-TM by clicking Write Device from the Object Edit page. The same practice applies to users, groups, and protocol settings.

Copyright © 2019 Control Solutions Minnesota, Inc.

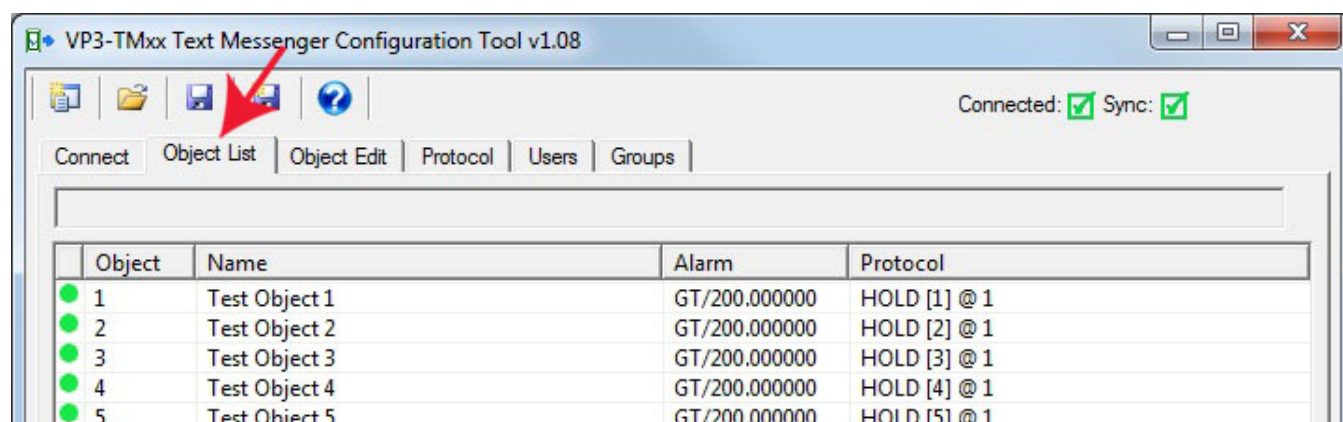


i.Report VP3-TMxx Remote Monitoring

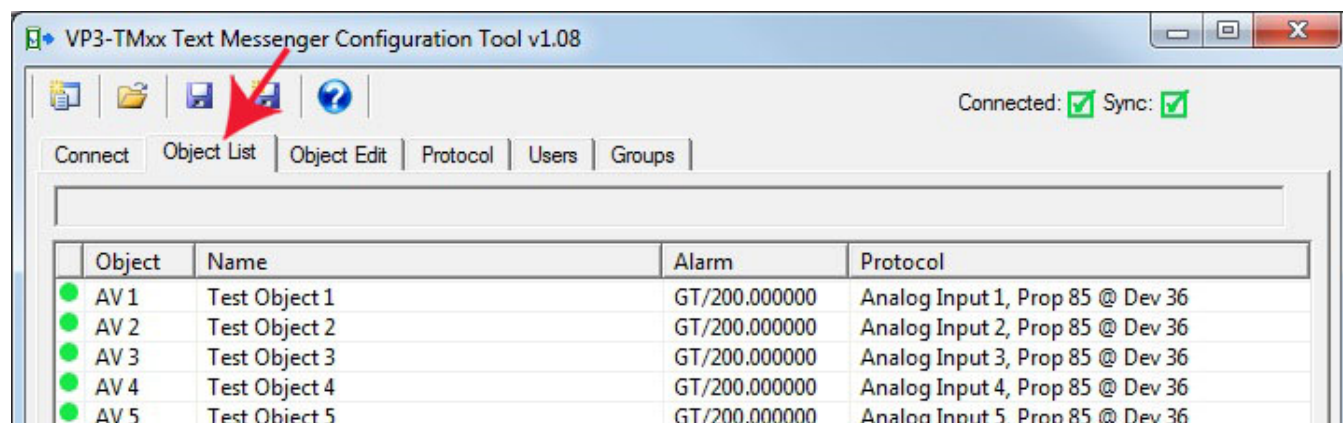


7. Configuration Tool: Data Objects

Your configured objects can be viewed on the Object List page. The appearance will be slightly different between Modbus and BACnet. If you have selected VP3-TM10 or VP3-TM60, then the protocol column will contain Modbus register information. If you have selected VP3-TM30 or VP3-TM70, then the protocol column will contain BACnet object information.

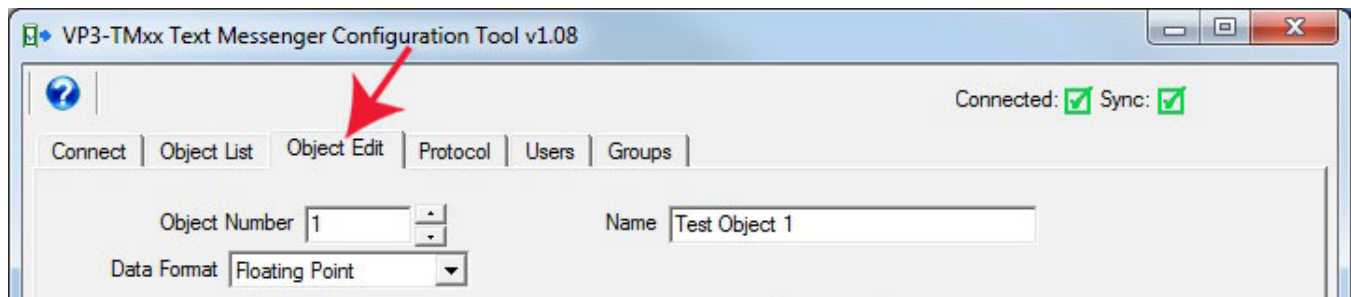


Object	Name	Alarm	Protocol
1	Test Object 1	GT/200.000000	HOLD [1] @ 1
2	Test Object 2	GT/200.000000	HOLD [2] @ 1
3	Test Object 3	GT/200.000000	HOLD [3] @ 1
4	Test Object 4	GT/200.000000	HOLD [4] @ 1
5	Test Object 5	GT/200.000000	HOLD [5] @ 1

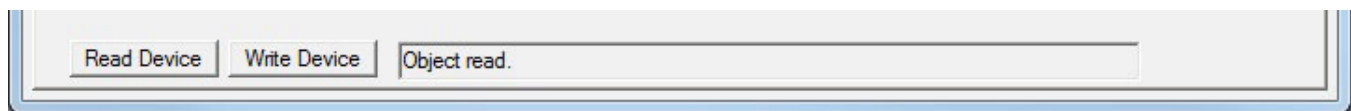


Object	Name	Alarm	Protocol
AV 1	Test Object 1	GT/200.000000	Analog Input 1, Prop 85 @ Dev 36
AV 2	Test Object 2	GT/200.000000	Analog Input 2, Prop 85 @ Dev 36
AV 3	Test Object 3	GT/200.000000	Analog Input 3, Prop 85 @ Dev 36
AV 4	Test Object 4	GT/200.000000	Analog Input 4, Prop 85 @ Dev 36
AV 5	Test Object 5	GT/200.000000	Analog Input 5, Prop 85 @ Dev 36

Double click on any line in the list to jump to the Object Edit page for that object. The icon in the first column will be green if this object is "in sync" with the device, meaning what you see on the screen is what is in the device. The icon will be red if changes have been made that have not been written to the VP3-TM yet.



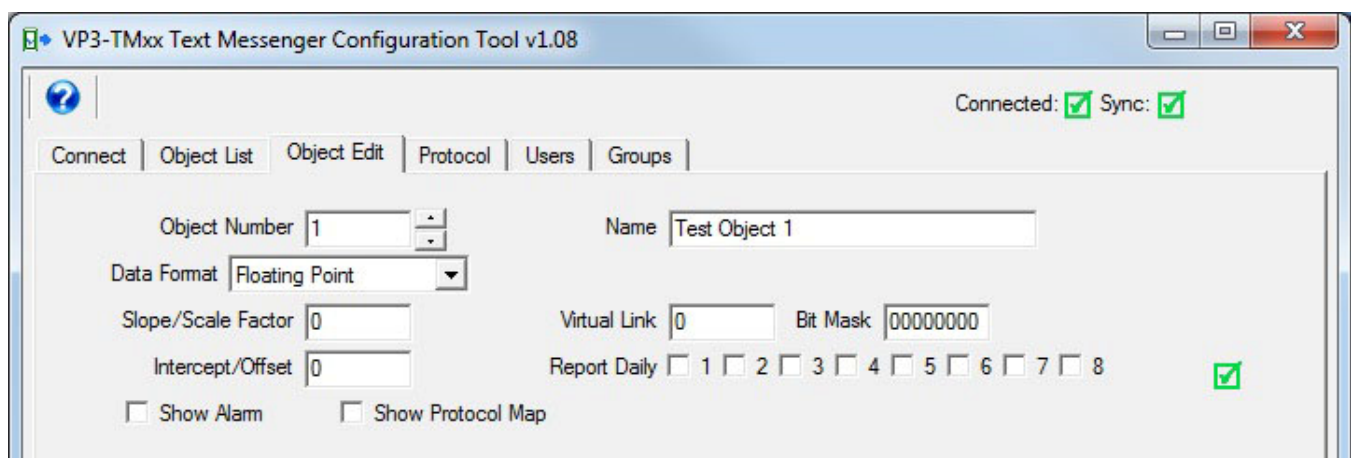
Changes to object configuration are made on the Object Edit page. Go here and select an object number or scroll through the list. The many parameters that may be entered here are discussed throughout the remainder of this section of the user guide.



If you are connected to a VP3-TM and you are ready to send your configuration changes to the VP3-TM for the object displayed on the screen, click Write Device at the bottom of the Object Edit page. If you want to read what is in the device for this object, click Read Device.

7.1. Object Configuration

The minimum requirement for configuring a data object is to select a data format and give it a name. There are only slight variations between the Modbus and BACnet versions when it comes to configuring a data object.



Changes to the selected object are made in the configuration tool by entering numbers, selecting items from a drop down list, or checking boxes. This on-screen template translates into configuration commands sent to the VP3-TM. These same commands can be sent via the command console (see Section 6.3) or via SMS. Throughout the remainder of this section, the configuration command parameters will be presented in command form, but the definition of those parameters will apply to the on-screen template as well.

When an object configuration command is sent to the VP3-TM, it always starts with "obj N" where the "obj" identifies the fact that we are sending object configuration, and N is the object number we want to configure.

The "obj" tag is delimited by a space. The first item following the space must always be the object number to be configured. After that, one or more configuration fields are delimited by commas. Each field starts with a tag name, followed by the "=" sign. Everything after "=" up to the next comma will be taken as the value for that tag. If commas are to be embedded in a name or message string, then the entire string must be enclosed within double quote marks, e.g. "This is one, two, three in a name". The quotes should be plain quotes, not "fancy" quotes created by Word like those around "fancy". Use a simpler text editor like just Notepad if creating a script file that will be copied to the device later.

Example:

```
obj 1,name="Engine Temp",datatype=FLOAT,scale=1.8,offset=32
```

It is not necessary to include a space after the comma, but may be inserted if desired for readability. Spaces after the comma will be discarded.

The VP3-TM provides 100 internal data objects. These may be mapped to read Modbus registers in an external device, read BACnet objects in an external device, or be written by an external master/client. Valid object numbers are 1-100.

Parameters are as follows.

```
obj1,name="Engine Temp"
```

Sets object name (ASCII string up to 39 characters). The name must be a quoted string.

obj 1,datatype=FLOAT

Sets data type for object's data. Types are as follows:

 FLOAT=floating point

 UINT32=unsigned 32-bit integer

 INT32=signed 32-bit integer

 UINT16=unsigned 16-bit integer

 INT16=signed 16-bit integer

 BIT=Boolean on/off, 1-bit value

Note: If using BACnet, this also determines object type. The BACnet object will be BV if datatype is BIT, otherwise it will be an AV, with conversion to/from BACnet floating point as needed. If using BACnet, then the only datatypes that make sense are FP and BIT.

obj 1,link=40

Sets link object for causing the source of data for this object to be some other object, or a virtual object in the system. If the link object is another object, then the value of that object is copied to this object. If the link object is a virtual object, then the value of that virtual object is placed into this object. All alarm processing then applies to the copied value as if it were a new value. If another non-virtual object is copied, then this becomes a means of applying multiple alarm levels to the same data point.

obj 1,mask=0080

Sets data mask for use in object link. Value is expressed in hexadecimal. Applies to VP3-TM10 and VP3-TM60 only. This object will take on the value of the link object logically AND-ed with this mask, and then right shifted so that the least significant bit of interest becomes the LSB of data.

obj 1,scale=1.0000

Sets scale factor, this is multiplied by the data value received from the network before being stored in the local object.

obj 1,offset=0.0000

Offset added to data value before being stored in object.

obj 1,bacunits=95

Specifies BACnet Units property for this object. Applies to VP3-TM30 and VP3-TM70 only.

obj 1,reportdaily=1+2+4

Sets the object for daily reporting to the notification groups given (may be any combination of 1 through 8 delimited by "+"). The 24-hour timer will restart when the device is restarted, or when the resync command is used. There is no internal

time-of-day clock, therefore, the daily report is simply a 24-hour timer. Over a long period of time, it may creep. Use the resync command to resync the reporting if desired. The message sent daily will be the alarm notification for the inactive state (or active state if the object is currently in alarm).

7.2. Alarm Configuration

obj 1,alarm=GT/100.0

Sets alarm where alarm tag gives type and threshold. Alarm type codes are as follows:

- GT= greater than
- GE=greater than or equal
- LT=less than
- LE=less than or equal
- *EQ=equal
- *NE=not equal.
- DV=deviates from threshold by hysteresis amount
- CB=changes by
- NO=none (used in CSV files)

Test type GT means the alarm is active if the object value is Greater Than the threshold given. Other comparisons are similar. DV amounts to testing for greater than or less than, but by the margin given as the threshold. CB means changed by the threshold amount since the last report or since start-up.

* Only the EQ and NE tests are valid for BIT/Boolean object types.

Note: The CB (changed by) alarm captures the first value of the object, and then notifies users if the value has changed by the threshold given. The new value that will be used to evaluate future changes is captured when the present alarm condition is acknowledged. For this reason, CB should only be used with requireack=yes. Ack is what resets the marker for the next change detection. Upon Ack, an alarm inactive message will be sent. Definition of active/inactive is a bit different for CB. Alarm "active" simply means change detected, and "inactive" simply means change acknowledged.

obj 1,sendto=1+2+4

Indicates one or more user group numbers 1 through 8 to send the alarm message to. Note that for groups, 1+2 means literally the string "1+2", not 3. Sendto=1+2 will give you groups 1 and 2, while 3 will give you group 3.

obj 1,minon=10

Sets minimum on time for alarm in seconds. The alarm condition must exist for this amount of time before it will become an active alarm. If the condition goes away before this time expires, the alarm is never reported.

obj 1,minoff=0

Sets minimum off time for alarm in seconds. The alarm condition must be clear for this amount of time before it will become an inactive alarm. If the condition goes away but returns again before this time expires, the alarm will simply remain in the previously reported active state.

obj 1,hyst=5.0

Sets hysteresis value applied to alarm thresholds. If alarm=GT,100 and hyst=5, then the alarm becomes active when the object value reaches 100, and the object value must fall below 95 before the alarm will return to inactive. This is intended to prevent nuisance alarms when the value is dithering right around the alarm threshold. (Does not apply to BIT/Boolean objects.)

obj 1,enableby=2/30

Selects another object that will enable this alarm. The alarm will be enabled with the given enableby object is nonzero. In this example alarms will not be produced by object 1 unless object 2 contains a nonzero value. The second value is a delay time in seconds. If non-zero, the enable will take effect this amount of time after the given object becomes non-zero. The delay applies to enable only. Disable will become effective immediately upon the object returning to zero if an object was given.

obj 1,requireack=yes

obj 1,requireack=no (default)

Selects whether the alarm must be acknowledged by an SMS reply. If the alarm notification requiring acknowledgement contained the identifier [1/14], then the acknowledgment reply would be:

Ack 1/14

Reply should be sent to the number that sent the notification. Sending "Ack" without any object number or sequence number will have no effect, and alarm notification may be repeated.

obj 1,activeonly=yes

Eliminates the alarm inactive notification when "yes". Only the alarm active notifications will be sent. This enables the creation of enumerated notifications using multiple linked objects and EQ test type.

7.3. Alarm Message Formatting

obj 1,message="Send this message when alarm makes transition"

Sets the message that will be sent upon alarm transition. The message is sent once when the alarm first goes active, and a second time when the alarm goes inactive. The message must be a quoted string.

Several variables may be embedded within the message. These variables will be replaced with real time data at the time the message is sent. The {} brackets denote a variable, and the brackets and variable name within the brackets will be replaced. If resulting message won't fit in 120 characters, make last 3 "..." to indicate that. **Note: These variable names must be lower case.**

{site}	Inserts site name.
{name}	Inserts object name
{obj}	Inserts object number
{val}	Inserts object present value (formatted according to object type, integer, floating point, etc)
{lim}	Inserts threshold (limit)
{hyst}	Inserts hysteresis (useful in reporting DV alarms)
{test}	Inserts test type ("GT" for greater than, etc)
{%nnn}	Inserts a percentage value where nnn is a number that present value is divided by to give percentage (can result in "Tank is 12% full" type messages)
{opt\active\inactive}	Inserts first string if alarm is active and second string if alarm is inactive (see below)
{uptime}	Inserts system uptime in seconds (time since bootup)

{opt\active\inactive} is a special case. If the alarm is active, then the active string will be inserted into the message. If the alarm is inactive, then the inactive string will be inserted into the message. For example, if the object included

obj 1, name=Fuel tank, message="{name} level is {opt\ high\ normal}"

Then an active alarm would produce the message

[1/14] Fuel tank level is high

and upon alarm returning to inactive, would produce the message

Fuel tank level is normal

Note that the “opt” message can be more than one word. Everything between the delimiters \ and } are included in the string.

Note that two numbers are included at the start of every notification if acknowledgement is required. The first is the object number, and the second is the alarm sequence number. Each object has its own alarm sequence number that counts up from 1 and rolls over at 255. The alarm sequence number increments every time that alarm reoccurs. If the alarm requires acknowledgement, then the SMS reply must include those two numbers. (See requireack configuration parameter, and ack query.)

7.4. Protocol Configuration

There is a Protocol tab or page in the configuration tool, but there is also a Protocol Map section for each object. The Protocol page is necessary for setting protocol specific parameters that apply to the entire VP3-TM device. The Protocol page settings are required for all applications. The Protocol Map section of each data object is required any time the VP3-TM will be configured to poll other devices to obtain data. If other devices will be writing data to the VP3-TM, then the Protocol Map section is left blank or unconfigured.

When the VP3-TM will be configured to poll other devices to obtain data, the Protocol Map section of the object configuration is how you tell the VP3-TM where to look.

The screenshot shows the 'Protocol Map' configuration section. At the top, there are two checkboxes: 'Show Alarm' (unchecked) and 'Show Protocol Map' (checked). Below this, it says 'Mapped to Modbus RTU'. There are three checkboxes: 'Read Periodic' (checked), 'Write on Command' (unchecked), and 'Set Default on Comm Fail' (checked). Below these are four input fields: 'Poll Time (S)' with value 5, 'Timeout (S)' with value 0, 'Fail Count' with value 3, and 'Default Value' with value 99.000000. Further down, there are two rows of settings. The first row has 'Register Number 1..N' with value 1 and 'Unit/Slave Addr' with value 1. The second row has 'Register Type' set to 'Holding Register (fc 16)' and 'Mask (Hex)' with value 00000000. To the right of these are two checkboxes: 'Member of Packed Register' (unchecked) and 'Read High Reg First' (unchecked). The third row has 'Register Format' set to 'Signed 16-bit' and 'Fill (Hex)' with value 00000000.

The Protocol Map section will show Modbus RTU parameters for a model VP3-TM10.

☐ Show Alarm ☒ Show Protocol Map

Mapped to BACnet MS/TP

☒ Read Periodic ☐ Write on Command ☐ Set Default on Comm Fail

Poll Time (S) Timeout (S) Fail Count Default Value

Remote Device Instance Property Bit Num

Object Type Instance Data Type

Mac address (no who-is) Array Index Priority

The Protocol Map section will show BACnet parameters for a model VP3-TM30.

☐ Show Alarm ☒ Show Protocol Map

Mapped to Modbus TCP

☒ Read Periodic ☐ Write on Command ☒ Set Default on Comm Fail

Poll Time (S) Timeout (S) Fail Count Default Value

Register Number 1..N Unit/Slave Addr ☐ Member of Packed Register

Register Type Mask (Hex) ☐ Read High Reg First

Register Format Fill (Hex)

The Protocol Map section will show Modbus TCP parameters for a model VP3-TM60. The only difference between Modbus RTU and Modbus TCP parameters is that RTU will have a single number (see modslave parameter), the slave address, for Unit/Slave Addr, while Modbus TCP will have two numbers, device/unit, in the Unit/Slave Addr window (see modtcp parameter).

☐ Show Alarm ☒ Show Protocol Map

Mapped to BACnet IP

☒ Read Periodic ☐ Write on Command ☐ Set Default on Comm Fail

Poll Time (S) Timeout (S) Fail Count Default Value

Remote Device Instance Property Bit Num

Object Type Instance Data Type

Mac address (no who-is) Array Index Priority

The Protocol Map section will show BACnet parameters for a model VP3-TM70. There are no configuration differences at the object level between BACnet IP and BACnet MS/TP.

Configuration parameters common to all protocol types:

obj 1,poll=5

Sets poll timer for reading. Setting is in seconds. Set poll=0 to disable periodic reading.

obj 1,writecommand=yes

obj 1,writecommand=no

Selects whether write on command is enabled for this object. Writing to a Modbus or BACnet device will only occur upon SMS command, only when received from a qualified SMS number, and only if the command is properly formatted. Unlike Control Solutions network gateways and other iReport devices, this device will never automatically write to an external device. The example command message

obj 1,value=50

would set object 1 to a value of 50 and write to the external device if enabled for writing. SMS has no direct access to the external device.

obj 1,defaultonfail=99.99/3

Tells the communication engine to set the object to a default value upon some number of communication failures. Syntax is defaultonfail=<value>/<count> where <value> is the default value to be set upon <count> failures. The fail count applies when operating as Modbus master or BACnet client. If the master/client query failed this number of times, then the object is set to the default value. When operating as slave/server, and a timeout is given, the object will be set to the default value if the remote master/client has not updated the object within the timeout period. When operating as slave/server, the default value is used, but count is not used. Count would simply increase the timeout by some multiple. If a longer timeout is desired before the object should assume its default value as slave/server, then simply change the timeout parameter. Use defaultonfail=0/0 to disable setting the object to any default (configuration defaults to disabled).

obj 1,timeout=0.5

Sets timeout, in seconds with resolution to tenths. When operating as Modbus master or BACnet client, this timeout results in a "no response" error if the remote slave/server did not respond in time, and optionally results in setting the object to the default value if "defaultonfail" is set. When operating as Modbus slave or BACnet server, results in optionally setting object to default value if remote master/client did not update this object within timeout period provided "defaultonfail" is set.

Note: If multiple registers become grouped into a single Modbus request, the timeout specified for the first object in the grouping will become the timeout for the entire request, meaning the timeout is implied to be the same for all objects in the group. Setting the object timeout to zero will result in the global default timeout set for the device to be used instead, and this is acceptable and recommended as a short cut if all timeouts will normally be the same.

Note: Timeout setting in Modbus only applies to RTU master or slave, and TCP slave. Timeout for Modbus TCP master/client is fixed at 10 seconds.

Use of timeout when VP3-TMxx is slave or server: The timeout will be reset when the object is written. If the object is not rewritten within this timeout, then a "no response" fault will be indicated, and if defaultonfail is set, the default value will take effect. Note that a default fail count other than one does not make sense when using defaultonfail for a slave/server. The timeout applies only to writing the object, and will go into effect upon the first write to this object. Reading the object will not set or reset the timer. This timeout is intended to make sure a remote master or host continues to periodically update the VP3-TMxx with new values. Set it to zero to disable the timeout if not used. Note: If the write times out but reads continue, the "comm fail" message will be sent, but the "device offline" message will not be sent.

Configuration parameters for Modbus models:

obj 1,modreg=201

Sets remote Modbus register number, indexed from 1, not Modicon.

obj 1,modaddr=200

Sets remote Modbus register address, indexed from 0. This is an alternate form of modreg, and only one or the other should be used as modaddr will overwrite modreg and vice versa. (Note: Only register numbers starting at 1 are used in the configuration tool.)

obj 1,modtype=4X

Set Modbus register type – determines Modbus function code. Types are:

NO=none

0X=coil (read/write)

1X=discrete input (read only)

3X=input register, 16-bit (read only)

4X=holding register, 16-bit (read/write)

0XS=single coil

4XS=single holding register

The single (S) designation applies only when writing, and selects function codes 5/6 instead of 15/16 (default for 0X and 4X). The function code for read is the same either way.

obj 1,moddata=UINT16

Sets Modbus remote register data format.

NONE=undefined

INT16=signed integer, 16-bit

UINT16=unsigned integer, 16-bit

INT32=signed integer, 32-bit

UINT32=unsigned integer, 32-bit

INT64=signed integer, 64-bit

FLOAT=floating point, IEEE 754, 32-bit
BIT=Boolean, single bit, applies to coil or discrete input ONLY
MOD10-2=Schneider Electric Mod10 format, 2-register
MOD10-3=Schneider Electric Mod10 format, 3-register
MOD10-4=Schneider Electric Mod10 format, 4-register

obj 1,modmask=0080

Sets data mask in Modbus map for Modbus bit masking. This object will take on the value of the remote Modbus data logically AND-ed with this mask, and then right shifted so that the least significant bit of interest becomes the LSB of data.

IMPORTANT: Bit mask in Modbus map will only be recognized if pack="1" is also used, even if the masking applies to only a single register. Mask value may be 16-bit or 32-bit.

obj 1,modfill=0080

Sets data fill for use in writing packed registers, has no effect on reading.

Note: Consecutive Modbus write maps may be "packed". If any of the included objects is commanded for write, then all included objects are accumulated for the write to the external device. If only a single bit should be commanded within a packed register, then all of the bits should be read by one or more objects, with the desired object enabled for writing.

obj 1,modslave=5

Sets Modbus RTU slave address to be read/written for this map.

obj 1,modtcp=1/5

Selects the TCP device from device table, and provides TCP unit number instead of RTU slave. Syntax is tcp=<device>/<unit>. Used only in TCP version of device. Both RTU and TCP are simultaneously active in the TCP device.

obj 1,modbigend=yes (or no, default=no)

Sets Modbus register swap flag for this object map. Only applies to multiple-register data values, such as Int32 or Float. If "yes" for big endian, this means the Modbus slave contains the high order data in the first or lowest numbered register. If "no" (default), then the low order data is in the first or lower numbered register.

obj 1,modpack=yes (or no, default=no)

Set this option flag if the same register will be shared among multiple objects using bit masking. Even if a single register is to use a bit mask, this flag must still be set to cause the mask to be recognized.

IMPORTANT: To be sure all components of a packed register do get included, make sure the first object included in the register has the desired poll time while all other objects associated with the same register have a longer poll time. All timeouts are reset when the packed register is processed. By forcing the first

component to always time out first, all components will always be included. If a component further down the list has a shorter poll time, all components prior to that will be skipped in the assembly of the packed register.

Configuration parameters for BACnet models:

obj 1,bacdesc="Send this message when alarm makes transition"

The SMS message is accessed via BACnet as the object's description property. The command *obj 1,bacdesc="xxx"* is the same as *obj 1,message="xxx"*. The message is accessible as BACnet object description for purposes of making it accessible to BACnet queries.

obj 1,bacunits=95

Specifies BACnet Units property for this object. (Note: Name selected in configuration tool drop down list for units is translated into the appropriate BACnet protocol code when sent to the VP3-TM.)

obj 1,bacdev=10

Sets remote device instance for BACnet client mapping. This is the device instance that the VP3-TMxx will look for using Who-Is, and subsequently send the configured BACnet read/write property request.

obj 1,bacobj=AI/1

Selects object type and instance which the BACnet client is to read/write at remote device instance. The following object types are supported by the client:

- AI=Analog Input
- AO=Analog Output
- AV=Analog Value
- BI=Binary Input
- BO=Binary Output
- BV=Binary Value
- MI=Multi-state Input
- MO=Multi-state Output
- MV=Multi-state Value
- DEV=Device

obj 1,bacmac=3 (hexadecimal)

obj 1,bacmac=c0:a8:0:2:0b:ac (indicates IP address 192.168.0.2 port 47808)

If specified, this MAC address will be used by the BACnet client to attempt to reach the remote BACnet device when Who-Is fails. This is used for devices that do not support Who-Is. A MAC address of 1 byte will imply MS/TP while a MAC address of 6 bytes will imply IP (if supported by hardware).

obj 1,bacprop=85

Selects object property to be read/written at remote device.

obj 1,bacdata=BIT

Specifies data encoding to be used when writing remote device. Supported data encoding types are:

- NULL=BACnet Application Tag Null (0)
- BOOL=BACnet Application Tag Boolean (1)
- UINT=BACnet Application Tag Unsigned Int (2)
- SINT=BACnet Application Tag Signed Int (3)
- REAL=BACnet Application Tag Real (4)
- BIT=BACnet Application Tag BitString (8)
- ENUM=BACnet Application Tag Enumerated (9)

obj 1,bacpriority=10

Specifies the command priority that should be used when writing a commandable object in the remote device. Commandable objects are any Output object. Commandable Value objects are not supported.

obj 1,bacindex=2

Specifies an index value if reading/writing an array, or "no index" if -1. Defaults to "no index".

obj 1,bacbitnum=1

Specifies a bit number to read a single bit from a bit string. The VP3-TMxx will not read an entire bit string as a single cumulative value (cannot make a meaningful alarm for that) but it will read an entire bit string and save a selected bit position from that string (value of 0 or 1). The bacbitnum is used to specify bit positions starting at zero. Bit strings cannot be written by the VP3-TMxx.

Copyright © 2019 Control Solutions Minnesota, Inc.



i.Report VP3-TMxx Remote Monitoring



8. Configuration Tool: Protocol Settings

The Protocol page is different for each different model of VP3-TM as necessary for the protocol supported by that model. The protocol page is basically the port setting page, although there is a bit more than just port settings for defining a BACnet connection.

8.1. Modbus RTU - VP3-TM10

VP3-TMxx Text Messenger Configuration Tool v1.08

Connected: ☒ Sync: ☒

Connect | Object List | Object Edit | Protocol | Users | Groups

☒ Modbus RTU Settings

Modbus Port Mode: Master

Modbus Port Baud Rate: 19200

Modbus Character: 8 Data, No Parity, 1 Stop

Timeout when Master (S): 1.0

Address when Slave: 1

Pre-Delay (mS): 50

☐ Slave has high reg first

☐ Reset Modbus counts daily

Site Name: Test Lab 4000-10.5.3a

Read Device | Write Device

mod baud=9600

Sets Modbus port baud rate. (Note: Baud rate and other parameters related to the serial port are only available and only used in the RTU version of the device.)

mod parity=none/odd/even

Sets Modbus port parity none, odd, or even.

mod stop=2

Sets number of stop bits, either 2 or 1, defaults to 1 if not 2.

mod bigend=yes/no

Sets big endian mode for Modbus when operating as a slave. Endian flag set in individual objects when operating as master (or sniffer).

mod mode=slave

mod mode=master

mod mode=sniffer

Sets Modbus port to operate as either master or slave.

Modbus RTU also includes "Sniffer Mode" which means you can monitor Modbus data without any reprogramming of the Modbus devices being monitored. As long as there is traffic on the network between a master and one or more slaves, you can monitor it and receive notifications when your selected registers match the criteria you set. Simply configure objects as if the VP3-TM10 were going to operate as a master.

mod timeout=0.5

Sets slave timeout in seconds, with resolution to tenths. Used as global default if timeout not set in object. Timeout applies to slave response when operating as Modbus master, i.e., results in "no response" error if remote slave did not respond in time. Timeout applies to host update when operating as Modbus slave, i.e., can cause object to assume default value if remote master did not update object within specified timeout.

mod predelay=50

Sets predelay timer for Modbus port.

mod slave=15

Sets slave address when operating as slave. Disregarded if master="1".

mod dailyreset=yes (or no)

Results in message counts and error counts for Modbus devices being reset once a day. The timing of this reset coincides with daily reports. This can be useful for determining if "show rtuerrors" or "show tcperrors" is showing recent or potentially outdated error counts.

8.2. BACnet MS/TP - VP3-TM30

VP3-TMxx Text Messenger Configuration Tool v1.08

Connected: ☒ Sync: ☒

Connect | Object List | Object Edit | Protocol | Users | Groups

☒ BACnet MS/TP Settings

Device Instance: 30

Device Name: VP3-TM30

Device Location: Unassigned

MS/TP Baud Rate: 38400

Max Master: 127

MS/TP Station/MAC Addr: 2

Max Info Frames: 1

APDU Timeout (mS): 15000

APDU Retries: 3

Segment Timeout (mS): 5000

Analog Value Count: 12

Binary Value Count: 0

Password:

Site Name: Test Lab 4000-TM30-10.5.2dl

Read Device | Write Device | Protocol info read.

bac instance=20800

Sets BACnet device instance.

bac name="My iReport"

Sets device object name. Must be unique, i.e. cannot be same as any object name.

bac desc="Site Name"

Site name is also accessed as device object description.

bac location="Test Lab"

Arbitrary location string for device.

bac maxmaster=127

Sets MS/TP Max Master value, must be 1..127.

bac baud=38400

Sets MS/TP baud rate. Must be one of 9600, 19200, 38400, 76800.

bac mac=2

Sets MAC address for MS/TP, must be 0..127.

bac pass="buster"

Sets BACnet password required for device reinitialization command from BACnet client.

bac apdutime=5000

Sets MS/TP APDU timeout in milliseconds.

bac apduretry=3

Sets MS/TP APDU retry count.

bac segtime=5000

Sets MS/TP APDU segment timeout in milliseconds.

bac maxinfo=1

Sets MS/TP Max Info Frames parameter.

Note: Maximum object counts are fixed at

AV: 100

BV: 100

Both AV's and BV's map to the same set of local internal objects, but each object can only be enabled as AV or BV, one or the other. BACnet object type is determined by internal data object type. If BIT, then it is a BV, otherwise it is AV. BACnet queries for object lists will return AV or BV as applicable, and there may be holes in the list (e.g. AV1-5, then AV 11-20, because 6-10 are BV6-10).

8.3. Modbus TCP - VP3-TM60

VP3-TMxx Text Messenger Configuration Tool v1.08

Connected: ☒ Sync: ☒

Connect | Object List | Object Edit | Protocol | Users | Groups

☒ Modbus TCP Settings

IP Address: 192.168.1.35
 Subnet Mask: 255.255.255.0
 Gateway: 192.168.1.1
 Port: 502

☐ Slave has high reg first
☒ Reset Modbus counts daily

Site Name: TM60 Test Lab 10.5.3

Device #	IP Address	Port
1	192.168.1.37	502
2	0.0.0.0	0
3	0.0.0.0	0
4	0.0.0.0	0
5	0.0.0.0	0
6	0.0.0.0	0
7	0.0.0.0	0
8	0.0.0.0	0
9	0.0.0.0	0
10	0.0.0.0	0
11	0.0.0.0	0
12	0.0.0.0	0
13	0.0.0.0	0
14	0.0.0.0	0
15	0.0.0.0	0
16	0.0.0.0	0
17	0.0.0.0	0

Read Device Write Device Protocol info written.

mod

ipaddr=192.168.1.90,subnet=255.255.255.0,gateway=192.168.1.1,port=502

mod ipaddr=n.n.n.n, subnet=m.m.m.m, gateway=q.q.q.q, port=p

Sets configured IP address of the iReport itself to n.n.n.n, subnet mask to m.m.m.m, gateway (if given) to q.q.q.q and Modbus port to 'p' (defaults to 502 if not given). If the IP address is set different than what it was, a reboot of the server is needed before the new IP address takes effect.

tcpdev 1,ipaddr=192.168.1.101,port=502

Sets up TCP device instance to IP address mapping. Object mappings reference a device number if TCP, and this table configures the IP address and port number for that device.

mod bigend=yes/no

Sets big endian mode for Modbus when operating as a slave. Endian flag set in individual objects when operating as master (or sniffer).

mod dailyreset=yes (or no)

Results in message counts and error counts for Modbus devices being reset once a day. The timing of this reset coincides with daily reports. This can be useful for determining if "show rtuerrors" or "show tcperrors" is showing recent or potentially outdated error counts.

8.4. BACnet IP - VP3-TM70

The screenshot shows the 'VP3-TMxx Text Messenger Configuration Tool v1.08' window. The 'BACnet IP Settings' tab is selected and checked. The 'Connected' and 'Sync' status indicators are both checked. The configuration fields are as follows:

Field	Value
Device Instance	20834
Device Name	VP3-TM70
Device Location	Unassigned
IP Address	192.168.1.34
Subnet Mask	255.255.255.0
Gateway	192.168.1.1
Port	47808
APDU Timeout (mS)	15000
APDU Retries	3
Segment Timeout (mS)	5000
Analog Value Count	12
Binary Value Count	0
Password	
Site Name	Test Lab 4000-TM70-10.5.2dl

At the bottom, there are buttons for 'Read Device' and 'Write Device'.

bac ipaddr=192.168.1.25, subnet=255.255.255.0, gateway=192.168.1.1, port=47808

bac ipaddr=n.n.n.n, subnet=m.m.m.m, gateway=q.q.q.q, port=p

Sets configured IP address of the iReport itself to n.n.n.n, subnet mask to m.m.m.m, gateway (if given) to q.q.q.q and port to 'p' (defaults to 47808, if not given). If the IP address is set different than what it was, a reboot of the server is needed before the new IP address takes effect.

bac pass="buster"

Sets BACnet password required for device reinitialization command from BACnet client.

bac apdutime=5000

Sets MS/TP APDU timeout in milliseconds.

bac apduretry=3

Sets MS/TP APDU retry count.

bac segtime=5000

Sets MS/TP APDU segment timeout in milliseconds.

Copyright © 2019 Control Solutions Minnesota, Inc.



i.Report VP3-TMxx Remote Monitoring



9. Configuration Tool: Users

9.1. The Phonebook

User #	SMS #	Groups	Comm...	Name
1	17634155950	1	Y	Jack C.
2	17634155954	1	Y	Jim C.
3	17634155958	1	Y	Pete P.
4	17634155959	1	Y	Tom T.

Configured similar to objects, user definitions (phonebook entries) start with an identifier, delimited with a space, and the first element following is the user number. Configuration fields follow. For example:

user 1,sms=17634155950,groups=1+2+7,name="John Smith",command=yes

The parameters available for configuring a user in the phonebook are:

user 1,sms=17634155950

Sets phone book entry 1 to the given SMS/phone number. IMPORTANT: The country code, e.g. 1, must be included in the phone number.

user 1,groups=1+2+7

Selects which groups (1..8) which this user is a member of. A user may be a member of 1 to 8 groups. Note that for groups, 1+2 means literally the string "1+2", not 3. Groups=1+2 will give you groups 1 and 2, while 3 will give you group 3.

user 1,name="John Smith"

The name is for reference only (30 char max), displayed for reference on the console.

user 1,command=yes

If this user is authorized to send commands via SMS, indicate "yes", defaults to "no" if omitted.

9.2. Password Locking

sys password=jkPE#23kp9&

sys password=0

Set password (any string up to 40 characters) used to unlock a command session via SMS. Any sender recognized as a user may query data via SMS, but only users whose command=yes option has been set may send commands via SMS, and even then, only after unlocking their session. Note: If no password is provided, SMS will remain open to commands from recognized, qualified senders indefinitely. Use password=0 to remove the password entirely.

NOTE: The password may be set remotely via SMS by any user whose session is unlocked, or if no password was previously in effect. Users designated as "Admin" will be notified of the password change. The password may not be unset (password=0) remotely.

unlock jkPE#23kp9&

When given via SMS, unlocks that user for up to 1 hour during which that user may issue commands via SMS, provided the user has been enabled for command mode (by configuring user n,command=yes). Has no effect on directly connected console. The console is always unlocked, but one has to have physical access to the device along with special knowledge in order to do anything.

NOTE: There is a single password for the device, and not a different password for each user. It is generally going to be the case that, while many users may be notified, only a very limited number of users will be granted the ability to make changes remotely (command=yes), and therefore the password will only be shared by a very small number of people. The password only pertains to making changes remotely, and has no impact on sending notifications.



NOTE: If a user is included in two groups, and the second group has a delay applied, then that user will receive the same message twice with the second time being after the delay.

NOTE: Only those SMS numbers receiving an alarm active notification will receive the corresponding alarm inactive notification. If the report delay resulted in an SMS number not receiving the active notification, then that number will also not receive the inactive notification.

group 1,admin=yes

Send message to this group any time a new user is added, or user configuration is changed. Admin will also receive a message when a user replies "stop" to their messages, or if messages are stopped automatically due to excessive errors attempting to send to that user. The admin group will also receive a notification if the password is changed by another user.

group 1,fails=yes

Send message to this group any time an object goes into default mode. The object's defaultonfail must be set for this to happen. The default will be set upon reliability code transitioning from zero to non-zero.

group 1,errors=yes

Sends message to this group any time an object's reliability code transitions from zero to non-zero.

NOTE: To clarify, errors=yes will report all objects transitioning from reliability code of zero (no faults) to non-zero (fault of some kind). Whether the fault results in the object being set to the default value depends on the object's "defaultonfail" setting. If the fault that would otherwise be reported as an error results in the object being set to its default value, then the same fault will be reported as a failure instead (fails=yes). If errors are not being reported but failures are being reported (errors=no,fails=yes), then only those faults resulting in an object being set to its default value as a result of the fault will be reported via SMS.

NOTE: Reliability is status value normally used for BACnet, but is also used for Modbus in the VP3-TM in order to report errors object by object. This is especially important for tracking down exception errors. CRC errors are general and usually related to wiring, so are not important to report by device. But exceptions are very object specific.

group 1,starts=yes

Sends message to this group every time the device restarts.

group 1,summary=yes

Results in a daily summary report being sent to this group. The timing of the daily summary is tied to the 24-hour timer used to send daily object reports (objn,reportdaily=yes). The 24-hour timer is maintained for other daily reporting purposes even if no object has its reportdaily option set. The daily summary includes the site name, count of objects (points) monitored, count of active alarms, and count

of objects with errors (most often communication problems).

Copyright © 2019 Control Solutions Minnesota, Inc.



11. Console Commands and Queries

The commands and queries noted throughout this section are valid via the "command console" (see section 6.3), and in most cases via SMS. Commands not valid via SMS are noted as such, but otherwise you can use these commands remotely. In most cases, you will need to "unlock" your session before you can use the commands remotely (see section 9.2).

11.1. Site or Device Level Commands and Queries

sys site="Site Name"

Sets site name that may optionally be included in SMS messages. The name must be a quoted string.

show

Show summary of device configuration

show cell

Show information and status about the cellular connection, including CCID of the SIM card, phone number, signal strength, and last received SMS message if any. Signal strength will be indicated as a number in the range of -51 dBm to -113 dBm with -51 being a perfect signal and -113 being call-dropping bad.

show uptime

Shows the time in seconds since the last restart, and also shows the restart reason code.

send sms=6514264410,message="Test SMS message"

Will send the given quote delimited message to the SMS number provided. Used as a diagnostic to test whether the modem is sending text messages.

sys run

Will exit configuration mode and begin operation according to whatever device has been configured to do. For Modbus RTU, the serial port will begin running the RTU protocol. For Modbus TCP, protocol operation will begin via the TCP connection, but the console will remain open to commands via the serial port, except that API mode is disabled. Note that the run command is assumed and executed automatically within 10 seconds of startup if no other valid command is received. (Note: This is the command sent to the VP3-TM by the configuration tool when you click the Run Device button. This also happens automatically after 10 seconds if you do not go into configuration mode on the device.)

sys reboot=server

sys reboot=all

Restarts iReport's IP server if applicable when "server" is indicated. Restarts entire device if "all" is given. Note that any open or active sessions are terminated.

sys resync

Resets the 24-hour timer for daily reporting of objects whose reportdaily option has been enabled. (see "obj n,reportdaily=...")

sys clear=objects

sys clear=users

sys clear=groups

sys clear=protocol

sys clear=all

sys clear=confirm (NOT valid via SMS)

Used in sequence to clear some or all parts of the device configuration. If "clear=objects", then all object configuration will be cleared, but not users or groups (unless they are also selected). If "clear=all", then everything will be cleared. Note, however, that the clear operation does not actually take place until a second command, "clear=confirm", is sent. If any command other than another "sys clear" is sent before the "clear=confirm", then the clear is entirely cancelled. This is to avoid accidentally wiping out the entire device with one errant command. The clear command is not available via SMS. The entire device can only be cleared via the console (or configuration tool).

sys scanning=stop

sys scanning=start (NOT valid via SMS)

The alarm scanner must be stopped before entering API mode. Use this command to stop and restart alarm scanning. The alarm scanner will default to being stopped while in configuration mode (using command console) and will automatically start when config mode is exited. In addition, protocol scanning is automatically stopped while in config mode, and automatically started when config mode is exited. It is not possible to have the protocol handler and command console running at the same time since they operate via the same communication port.

sys apimode (NOT valid via SMS)

Will enter API mode allowing console interaction directly with the cellular modem. Must exit API mode before console returns to recognizing normal console commands. API mode is not available via SMS. API mode is also not available once the "sys run" command has been issued. Note: This command should only be used upon advice from Control Solutions technical support.

11.2. Data Object Commands and Queries

obj 1,parameter=?

Will look up the value of the "parameter" given, e.g. alarm, and return the value

via SMS. The session must be unlocked before the "obj" command is accessible.

query 1,parameter=?

Will look up the value of the "parameter" given, e.g. alarm, and return the value via SMS. The query command is available to recognized users who are not authorized for command access, and/or without unlocking the session.

ack 1/14

Will acknowledge alarm for object 1, sequence number 14.

obj 1,value=n.nnn

Will set the present value of the given object number to the value given. As with configuration changes, only users authorized to send commands, and who have unlocked their SMS session, may use this command via SMS. If the object is mapped for reading from Modbus or BACnet, then the value set by this command will most often be overwritten soon, but can be used to exercise alarms as a test while Modbus is not connected. If the object is mapped for writing to Modbus or BACnet, then using this command will result in a register being written in the Modbus device, or object written in the BACnet device. This provides the ability to remotely control Modbus or BACnet devices.

obj 1,relinquish=yes

Will result in the VP3-TM30 or VP3-TM70 sending a relinquish to the commandable object previously written at its configured command priority (as result of obj 1,value=n). This is only valid for BACnet objects, and only if configured to write to a commandable object. Issuing a relinquish to an object that is not writing to a commandable object will result in that object returning an error.

obj 1,value=?

obj 1,fault=?

Will display value or fault code for object specified, provided session is unlocked.

query 1,value=?

query 1,fault=?

Will display value or fault code for object specified even if user is locked out of command mode.

show obj 1

show obj first

show obj next 5

Will return an object's name, present value, and alarm state. If only a number is given, then that object is returned. If "first" is given, then the first configured object will be returned, which would most often be object 1. If "next N" is given, the first configured object after object N is returned. The "next N" will most often simply return object N+1, but can be useful in searching for objects beyond some that may have been unconfigured.

show objconfig 1 (NOT valid via SMS)

Will return summary of object configuration listing all currently set parameters for that object. NOT valid via SMS since the reply would exceed SMS message length. Use individual parameter query to retrieve configuration via SMS.

show objlist

Will return the list of objects as known to BACnet. They will be either AV or BV, or not included in the list because they are unconfigured. NOT valid via SMS. Valid only via the console (BACnet versions only).

*show alarms first**show alarms next 5**show alarms all (NOT valid via SMS)*

Will produce an single-line summary of active alarms. When "first" is specified, the first object having an alarm is provided. When "next N" is given, the first object in alarm after object N is provided. The combination of first/next allows effectively scanning through the alarm list via SMS. For example, if "first" provided an alarm message about object 5, then the next query would be "next 5" to start checking for more alarms starting at object 6. If "all" is specified, a multi-line list of all active alarms is generated - the "all" option is valid only via the console, NOT valid via SMS.

report Fuel tank

Will search objects for an object named "Fuel tank" and return that object as if "show obj n" had been sent, except object number will also be included for reference. This name search will be case insensitive, therefore objects should not use the same name with variations on capital versus lower case (e.g. FUEL TANK, Fuel Tank, and fuel tank are all the same name).

*show objerrors first**show objerrors next 4*

Show next object having a non-zero reliability code starting at first, or in second example, first object after object 4. Defaults to first if no parameter given.

obj 1,unconfigure=yes

Will mean clear all configuration for object number 1.

obj 1,reset=yes

Will cause object to get reinitialized, zero out data, reset any active alarms, and so forth.

11.3. User Commands and Queries

*show user 1**show user 1 10 (NOT valid via SMS)**show user (NOT valid via SMS)*

Will show phone book entries for a single user, a range of users, or all users with

valid entries in the phone book. Only the single user instance is valid via SMS, other variations are for console use only. With no user number specified, all users will be listed (not valid via SMS).

show usererrors first

show usererrors next 2

Will return a message indicating error information by user number pertaining to failure to send SMS messages to that user.

user 1,unconfigure=yes

Will mean clear all configuration for user number 1 effectively removing them from the phonebook. User number may be 1 to 50.

11.4. Group Commands and Queries

show group 1

show group (NOT valid via SMS)

Will show parameters for given group, or all groups. Only the single group instance is valid via SMS. With no group number specified, all groups will be listed.

group 1,unconfigure=yes

Will mean clear all configuration for group number 1. Group number may be 1 to 8. This does not eliminate the group, it only clears all of its special qualifications and resets timers to zero. An "unconfigured" group will still send alarm messages.

11.5. Protocol Commands and Queries - Modbus

show modbus

Displays Modbus port parameters. Not valid via SMS - query individual parameters, e.g. "mod baud=?".

show tcplist (NOT valid via SMS)

Displays Modbus TCP device list as set using tcpdev commands (Modbus TCP only, multi-line response not available via SMS).

show tcpdev 1

Displays single Modbus TCP device as set using tcpdev command (Modbus TCP only).

show server

Displays the firmware version in the server module, which will be different than the primary device firmware version indicated by the "show" command without any parameters. (Modbus TCP only)

show rtuerrors first

show rtuerrors next 3

show tcperrors first

show tcperrors next 2

show tcperrors server

Show first/next device having error counts. The TCP device will refer to TCP client. Use "server" to obtain counts for the TCP server. RTU can only be master or slave, not both (like TCP). If RTU is slave, then only "first" is valid and this will refer to the slave counts. (TCP is only valid for the TCP version of the device.)

mod rtuclear=1

mod tcpclear=2

mod tcpclear=server

Clear counts for RTU/TCP device number given, or for the TCP server. If RTU is slave, then "1" refers to the slave. (TCP is only valid for the TCP version of the device.) The clear command with no parameters will clear all counts. Counts include total message counts and all types of error counts.

show rtucounts 3

show tcpcounts 2

show tcpcounts server

Show message counts for RTU/TCP device number given, or for the TCP server. If RTU is slave, then "1" is the slave. (TCP is only valid for the TCP version of the device.)

mod macaddr=?

mod macaddr=00:40:9D:12:34:56

The macaddr=? may be used to see what the server's MAC address is. It may be set using this command, but DO NOT USE THIS COMMAND without guidance from tech support. In rare cases, the MAC address can get reset to a default 00:40:9D:00:00:00. If this happens, you will need to recover the original MAC address from the bar code label on the server module and re-enter it. The first 3 fields must always be 00:40:9D and the remaining 3 fields should be restored to what is on the label.

mod rootpass="buster"

Sets the server's root password (only applicable to IP version). The only use for this password, which defaults to "buster", is to update firmware in the server module.

11.6. Protocol Commands and Queries - BACnet

show bacnet

Displays BACnet port parameters. Not valid via SMS - query individual parameters.

show server

Displays the firmware version in the server module, which will be different than the primary device firmware version indicated by the "show" command without any parameters. (Applies to IP only)

show objerrors first

show objerrors next 4

Show next object having a non-zero reliability code starting at first, or in second example, first object after object 4. Defaults to first if no parameter given.

bac macaddr=?

bac macaddr=00:40:9D:12:34:56

The macaddr=? may be used to see what the server's MAC address is. It may be set using this command, but DO NOT USE THIS COMMAND without guidance from tech support. In rare cases, the MAC address can get reset to a default 00:40:9D:00:00:00. If this happens, you will need to recover the original MAC address from the bar code label on the server module and re-enter it. The first 3 fields must always be 00:40:9D and the remaining 3 fields should be restored to what is on the label.

bac rootpass="buster"

Sets the server's root password (only applicable to IP version). The only use for this password, which defaults to "buster", is to update firmware in the server module.

Copyright © 2019 Control Solutions Minnesota, Inc.



12. Remote Commands and Queries via SMS

12.1. Available Commands and Queries

All of the commands detailed in Section 11 of this user guide are available via SMS except where noted. In addition, object configuration, user configuration, and user group configuration, may all be done via SMS by a user who is enabled for sending commands (command=yes in user definition), and provided the session is unlocked if a password has been set.

12.2. Message STOP

STOP

If a user replies "stop" via SMS, then no further text messages will be sent to that user. Those other users selected as admin will be notified when a user replies "stop". The notification will include the stopped user's phone number.

Note: An automatic stop will occur if too many errors are encountered in attempting to send text messages to a given user. The same stop notification will be sent to admin when this happens, but the notification will indicate automatic due to errors rather than stopped by user.

user 1,start=yes

Will un-stop the given user number. A user may simply send "start" to restart their own messages. This command is intended be sent by admin to override a user's "stop" and restart messages to that user.

START

Will un-stop the sending user if previously stopped. The SMS session does not need to be unlocked in order to use "start".

12.3. Claiming Ownership of New Device

owner="John Adams"

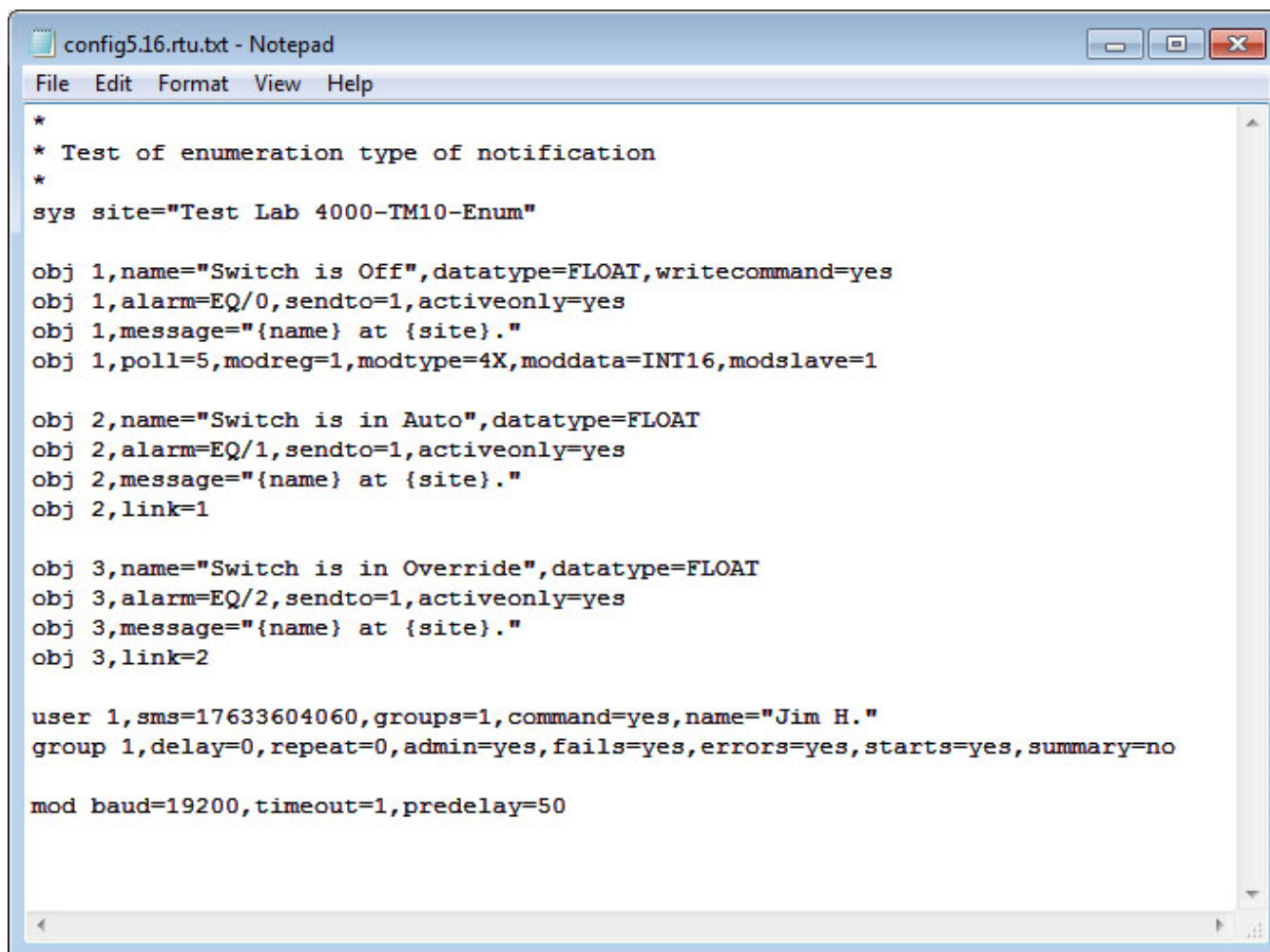
Configuration of a brand new device using configuration mode via the console connection will be the most efficient way to configure a larger number of points. But for a very simple configuration, it is possible to commission a brand new device strictly via SMS. To start this process, the caller must establish themselves as the owner. Without any predefined users, there would otherwise be no way to send commands to the device. If the monitoring device has never before been configured, i.e. no users and no objects exist, then the owner command may be

used one time only to establish the caller as the owner. The phone number from which the owner sent the owner command will be captured as the user's phone number, and the given name will be assigned along with that number as user #1. This user will be assigned to group #1, and all possible options will be set/enabled. Note that this command can only be used one time. Once used, the same user must continue with configuration or one must connect via the console. If a quoted name is not found following owner=, then the device will behave as if the owner command had never been received and remains open to another use of the owner command. If the owner command is accepted, the reply will be "Welcome". If not successful, there will be no reply just as there is with anything received from an unrecognized user.

Copyright © 2019 Control Solutions Minnesota, Inc.



13. Configuration Script Files



```
*
* Test of enumeration type of notification
*
sys site="Test Lab 4000-TM10-Enum"

obj 1,name="Switch is Off",datatype=FLOAT,writecommand=yes
obj 1,alarm=EQ/0,sendto=1,activeonly=yes
obj 1,message="{name} at {site}."
obj 1,poll=5,modreg=1,modtype=4X,moddata=INT16,modslave=1

obj 2,name="Switch is in Auto",datatype=FLOAT
obj 2,alarm=EQ/1,sendto=1,activeonly=yes
obj 2,message="{name} at {site}."
obj 2,link=1

obj 3,name="Switch is in Override",datatype=FLOAT
obj 3,alarm=EQ/2,sendto=1,activeonly=yes
obj 3,message="{name} at {site}."
obj 3,link=2

user 1,sms=17633604060,groups=1,command=yes,name="Jim H."
group 1,delay=0,repeat=0,admin=yes,fails=yes,errors=yes,starts=yes,summary=no

mod baud=19200,timeout=1,predelay=50
```

The configuration file is a simple text file containing configuration commands and parameters. These are the same commands you could enter via the "command console" of the configuration tool (Connect page), via any terminal emulator connected to the serial port on the VP3-TM, or via SMS if the sender is recognized and authorized.

The commands that could be contained in the file are outlined in sections 7, 8, 9, and 10.

Blank lines in the file are skipped. Any line with an asterisk (*) in the first column is also skipped as a comment line.

This file may be read into the configuration tool from the Connect page. This file may be created by the configuration tool also from the Connect page. This file is essentially uploaded or downloaded when you click Read All or Write All on the Connect page.

Copyright © 2019 Control Solutions Minnesota, Inc.



i.Report VP3-TMxx Remote Monitoring



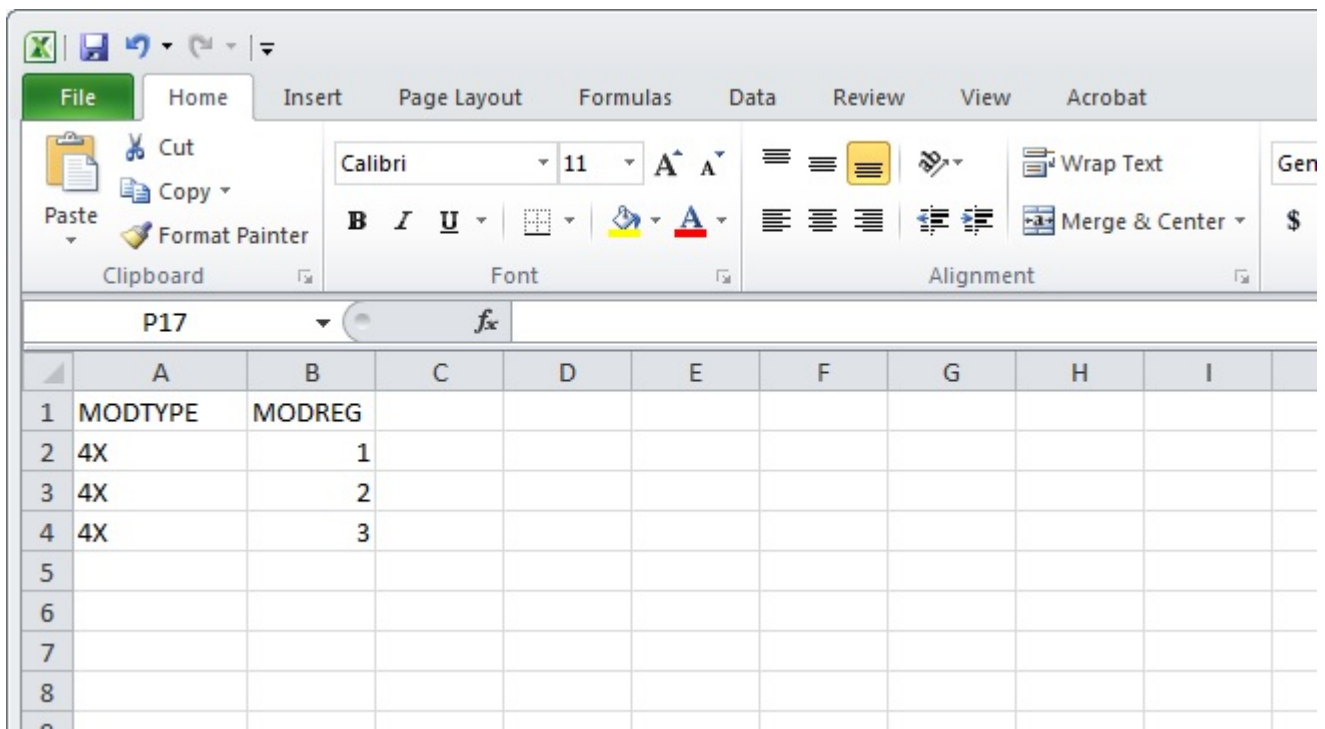
14. CSV File Import/Export

14.1 Using CSV Files to Speed Configuration

The CSV import capability simplifies the process of creating or changing a large number of entries because you can use any standard spread sheet program to manipulate the content of the CSV file, and then import that into the VP3-TM via the configuration tool. If the VP3-TM will be reading a long list of Modbus registers, for example, you can sometimes just copy a list of registers from another source, paste into a simple text file, and import that into the spread sheet program. Then add a header line to label the content, add a handful of additional columns, and you quickly have most of a complete configuration. Very often, the only thing that changes from one line to the next is the register number. The other entries can be quickly made by entering once and using the spread sheet program's "fill down".

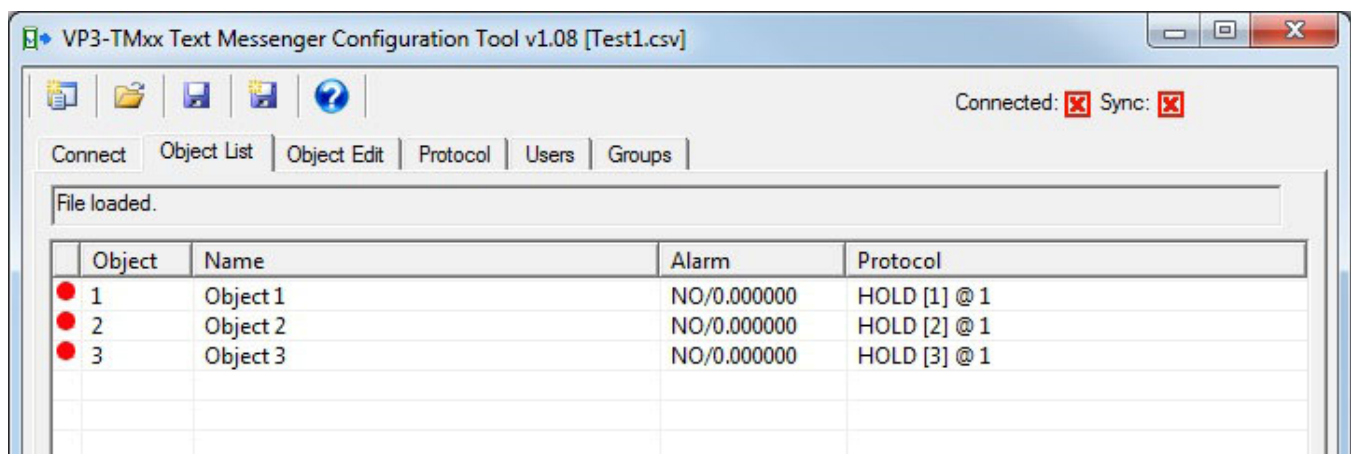
	A	B	C	D	E	F	G	H	I
1	Modicon								
2	40001								
3	40002								
4	40003								
5									
6									
7									
8									
9									

You can quickly create a configuration for a Modbus master that will poll a list of registers by simply providing the list of registers. Everything else will default to the most commonly used parameters. If you are using Modicon notation for the import, the minimum requirement is just a list of registers with a header label MODICON.



	A	B	C	D	E	F	G	H	I
1	MODTYPE	MODREG							
2	4X	1							
3	4X	2							
4	4X	3							
5									
6									
7									
8									
9									

The alternative to Modicon notation is just a list of register numbers labeled MODREG that will default to holding registers (4X). You can also add the MODTYPE column to specify register type.



Object	Name	Alarm	Protocol
1	Object 1	NO/0.000000	HOLD [1] @ 1
2	Object 2	NO/0.000000	HOLD [2] @ 1
3	Object 3	NO/0.000000	HOLD [3] @ 1

Both of the CSV files illustrated above import to the same configuration illustrated by the Object List above. Picking just one for editing, illustrated below, shows the various default settings that were made.

The minimum requirement for importing a list of Modbus registers is just one of MODREG or MODADDR or MODICON. If MODICON used, then MODTYPE cannot be used because type is implied by the Modicon number. If MODICON is not used, then MODTYPE can be used, but registers will default to holding registers if MODTYPE is not included.

The minimum requirement for importing a list of BACnet objects is BACDEV and BACOBJTYPE and BACOBJINST - all 3 required. Everything else will default.

The NUMBER, NAME, and DATATYPE columns seem like obvious requirements but are actually not included in minimum requirements for an import. Object number will be auto-assigned simply in the order found in the CSV file. Name will default to a generic "Object n" name, and data type will default to floating point.

14.2. Data Object CSV File Format

The following columns are generated by the CSV export of data objects from the Object List page in the VP3-TM configuration tool. This table references the object configuration command that would be used. Refer to the respective commands in Section 7 of this user guide for additional details about certain parameters.

When creating a CSV file for importing, it is not necessary to include all columns, and order is generally not critical. The minimum required columns would be those

noted above. In addition, if creating a CSV file for a Modbus model (VP3-TM10, VP3-TM60), do not include columns pertaining to BACnet. Likewise, if creating a CSV file for a BACnet model (VP3-TM30, VP3-TM70), do not include columns pertaining to Modbus.

A simple way of starting a new CSV file is to enter a very minimal 1-object configuration in the configuration tool, and then export a CSV file from the Object List page. The entire header will be created for you. Now simply proceed to fill in additional rows. Feel free to delete unused columns.

NUMBER	<i>obj 1,xxx</i> Sets object number for the parameters in this line of the CSV file.
NAME	<i>obj 1,name="Engine Temp"</i> Sets object name (ASCII string up to 39 characters). The name must be a quoted string.
DATATYPE	<i>obj 1,datatype=FLOAT</i> Sets data type for object's data. Types are as follows: FLOAT=floating point UINT32=unsigned 32-bit integer INT32=signed 32-bit integer UINT16=unsigned 16-bit integer INT16=signed 16-bit integer BIT=Boolean on/off, 1-bit value
LINK	<i>obj 1,link=40</i> Sets link object (virtual link) for causing the source of data for this object to be some other object, or a virtual object in the system.
MASK	<i>obj 1,mask=0080</i> Sets data mask for use with virtual link. Value is expressed in hexadecimal. Applies to VP3-TM10 and VP3-TM60 only.
SCALE	<i>obj 1,scale=1.0000</i> Sets scale factor, this is multiplied by data value before being stored in object.
OFFSET	<i>obj 1,offset=0.0000</i> Offset added to data value before being stored in object.
	<i>obj 1,alarm=GT/100.0</i> Sets alarm type. Alarm type codes are as follows: GT= greater than GE=greater than or equal LT=less than

ALARMTYPE	<p>LE=less than or equal *EQ=equal *NE=not equal. DV=deviates from threshold by hysteresis amount CB=changes by NO=none (used in CSV files)</p>
ALARMLEVEL	<p><i>obj 1,alarm=GT/100.0</i> Sets alarm threshold, second half of alarm command from console.</p>
SENDTO	<p><i>sendto=1+2+4</i> Indicates one or more notification group numbers 1 through 8 to send the alarm message to. Note that for groups, 1+2 means literally the string "1+2", not 3. Sendto=1+2 will give you groups 1 and 2, while 3 will give you group 3.</p>
MINON	<p><i>obj 1,minon=10</i> Sets minimum on time for alarm in seconds.</p>
MINOFF	<p><i>obj 1,minoff=0</i> Sets minimum off time for alarm in seconds.</p>
HYST	<p><i>obj 1,hyst=5.0</i> Sets hysteresis value applied to alarm thresholds.</p>
MESSAGE	<p><i>obj 1,message="Send this message when alarm makes transition"</i> Sets the message that will be sent upon alarm transition.</p>
ENABLEOBJ	<p><i>obj 1,enableby=2/30</i> Selects another object that will enable this alarm.</p>
ENABLEDELAY	<p><i>obj 1,enableby=2/30</i> The second value is a delay time in seconds. If non-zero, the enable will take effect this amount of time after the given object becomes non-zero.</p>
REQUIREACK	<p><i>obj 1,requireack=yes</i> Selects whether the alarm must be acknowledged by an SMS reply. The yes/no selection is Y or N in the CSV file.</p>
ACTIVEONLY	<p><i>obj 1,activeonly=yes</i> Eliminates the alarm inactive notification when "yes". The yes/no selection is Y or N in the CSV file.</p>
POLL	<p><i>obj 1,poll=5</i> Sets poll timer for reading. Setting is in seconds.</p>

WRITECOMMAND	<i>obj 1,writecommand=yes</i> Selects whether write on command is enabled for this object. The yes/no selection is Y or N in the CSV file.
FAILCOUNT	<i>obj 1,defaultonfail=99.99/3</i> Tells the communication engine to set the object to a default value upon some number of communication failures. Syntax is defaultonfail=<value>/<count> where <value> is the default value to be set upon <count> failures. In the CSV file, this column is the <count> part.
DEFAULTVALUE	<i>obj 1,defaultonfail=99.99/3</i> Tells the communication engine to set the object to a default value upon some number of communication failures. Syntax is defaultonfail=<value>/<count> where <value> is the default value to be set upon <count> failures. In the CSV file, this column is the <value> part.
TIMEOUT	<i>obj 1,timeout=0.5</i> Sets timeout, in seconds with resolution to tenths.
REPORTDAILY	<i>obj 1,reportdaily=1+2+4</i> Sets the object for daily reporting to the notification groups given.
MODREG	<i>obj 1,modreg=201</i> Sets remote Modbus register number, indexed from 1, not Modicon.
MODTYPE	<i>obj 1,modtype=4X</i> Set Modbus register type – determines Modbus function code. Types are: NO=none 0X=coil (read/write) 1X=discrete input (read only) 3X=input register, 16-bit (read only) 4X=holding register, 16-bit (read/write) 0XS=single coil 4XS=single holding register
	<i>obj 1,moddata=UINT16</i> Sets Modbus remote register data format. NONE=undefined INT16=signed integer, 16-bit UINT16=unsigned integer, 16-bit INT32=signed integer, 32-bit UINT32=unsigned integer, 32-bit INT64=signed integer, 64-bit

MODDATA	<p>FLOAT=floating point, IEEE 754, 32-bit BIT=Boolean, single bit, applies to coil or discrete input ONLY</p> <p>MOD10-2=Schneider Electric Mod10 format, 2-register</p> <p>MOD10-3=Schneider Electric Mod10 format, 3-register</p> <p>MOD10-4=Schneider Electric Mod10 format, 4-register</p>
MODMASK	<p><i>obj 1,modmask=0080</i> Sets data mask in Modbus map for Modbus bit masking.</p>
MODFILL	<p><i>obj 1,modfill=0080</i> Sets data fill for use in writing packed registers, has no effect on reading.</p>
MODSLAVE	<p><i>obj 1,modslave=5</i> Sets Modbus RTU slave address to be read/written for this map.</p>
MODTCPDEV	<p><i>obj 1,modtcp=1/5</i> Selects the TCP device from device table, and provides TCP unit number instead of RTU slave. Syntax is tcp=<device>/<unit>. Used only in TCP version of device. Both RTU and TCP are simultaneously active in the TCP device.</p>
MODTCPUNIT	<p><i>obj 1,modtcp=1/5</i> Selects the TCP device from device table, and provides TCP unit number instead of RTU slave. Syntax is tcp=<device>/<unit>. Used only in TCP version of device. Both RTU and TCP are simultaneously active in the TCP device.</p>
MODBIGEND	<p><i>obj 1,modbigend=yes (or no, default=no)</i> Sets Modbus register swap flag for this object map. The yes/no selection is Y or N in the CSV file.</p>
MODPACK	<p><i>obj 1,modpack=yes (or no, default=no)</i> Set this option flag if the same register will be shared among multiple objects using bit masking. Even if a single register is to use a bit mask, this flag must still be set to cause the mask to be recognized. The yes/no selection is Y or N in the CSV file.</p>
BACUNITS	<p><i>obj 1,bacunits=95</i> Specifies BACnet Units property for this object.</p>

BACDEV	<i>obj 1,bacdev=10</i> Sets remote device instance for BACnet client mapping.
BACOBJTYPE	<i>obj 1,bacobj=AI/1</i> Selects object type which the BACnet client is to read/write at remote device instance. The following object types are supported by the client: AI=Analog Input AO=Analog Output AV=Analog Value BI=Binary Input BO=Binary Output BV=Binary Value MI=Multi-state Input MO=Multi-state Output MV=Multi-state Value DEV=Device
BACOBJINST	<i>obj 1,bacobj=AI/1</i> Selects object instance which the BACnet client is to read/write at remote device instance.
BACMAC	<i>obj 1,bacmac=3 (hexadecimal)</i> <i>obj 1,bacmac=c0:a8:0:2:0b:ac (indicates IP address 192.168.0.2 port 47808)</i> If specified, this MAC address will be used by the BACnet client to attempt to reach the remote BACnet device when Who-Is fails.
BACPROP	<i>obj 1,bacprop=85</i> Selects object property to be read/written at remote device.
BACDATA	<i>obj 1,bacdata=BIT</i> Specifies data encoding to be used when writing remote device. Supported data encoding types are: NULL=BACnet Application Tag Null (0) BOOL=BACnet Application Tag Boolean (1) UINT=BACnet Application Tag Unsigned Int (2) SINT=BACnet Application Tag Signed Int (3) REAL=BACnet Application Tag Real (4) BIT=BACnet Application Tag BitString (8) ENUM=BACnet Application Tag Enumerated (9)
BACPRIORITY	<i>obj 1,bacpriority=10</i> Specifies the command priority that should be used when writing a commandable object in the remote device. Commandable objects are any Output object. Commandable Value objects are not supported.

BACINDEX	<i>obj 1,bacindex=2</i> Specifies an index value if reading/writing an array, or "no index" if -1. Defaults to "no index".
BACBITNUM	<i>obj 1,bacbitnum=1</i> Specifies a bit number to read a single bit from a bit string.

14.3. User (Phonebook) CSV File Format

The columns in the User CSV file are as noted in the following table. Import and export of User CSV files is done from the Users page in the configuration tool.

The minimum required columns for a User CSV import are USERSMS and GROUPS. Number will be automatically assigned in the order users are found in the CSV file. Name is not used for sending messages, and therefore is not needed for anything other than reference on the screen of the configuration tool - or in other words, just not really needed.

NUMBER	<i>user 1,xxx</i> Sets user number for the parameters in this line of the CSV file.
USERSMS	<i>user 1,sms=17634155950</i> Sets phone book entry 1 to the given SMS/phone number. IMPORTANT: The country code, e.g. 1, must be included in the phone number.
USERNAME	<i>user 1,name="John Smith"</i> The name is for reference only (30 char max), displayed for reference on the console.
GROUPS	<i>user 1,groups=1+2+7</i> Selects which groups (1..8) which this user is a member of. A user may be a member of 1 to 8 groups.
COMMAND	<i>user 1,command=yes</i> If this user is authorized to send commands via SMS, indicate "yes", defaults to "no" if omitted. The yes/no selection is Y or N in the CSV file.



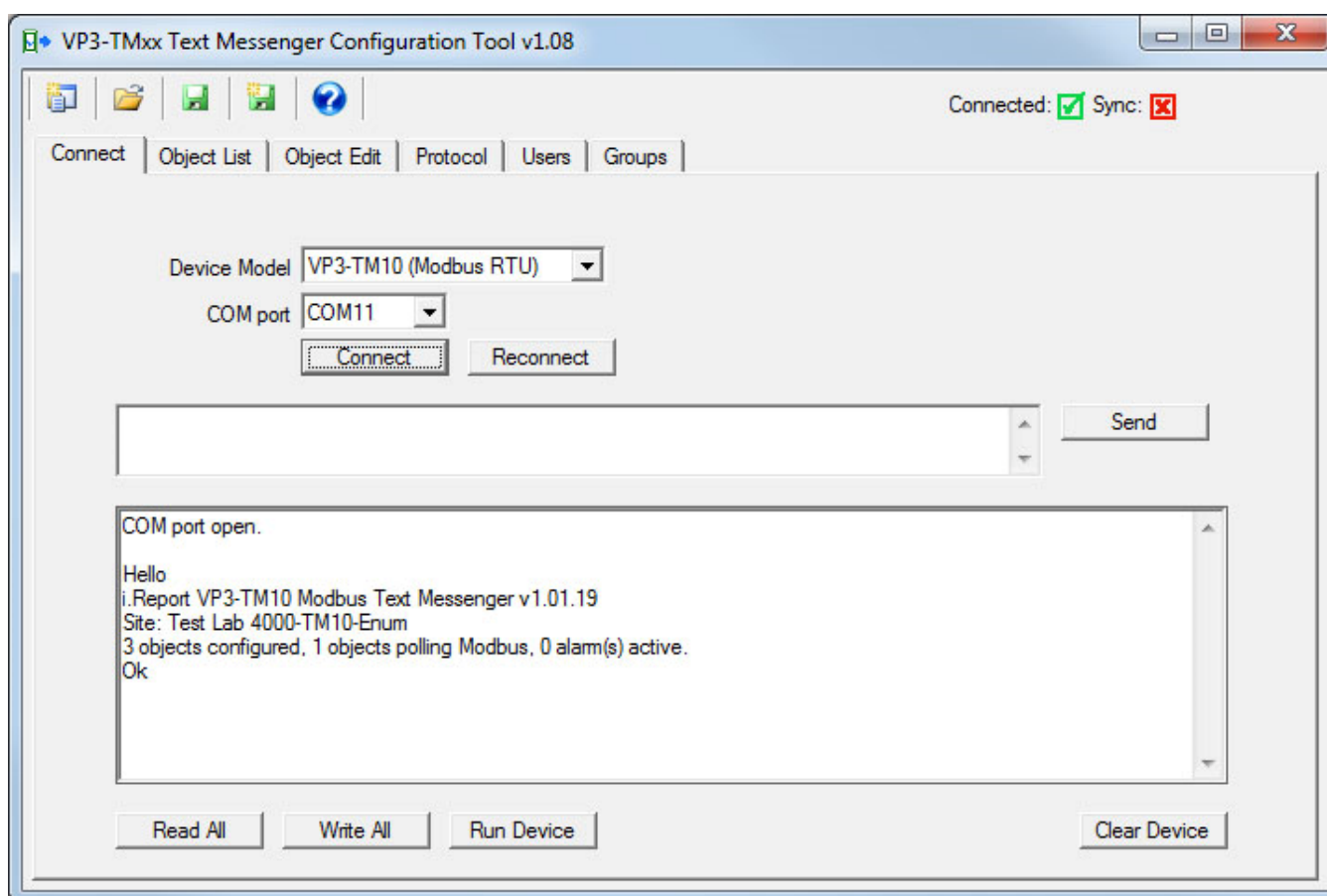
i.Report VP3-TMxx Remote Monitoring



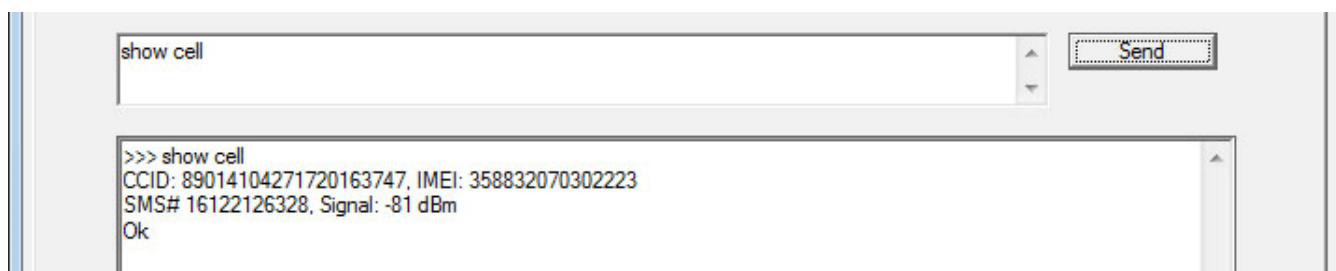
15. Diagnostics and Trouble Shooting

15.1. Sending a Test SMS Message

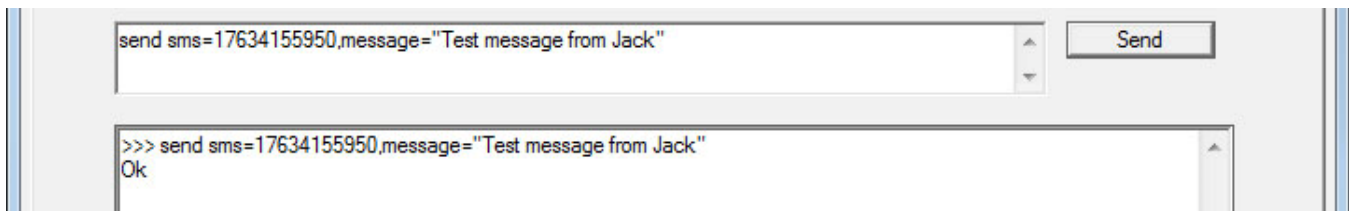
You can send a test SMS message from the command console to any mobile phone number. The number does not have to be in the Users list (phonebook) to send a test message.



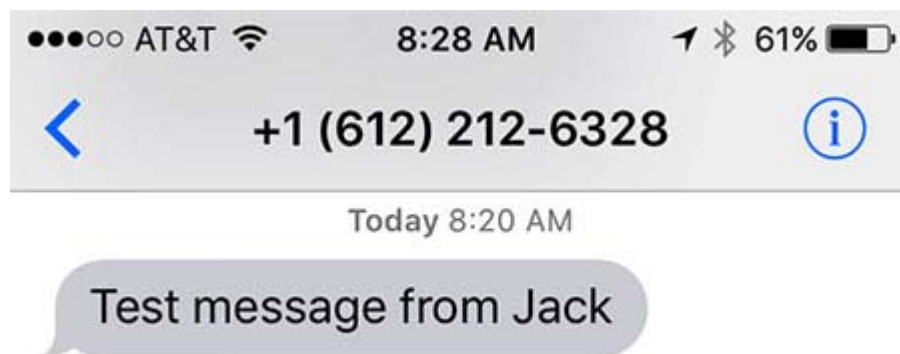
The first step is to get connected to the VP3-TM as discussed in Section 6.



You cannot send a message until the cellular modem connects to the network. Verify the connection using the "show cell" command. If you are not yet connected, you will see "Not connected to network" instead of a signal strength indication.



Now use the send command to send a test message as illustrated here. Note that the message must be enclosed in quotes.



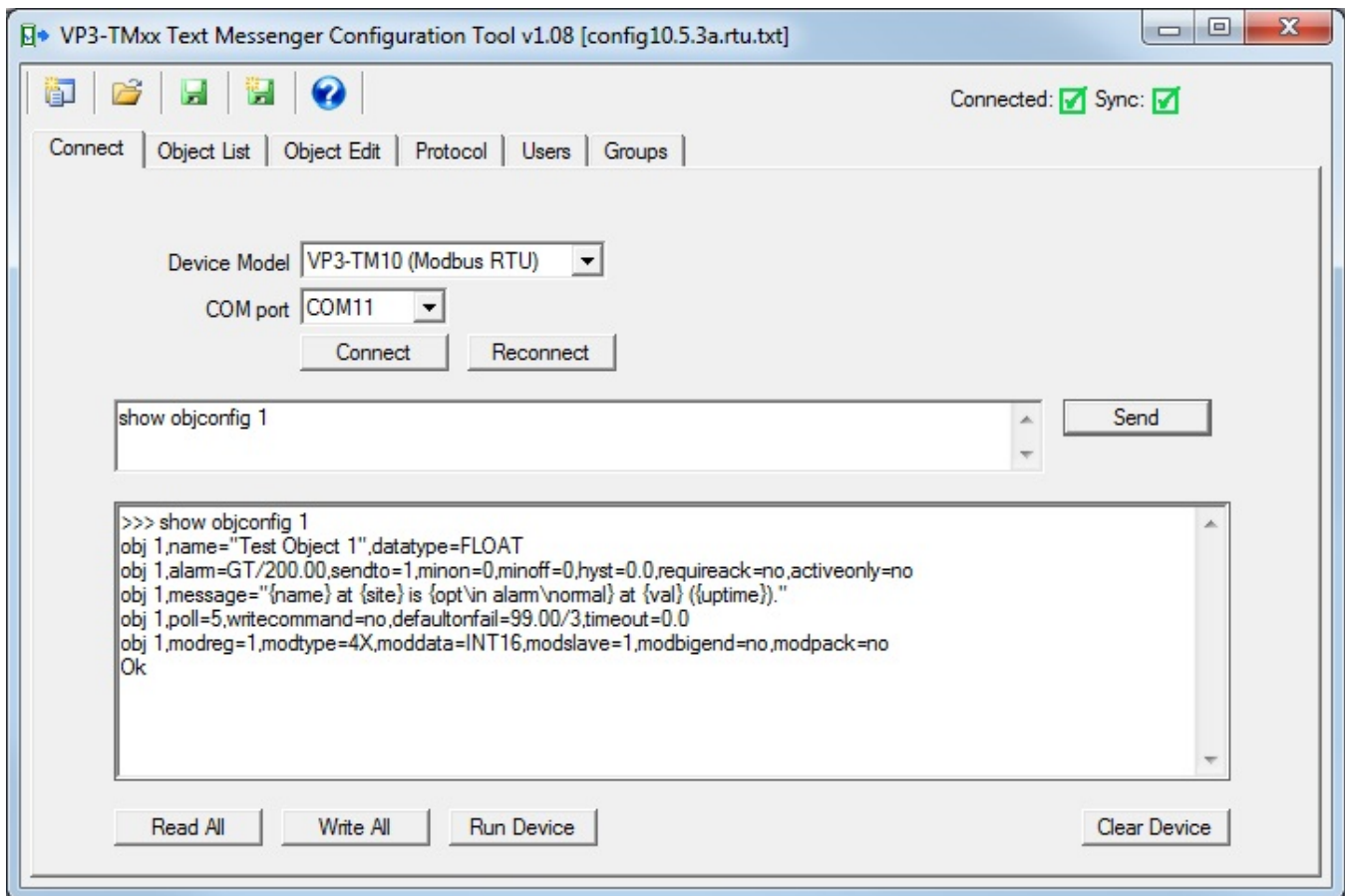
The SMS message should show up on your cell phone within a reasonable amount of time. Usually it will be fairly prompt. Sometimes it may take several seconds, up to a minute or two depending on the cellular network.

Note that the LNK (link) LED on the VP3-TM will be on solid if the cellular modem is not connected to the network, and will normally be blinking at a rate of about twice a second if connected. If it begins to blink with a pattern of two flashes and then a pause, this is the indication that the last attempt to send an SMS message failed.

If the SMS send failed during normal operation while sending a notification to a user in the phone book, you will be able to check the error code using the "show usererrors" command. However, the send command here does not log error codes since the phonebook is bypassed in this test mode.

15.2. Testing Alarms

An obvious way of testing alarm notifications is to observe something happen in the field that should result in an alarm, and verify that you receive the notification on your mobile phone. But there is a way to "bench test" the alarms before ever placing the i.Report in the field.



Start by connecting to the VP3-TM with the configuration tool. Make sure you are in configuration mode as confirmed by the STA LED remaining on solid amber. Verify that you have configured the point you are about to test using the "show objconfig" command. In this example, our object will normally be polling a Modbus register. For test purposes here, you will want to have the Modbus device disconnected. You can't poll Modbus and use the command console at the same time.



Use the value command to set the value of the object from the console. This sets the data value as if it had read that value from your Modbus device. In this case, we see an error message because the object was not configured as writable. It will not normally need to be writable in most cases, but for test purposes, we need to at least temporarily enable writing to the object.



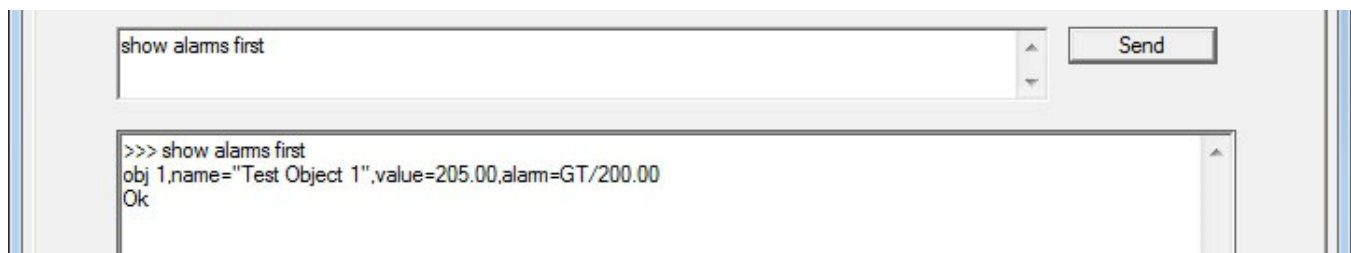
Enable writing with one minor configuration change. The other change you may want to do temporarily is get rid of the defaultonfail since this will result in setting the object value due to the fact that Modbus is disconnected.



We can now successfully set the object value, and in this example, we are making sure we set the value above the alarm threshold.



The other thing you must do to test alarms is enable scanning. Alarm scanning is normally disabled in configuration mode, and automatically enabled when you exit configuration mode. For purposes of testing alarms, you will need to enable scanning while still in configuration mode.



If you have followed the above sequence on your live VP3-TM device, and had previously configured your own mobile phone number in the Users list, you should receive a notification shortly after enabling scanning. You can also check alarms using the "show alarms" command at the console.



Now we set the object value back below the alarm threshold. If you received the alarm active notification, you should now receive the alarm inactive notification.



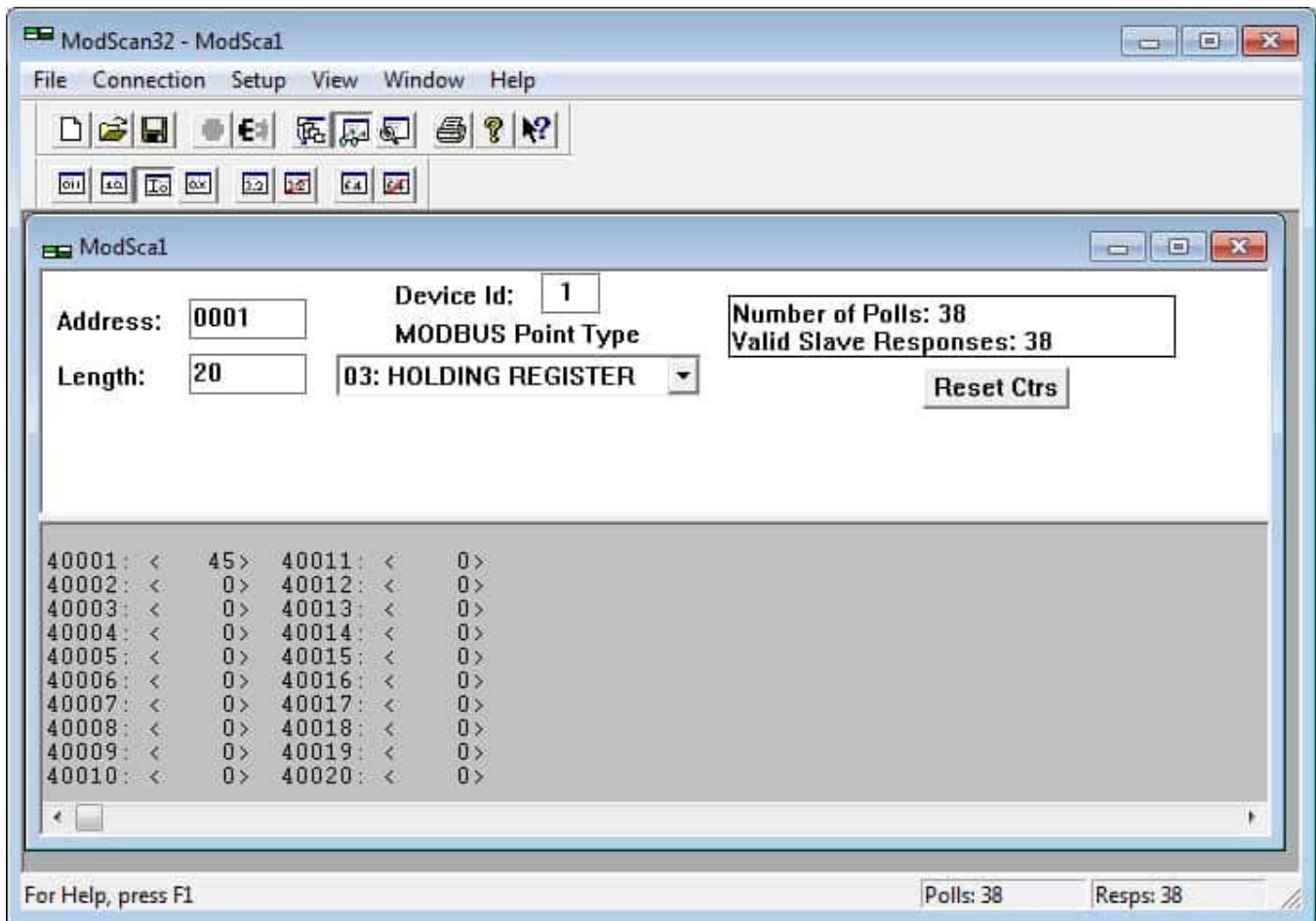
You can verify the alarm was cleared using the "show alarms" command.

Test Object 1 at Test
Lab 4000-10.5.3a is in
alarm at 205.00 (555).

Test Object 1 at Test
Lab 4000-10.5.3a is
normal at 15.000 (661).

The text messages received on our cell phone while preparing this example are illustrated here.

15.3. Testing Communications - Modbus



ModScan and ModSim from Win-TECH Software Design

The Modbus diagnostic tools we use most often at Control Solutions are ModScan32 for testing Modbus slaves (either RTU or TCP), and ModSim32 for simulating Modbus slaves when testing Modbus masters. These are available for purchase (from Win-TECH) for a very reasonable price.

These are certainly not the only Modbus tools available for purchase (see note about searching for others below). Win-TECH is simply the one that has been around the longest, and we have been using their products for about 20 years. We find that if ModScan can talk to it, there is a 99.99% chance that anything else we make can talk to it as well. After further analysis, we found that those rare exceptions were with devices that did not fully comply with Modbus protocol specifications in the first place.

Win-TECH site for purchasing ModScan/ModSim: [ModScan/ModSim](#)

Other Modbus Test Tools

Simply Google "Modbus RTU test software" or "Modbus TCP test software" to find an assortment of Modbus test tools. Some are free, some have a free demo, and

others are available for purchase. We at Control Solutions have tested some of these, and know that our customers have also tested others. We do not use all of the available tools on a regular basis, and are therefore avoiding any specific endorsements here.

Trouble Shooting Tips

No-response errors are probably the toughest because it means no activity is being recognized. CRC errors are marginal progress because it says the devices are at least seeing some bits on the line, even if the bits don't make sense yet. Exception errors are a good sign because it means you are successfully communicating with the Modbus device. Receiving an exception error requires receiving a good packet with a good CRC check. This means communication is ok, but configuration is asking for something the Modbus device does not like.

No-response errors:

- Check to see that communication parameters are correct (baud rate, etc).
- Check to see that the slave address matches.
- Check to see that Pre-Delay is at least 50 mS.
- Check wiring and power.
- Check for reversed polarity on RS485 lines. If uncertain, just try swapping them.
- Check to see that slave device is enabled for Modbus communication (many devices default to disabled)

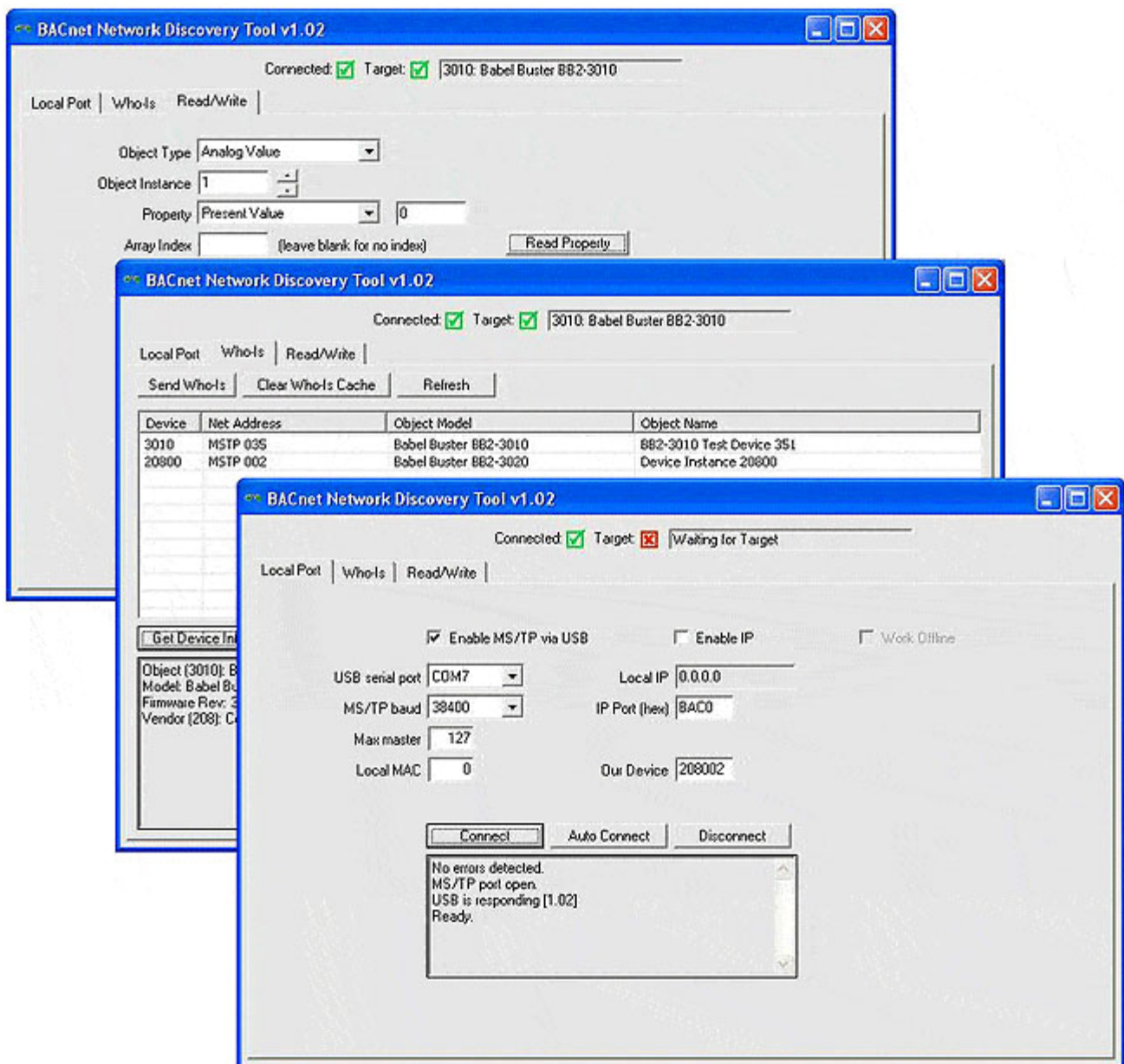
CRC errors:

- Check baud rate and character format.
- Check wiring – if everything else is correct, CRC errors mean noise on the line.
- Check for reversed polarity on RS485 lines. Reversed polarity often looks like just noise.
- Check to see that Pre-Delay is at least 50 mS.

Exception errors:

- Check configuration. You cannot receive an exception error report if you are not successfully communicating with the Modbus device. Wiring, etc, is not a problem. Configuration has something wrong (most often the register number requested is not available).

15.4. Testing Communications - BACnet



BACnet Network Discovery Tool

This free tool, when accompanied by the MTX002, can be used to help you locate MS/TP devices when you may have lost track of settings such as baud rate, max master, MAC address, etc. If you know what speed the network is running at, select the baud rate and click Connect. But if you need to “search” for the right baud rate and other settings, click Auto Connect and wait a minute or two. The discovered baud rate, along with discovered max master setting, will be displayed when the auto connect process is done.

You may also use this tool as an object browser. Once you have selected a device on the Who-Is tab, go to the Read/Write tab. The object types supported are included in the Object Type list - only the basic types are supported by this tool. The most common properties are listed in the Property drop down list, but you can

select "Other" and enter the BACnet property code in the window next to the list. For example, 85 would give you present value.

This tool is useful without any additional connection hardware if using it with BACnet IP. Using it with MS/TP requires the Control Solutions MTX002 USB to MS/TP adapter. This tool will not run with a generic RS-485 port adapter. A standard PC serial port with an adapter is not capable of 76800 baud, but the MTX002 does allow your PC to connect to an MS/TP network running at 76800 baud.

Download the BACnet Network Discovery Tool under the Tools link at csimn.com.

Trouble Shooting Tips

An MS/TP device that is functioning normally will always be at least passing the token, and usually polling for master periodically. The only time a device will not poll for master is if another device exists on the network with a MAC address only 1 greater than the gateway itself. It then just passes the token to that device without any intermediate polling for master.

Two particular indications of the MS/TP token LED are worth noting.

If the token LED appears to be on nearly solid yellow (or amber), this means the gateway is doing nothing but poll for token, which implies it is not finding any other devices on the network. You will see this any time you apply power to the gateway without connecting any network. If the network is connected, there is a problem with connections or port settings.

If the token LED is completely off and never flashes on, this means the gateway is hearing other traffic on the network, but just not connecting. An MS/TP device is required to "be quiet until spoken to". Therefore, if there is chatter on the network, but the gateway cannot find anything that is addressed to the gateway, it will remain quiet. This problem is usually the result of problems with port settings.

An MS/TP device can alternate between the above two conditions. The "be quiet until spoken to" rule is up for grabs when the entire network is powered up simultaneously. Whoever wakes up first will be generating all the chatter while everybody else on the network listens.

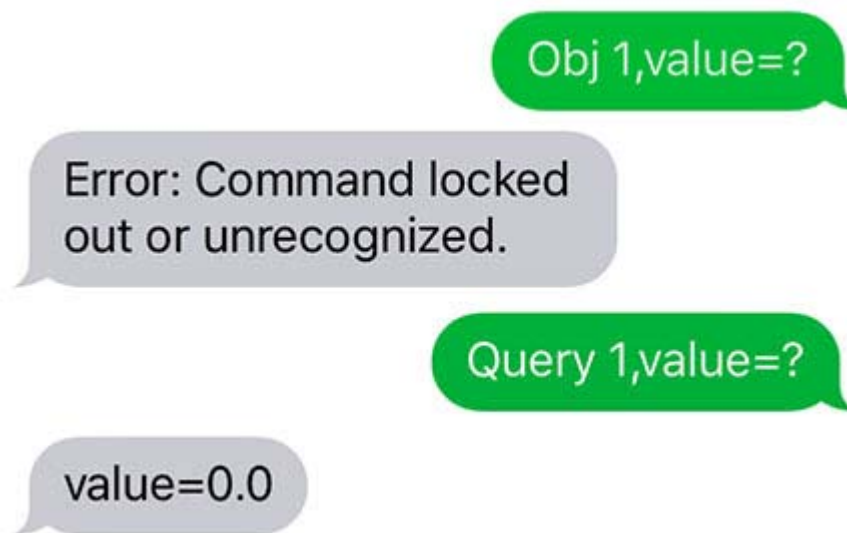
If the token LED is very intermittent, flashes rapidly a few times (including green on the token LED), then is off completely for a period of time, this usually means it is trying to talk, thought it was talking or actually was for a bit, but something got out of sync. If there are duplicate device addresses on the network or mismatching Max Master settings, this will result in the appearance of intermittent communications.

Check your wiring. Noise on the line resulting from not following RS-485 wiring

guidelines will result in communication problems ranging from no connection at all to frequent errors. Also be sure that you have a ground connection between all devices on the network. The RS-485 network is not a 2-wire network. You need two data lines plus signal ground. If you consider cable shield a connection, then you need 4 connections.

15.5. Diagnostic SMS Queries

The VP3-TM was designed to notify you when something happens that you want to know about, but also allow you to check on things "on demand". You may want to simply check the present value of a sensor. You may want to investigate error indications.



You can query the present value of a data object using "obj 1,value=?". However, if the i.Report is password protected and the session is locked, you will get an error message (assuming your phone number is found in the phonebook, ignored completely if not).

Users found in the phonebook but whose session is locked will not be allowed to use the "obj" command because that is considered a configuration command. If their session is unlocked but they are not authorized for issuing commands, they will still get the error message.

Users not authorized for commands can use the "query" command instead. Users must be found in the phonebook before they will get any response. But as long as the user is known, they can use the query command to check on values.

Show objerrors first

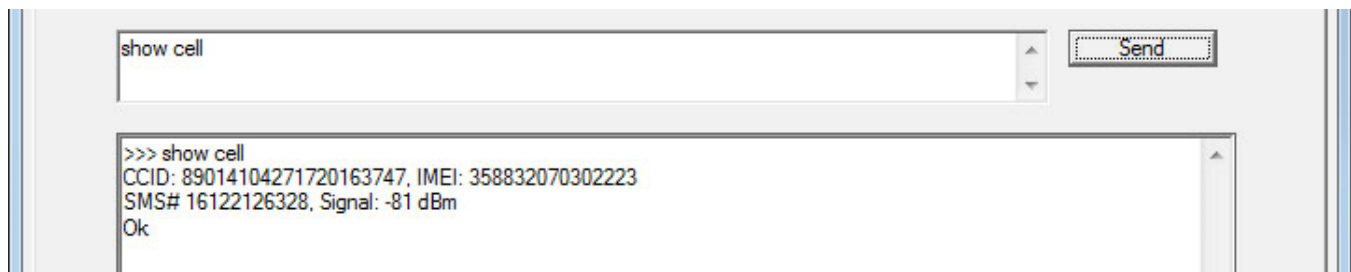
Obj 1 (Switch is Off) Rel:
101, Class: 0, Code: 1.

Show rtuerrors first

RTU 1 Total: 63, No-
Resp: 63, Exceptions: 0,
CRC: 0.

Most of the "show" commands can also be used by known users even if not authorized for other commands used to make changes.

15.6. Signal Strength Indication



The link LED labeled LNK on the cover of the VP3-TM is connected directly to the cellular modem. The possible indications of the LNK LED are as follows:

LNK LED is:	What it means:
OFF	Possible hardware failure if LED remains in this state.
ON	Not connected to network, but trying.
Flash @ 2/Sec	Connected to network, operating normally.
Flash twice, pause,	Connected to network, operating, but last attempt to send a message failed.

repeat	
--------	--

While connected to the VP3-TM in configuration mode, you can use the "show cell" command to check signal strength. If connected to the network, you will see a "Signal: xx dBm" indication. Signal strength will be indicated as a number in the range of -51 dBm to -113 dBm with -51 being a perfect signal and -113 being call-dropping bad.

You can also use the "show cell" command remotely via SMS. Of course if the signal is too weak to send a message, you are not going to get a reply, and therefore the "show cell" remotely is merely a confirmation of signal strength. It can still have some value remotely. If you are getting messages intermittently and see a signal strength closer to the bottom end of the range, this may be a useful clue as to why messages are intermittent.

15.7. Fault Codes

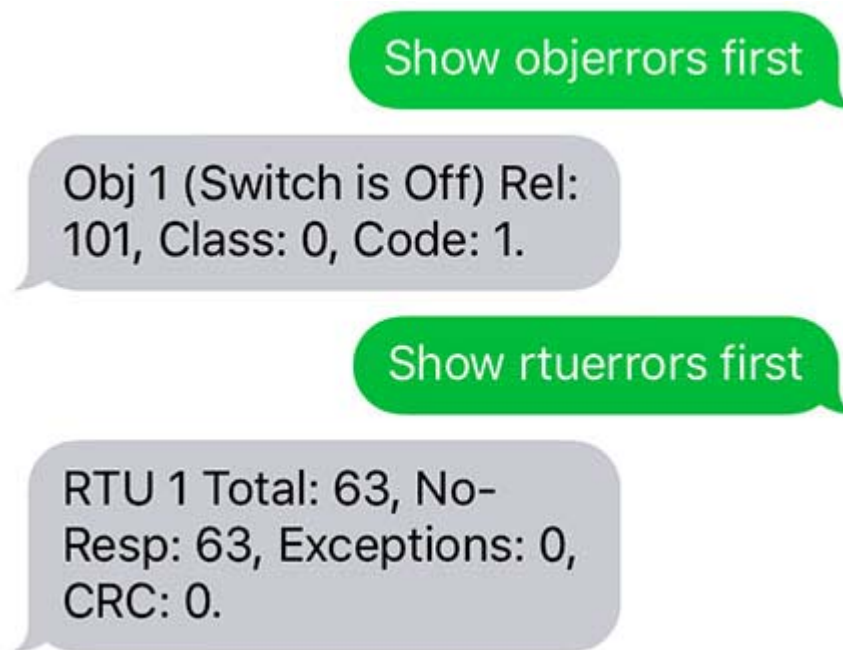
The VP3-TM attempts to be as helpful as possible in detecting and reporting communication faults while in operation. These will be reported via SMS, but only to those users who have been selected to receive them. Enable error and failure messages per user in the Users configuration (Section 9).

RTU slave(s) that may
be offline: 1

Comm fails at Test Lab
4000-10.5.3e on
object(s) 1,2,3,4,5,6

Comm errors at Test
Lab 4000-10.5.3e on
object(s) 7,8,9,10,11,12

The automatic notification of communication faults will indicate which objects are having problems. From there, you need to do further queries to see exactly what the nature of the problem is.



All models of VP3-TM provide a fault code denoted as "Rel" for reliability, and also provide an error class and error code. Some models provide additional queries relevant at the device level. The entire list of queries available is outlined in Section 11.

15.7.1. Fault Codes - Modbus

Each object has three possible error indicator fields: Reliability, Error Class, Error Code, as defined by BACnet protocol. The Modbus version of the device uses these same error fields for consistency, but ultimately only the reliability value, which Modbus will refer to as "fault code", will be returned via Modbus virtual objects.

Modbus error class and codes are arbitrarily assigned, and do overlap BACnet codes. One needs to simply look at the codes relevant to the protocol in use to determine their meaning. The reliability codes that is derived from the class and code are uniquely Modbus or BACnet, and as BACnet reliability codes, do conform to BACnet protocol boundaries.

Modbus error class/codes:

Class 0, code 1 = no response

Class 0, code 2 = CRC error

Class 1, code N = exception code N

code 1 = illegal function code

code 2 = illegal data address

code 3 = illegal data value

code 10 = gateway path unavailable (TCP gateway not responding)
(see Modbus spec for additional uncommon exceptions)

Class 2, code 2 = faulty Modbus packet

Class 2, code 4 = configuration fault

Modbus reliability code will be $((\text{class}+1) * 100) + \text{code}$.

Modbus fault (reliability) codes:

101 = no response

102 = CRC error

201 = Modbus exception, illegal function code

202 = Modbus exception, illegal data address

203 = Modbus exception, illegal data value

210 = Modbus exception, gateway path unavailable

2XX = Modbus exception, other where XX is exception code, see Modbus spec

302 = Faulty Modbus packet

304 = Configuration fault

15.7.2. Fault Codes - BACnet

Each object has three possible error indicator fields: Reliability, Error Class, Error Code, as defined by BACnet protocol. Since the VP3-BTM is not a gateway, its protocol usage is mutually exclusive and will be either Modbus or BACnet but never both.

The error class and code will be retained upon receipt by the BACnet client, but these codes will result in a single reliability code that is derived from class and code. Since we assume repeated attempts will return the same error code and class, the code/class will be retained immediately but transitioning of reliability code from zero to non-zero can be delayed by the default count set by "defaultonfails".

BACnet reliability code will be $((\text{class}+1)*1000) + \text{code}$ where class may be 0..3, and any class above 3 capped at class 4.

Example: A common error is trying to read an object in another device that does not exist in that device. The device will return error class 1, code 31. This will become fault/reliability code 2031 as reported via SMS. If the remote device is not responding, this will internally generate class 0, code 300, reported as fault/reliability code 1300 via SMS. As an SMS message, this code will be called "fault". If queried as a BACnet object property, it will be returned as the reliability value.

Proprietary error codes:

300 = Response timeout

301 = Configuration error

302 = BACnet error code "other" was received from remote device

303 = Unable to allocate invoke ID

All other error classes/codes are per BACnet standard, copied here from the open

source BACnet project bacenum.h file (the BACnet standard itself cannot be copied).

```
0 = ERROR_CLASS_DEVICE
1 = ERROR_CLASS_OBJECT
2 = ERROR_CLASS_PROPERTY
3 = ERROR_CLASS_RESOURCES
4 = ERROR_CLASS_SECURITY
5 = ERROR_CLASS_SERVICES
```

```
/* valid for all classes */
```

```
0 = ERROR_CODE_OTHER
```

```
/* Error Class - Device */
```

```
2 = ERROR_CODE_CONFIGURATION_IN_PROGRESS
3 = ERROR_CODE_DEVICE_BUSY
25 = ERROR_CODE_OPERATIONAL_PROBLEM
```

```
/* Error Class - Object */
```

```
4 = ERROR_CODE_DYNAMIC_CREATION_NOT_SUPPORTED
17 = ERROR_CODE_NO_OBJECTS_OF_SPECIFIED_TYPE
23 = ERROR_CODE_OBJECT_DELETION_NOT_PERMITTED
24 = ERROR_CODE_OBJECT_IDENTIFIER_ALREADY_EXISTS
27 = ERROR_CODE_READ_ACCESS_DENIED
31 = ERROR_CODE_UNKNOWN_OBJECT
36 = ERROR_CODE_UNSUPPORTED_OBJECT_TYPE
```

```
/* Error Class - Property */
```

```
8 = ERROR_CODE_INCONSISTENT_SELECTION_CRITERION
9 = ERROR_CODE_INVALID_DATA_TYPE
32 = ERROR_CODE_UNKNOWN_PROPERTY
37 = ERROR_CODE_VALUE_OUT_OF_RANGE
40 = ERROR_CODE_WRITE_ACCESS_DENIED
41 = ERROR_CODE_CHARACTER_SET_NOT_SUPPORTED
42 = ERROR_CODE_INVALID_ARRAY_INDEX
44 = ERROR_CODE_NOT_COV_PROPERTY
45 = ERROR_CODE_OPTIONAL_FUNCTIONALITY_NOT_SUPPORTED
47 = ERROR_CODE_DATATYPE_NOT_SUPPORTED
50 = ERROR_CODE_PROPERTY_IS_NOT_AN_ARRAY
```

```
/* Error Class - Resources */
```

```
18 = ERROR_CODE_NO_SPACE_FOR_OBJECT
```

19 = ERROR_CODE_NO_SPACE_TO_ADD_LIST_ELEMENT
20 = ERROR_CODE_NO_SPACE_TO_WRITE_PROPERTY

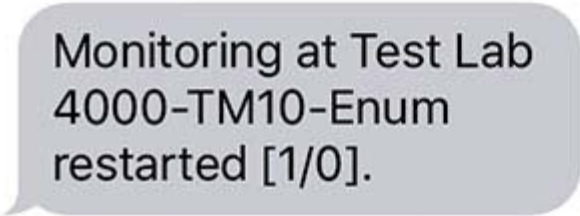
/* Error Class - Security */

1 = ERROR_CODE_AUTHENTICATION_FAILED
6 = ERROR_CODE_INCOMPATIBLE_SECURITY_LEVELS
12 = ERROR_CODE_INVALID_OPERATOR_NAME
15 = ERROR_CODE_KEY_GENERATION_ERROR
26 = ERROR_CODE_PASSWORD_FAILURE
28 = ERROR_CODE_SECURITY_NOT_SUPPORTED
30 = ERROR_CODE_TIMEOUT

/* Error Class - Services */

5 = ERROR_CODE_FILE_ACCESS_DENIED
7 = ERROR_CODE_INCONSISTENT_PARAMETERS
10 = ERROR_CODE_INVALID_FILE_ACCESS_METHOD
11 = ERROR_CODE_ERROR_CODE_INVALID_FILE_START_POSITION
13 = ERROR_CODE_INVALID_PARAMETER_DATA_TYPE
14 = ERROR_CODE_INVALID_TIME_STAMP
16 = ERROR_CODE_MISSING_REQUIRED_PARAMETER
22 = ERROR_CODE_PROPERTY_IS_NOT_A_LIST
29 = ERROR_CODE_SERVICE_REQUEST_DENIED
43 = ERROR_CODE_COV_SUBSCRIPTION_FAILED
46 = ERROR_CODE_INVALID_CONFIGURATION_DATA
48 = ERROR_CODE_DUPLICATE_NAME
49 = ERROR_CODE_DUPLICATE_OBJECT_ID

15.8. Restart Codes



Monitoring at Test Lab
4000-TM10-Enum
restarted [1/0].

Any time the VP3-TM restarts, a restart message will be sent to any users in groups that have been selected to receive them by checking "Starts" on the Groups configuration page. The site name and restart code will be included in the message. The restart code will be indicated as "[a/b]" where the "a" and "b" are numbers identified below.

The restart code [1/0] is simply a power-up cold start. This code is normal. If you use the "sys reboot=all" command to remotely restart the VP3-TM, the restart

code will be [5/0] and would also be considered normal in this case. Any other combination of numbers would indicate something unexpected, for which you should seek technical support.

Restart reason "a":

- 1 = cold start/power-up
- 2 = restart due to application fault code (or BACnet warm start)
- 5 = restart due to processor fault code
- 6 = watchdog timeout

Fault code "b" if nonzero:

Codes 1-5 are low level processor aborts (restart reason 5):

- 0 = requested restart, no fault
- 1 = undefined instruction
- 2 = program abort (instruction address fault)
- 3 = data abort (memory address fault)
- 4 = uncaught interrupt (IRQ)
- 5 = uncaught fast interrupt (FIRQ)
- 6 = stack overflow

Codes 7-12 are application level system errors (restart reason 2):

- 7 = system configuration CRC error
- 8 = bad parameter in system configuration
- 9 = EEPROM read failure
- 10 = EEPROM write failure
- 11 = EEPROM lock failure
- 12 = object allocation failure

Codes 20-25 are application requested restarts from the crash monitor (restart reason 2):

- 20 = modem handler unresponsive
- 21 = excessive modem restarts
- 22 = data scanner unresponsive
- 23 = communication client unresponsive
- 24 = communication engine unresponsive
- 25 = main program unresponsive

Depending on the error condition present, it is possible that the error will go unreported due to the system's inability to send a text message. In the event any of the above codes do show up, these are their meanings.

15.9. Connection Error Codes

SMS failure to send will be captured and reported as a user error that may be viewed with the "show usererrors" command. The VP3-TM will not attempt to send a message if there is no network connection, but the "no network

registration" error could occur if the connection dropped right in the middle of processing the message. Otherwise, the only failure that is likely to occur is trying to send to an invalid mobile number.

0x00 = SMS successfully sent.

0x01 = SMS failed to send.

0x02 = Invalid SMS parameters - check P# (Destination Phone Number).

0x03 = SMS not supported.

0x10 = No network registration.

0x11 = Cellular component stack error.

0x13 = Socket leak

0xFF = No SMS state to report (no SMS messages have been sent).

Copyright © 2019 Control Solutions Minnesota, Inc.



i.Report VP3-TMxx Remote Monitoring



CONTROL SOLUTIONS MINNESOTA

Appendix A. SIM Card Activation

The i.Report VP3-TM devices are normally shipped with a SIM card pre-installed if shipping to a destination in the US (for use in the US). The SIM card is installed but not activated. You are given the choice of AT&T network or Verizon network when placing your order. For use outside of the US, you should choose "No SIM" when placing your order. You will need to provide your own SIM card outside of the US.

The SIM card pre-installed is a TracFone SIM card. TracFone is one of America's biggest prepaid service providers. We chose TracFone because their rates are very reasonable, and getting a SIM card activated is quick and easy with TracFone.

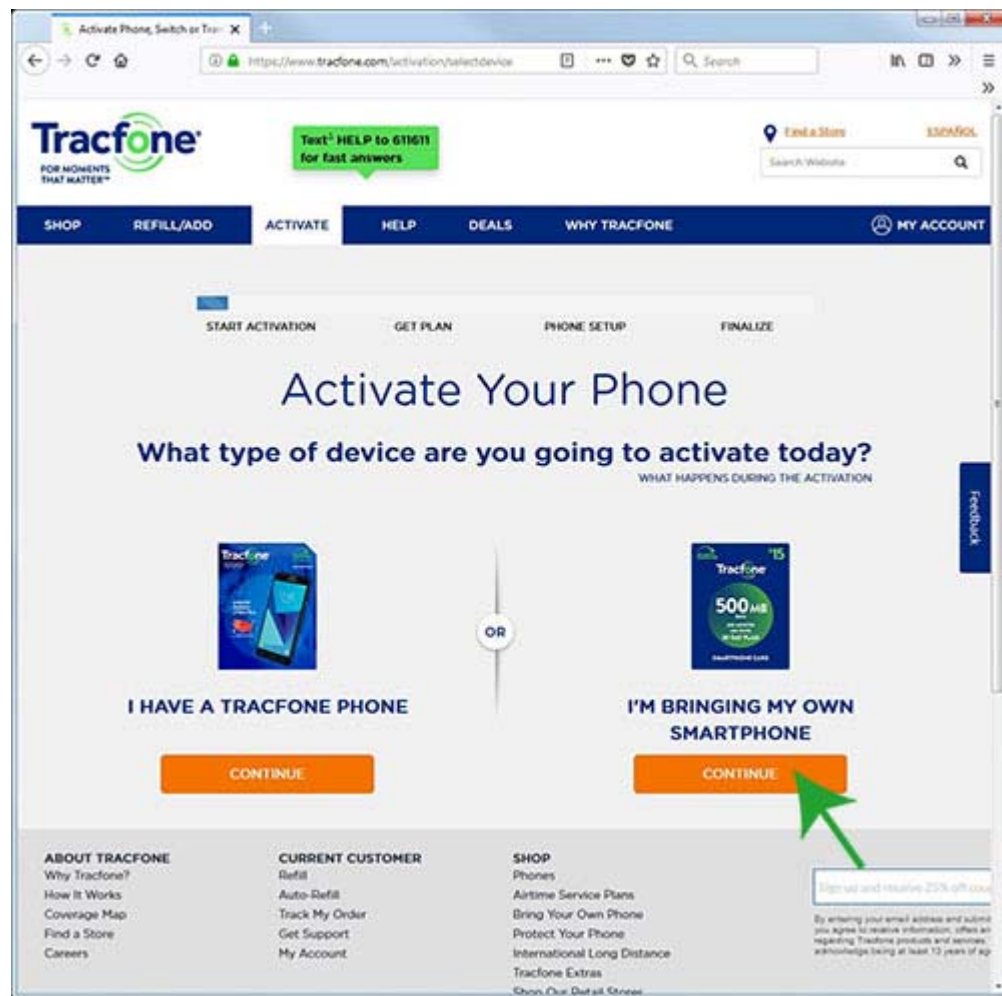
If you are planning to deploy a significant number of i.Report remote monitoring devices, you may want to consider creating your own commercial account with an M2M reseller that may offer volume plan discounts. Control Solutions can give you advice on that matter if applicable.

A.1. Activating TracFone Service on AT&T Network

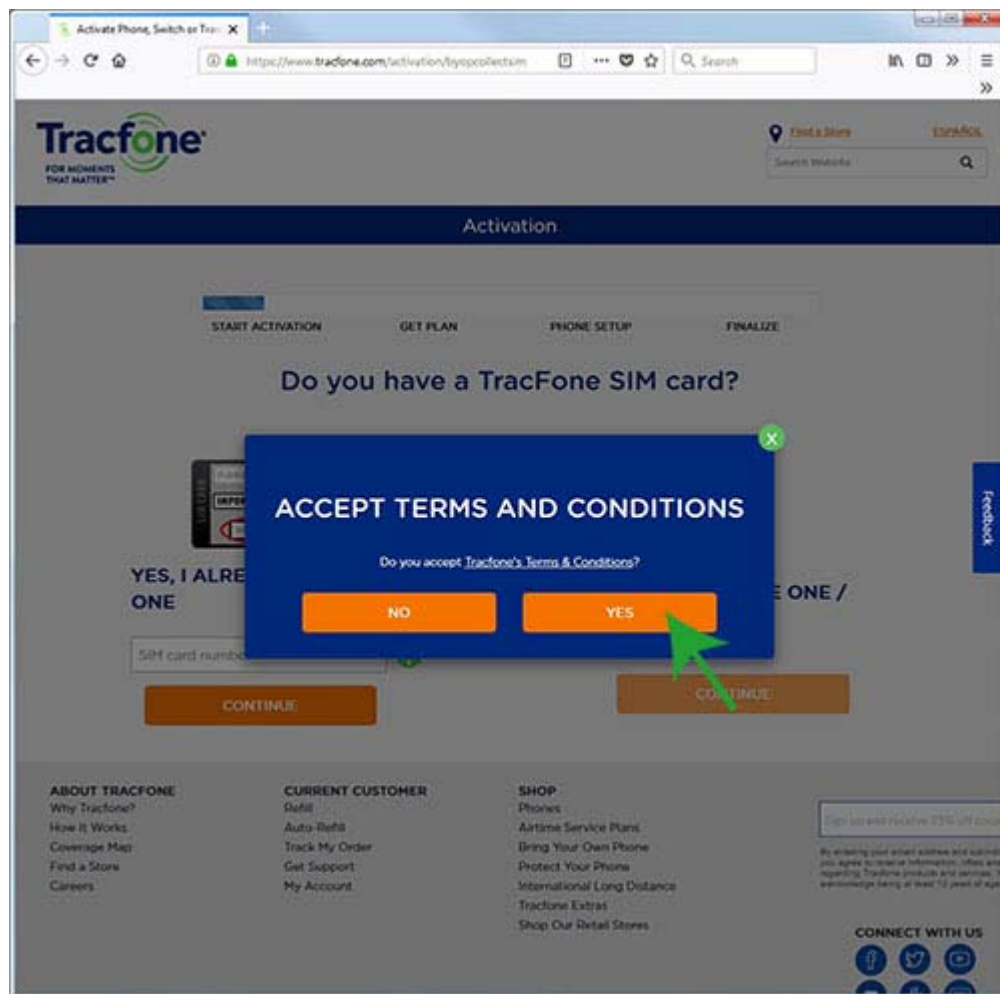
The first step in activating the pre-installed TracFone SIM card is to go to www.tracfone.com and create an account for yourself. Then follow the steps here to activate the SIM.

The screenshot shows the Tracfone website's login and account creation interface. At the top, there's a navigation bar with links for SHOP, REFILL/ADD, ACTIVATE, HELP, DEALS, WHY TRACFONE, and MY ACCOUNT. A green banner at the top center says "Text HELP to 611611 for fast answers". Below the navigation bar, there are two main sections: "LOG INTO MY ACCOUNT" and "CREATE ACCOUNT". The "LOG INTO MY ACCOUNT" section has a username field (jimbogenson@csimn.com), a password field (masked with dots), and buttons for "FORGOT USERNAME?", "FORGOT PASSWORD?", and "LOG IN". A green arrow points to the "LOG IN" button. The "CREATE ACCOUNT" section has a "CREATE ACCOUNT" button. Below the login and create account sections, there are three columns of links: "ABOUT TRACFONE" (Why Tracfone?, How It Works, Coverage Map, Find a Store, Careers), "CURRENT CUSTOMER" (Refill, Auto-Refill, Track My Order, Get Support, My Account), and "SHOP" (Phones, Airtime Service Plans, Bring Your Own Phone, Protect Your Phone, International Long Distance, Tracfone Extras). A small promotional box at the bottom right says "Sign up and receive 25% off call".

Start by logging in.



From the menu bar at the top, select ACTIVATE. Choose "I'm bringing my own smartphone".



As you might guess, you need to accept terms and conditions in order to obtain service.

TracFone
FOR MOMENTS THAT MATTER™

Find a Store

Search Website

Activation

START ACTIVATION GET PLAN PHONE SETUP FINALIZE

Do you have a TracFone SIM card?

YES, I ALREADY HAVE ONE

89014

CONTINUE

NO, I DON'T HAVE ONE / NOT SURE

CONTINUE

ABOUT TRACFONE
Why TracFone?
How It Works
Coverage Map
Find a Store
Careers

CURRENT CUSTOMER
Refill
Auto-Refill
Track My Order
Get Support
My Account

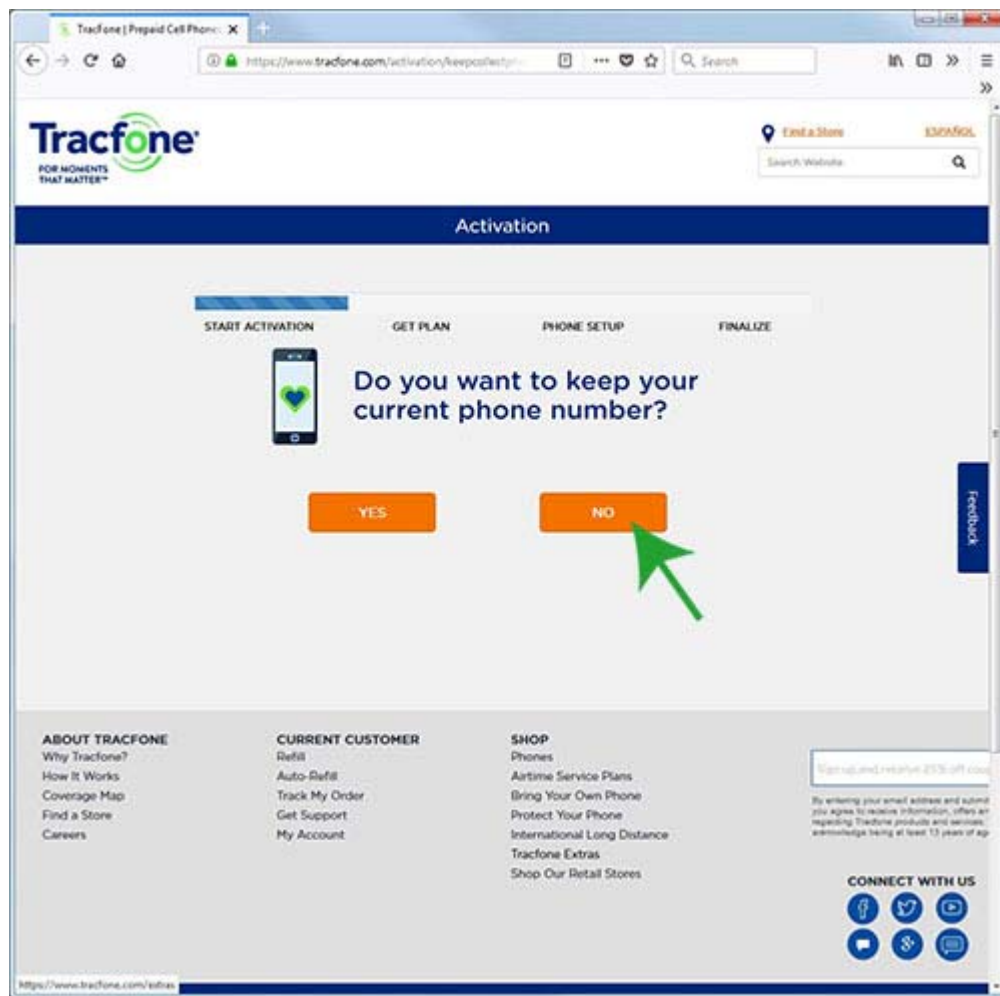
SHOP
Phones
Airtime Service Plans
Bring Your Own Phone
Protect Your Phone
International Long Distance
TracFone Extras
Shop Our Retail Stores

Sign up and receive 25% off code

By entering your email address and submit you agree to receive information, offers and regarding TracFone products and services, acknowledging being at least 18 years of age.

CONNECT WITH US

You already have a TracFone SIM card. You can find the CCID number, aka SIM card number, on the card carrier that originally held the SIM card now installed in the VP3-TM. The card carrier should have been included in your shipment just for the purpose of entering the CCID number here. However, if it got misplaced, you can still obtain the CCID number from the VP3-TM device itself. The "nano" SIM card itself is too small to easily read a number from by just looking at it. It is far easier to read it electronically. Refer to the "show cell" command noted in Section 6.4. Enter the entire CCID or SIM card number here (only partial entry shown in illustration) and click Continue.



You do not want to keep your current phone number because you don't have one yet.

The screenshot shows the Tracfone activation process on a web browser. The page title is "Activation" and the Tracfone logo is at the top left. The navigation bar includes "START ACTIVATION", "GET PLAN", "PHONE SETUP", and "FINALIZE". The main content area asks, "Do you want to keep your current phone number?" with "YES" and "NO" buttons. Below this, a white box asks, "What is the zip code of where you will use your phone the most?" with a text input field labeled "Enter zip code*" and a "CONTINUE" button. A green arrow points to the "CONTINUE" button. The footer contains links for "ABOUT TRACFONE", "CURRENT CUSTOMER", and "SHOP".

Tracfone
FOR MOMENTS THAT MATTER™

Find a Store
ESN/MSL
Search Website

Activation

START ACTIVATION GET PLAN PHONE SETUP FINALIZE

Do you want to keep your current phone number?

YES NO

What is the zip code of where you will use your phone the most?

Enter zip code*

CONTINUE

Feedback

ABOUT TRACFONE
Why Tracfone?
How It Works
Coverage Map
Find a Store
Careers

CURRENT CUSTOMER
Refill
Auto-Refill
Track My Order
Get Support
My Account

SHOP
Phones
Airtime Service Plans
Bring Your Own Phone
Protect Your Phone
International Long Distance
Tracfone Extras

Signup and receive 25% off ring

By entering your email address and submit you agree to receive information, offers and regarding Tracfone products and services. Knowledge being at least 13 years of age.

Enter the zip code where the i.Report will be installed. This results in getting a phone number local to that area.

Tracfone | Prepaid Cell Phone: X

https://www.tracfone.com/activation/airtime-service

Find a Store

Search Website

Activation

START ACTIVATION GET PLAN PHONE SETUP FINALIZE

Do you have an Airtime Service Plan?

I HAVE AN AIRTIME SERVICE PLAN

Enter service plan PIN ?

Enter promo code (optional) ?

CONTINUE

OR

NO. I NEED TO PURCHASE ONE

CONTINUE

ABOUT TRACFONE

- Why Tracfone?
- How It Works
- Coverage Map
- Find a Store
- Careers

CURRENT CUSTOMER

- Refill
- Auto-Refill
- Track My Order
- Get Support
- My Account

SHOP

- Phones
- Airtime Service Plans
- Bring Your Own Phone
- Protect Your Phone
- International Long Distance
- Tracfone Extras
- Shop Our Retail Stores

Sign up and receive 20% off code

By entering your email address and submit you agree to receive information, offers and regarding Tracfone products and services, acknowledge being at least 13 years of age

CONNECT WITH US

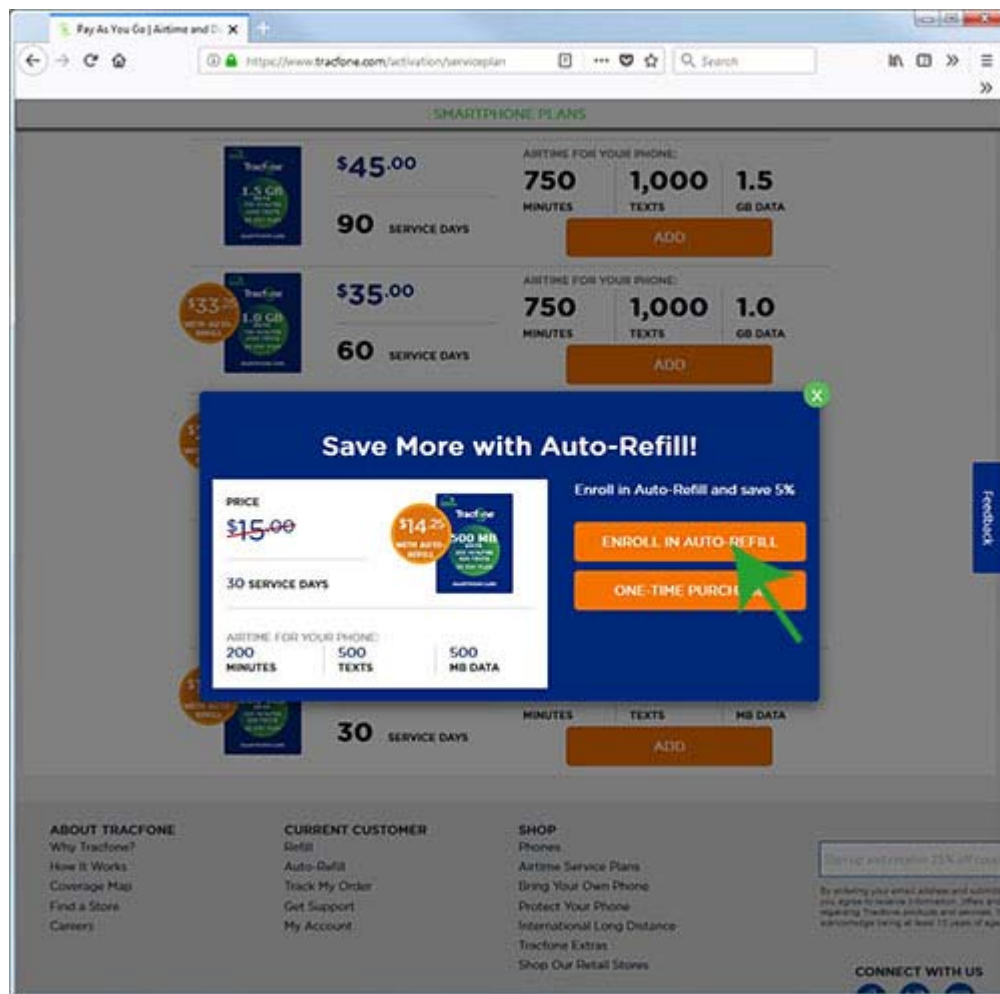
You do have a SIM card but do not have an airtime service plan yet. Getting a service plan is the whole point of this exercise, so click "No, I need to purchase one".

The screenshot displays the Tracfone website's 'SMARTPHONE PLANS' section. It lists five plans with their respective prices, service durations, and included features. A green arrow points to the 'ADD' button for the \$15.00 plan.

Plan Price	Service Days	Airtime (Minutes)	Texts	Data (GB/MB)
\$45.00	90	750	1,000	1.5 GB DATA
\$35.00	60	750	1,000	1.0 GB DATA
\$25.00	60	500	1,000	500 MB DATA
\$20.00	30	300	1,000	1.0 GB DATA
\$15.00	30	200	500	500 MB DATA

The bottom of the page features navigation links under 'ABOUT TRACFONE', 'CURRENT CUSTOMER', and 'SHOP'. A 'CONNECT WITH US' section is also present at the bottom right.

If you really think you're going to be generating a lot of text messages, you can opt for a bigger plan, but for most applications, the least expensive plan is going to be adequate.



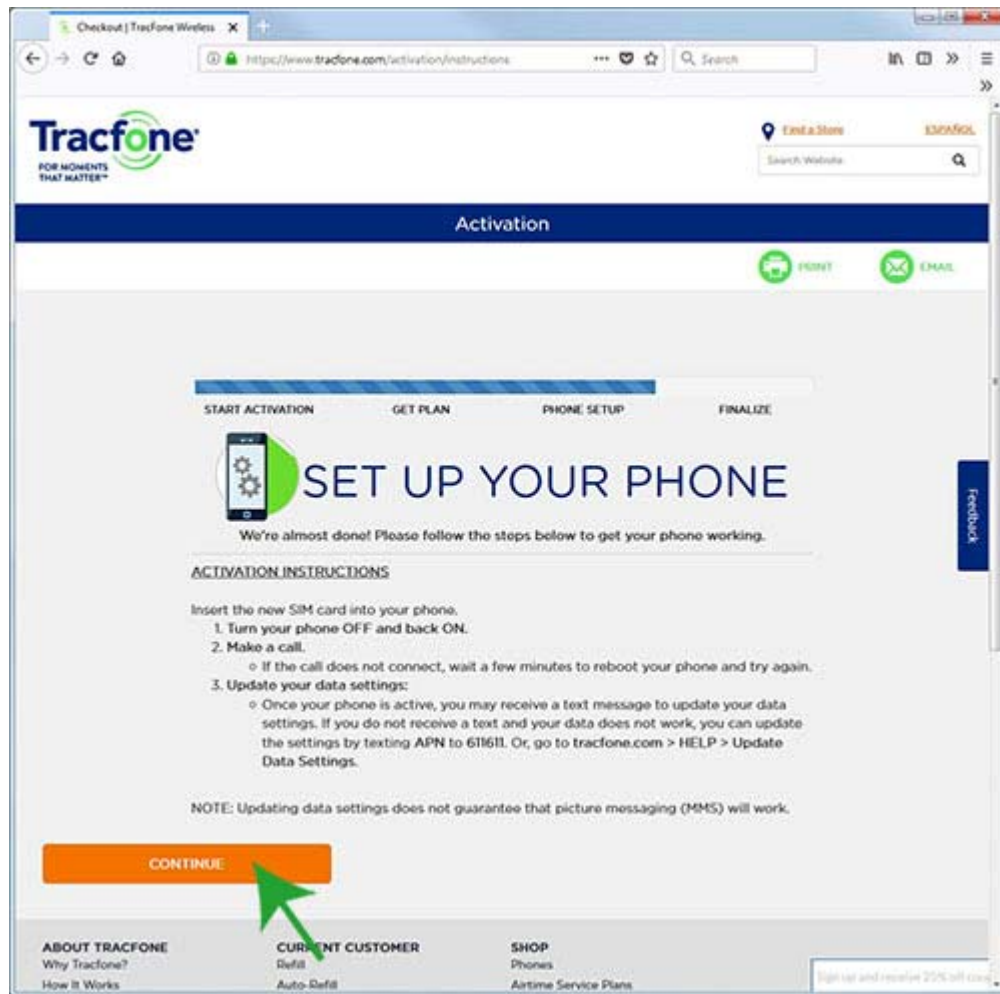
We recommend enrolling in Auto-Refill. That way you won't miss messages because you forgot to refill your airtime plan a month later.

The screenshot shows the Tracfone checkout page. The browser address bar displays <https://www.tracfone.com/activation/checkout>. The page features the Tracfone logo and a navigation bar with 'Activation' and 'CHECKOUT' buttons. A progress bar indicates the steps: START ACTIVATION, GET PLAN, PHONE SETUP, and FINALIZE. The main content area is titled 'CHECKOUT' and includes a 'REVIEW ORDER' section with 'ORDER DETAILS' and a 'PAYMENT' section. The 'ORDER DETAILS' section shows a \$15 Smartphone Plan. The 'PAYMENT' section has buttons for 'SAVED PAYMENT METHOD' and 'NEW PAYMENT METHOD'. The 'BILLING SUMMARY' section on the right lists the following items and amounts:

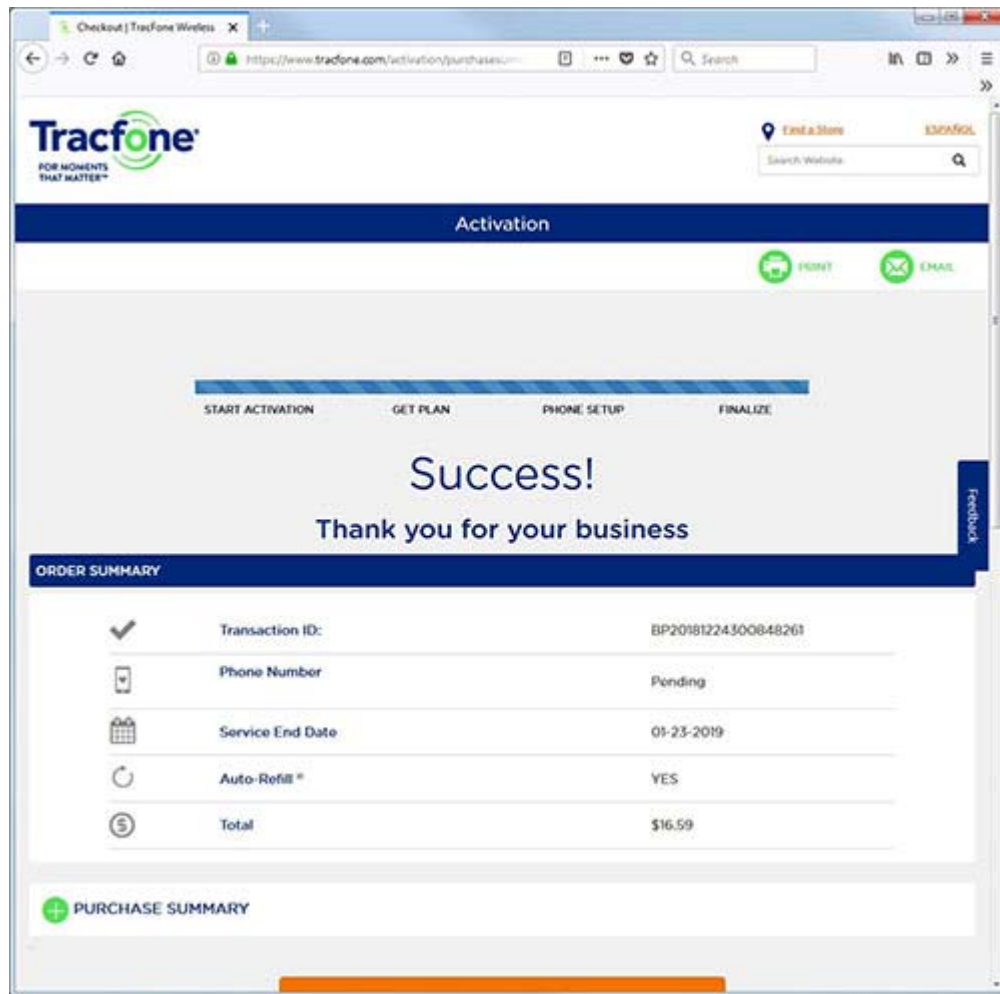
BILLING SUMMARY	
Subtotal:	\$14.25
Discounts	\$0.75
Tax ¹	\$1.12
Prepaid Wireless E911/TAM Fee ²	\$1.00
Federal Universal Service ³	\$0.19
Regulatory Cost Recovery ⁴	\$0.03
TOTAL	\$16.59

Below the billing summary, there is a checkbox for the terms and conditions: ☐ BY CONTINUING WITH THIS TRANSACTION, I ACCEPT AND AGREE TO TRACFONE'S PLAN AND TERMS AND CONDITIONS. I ALSO AUTHORIZE TRACFONE TO INITIATE PAYMENT ON THE SELECTED PAYMENT METHOD.

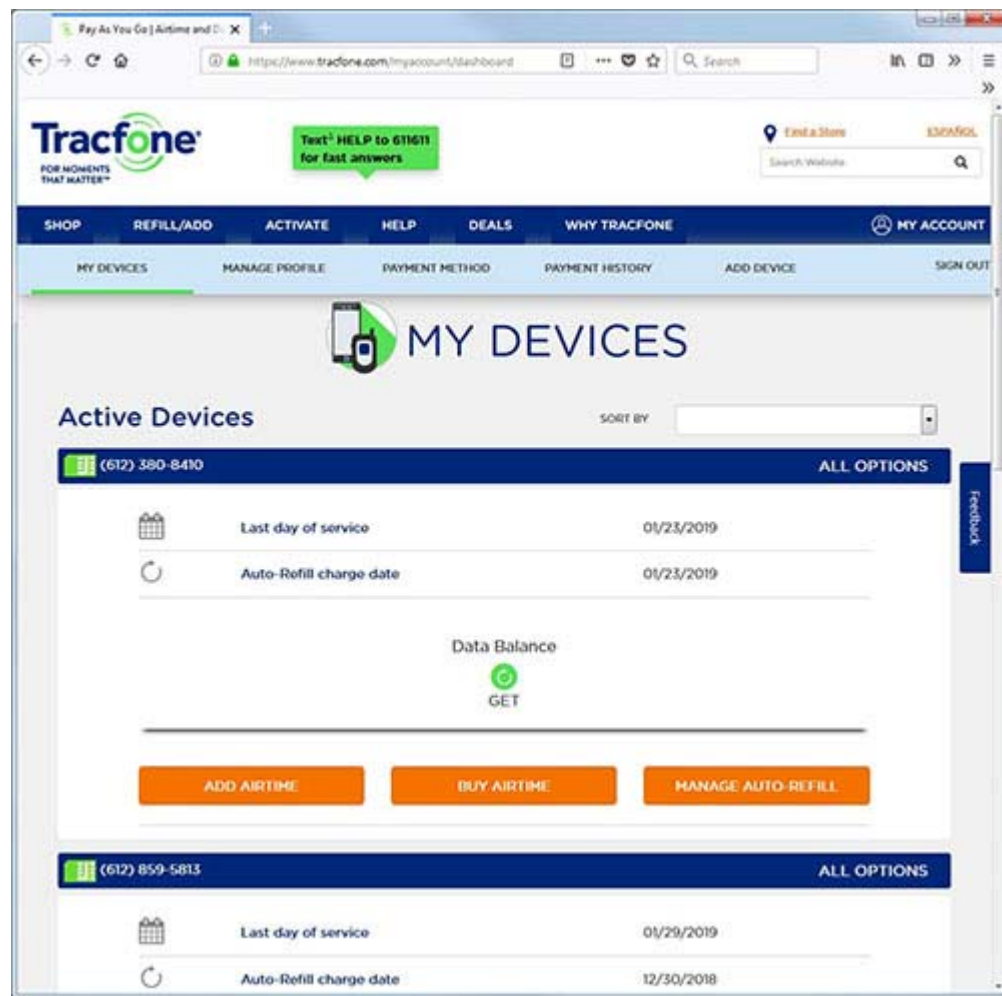
Complete the checkout by entering your credit card information, etc.



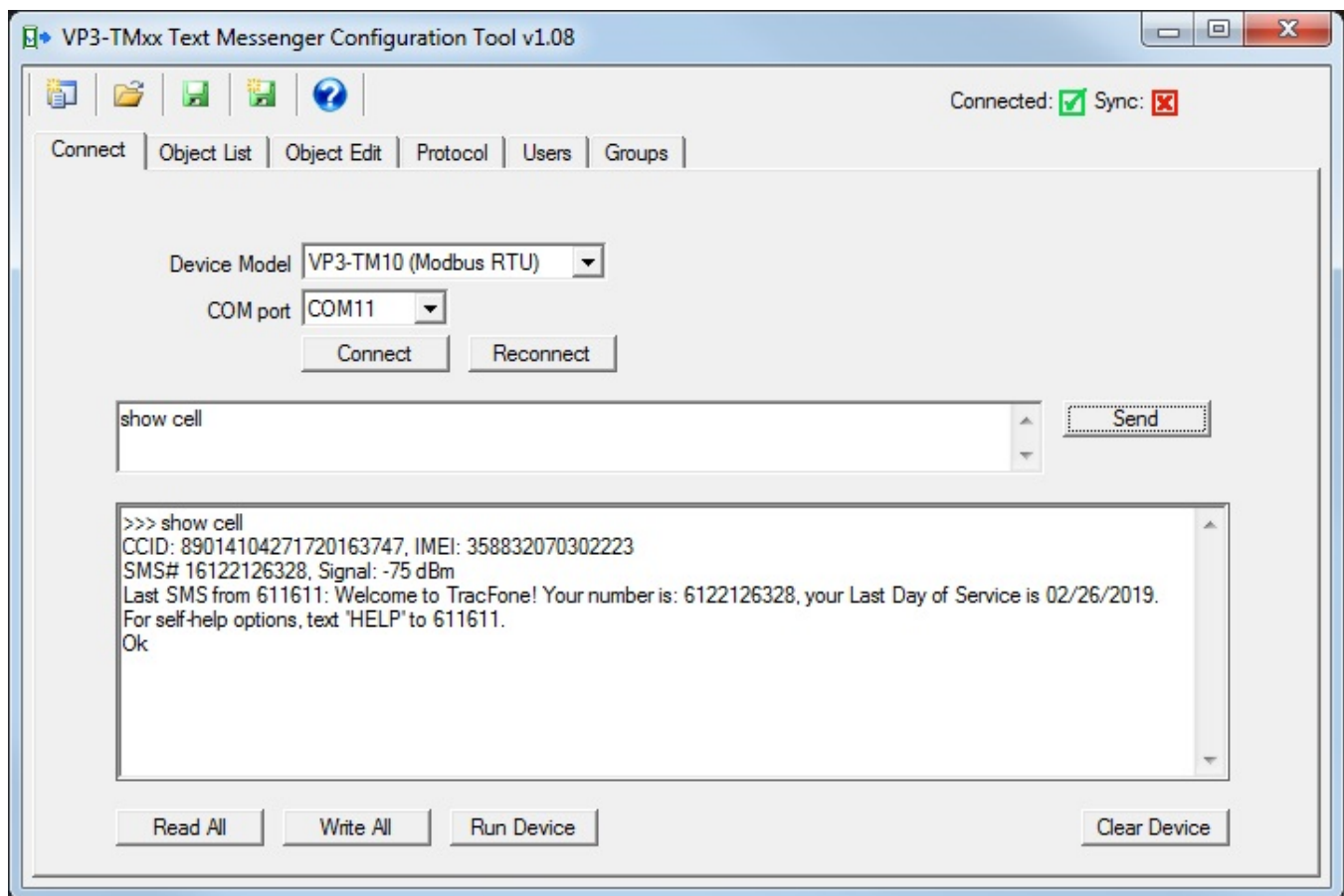
Forget about the "make a call" and everything they suggest about setting up your phone.



The only thing you need to do on this screen is smile.



Wait a few minutes and come back to "My Devices". The My Devices page is the account home page. This is where you will start every time you log in, or each time you click on My Account in the upper right corner (if already logged in). When the device is fully activated, its phone number will show up here.

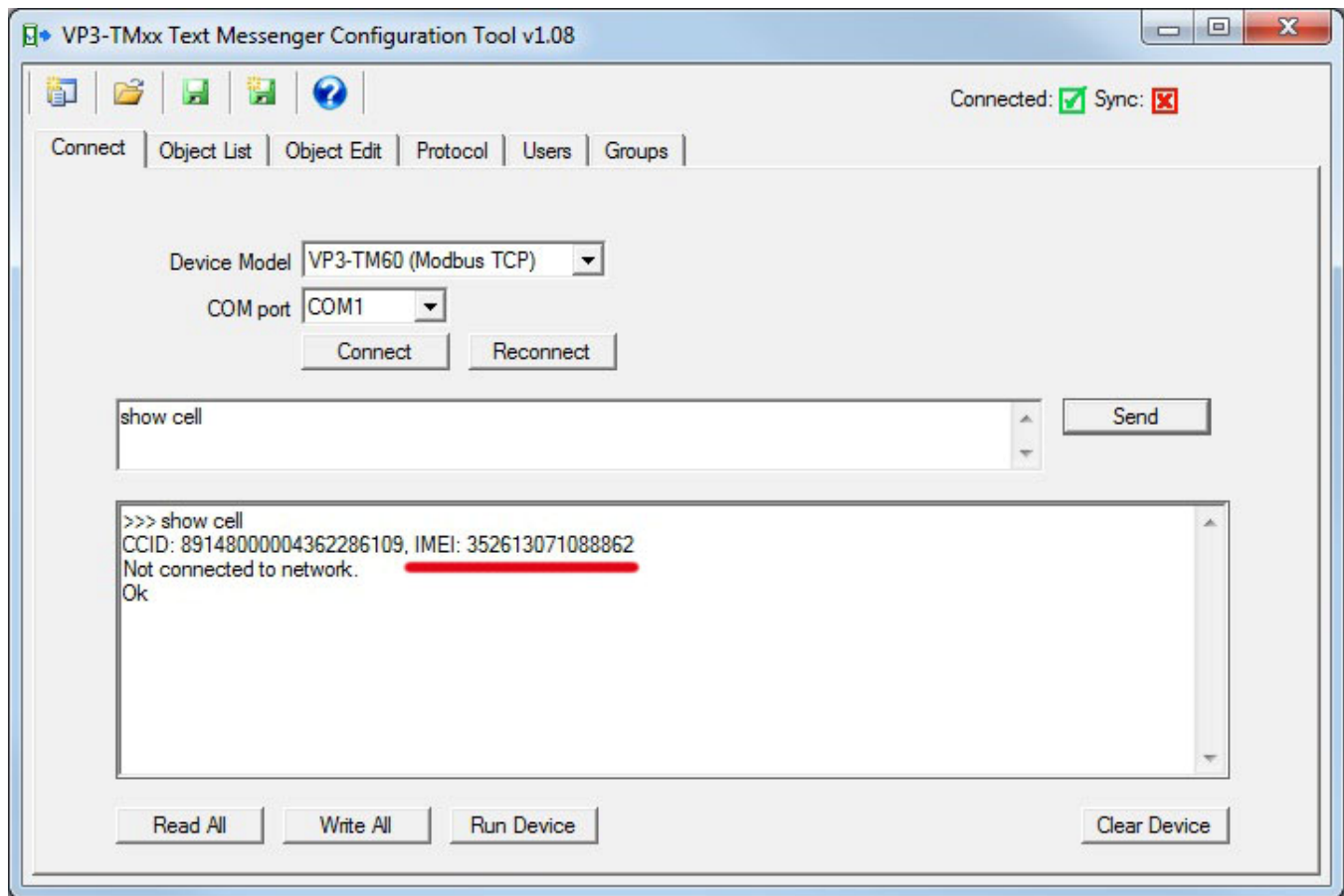


Follow directions in Section 6 for getting connected, and use the "show cell" command to verify your SIM card activation. The "show cell" command shows the CCID and IMEI numbers. If connected to the network, it also shows the device's phone number and signal strength. If a text message has been received, the "show cell" command always displays the most recently received message. Immediately after activating the SIM card, it is going to be a welcome message from TracFone.

It is not a requirement that you connect via the configuration tool and verify SIM activation. You also have the option of using the "Owner" command and beginning the configuration process via SMS as noted in Section 5. Activating a Verizon compatible SIM card requires connecting to the VP3-TM with the configuration tool (or terminal emulator) in order to read the IMEI from the device. Activation of an AT&T compatible SIM card does not require knowing the IMEI, so it is possible to activate an AT&T compatible SIM card and configure the VP3-TM remotely without ever physically connecting the configuration tool to the VP3-TM device.

A.2. Activating Tracfone Service on Verizon Network

Before starting the activation process for a Verizon compatible SIM card, make sure you have obtained your IMEI number from the VP3-TM. Refer to Section 6.4.



The first step in activating the pre-installed TracFone SIM card is to go to www.tracfone.com and create an account for yourself. Then follow the steps here to activate the SIM.

Tracfone
FOR MOMENTS THAT MATTER™

Text² HELP to 611611 for fast answers

Find a Store

Search Website

SHOP REFILL/ADD ACTIVATE HELP DEALS WHY TRACFONE MY ACCOUNT

LOG INTO MY ACCOUNT

jimhogenson@csimn.com

FORGOT USERNAME?

FORGOT PASSWORD?

LOG IN

OR

Log In

CREATE ACCOUNT

CREATE ACCOUNT

Feedback

ABOUT TRACFONE

- Why Tracfone?
- How It Works
- Coverage Map
- Find a Store
- Careers

CURRENT CUSTOMER

- Refill
- Auto-Refill
- Track My Order
- Get Support
- My Account

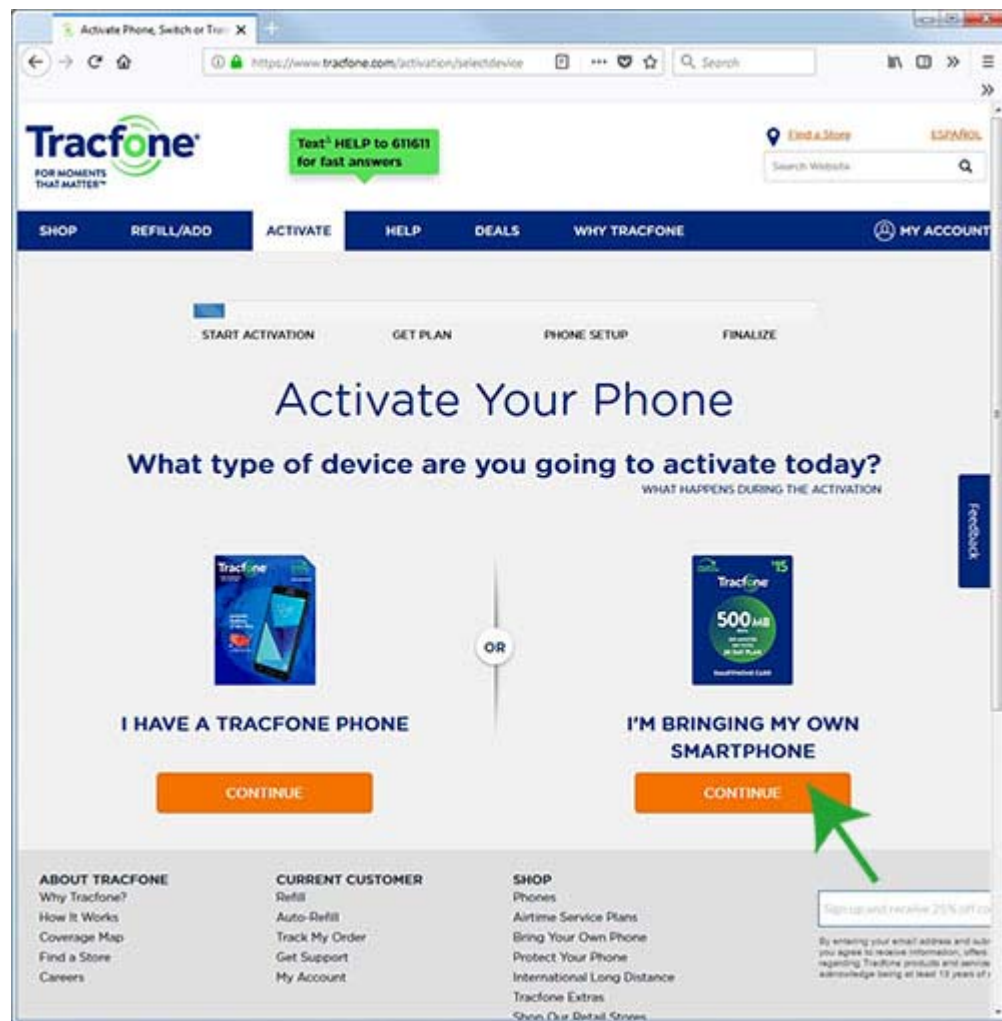
SHOP

- Phones
- Airtime Service Plans
- Bring Your Own Phone
- Protect Your Phone
- International Long Distance
- Tracfone Extras

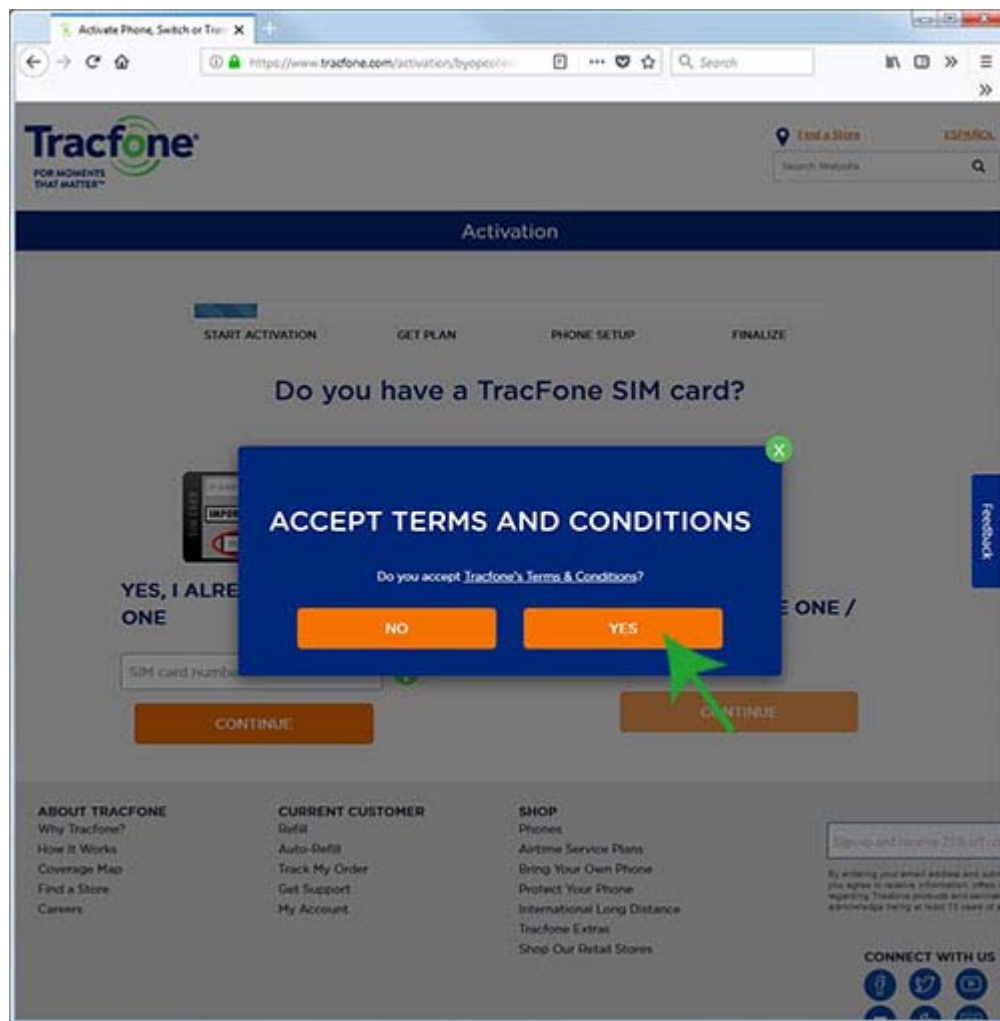
Sign up and receive 25% off call

By entering your email address and submitting this form, you agree to receive information, offers, regarding Tracfone products and services, acknowledge being at least 13 years of age.

Start by logging in.



From the menu bar at the top, select ACTIVATE. Choose "I'm bringing my own smartphone".



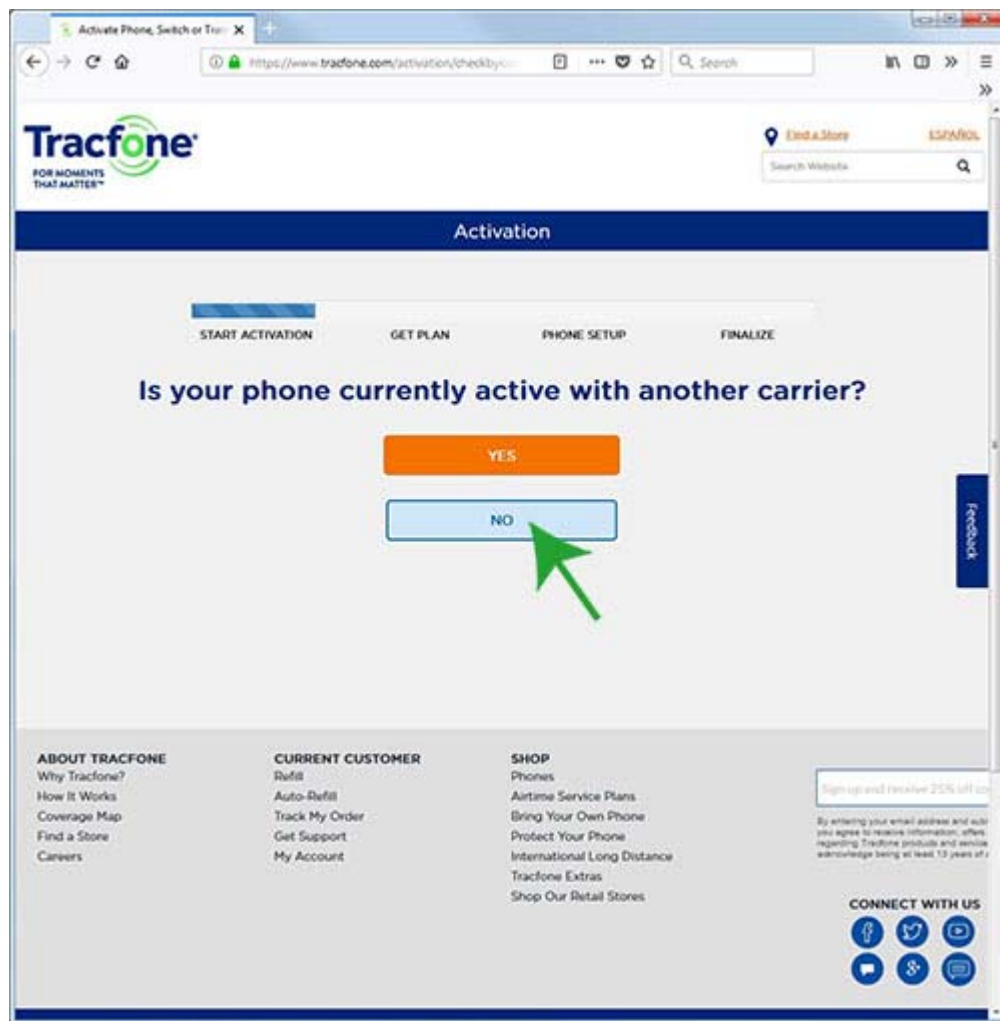
As you might guess, you need to accept terms and conditions in order to obtain service.

The screenshot shows the TracFone activation website in a web browser. The URL is <https://www.tracfone.com/activation/byopccid>. The page has a blue header with the TracFone logo and a search bar. Below the header is a blue bar with the word "Activation". A progress bar shows four steps: START ACTIVATION (highlighted), GET PLAN, PHONE SETUP, and FINALIZE. The main heading is "Do you have a TracFone SIM card?". There are two options: "YES, I ALREADY HAVE ONE" and "NO, I DON'T HAVE ONE / NOT SURE". Under the "YES" option, there is a text input field containing "89148000" and a green arrow pointing to it. Below the input field is an orange "CONTINUE" button. Under the "NO" option, there is a large question mark icon and an orange "CONTINUE" button. The footer contains links for "ABOUT TRACFONE", "CURRENT CUSTOMER", and "SHOP".

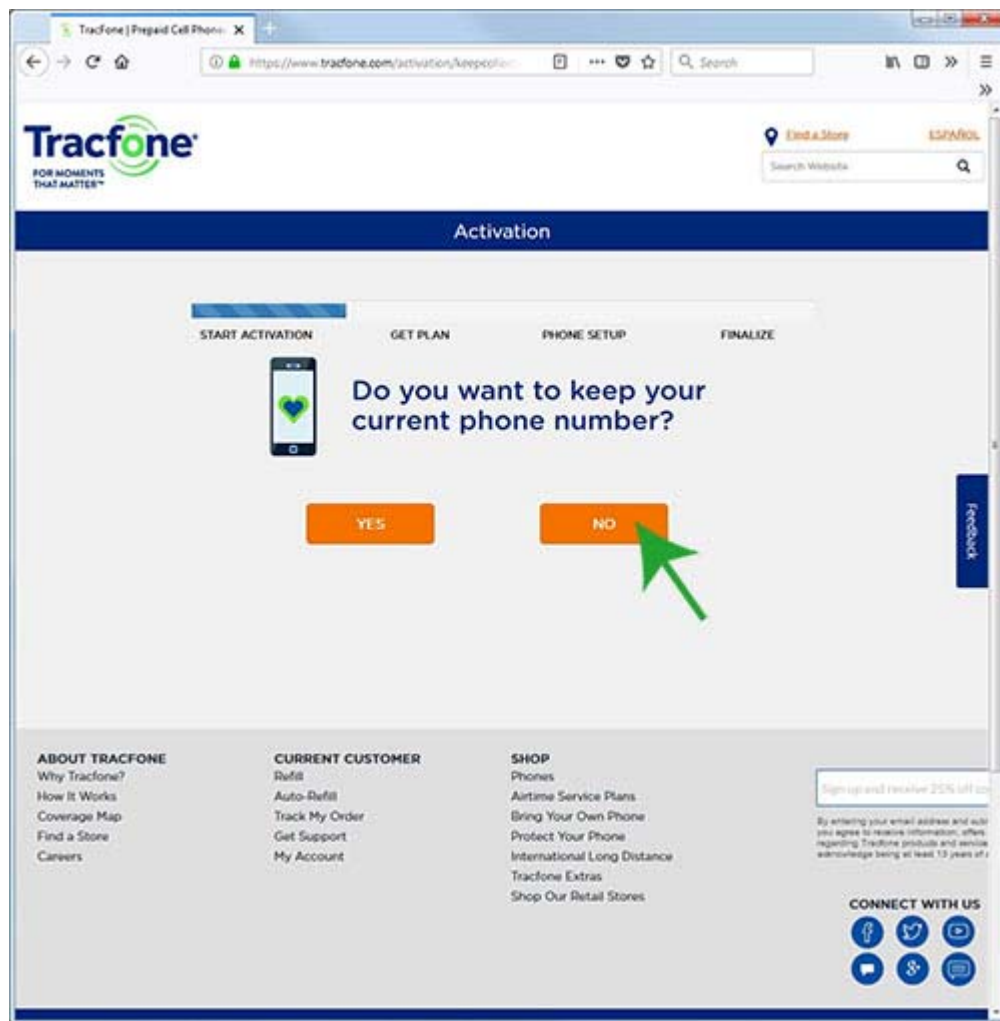
You already have a TracFone SIM card. You can find the CCID number, aka SIM card number, on the card carrier that originally held the SIM card now installed in the VP3-TM. The card carrier should have been included in your shipment just for the purpose of entering the CCID number here. However, if it got misplaced, you can still obtain the CCID number from the VP3-TM device itself. The "nano" SIM card itself is too small to easily read a number from by just looking at it. It is far easier to read it electronically. Refer to the "show cell" command noted in Section 6.4. Enter the entire CCID or SIM card number here (only partial entry shown in illustration) and click Continue.

The screenshot shows the Tracfone Activation website in a web browser. The URL is <https://www.tracfone.com/activation/byopce>. The page has a blue header with the Tracfone logo and a navigation bar with the following steps: START ACTIVATION, GET PLAN, PHONE SETUP, and FINALIZE. The main heading is "Please enter phone's IMEI or MEID." Below this, there is a graphic of a phone with "#06#" on its screen. Text explains that the number can be found by dialing *#06# on the phone. A text input field contains "3526" and has a green checkmark icon to its right. A green arrow points to the "CONTINUE" button. The footer contains links for ABOUT TRACFONE, CURRENT CUSTOMER, and SHOP, along with a "CONNECT WITH US" section for social media.

When activating a SIM card on the Verizon network, Verizon wants to know the IMEI number of the device you are activating the SIM card for. The SIM card number you entered in the previous step told the system that this is a Verizon compatible device. To obtain the IMEI number, connect the configuration tool to the VP3-TM and use the "show cell" command as described in Section 6.4. Once you have obtained it, enter it here.



No, your VP3-TM is not currently active with another carrier.



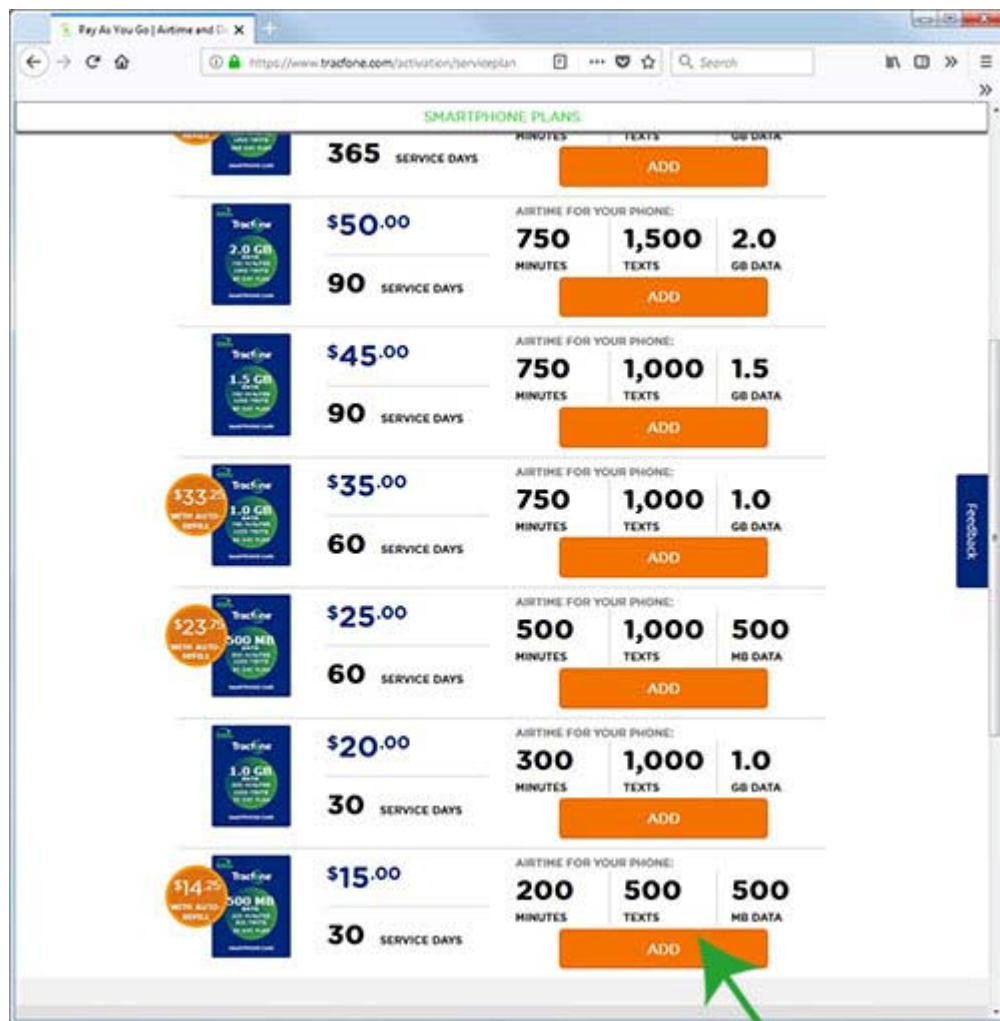
You do not want to keep your current phone number because you don't have one yet.

The screenshot shows the Tracfone activation process on a web browser. The page title is "Activation" and the Tracfone logo is at the top left. The navigation bar includes "START ACTIVATION", "GET PLAN", "PHONE SETUP", and "FINALIZE". The main content area asks, "Do you want to keep your current phone number?" with "YES" and "NO" buttons. Below this, a form asks, "What is the zip code of where you will use your phone the most?" with the input field containing "55127" and a green checkmark. A green arrow points to the "CONTINUE" button. The footer contains links for "ABOUT TRACFONE", "CURRENT CUSTOMER", and "SHOP".

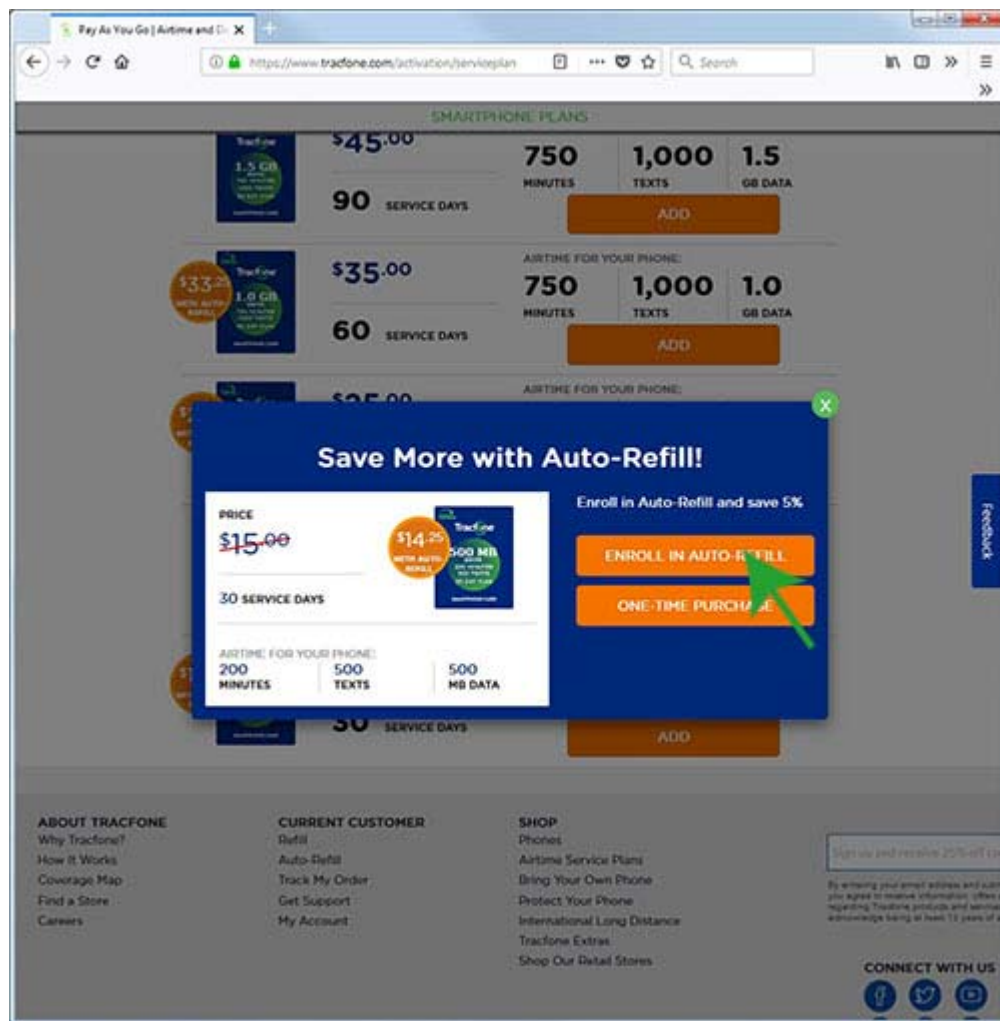
Enter the zip code where the i.Report will be installed. This results in getting a phone number local to that area.

The screenshot shows the Tracfone Activation website in a web browser. The URL is <https://www.tracfone.com/activation/airtimeplan>. The page has a blue header with the Tracfone logo and the tagline "FOR MOMENTS THAT MATTER™". Below the header is a blue bar with the word "Activation". A progress bar shows four steps: "START ACTIVATION" (highlighted), "GET PLAN", "PHONE SETUP", and "FINALIZE". The main heading is "Do you have an Airtime Service Plan?". There are two options: "I HAVE AN AIRTIME SERVICE PLAN" and "NO. I NEED TO PURCHASE ONE". The "I HAVE AN AIRTIME SERVICE PLAN" option has two input fields: "Enter service plan PIN" and "Enter promo code (optional)", both with green question mark icons. Below these fields is an orange "CONTINUE" button. The "NO. I NEED TO PURCHASE ONE" option has a shopping cart icon and an orange "CONTINUE" button. A green arrow points to the "CONTINUE" button for the "NO. I NEED TO PURCHASE ONE" option. The footer contains three columns of links: "ABOUT TRACFONE" (Why Tracfone?, How It Works, Coverage Map, Find a Store, Careers), "CURRENT CUSTOMER" (Refill, Auto-Refill, Track My Order, Get Support, My Account), and "SHOP" (Phones, Airtime Service Plans, Bring Your Own Phone, Protect Your Phone, International Long Distance, Tracfone Extras, Shop Our Retail Stores). There is also a "Sign up and receive 20% off" offer and a "CONNECT WITH US" section with social media icons.

You do have a SIM card but do not have an airtime service plan yet. Getting a service plan is the whole point of this exercise, so click "No, I need to purchase one".



If you really think you're going to be generating a lot of text messages, you can opt for a bigger plan, but for most applications, the least expensive plan is going to be adequate.



We recommend enrolling in Auto-Refill. That way you won't miss messages because you forgot to refill your airtime plan a month later.

The screenshot shows the Tracfone checkout page. At the top, the Tracfone logo and navigation links are visible. The main heading is "Activation". Below it, a progress bar shows the steps: START ACTIVATION, GET PLAN, PHONE SETUP, and FINALIZE. The current step is "CHECKOUT".

The "CHECKOUT" section is divided into two main areas: "REVIEW ORDER" and "BILLING SUMMARY".

REVIEW ORDER

ORDER DETAILS

Item	Quantity	Price
Smartphone Plans	1	\$15

[SEE BENEFITS SUMMARY](#)

PAYMENT

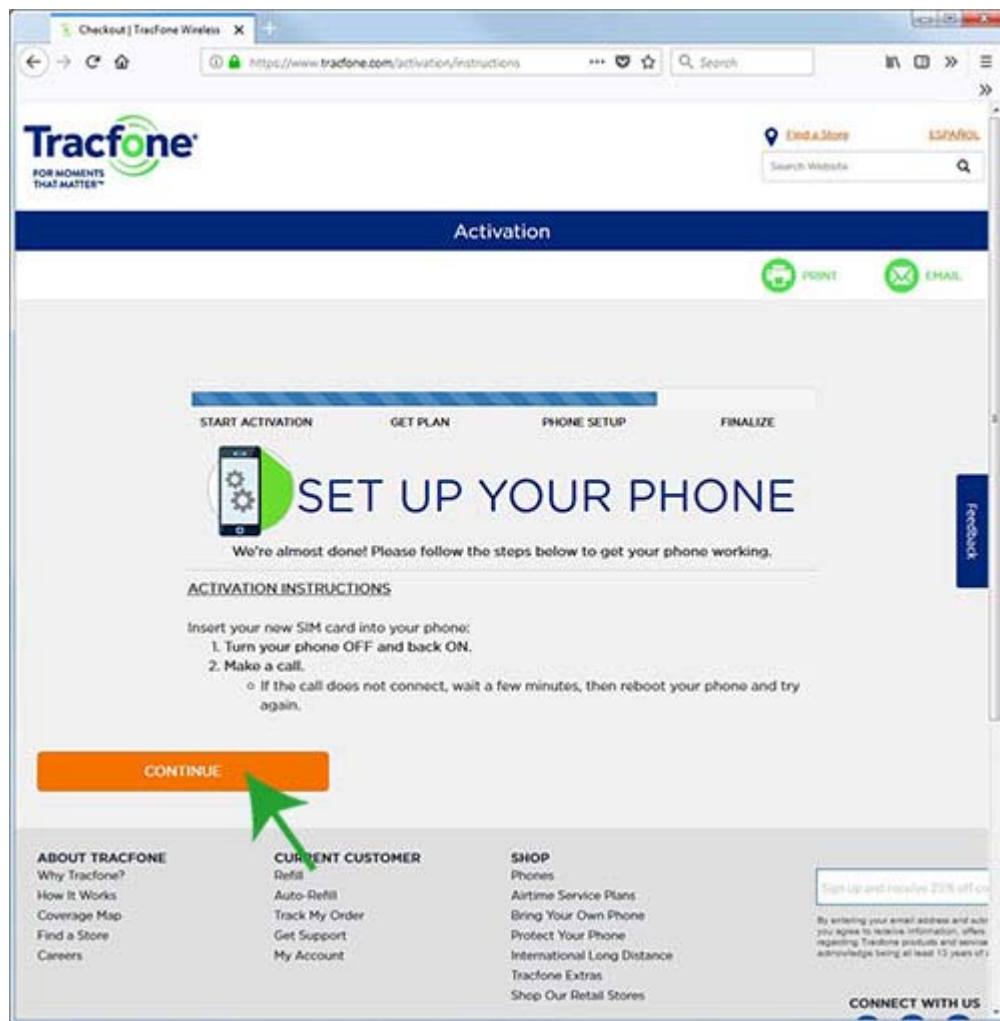
SAVED PAYMENT METHOD | **NEW PAYMENT METHOD**

BILLING SUMMARY

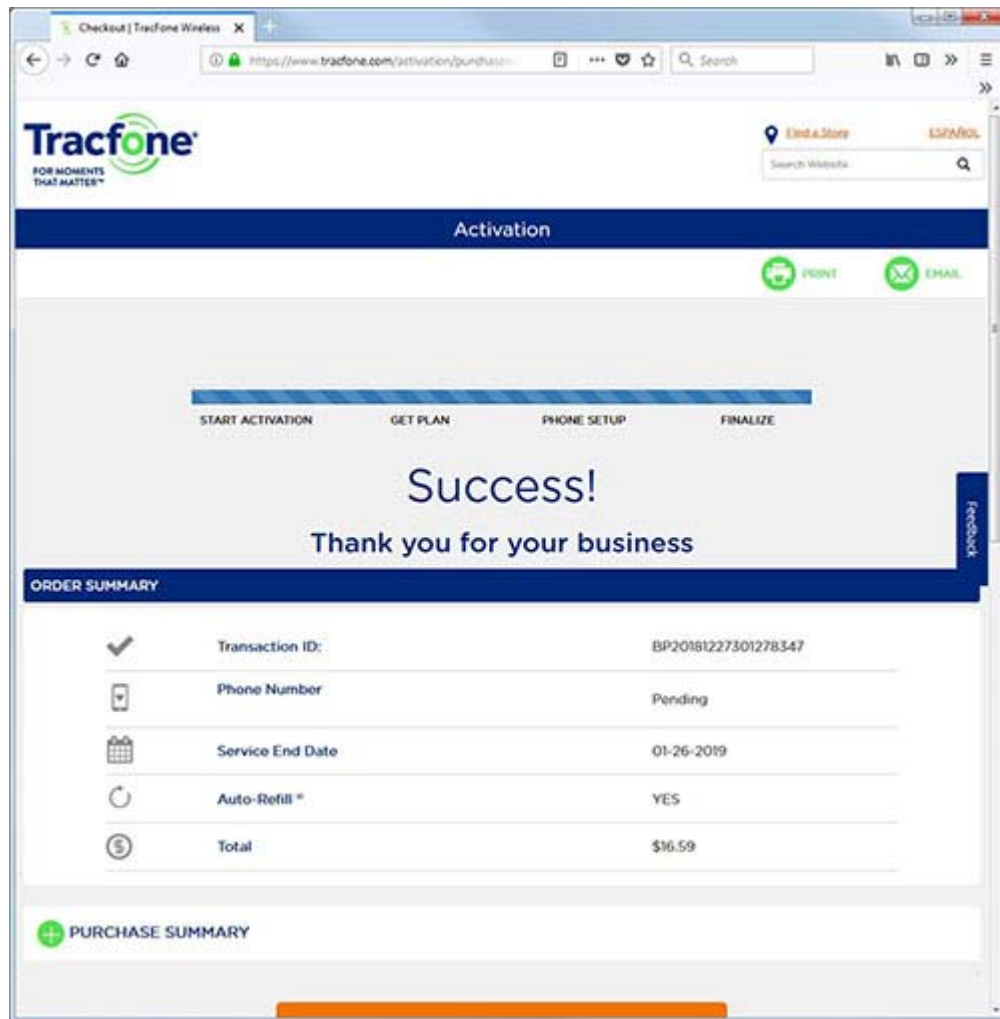
Item	Amount
Subtotal:	\$14.25
Discounts	\$0.75
Tax ¹	\$1.12
Prepaid Wireless E911/TAM Fee ²	\$1.00
Federal Universal Service ³	\$0.19
Regulatory Cost Recovery ⁴	\$0.03
TOTAL	\$16.59

☐ BY CONTINUING WITH THIS TRANSACTION, I ACCEPT AND AGREE TO TRACFONE'S PLAN AND [TERMS AND CONDITIONS](#). I ALSO AUTHORIZE TRACFONE TO INITIATE PAYMENT ON THE SELECTED PAYMENT METHOD.

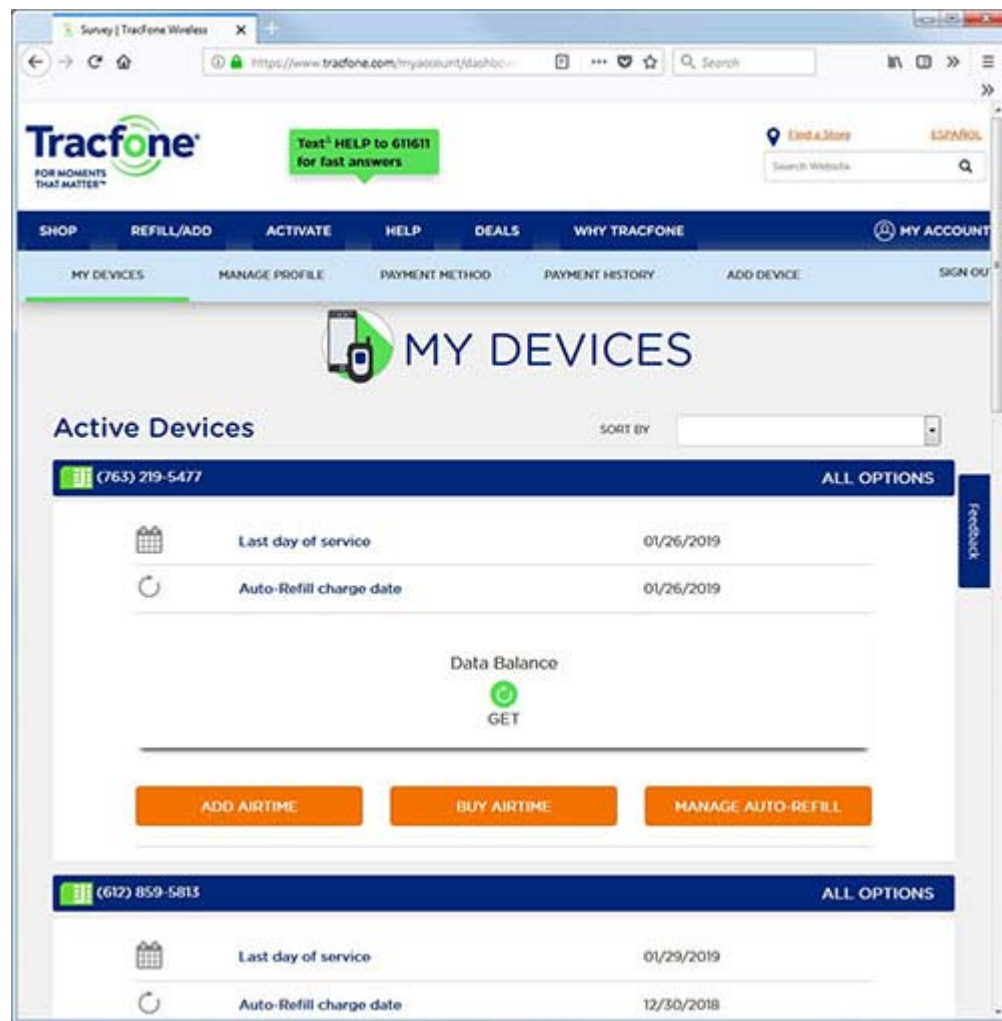
Complete the checkout by entering your credit card information, etc.



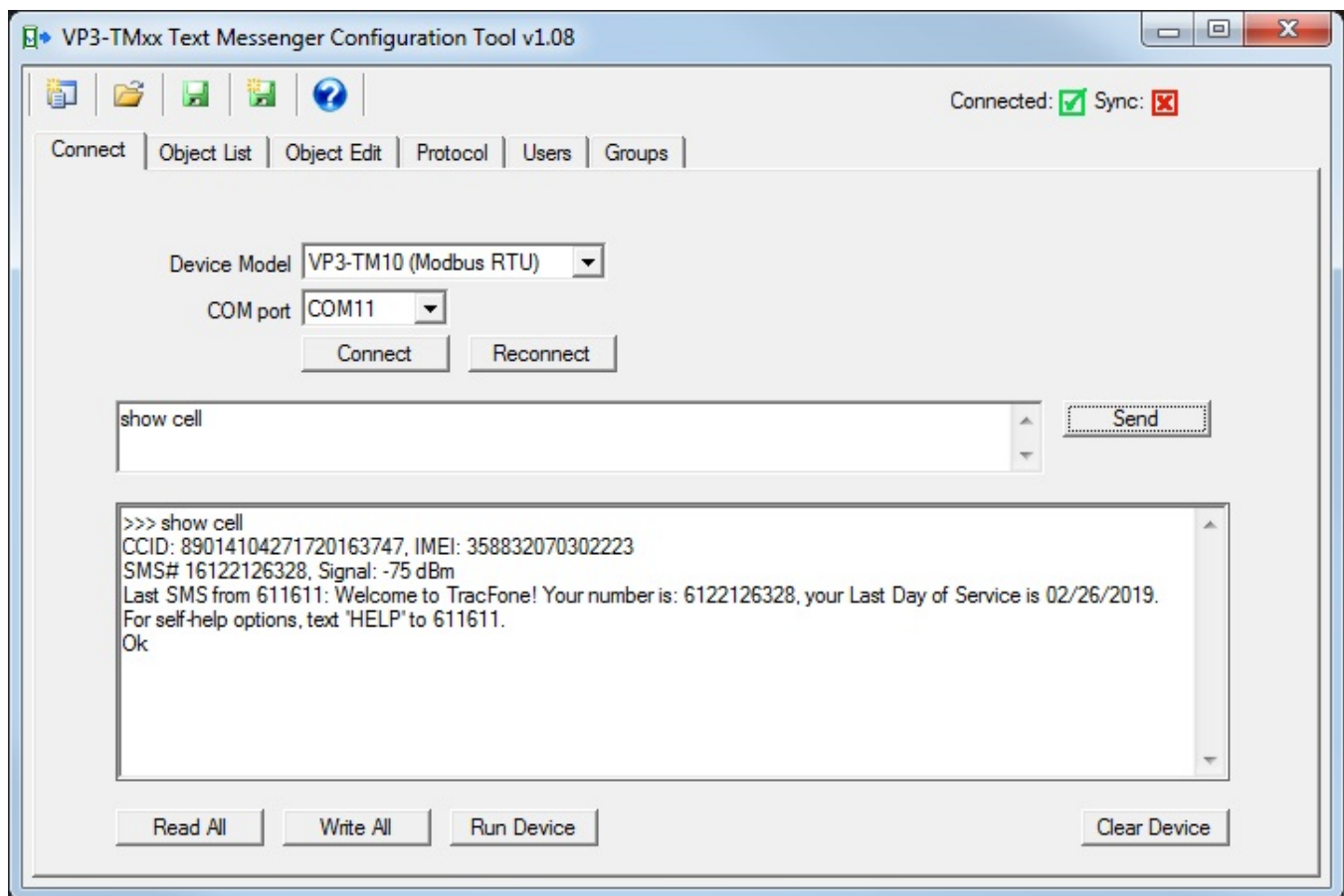
Forget about the "make a call" and everything they suggest about setting up your phone.



The only thing you need to do on this screen is smile.



Wait a few minutes and come back to "My Devices". The My Devices page is the account home page. This is where you will start every time you log in, or each time you click on My Account in the upper right corner (if already logged in). When the device is fully activated, its phone number will show up here.



Use the "show cell" command to verify your SIM card activation. The "show cell" command shows the CCID and IMEI numbers. If connected to the network, it also shows the device's phone number and signal strength. If a text message has been received, the "show cell" command always displays the most recently received message. Immediately after activating the SIM card, it is going to be a welcome message from TracFone.

Copyright © 2019 Control Solutions Minnesota, Inc.



Appendix B. Modbus Slave Register Map

B.1. Modbus Register Numbers for Data Objects

The following chart shows the available Modbus registers. Data objects are typically treated as holding registers. The same objects are also accessible as input registers, discrete inputs, and coils.

Data objects accessed as holding registers registers				
Modicon Std	Modicon Extd	Type	Std. Reg. No.	Description
40001 - 40100	400001 - 400100	Holding Register	1 - 100	Objects 1-100 accessed as signed integer, 16-bit, single Modbus register
41001 - 41100	401001 - 401100	Holding Register	1001 - 1100	Objects 1-100 accessed as unsigned integer, 16-bit, single Modbus register
42001 - 42200	402001 - 402200	Holding Register	2001 - 2200	Objects 1-100 accessed as IEEE754 floating point, 32-bit, double Modbus register
43001 - 43200	403001 - 403200	Holding Register	3001 - 3200	Objects 1-100 accessed as signed integer, 32-bit, double Modbus register
Data objects accessed via Modbus function codes other than holding registers				
Modicon Std	Modicon Extd	Type	Std. Reg. No.	Description
00001 - 00100	000001 - 000100	Coil	1 - 100	Objects 1-100 accessed as single bit Coil registers
10001 - 10100	100001 - 100100	Discrete Input	1 - 100	Objects 1-100 accessed as single bit Discrete Input registers
30001 - 30100	300001 - 300100	Input Register	1 - 100	Objects 1-100 accessed as unsigned integer, 16-bit, single Modbus register
31001 -	301001 -	Input	1001 -	Objects 1-100 accessed as signed integer, 16-bit, single

31100	301100	Register	1100	Modbus register
32001 - 32200	302001 - 302200	Input Register	2001 - 2200	Objects 1-100 accessed as IEEE754 floating point, 32-bit, double Modbus register
33001 - 33200	303001 - 303200	Input Register	3001 - 3200	Objects 1-100 accessed as signed integer, 32-bit, double Modbus register

Copyright © 2019 Control Solutions Minnesota, Inc.



Appendix C. Modbus Protocol Reference

Modbus Register Types

The types of registers referenced in Modbus devices include the following:

- Coil (Discrete Output)
- Discrete Input
- Input Register
- Holding Register

Whether a particular device includes all of these register types is up to the manufacturer. It is very common to find all I/O mapped to holding registers only. Coils are 1-bit registers, are used to control discrete outputs, and may be read or written. Discrete Inputs are 1-bit registers used as inputs, and may only be read. Input registers are 16-bit registers used for input, and may only be read. Holding registers are the most universal 16-bit register, may be read or written, and may be used for a variety of things including inputs, outputs, configuration data, or any requirement for "holding" data.

Modbus Function Codes

Modbus protocol defines several function codes for accessing Modbus registers. There are four different data blocks defined by Modbus, and the addresses or register numbers in each of those overlap. Therefore, a complete definition of where to find a piece of data requires both the address (or register number) and function code (or register type).

The function codes most commonly recognized by Modbus devices are indicated in the table below. This is only a subset of the codes available - several of the codes have special applications that most often do not apply.

Function Code	Register Type
1	Read Coil
2	Read Discrete Input
3	Read Holding Registers
4	Read Input Registers
5	Write Single Coil
6	Write Single Holding Register
15	Write Multiple Coils

16	Write Multiple Holding Registers
----	----------------------------------

Modbus Exception (error) Codes

When a Modbus slave recognizes a packet, but determines that there is an error in the request, it will return an exception code reply instead of a data reply. The exception reply consists of the slave address or unit number, a copy of the function code with the high bit set, and an exception code. If the function code was 3, for example, the function code in the exception reply will be 0x83. The exception codes will be one of the following:

1	Illegal Function	The function code received in the query is not recognized by the slave or is not allowed by the slave.
2	Illegal Data Address	The data address (register number) received in the query is not an allowed address for the slave, i.e., the register does not exist. If multiple registers were requested, at least one was not permitted.
3	Illegal Data Value	The value contained in the query's data field is not acceptable to the slave.
4	Slave Device Failure	An unrecoverable error occurred.
6	Slave Device Busy	The slave is engaged in processing a long-duration command. The master should try again later.
10 (hex 0A)	Gateway Path Unavailable	Gateway could not establish communication with target device.
11 (hex 0B)	Gateway Target Device Failed to Respond	Specialized use in conjunction with gateways, indicates no response was received from the target device.
17 (hex 11)	Gateway Target Device Failed to Respond	No response from slave, request timed out.

Modicon convention notation for Modbus registers

Modbus was originally developed by Gould-Modicon, which is presently Schneider Electric. The notation originally used by Modicon is still often used today, even though considered obsolete by present Modbus standards. The advantage in using the Modicon notation is that two pieces of information are included in a single number: (a) The register type; (b) The register number. A register number offset defines the type.

The types of registers referenced in Modbus devices, and supported by i.Report, include the following:

- Coil (Discrete Output)
- Discrete Input
- Input Register
- Holding Register

Valid address ranges as originally defined for Modbus were 0 to 9999 for each of the above register types. Valid ranges allowed in the current specification are 0 to 65,535. The address range applies to each type of register, and one needs to look at the function code in the Modbus message packet to determine what register type is being referenced. The Modicon convention uses the first digit of a register reference to identify the register type.

Register types and reference ranges recognized by i.Report are as follows:

0x = Coil = 00001-09999
1x = Discrete Input = 10001-19999
3x = Input Register = 30001-39999
4x = Holding Register = 40001-49999

Translating references to addresses, reference 40001 selects the holding register at address 0000, most often referred to as holding register number 1. The reference 40001 will appear in documentation using Modicon notation, but i.Report requires specifying "holding register" and entering that register number as just "1".

On occasion, it was necessary to access more than 10,000 of a register type using Modicon notation. Based on the original convention, there is another defacto standard that looks very similar. Additional register types and reference ranges recognized by i.Report are as follows:

0x = Coil = 000001-065535
1x = Discrete Input = 100001-165535
3x = Input Register = 300001-365535
4x = Holding Register = 400001-465535

If registers are 16-bits, how does one read Floating Point or 32-bit data?

Modbus protocol defines a holding register as 16 bits wide; however, there is a widely used defacto standard for reading and writing data wider than 16 bits. The most common are IEEE 754 floating point, and 32-bit integer. The convention may also be extended to double precision floating point and 64-bit integer data.

The wide data simply consists of two consecutive "registers" treated as a single wide register. Floating point in 32-bit IEEE 754 standard, and 32-bit integer data, are widely used. Although the convention of register pairs is widely recognized, agreement on whether the high order or low order register should come first is not standardized. For this reason, many devices, including all Control Solutions

Modbus devices, support register "swapping". This means you simply check the "swapped" option (aka "High reg first" in some devices) if the other device treats wide data in the opposite order relative to Control Solutions default order.

What does notation like 40001:7 mean?

This is a commonly used notation for referencing individual bits in a register. This particular example, 40001:7, references (Modicon) register 40001, bit 7. Bits are generally numbered starting at bit 0, which is the least significant or right most bit in the field of 16 bits found in a Modbus register.

How do I read individual bits in a register?

Documentation tends to be slightly different for every Modbus device. But if your device packs multiple bits into a single holding register, the documentation will note up to 16 different items found at the same register number or address. The bits may be identified with "Bn" or "Dn" or just "bit n". Most of the time, the least significant bit will be called bit 0 and the most significant will be bit 15. It is possible you could find reference to bit 1 through bit 16, in which case just subtract one from the number to reference the table below.

You cannot read just one bit from a holding register. There is no way to do that - Modbus protocol simply does not provide that function. You must read all 16 bits, and then test the individual bit you are interested in for true or false (1 or 0). The i.Report devices provide an automatic way of doing that by including a "mask" in each object map. Each time the register is read, the mask will be logically AND-ed with the data from the register, and the result will be right justified to yield a 1 or 0 based on whether the selected bit was 1 or 0. The i.Report provides optimization when successive object maps are selecting different bits from the same register. The Modbus register will be read from the slave once, and the 16-bit data will be shared with successive maps, with each object map selecting its bit of interest.

The bit mask shown in the i.Report object map is a 4 digit hexadecimal (16 bit) value used to mask out one or more bits in a register. The selected bits will be right justified, so a single bit regardless of where positioned in the source register will be stored locally as 0 or 1. The hex bit mask values would be as follows:

B0/D0/bit 0 mask = 0001
B1/D1/bit 1 mask = 0002
B2/D2/bit 2 mask = 0004
B3/D3/bit 3 mask = 0008
B4/D4/bit 4 mask = 0010
B5/D5/bit 5 mask = 0020
B6/D6/bit 6 mask = 0040
B7/D7/bit 7 mask = 0080
B8/D8/bit 8 mask = 0100
B9/D9/bit 9 mask = 0200

B10/D10/bit 10 mask = 0400
B11/D11/bit 11 mask = 0800
B12/D12/bit 12 mask = 1000
B13/D13/bit 13 mask = 2000
B14/D14/bit 14 mask = 4000
B15/D15/bit 15 mask = 8000

Some Modbus devices also back two 8-bit values into a single 16-bit register. The two values will typically be documented as "high byte" and "low byte" or simply have "H" and "L" indicated. If you run into this scenario, the masking for bytes is as follows:

High byte mask = FF00
Low byte mask = 00FF

When the mask value in the i.Report is more than just one bit, the mask is still logically AND-ed with the data from the Modbus slave, and the entire resulting value is right justified to produce an integer value of less than the original bit width of the original register.

There have been a few instances of documenting packed bits in a 32-bit register. Although Modbus protocol is strictly 16-bit registers, some implementations force you to read pairs of registers. If your device documents 32 packed bits, then you would insert 0000 in front of each mask above, and the remainder of the list would be as follows:

B16/D16/bit 16 mask = 00010000
B17/D17/bit 17 mask = 00020000
B18/D18/bit 18 mask = 00040000
B19/D19/bit 19 mask = 00080000
B20/D20/bit 20 mask = 00100000
B21/D21/bit 21 mask = 00200000
B22/D22/bit 22 mask = 00400000
B23/D23/bit 23 mask = 00800000
B24/D24/bit 24 mask = 01000000
B25/D25/bit 25 mask = 02000000
B26/D26/bit 26 mask = 04000000
B27/D27/bit 27 mask = 08000000
B28/D28/bit 28 mask = 10000000
B29/D29/bit 29 mask = 20000000
B30/D30/bit 30 mask = 40000000
B31/D31/bit 31 mask = 80000000

Deciphering Modbus Documentation

Documentation for Modbus is not well standardized. Actually there is a standard, but not well followed when it comes to documentation. You will have to do one or

more of the following to decipher which register a manufacturer is really referring to:

- a) Look for the register description, such as holding register, coil, etc. If the documentation says #1, and tells you they are holding registers, then you have holding register #1. You also have user friendly documentation.
- b) Look at the numbers themselves. If you see the first register on the list having a number 40001, that really tells you register #1, and it is a holding register. This form of notation is often referred to as the old Modicon convention.
- c) Look for a definition of function codes to be used. If you see a register #1, along with notation telling you to use function codes 3 and 16, that also tells you it is holding register #1.

IMPORTANT: Register 1 is address 0. Read on...

- d) Do the numbers in your documentation refer to the register number or address? Register #1 is address zero. If it is not clear whether your documentation refers to register or address, and you are not getting the expected result, try plus or minus one for register number. All Control Solutions products refer to register numbers in configuration software or web pages. However, some manufacturers document their devices showing address, not register numbers. When you have addresses, you must add one when entering that register into configuration software from Control Solutions.

Can I put 2 i.Reports on the same Modbus network?

You can not have more than one Master on a Modbus RTU (RS-485) network. Therefore, if the i.Report is to be configured as the Master, you can only have 1 i.Report. You cannot use multiple i.Report devices to read more points from the same Modbus slave device.

Multiple i.Report devices configured as slaves can reside on the same Modbus RS-485 network.

If you are using RS-232 devices, you can have only two devices total, regardless of how they are configured. RS-232 is not multi-drop.

How many devices can I have on a Modbus RTU network?

Logically you can address over 250 devices; however, the RS-485 transceivers are not capable of physically driving that many devices. Modbus protocol states that the limit is 32 devices, and most RS-485 transceivers will agree with this. Only if all devices on the network have low load transceivers can you have more than 32 devices.

Copyright © 2019 Control Solutions Minnesota, Inc.



Appendix D. BACnet Object Properties

D.1 Analog Value, Binary Value Object Properties

The following properties are found in the Analog Value and Binary Value objects. Some properties apply only to certain object types as noted where applicable.

Property	Encoding
Object_Identifier (75)	BACnetObjectIdentifier
Object_Name (77) (W)	CharacterString "Analog Input <i>n</i> "
Object_Description (28) (W)	Character String Same as Object_Name, is only alias for Object_Name
Object_Type (79)	BACnetObjectType ENUMERATED: analog-input (0) analog-output (1) analog-value (2) binary-input (3) binary-output (4) binary-value (5) device (8) multi-state-input (13) multi-state-output (14) multi-state-value (19)
Present_Value (85) (W)	REAL (analog objects) ENUMERATED (binary objects) Unsigned (multi-state objects) (no index) (priority required when writing commandable objects) (input objects writeable only when out of service)
Status_Flags (111)	BACnetStatusFlags BIT STRING: fault(1), out-of-service(3)
Event_State (36)	BACnetEventState ENUMERATED: normal(0), fault(1)

Reliability (103)	BACnetReliability ENUMERATED: normal(0) <i>Vendor specific:</i> See Section 15.7.2.
Out_Of_Service (81) (W)	BOOLEAN
Units (117)	BACnetEngineeringUnits (analog objects only)

D.2 Device Object Properties

The following properties are found in the Device object of the VP3-TM30 or VP3-TM70.

<u>Property</u>	<u>Encoding</u>
Object_Identifier (75)	BACnetObjectIdentifier
Object_Name (77)	CharacterString
Object_Type (79)	BACnetObjectType ENUMERATED: device (8)
System_Status (112)	BACnetDeviceStatus
Vendor_Name (121)	CharacterString
Vendor_Identifier (120)	Unsigned16 (should always return 208)
Model_Name (70)	CharacterString
Firmware_Revision (44)	CharacterString
Application_Software_Version (12)	CharacterString
Protocol_Version (98)	Unsigned
Protocol_Revision (139)	Unsigned
Protocol_Services_Supported (97)	BACnetServicesSupported
Protocol_Object_Types_Supported (96)	BACnetObjectTypesSupported
Object_List (76)	BACnetARRAY[N] of BACnetObjectIdentifier
Max_APDU_Length_Accepted (62)	Unsigned

Segmentation_Supported (107)	BACnetSegmentation
APDU_Timeout (11)	Unsigned
Number_Of_APDU_Retries (73)	Unsigned
Device_Address_Binding (30)	List of BACnetAddressBinding
Database_Revision (155)	Unsigned

Copyright © 2019 Control Solutions Minnesota, Inc.



Appendix E. BACnet Codes

E.1 BACnet Object Property Codes

BACnet property type codes may be found in your copy of the BACnet protocol specification, ANSI/ASHRAE Standard 135. That document is copyrighted, but the C enumeration shown below for reference is taken from open source code available under GPL at <http://sourceforge.net>, and provides essentially the same information (copyrighted by Steve Karg, licensed under GPL as noted at <http://sourceforge.net>).

```
typedef enum {
    PROP_ACKED_TRANSITIONS = 0,
    PROP_ACK_REQUIRED = 1,
    PROP_ACTION = 2,
    PROP_ACTION_TEXT = 3,
    PROP_ACTIVE_TEXT = 4,
    PROP_ACTIVE_VT_SESSIONS = 5,
    PROP_ALARM_VALUE = 6,
    PROP_ALARM_VALUES = 7,
    PROP_ALL = 8,
    PROP_ALL_WRITES_SUCCESSFUL = 9,
    PROP_APDU_SEGMENT_TIMEOUT = 10,
    PROP_APDU_TIMEOUT = 11,
    PROP_APPLICATION_SOFTWARE_VERSION = 12,
    PROP_ARCHIVE = 13,
    PROP_BIAS = 14,
    PROP_CHANGE_OF_STATE_COUNT = 15,
    PROP_CHANGE_OF_STATE_TIME = 16,
    PROP_NOTIFICATION_CLASS = 17,
    PROP_BLANK_1 = 18,
    PROP_CONTROLLED_VARIABLE_REFERENCE = 19,
    PROP_CONTROLLED_VARIABLE_UNITS = 20,
    PROP_CONTROLLED_VARIABLE_VALUE = 21,
    PROP_COV_INCREMENT = 22,
    PROP_DATE_LIST = 23,
    PROP_DAYLIGHT_SAVINGS_STATUS = 24,
    PROP_DEADBAND = 25,
    PROP_DERIVATIVE_CONSTANT = 26,
    PROP_DERIVATIVE_CONSTANT_UNITS = 27,
    PROP_DESCRIPTION = 28,
    PROP_DESCRIPTION_OF_HALT = 29,
    PROP_DEVICE_ADDRESS_BINDING = 30,
    PROP_DEVICE_TYPE = 31,
    PROP_EFFECTIVE_PERIOD = 32,
    PROP_ELAPSED_ACTIVE_TIME = 33,
    PROP_ERROR_LIMIT = 34,
    PROP_EVENT_ENABLE = 35,
    PROP_EVENT_STATE = 36,
    PROP_EVENT_TYPE = 37,
```

```

PROP_EXCEPTION_SCHEDULE = 38,
PROP_FAULT_VALUES = 39,
PROP_FEEDBACK_VALUE = 40,
PROP_FILE_ACCESS_METHOD = 41,
PROP_FILE_SIZE = 42,
PROP_FILE_TYPE = 43,
PROP_FIRMWARE_REVISION = 44,
PROP_HIGH_LIMIT = 45,
PROP_INACTIVE_TEXT = 46,
PROP_IN_PROCESS = 47,
PROP_INSTANCE_OF = 48,
PROP_INTEGRAL_CONSTANT = 49,
PROP_INTEGRAL_CONSTANT_UNITS = 50,
PROP_ISSUE_CONFIRMED_NOTIFICATIONS = 51,
PROP_LIMIT_ENABLE = 52,
PROP_LIST_OF_GROUP_MEMBERS = 53,
PROP_LIST_OF_OBJECT_PROPERTY_REFERENCES = 54,
PROP_LIST_OF_SESSION_KEYS = 55,
PROP_LOCAL_DATE = 56,
PROP_LOCAL_TIME = 57,
PROP_LOCATION = 58,
PROP_LOW_LIMIT = 59,
PROP_MANIPULATED_VARIABLE_REFERENCE = 60,
PROP_MAXIMUM_OUTPUT = 61,
PROP_MAX_APDU_LENGTH_ACCEPTED = 62,
PROP_MAX_INFO_FRAMES = 63,
PROP_MAX_MASTER = 64,
PROP_MAX_PRES_VALUE = 65,
PROP_MINIMUM_OFF_TIME = 66,
PROP_MINIMUM_ON_TIME = 67,
PROP_MINIMUM_OUTPUT = 68,
PROP_MIN_PRES_VALUE = 69,
PROP_MODEL_NAME = 70,
PROP_MODIFICATION_DATE = 71,
PROP_NOTIFY_TYPE = 72,
PROP_NUMBER_OF_APDU_RETRIES = 73,
PROP_NUMBER_OF_STATES = 74,
PROP_OBJECT_IDENTIFIER = 75,
PROP_OBJECT_LIST = 76,
PROP_OBJECT_NAME = 77,
PROP_OBJECT_PROPERTY_REFERENCE = 78,
PROP_OBJECT_TYPE = 79,
PROP_OPTIONAL = 80,
PROP_OUT_OF_SERVICE = 81,
PROP_OUTPUT_UNITS = 82,
PROP_EVENT_PARAMETERS = 83,
PROP_POLARITY = 84,
PROP_PRESENT_VALUE = 85,
PROP_PRIORITY = 86,
PROP_PRIORITY_ARRAY = 87,
PROP_PRIORITY_FOR_WRITING = 88,
PROP_PROCESS_IDENTIFIER = 89,
PROP_PROGRAM_CHANGE = 90,
PROP_PROGRAM_LOCATION = 91,
PROP_PROGRAM_STATE = 92,
PROP_PROPORTIONAL_CONSTANT = 93,
PROP_PROPORTIONAL_CONSTANT_UNITS = 94,
PROP_PROTOCOL_CONFORMANCE_CLASS = 95,          /* deleted in version 1 revision 2
*/
PROP_PROTOCOL_OBJECT_TYPES_SUPPORTED = 96,

```

```
PROP_PROTOCOL_SERVICES_SUPPORTED = 97,  
PROP_PROTOCOL_VERSION = 98,  
PROP_READ_ONLY = 99,  
PROP_REASON_FOR_HALT = 100,  
PROP_RECIPIENT = 101,  
PROP_RECIPIENT_LIST = 102,  
PROP_RELIABILITY = 103,  
PROP_RELINQUISH_DEFAULT = 104,  
PROP_REQUIRED = 105,  
PROP_RESOLUTION = 106,  
PROP_SEGMENTATION_SUPPORTED = 107,  
PROP_SETPOINT = 108,  
PROP_SETPOINT_REFERENCE = 109,  
PROP_STATE_TEXT = 110,  
PROP_STATUS_FLAGS = 111,  
PROP_SYSTEM_STATUS = 112,  
PROP_TIME_DELAY = 113,  
PROP_TIME_OF_ACTIVE_TIME_RESET = 114,  
PROP_TIME_OF_STATE_COUNT_RESET = 115,  
PROP_TIME_SYNCHRONIZATION_RECIPIENTS = 116,  
PROP_UNITS = 117,  
PROP_UPDATE_INTERVAL = 118,  
PROP_UTC_OFFSET = 119,  
PROP_VENDOR_IDENTIFIER = 120,  
PROP_VENDOR_NAME = 121,  
PROP_VT_CLASSES_SUPPORTED = 122,  
PROP_WEEKLY_SCHEDULE = 123,  
PROP_ATTEMPTED_SAMPLES = 124,  
PROP_AVERAGE_VALUE = 125,  
PROP_BUFFER_SIZE = 126,  
PROP_CLIENT_COV_INCREMENT = 127,  
PROP_COV_RESUBSCRIPTION_INTERVAL = 128,  
PROP_CURRENT_NOTIFY_TIME = 129,  
PROP_EVENT_TIME_STAMPS = 130,  
PROP_LOG_BUFFER = 131,  
PROP_LOG_DEVICE_OBJECT = 132,  
/* The enable property is renamed from log-enable in  
   Addendum b to ANSI/ASHRAE 135-2004(135b-2) */  
PROP_ENABLE = 133,  
PROP_LOG_INTERVAL = 134,  
PROP_MAXIMUM_VALUE = 135,  
PROP_MINIMUM_VALUE = 136,  
PROP_NOTIFICATION_THRESHOLD = 137,  
PROP_PREVIOUS_NOTIFY_TIME = 138,  
PROP_PROTOCOL_REVISION = 139,  
PROP_RECORDS_SINCE_NOTIFICATION = 140,  
PROP_RECORD_COUNT = 141,  
PROP_START_TIME = 142,  
PROP_STOP_TIME = 143,  
PROP_STOP_WHEN_FULL = 144,  
PROP_TOTAL_RECORD_COUNT = 145,  
PROP_VALID_SAMPLES = 146,  
PROP_WINDOW_INTERVAL = 147,  
PROP_WINDOW_SAMPLES = 148,  
PROP_MAXIMUM_VALUE_TIMESTAMP = 149,  
PROP_MINIMUM_VALUE_TIMESTAMP = 150,  
PROP_VARIANCE_VALUE = 151,  
PROP_ACTIVE_COV_SUBSCRIPTIONS = 152,  
PROP_BACKUP_FAILURE_TIMEOUT = 153,  
PROP_CONFIGURATION_FILES = 154,
```

```
PROP_DATABASE_REVISION = 155,  
PROP_DIRECT_READING = 156,  
PROP_LAST_RESTORE_TIME = 157,  
PROP_MAINTENANCE_REQUIRED = 158,  
PROP_MEMBER_OF = 159,  
PROP_MODE = 160,  
PROP_OPERATION_EXPECTED = 161,  
PROP_SETTING = 162,  
PROP_SILENCED = 163,  
PROP_TRACKING_VALUE = 164,  
PROP_ZONE_MEMBERS = 165,  
PROP_LIFE_SAFETY_ALARM_VALUES = 166,  
PROP_MAX_SEGMENTS_ACCEPTED = 167,  
PROP_PROFILE_NAME = 168,  
PROP_AUTO_SLAVE_DISCOVERY = 169,  
PROP_MANUAL_SLAVE_ADDRESS_BINDING = 170,  
PROP_SLAVE_ADDRESS_BINDING = 171,  
PROP_SLAVE_PROXY_ENABLE = 172,  
PROP_LAST_NOTIFY_TIME = 173,  
PROP_SCHEDULE_DEFAULT = 174,  
PROP_ACCEPTED_MODES = 175,  
PROP_ADJUST_VALUE = 176,  
PROP_COUNT = 177,  
PROP_COUNT_BEFORE_CHANGE = 178,  
PROP_COUNT_CHANGE_TIME = 179,  
PROP_COV_PERIOD = 180,  
PROP_INPUT_REFERENCE = 181,  
PROP_LIMIT_MONITORING_INTERVAL = 182,  
PROP_LOGGING_DEVICE = 183,  
PROP_LOGGING_RECORD = 184,  
PROP_PRESCALE = 185,  
PROP_PULSE_RATE = 186,  
PROP_SCALE = 187,  
PROP_SCALE_FACTOR = 188,  
PROP_UPDATE_TIME = 189,  
PROP_VALUE_BEFORE_CHANGE = 190,  
PROP_VALUE_SET = 191,  
PROP_VALUE_CHANGE_TIME = 192,  
/* enumerations 193-206 are new */  
PROP_ALIGN_INTERVALS = 193,  
PROP_GROUP_MEMBER_NAMES = 194,  
PROP_INTERVAL_OFFSET = 195,  
PROP_LAST_RESTART_REASON = 196,  
PROP_LOGGING_TYPE = 197,  
PROP_MEMBER_STATUS_FLAGS = 198,  
PROP_NOTIFICATION_PERIOD = 199,  
PROP_PREVIOUS_NOTIFY_RECORD = 200,  
PROP_REQUESTED_UPDATE_INTERVAL = 201,  
PROP_RESTART_NOTIFICATION_RECIPIENTS = 202,  
PROP_TIME_OF_DEVICE_RESTART = 203,  
PROP_TIME_SYNCHRONIZATION_INTERVAL = 204,  
PROP_TRIGGER = 205,  
PROP_UTC_TIME_SYNCHRONIZATION_RECIPIENTS = 206,  
/* enumerations 207-211 are used in Addendum d to ANSI/ASHRAE 135-2004 */  
PROP_NODE_SUBTYPE = 207,  
PROP_NODE_TYPE = 208,  
PROP_STRUCTURED_OBJECT_LIST = 209,  
PROP_SUBORDINATE_ANNOTATIONS = 210,  
PROP_SUBORDINATE_LIST = 211,  
/* enumerations 212-225 are used in Addendum e to ANSI/ASHRAE 135-2004 */
```



```
PROP_ACTUAL_SHED_LEVEL = 212,  
PROP_DUTY_WINDOW = 213,  
PROP_EXPECTED_SHED_LEVEL = 214,  
PROP_FULL_DUTY_BASELINE = 215,  
/* enumerations 216-217 are used in Addendum i to ANSI/ASHRAE 135-2004 */  
PROP_BLINK_PRIORITY_THRESHOLD = 216,  
PROP_BLINK_TIME = 217,  
/* enumerations 212-225 are used in Addendum e to ANSI/ASHRAE 135-2004 */  
PROP_REQUESTED_SHED_LEVEL = 218,  
PROP_SHED_DURATION = 219,  
PROP_SHED_LEVEL_DESCRIPTIONS = 220,  
PROP_SHED_LEVELS = 221,  
PROP_STATE_DESCRIPTION = 222,  
/* enumerations 223-225 are used in Addendum i to ANSI/ASHRAE 135-2004 */  
PROP_FADE_TIME = 223,  
PROP_LIGHTING_COMMAND = 224,  
PROP_LIGHTING_COMMAND_PRIORITY = 225,  
/* enumerations 226-235 are used in Addendum f to ANSI/ASHRAE 135-2004 */  
PROP_DOOR_ALARM_STATE = 226,  
PROP_DOOR_EXTENDED_PULSE_TIME = 227,  
PROP_DOOR_MEMBERS = 228,  
PROP_DOOR_OPEN_TOO_LONG_TIME = 229,  
PROP_DOOR_PULSE_TIME = 230,  
PROP_DOOR_STATUS = 231,  
PROP_DOOR_UNLOCK_DELAY_TIME = 232,  
PROP_LOCK_STATUS = 233,  
PROP_MASKED_ALARM_VALUES = 234,  
PROP_SECURED_STATUS = 235,  
/* enumerations 236-243 are used in Addendum i to ANSI/ASHRAE 135-2004 */  
PROP_OFF_DELAY = 236,  
PROP_ON_DELAY = 237,  
PROP_POWER = 238,  
PROP_POWER_ON_VALUE = 239,  
PROP_PROGRESS_VALUE = 240,  
PROP_RAMP_RATE = 241,  
PROP_STEP_INCREMENT = 242,  
PROP_SYSTEM_FAILURE_VALUE = 243,  
/* enumerations 244-311 are used in Addendum j to ANSI/ASHRAE 135-2004 */  
PROP_ABSENTEE_LIMIT = 244,  
PROP_ACCESS_ALARM_EVENTS = 245,  
PROP_ACCESS_DOORS = 246,  
PROP_ACCESS_EVENT = 247,  
PROP_ACCESS_EVENT_AUTHENTICATION_FACTOR = 248,  
PROP_ACCESS_EVENT_CREDENTIAL = 249,  
PROP_ACCESS_EVENT_TIME = 250,  
PROP_ACCESS_RULES = 251,  
PROP_ACCESS_RULES_ENABLE = 252,  
PROP_ACCESS_TRANSACTION_EVENTS = 253,  
PROP_ACCOMPANIED = 254,  
PROP_ACTIVATION_TIME = 255,  
PROP_ACTIVE_AUTHENTICATION_POLICY = 256,  
PROP_ASSIGNED_ACCESS_RIGHTS = 257,  
PROP_AUTHENTICATION_FACTOR_INPUT_LIST = 258,  
PROP_AUTHENTICATION_FACTORS = 259,  
PROP_AUTHENTICATION_POLICY_LIST = 260,  
PROP_AUTHENTICATION_POLICY_NAMES = 261,  
PROP_AUTHORIZATION_MODE = 262,  
PROP_BELONGS_TO = 263,  
PROP_CREDENTIAL_DISABLE = 264,  
PROP_CREDENTIAL_STATUS = 265,
```

```
PROP_CREDENTIALS = 266,  
PROP_CREDENTIALS_IN_ZONE = 267,  
PROP_DAYS_REMAINING = 268,  
PROP_ENTRY_POINTS = 269,  
PROP_EXIT_POINTS = 270,  
PROP_EXPIRY_TIME = 271,  
PROP_EXTENDED_TIME_ENABLE = 272,  
PROP_FAILED_ATTEMPT_EVENTS = 273,  
PROP_FAILED_ATTEMPTS = 274,  
PROP_FAILED_ATTEMPTS_TIME = 275,  
PROP_FORMAT_CLASS_SUPPORTED = 276,  
PROP_FORMAT_TYPE = 277,  
PROP_LAST_ACCESS_EVENT = 278,  
PROP_LAST_ACCESS_POINT = 279,  
PROP_LAST_CREDENTIAL_ADDED = 280,  
PROP_LAST_CREDENTIAL_ADDED_TIME = 281,  
PROP_LAST_CREDENTIAL_REMOVED = 282,  
PROP_LAST_CREDENTIAL_REMOVED_TIME = 283,  
PROP_LAST_USE_TIME = 284,  
PROP_LOCKDOWN = 285,  
PROP_LOCKDOWN_RELINQUISH_TIME = 286,  
PROP_MASTER_EXEMPTION = 287,  
PROP_MAX_FAILED_ATTEMPTS = 288,  
PROP_MEMBERS = 289,  
PROP_MASTER_POINT = 290,  
PROP_NUMBER_OF_AUTHENTICATION_POLICIES = 291,  
PROP_OCCUPANCY_COUNT = 293,  
PROP_OCCUPANCY_COUNT_ENABLE = 294,  
PROP_OCCUPANCY_COUNT_EXEMPTION = 295,  
PROP_OCCUPANCY_LOWER_THRESHOLD = 296,  
PROP_OCCUPANCY_LOWER_THRESHOLD_ENFORCED = 297,  
PROP_OCCUPANCY_STATE = 298,  
PROP_OCCUPANCY_UPPER_LIMIT = 299,  
PROP_OCCUPANCY_UPPER_LIMIT_ENFORCED = 300,  
PROP_PASSBACK_EXEMPTION = 301,  
PROP_PASSBACK_MODE = 302,  
PROP_PASSBACK_TIMEOUT = 303,  
PROP_POSITIVE_ACCESS_RULES = 304,  
PROP_READ_STATUS = 305,  
PROP_REASON_FOR_DISABLE = 306,  
PROP_THREAT_AUTHORITY = 307,  
PROP_THREAT_LEVEL = 308,  
PROP_TRACE_FLAG = 309,  
PROP_TRANSACTION_NOTIFICATION_CLASS = 310,  
PROP_USER_EXTERNAL_IDENTIFIER = 311,  
/* enumerations 312-313 are used in Addendum k to ANSI/ASHRAE 135-2004 */  
PROP_CHARACTER_SET = 312,  
PROP_STRICT_CHARACTER_MODE = 313,  
/* enumerations 312-313 are used in Addendum k to ANSI/ASHRAE 135-2004 */  
PROP_BACKUP_AND_RESTORE_STATE = 314,  
PROP_BACKUP_PREPARATION_TIME = 315,  
PROP_RESTORE_PREPARATION_TIME = 316,  
/* enumerations 317-323 are used in Addendum j to ANSI/ASHRAE 135-2004 */  
PROP_USER_INFORMATION_REFERENCE = 317,  
PROP_USER_NAME = 318,  
PROP_USER_TYPE = 319,  
PROP_USES_REMAINING = 320,  
PROP_VENDOR_FORMAT_IDENTIFIER = 321,  
PROP_ZONE_FROM = 322,  
PROP_ZONE_TO = 323,
```

```

/* enumerations 324-325 are used in Addendum i to ANSI/ASHRAE 135-2004 */
PROP_BINARY_ACTIVE_VALUE = 324,
PROP_BINARY_INACTIVE_VALUE = 325
/* The special property identifiers all, optional, and required */
/* are reserved for use in the ReadPropertyConditional and */
/* ReadPropertyMultiple services or services not defined in this standard.
*/

/* Enumerated values 0-511 are reserved for definition by ASHRAE. */
/* Enumerated values 512-4194303 may be used by others subject to the */
/* procedures and constraints described in Clause 23. */
} BACNET_PROPERTY_ID;

```

E.2 BACnet Engineering Units Codes

BACnet engineering units codes may be found in your copy of the BACnet protocol specification, ANSI/ASHRAE Standard 135. That document is copyrighted, but the C enumeration shown below for reference is taken from open source code available under GPL at <http://sourceforge.net>, and provides essentially the same information (copyrighted by Steve Karg, licensed under GPL as noted at <http://sourceforge.net>).

```

typedef enum {
/* Acceleration */
UNITS_METERS_PER_SECOND_PER_SECOND = 166,
/* Area */
UNITS_SQUARE_METERS = 0,
UNITS_SQUARE_CENTIMETERS = 116,
UNITS_SQUARE_FEET = 1,
UNITS_SQUARE_INCHES = 115,
/* Currency */
UNITS_CURRENCY1 = 105,
UNITS_CURRENCY2 = 106,
UNITS_CURRENCY3 = 107,
UNITS_CURRENCY4 = 108,
UNITS_CURRENCY5 = 109,
UNITS_CURRENCY6 = 110,
UNITS_CURRENCY7 = 111,
UNITS_CURRENCY8 = 112,
UNITS_CURRENCY9 = 113,
UNITS_CURRENCY10 = 114,
/* Electrical */
UNITS_MILLIAMPERES = 2,
UNITS_AMPERES = 3,
UNITS_AMPERES_PER_METER = 167,
UNITS_AMPERES_PER_SQUARE_METER = 168,
UNITS_AMPERE_SQUARE_METERS = 169,
UNITS_FARADS = 170,
UNITS_HENRYS = 171,
UNITS_OHMS = 4,
UNITS_OHM_METERS = 172,
UNITS_MILLIOHMS = 145,
UNITS_KILOHMS = 122,
UNITS_MEGOHMS = 123,
UNITS_SIEMENS = 173, /* 1 mho equals 1 siemens */
UNITS_SIEMENS_PER_METER = 174,
UNITS_TESLAS = 175,
UNITS_VOLTS = 5,

```

```
UNITS_MILLIVOLTS = 124,  
UNITS_KILOVOLTS = 6,  
UNITS_MEGAVOLTS = 7,  
UNITS_VOLT_AMPERES = 8,  
UNITS_KILOVOLT_AMPERES = 9,  
UNITS_MEGAVOLT_AMPERES = 10,  
UNITS_VOLT_AMPERES_REACTIVE = 11,  
UNITS_KILOVOLT_AMPERES_REACTIVE = 12,  
UNITS_MEGAVOLT_AMPERES_REACTIVE = 13,  
UNITS_VOLTS_PER_DEGREE_KELVIN = 176,  
UNITS_VOLTS_PER_METER = 177,  
UNITS_DEGREES_PHASE = 14,  
UNITS_POWER_FACTOR = 15,  
UNITS_WEBERS = 178,  
/* Energy */  
UNITS_JOULES = 16,  
UNITS_KILOJOULES = 17,  
UNITS_KILOJOULES_PER_KILOGRAM = 125,  
UNITS_MEGAJOULES = 126,  
UNITS_WATT_HOURS = 18,  
UNITS_KILOWATT_HOURS = 19,  
UNITS_MEGAWATT_HOURS = 146,  
UNITS_BTUS = 20,  
UNITS_KILO_BTUS = 147,  
UNITS_MEGA_BTUS = 148,  
UNITS_THERMS = 21,  
UNITS_TON_HOURS = 22,  
/* Enthalpy */  
UNITS_JOULES_PER_KILOGRAM_DRY_AIR = 23,  
UNITS_KILOJOULES_PER_KILOGRAM_DRY_AIR = 149,  
UNITS_MEGAJOULES_PER_KILOGRAM_DRY_AIR = 150,  
UNITS_BTUS_PER_POUND_DRY_AIR = 24,  
UNITS_BTUS_PER_POUND = 117,  
/* Entropy */  
UNITS_JOULES_PER_DEGREE_KELVIN = 127,  
UNITS_KILOJOULES_PER_DEGREE_KELVIN = 151,  
UNITS_MEGAJOULES_PER_DEGREE_KELVIN = 152,  
UNITS_JOULES_PER_KILOGRAM_DEGREE_KELVIN = 128,  
/* Force */  
UNITS_NEWTON = 153,  
/* Frequency */  
UNITS_CYCLES_PER_HOUR = 25,  
UNITS_CYCLES_PER_MINUTE = 26,  
UNITS_HERTZ = 27,  
UNITS_KILOHERTZ = 129,  
UNITS_MEGAHERTZ = 130,  
UNITS_PER_HOUR = 131,  
/* Humidity */  
UNITS_GRAMS_OF_WATER_PER_KILOGRAM_DRY_AIR = 28,  
UNITS_PERCENT_RELATIVE_HUMIDITY = 29,  
/* Length */  
UNITS_MILLIMETERS = 30,  
UNITS_CENTIMETERS = 118,  
UNITS_METERS = 31,  
UNITS_INCHES = 32,  
UNITS_FEET = 33,  
/* Light */  
UNITS_CANDELAS = 179,  
UNITS_CANDELAS_PER_SQUARE_METER = 180,  
UNITS_WATTS_PER_SQUARE_FOOT = 34,
```

```
UNITS_WATTS_PER_SQUARE_METER = 35,  
UNITS_LUMENS = 36,  
UNITS_LUXES = 37,  
UNITS_FOOT_CANDLES = 38,  
/* Mass */  
UNITS_KILOGRAMS = 39,  
UNITS_POUNDS_MASS = 40,  
UNITS_TONS = 41,  
/* Mass Flow */  
UNITS_GRAMS_PER_SECOND = 154,  
UNITS_GRAMS_PER_MINUTE = 155,  
UNITS_KILOGRAMS_PER_SECOND = 42,  
UNITS_KILOGRAMS_PER_MINUTE = 43,  
UNITS_KILOGRAMS_PER_HOUR = 44,  
UNITS_POUNDS_MASS_PER_SECOND = 119,  
UNITS_POUNDS_MASS_PER_MINUTE = 45,  
UNITS_POUNDS_MASS_PER_HOUR = 46,  
UNITS_TONS_PER_HOUR = 156,  
/* Power */  
UNITS_MILLIWATTS = 132,  
UNITS_WATTS = 47,  
UNITS_KILOWATTS = 48,  
UNITS_MEGAWATTS = 49,  
UNITS_BTUS_PER_HOUR = 50,  
UNITS_KILO_BTUS_PER_HOUR = 157,  
UNITS_HORSEPOWER = 51,  
UNITS_TONS_REFRIGERATION = 52,  
/* Pressure */  
UNITS_PASCALS = 53,  
UNITS_HECTOPASCALS = 133,  
UNITS_KILOPASCALS = 54,  
UNITS_MILLIBARS = 134,  
UNITS_BARS = 55,  
UNITS_POUNDS_FORCE_PER_SQUARE_INCH = 56,  
UNITS_CENTIMETERS_OF_WATER = 57,  
UNITS_INCHES_OF_WATER = 58,  
UNITS_MILLIMETERS_OF_MERCURY = 59,  
UNITS_CENTIMETERS_OF_MERCURY = 60,  
UNITS_INCHES_OF_MERCURY = 61,  
/* Temperature */  
UNITS_DEGREES_CELSIUS = 62,  
UNITS_DEGREES_KELVIN = 63,  
UNITS_DEGREES_KELVIN_PER_HOUR = 181,  
UNITS_DEGREES_KELVIN_PER_MINUTE = 182,  
UNITS_DEGREES_FAHRENHEIT = 64,  
UNITS_DEGREE_DAYS_CELSIUS = 65,  
UNITS_DEGREE_DAYS_FAHRENHEIT = 66,  
UNITS_DELTA_DEGREES_FAHRENHEIT = 120,  
UNITS_DELTA_DEGREES_KELVIN = 121,  
/* Time */  
UNITS_YEARS = 67,  
UNITS_MONTHS = 68,  
UNITS_WEEKS = 69,  
UNITS_DAYS = 70,  
UNITS_HOURS = 71,  
UNITS_MINUTES = 72,  
UNITS_SECONDS = 73,  
UNITS_HUNDREDTHS_SECONDS = 158,  
UNITS_MILLISECONDS = 159,  
/* Torque */
```

```

UNITS_NEWTON_METERS = 160,
/* Velocity */
UNITS_MILLIMETERS_PER_SECOND = 161,
UNITS_MILLIMETERS_PER_MINUTE = 162,
UNITS_METERS_PER_SECOND = 74,
UNITS_METERS_PER_MINUTE = 163,
UNITS_METERS_PER_HOUR = 164,
UNITS_KILOMETERS_PER_HOUR = 75,
UNITS_FEET_PER_SECOND = 76,
UNITS_FEET_PER_MINUTE = 77,
UNITS_MILES_PER_HOUR = 78,
/* Volume */
UNITS_CUBIC_FEET = 79,
UNITS_CUBIC_METERS = 80,
UNITS_IMPERIAL_GALLONS = 81,
UNITS_LITERS = 82,
UNITS_US_GALLONS = 83,
/* Volumetric Flow */
UNITS_CUBIC_FEET_PER_SECOND = 142,
UNITS_CUBIC_FEET_PER_MINUTE = 84,
UNITS_CUBIC_METERS_PER_SECOND = 85,
UNITS_CUBIC_METERS_PER_MINUTE = 165,
UNITS_CUBIC_METERS_PER_HOUR = 135,
UNITS_IMPERIAL_GALLONS_PER_MINUTE = 86,
UNITS_LITERS_PER_SECOND = 87,
UNITS_LITERS_PER_MINUTE = 88,
UNITS_LITERS_PER_HOUR = 136,
UNITS_US_GALLONS_PER_MINUTE = 89,
/* Other */
UNITS_DEGREES_ANGULAR = 90,
UNITS_DEGREES_CELSIUS_PER_HOUR = 91,
UNITS_DEGREES_CELSIUS_PER_MINUTE = 92,
UNITS_DEGREES_FAHRENHEIT_PER_HOUR = 93,
UNITS_DEGREES_FAHRENHEIT_PER_MINUTE = 94,
UNITS_JOULE_SECONDS = 183,
UNITS_KILOGRAMS_PER_CUBIC_METER = 186,
UNITS_KW_HOURS_PER_SQUARE_METER = 137,
UNITS_KW_HOURS_PER_SQUARE_FOOT = 138,
UNITS_MEGAJOULES_PER_SQUARE_METER = 139,
UNITS_MEGAJOULES_PER_SQUARE_FOOT = 140,
UNITS_NO_UNITS = 95,
UNITS_NEWTON_SECONDS = 187,
UNITS_NEWTONS_PER_METER = 188,
UNITS_PARTS_PER_MILLION = 96,
UNITS_PARTS_PER_BILLION = 97,
UNITS_PERCENT = 98,
UNITS_PERCENT_OBSCURATION_PER_FOOT = 143,
UNITS_PERCENT_OBSCURATION_PER_METER = 144,
UNITS_PERCENT_PER_SECOND = 99,
UNITS_PER_MINUTE = 100,
UNITS_PER_SECOND = 101,
UNITS_PSI_PER_DEGREE_FAHRENHEIT = 102,
UNITS_RADIANS = 103,
UNITS_RADIANS_PER_SECOND = 184,
UNITS_REVOLUTIONS_PER_MINUTE = 104,
UNITS_SQUARE_METERS_PER_NEWTON = 185,
UNITS_WATTS_PER_METER_PER_DEGREE_KELVIN = 189,
UNITS_WATTS_PER_SQUARE_METER_DEGREE_KELVIN = 141,
; /* Enumerated values 0-255 are reserved for definition by ASHRAE. */
/* Enumerated values 256-65535 may be used by others subject to */

```

```
        /* the procedures and constraints described in Clause 23. */  
        /* The last enumeration used in this version is 189. */  
    MAX_UNITS = 190  
} BACNET_ENGINEERING_UNITS;
```

Copyright © 2019 Control Solutions Minnesota, Inc.



Appendix F. Hardware Details

F.1. LED Indications Common to All Models

The link LED labeled LNK on the cover of the VP3-TM is connected directly to the cellular modem. The possible indications of the LNK LED are as follows:

LNK LED is:	What it means:
OFF	Possible hardware failure if LED remains in this state.
ON	Not connected to network, but trying.
Flash @ 2/Sec	Connected to network, operating normally.
Flash twice, pause, repeat	Connected to network, operating, but last attempt to send a message failed.

The fact that you are in configuration mode will be indicated by the LED labeled "STA" remaining on solid amber. In normal operation, this LED will be off, or flashing. If on solid amber, you are in configuration mode.

STA LED is:	What it means:
ON	You are in configuration mode.
OFF or Flashing	You are not in configuration mode. When not in configuration mode, the meaning of the STA LED will vary by model, as outlined in following sections.

F.2. LED Indications for Modbus RTU on VP3-TM10



Power-up LED behavior: STA and STB LEDs on front panel will turn on yellow or red for half a second, then all will turn on green for half a second. Then they will proceed to indicate as normally defined for the indicators. The power LED will be lighted (blue) any time power is applied to the unit.

The STA and STB LED indicators on the front of the VP3-TM10 indicate Modbus errors. These are global indicators that do not tell you which device or which register is having trouble, but these indicators are a very quick way to observe whether there are problems, and also whether there is any activity at all.

The STA and STB LEDs will indicate Modbus traffic as indicated in the table below.

Mode	"STA" LED	"STB" LED
VP3-TM10 is Master	Flash yellow each time master (VP3-TM10) sends a request to a remote slave.	Flash green when master receives a good response. Flash red when master receives exception message from slave, or if timed out with no response from slave.
VP3-TM10 is Slave	Flash yellow each time slave (VP3-TM10) receives a request from external master.	Flash green when slave recognizes request as good/valid and sends a good reply. Flash red when slave receives a request that results in replying with an exception, or there was a CRC error in the request.

F.3. LED Indications for BACnet MS/TP on VP3-TM30

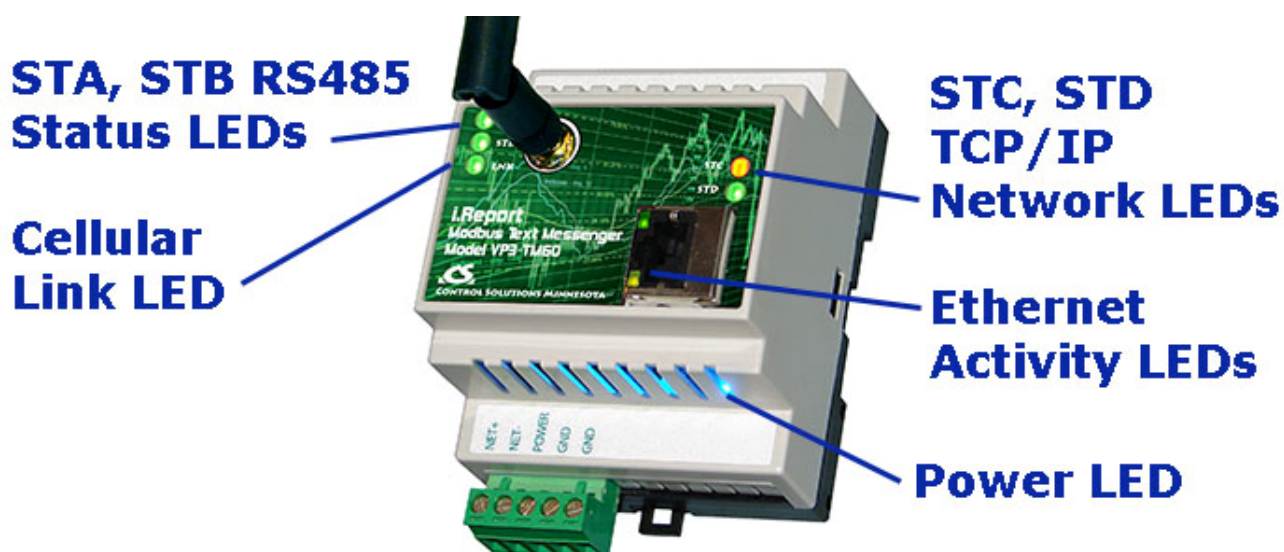


Power-up LED behavior: STA and STB LEDs on front panel will turn on yellow or red for half a second, then all will turn on green for half a second. Then they will proceed to indicate as normally defined for the indicators. The power LED will be lighted (blue) any time power is applied to the unit.

The LEDs will indicate BACnet traffic as indicated in the table below.

Mode	"STA" LED	"STB" LED
VP3-TM30 is Client or Server	<p>"Token" LED</p> <p>Flash yellow each time the VP3-TM30 sends a "poll for master".</p> <p>Flash green each time the token is passed.</p>	<p>"Packet" LED</p> <p>Flash green any time a packet is sent on the network. This can be either a request or a response to a request</p> <p>Flash red any time an error is detected. The error can be an error code reply, or timeout. The object reliability code will indicate which one it was.</p>

F.4. LED Indications for Modbus TCP on VP3-TM60



Power-up LED behavior: STA and STB LEDs on front panel will turn on yellow or red for half a second, then all will turn on green for half a second. The STC and STD LEDs will replicated this behavior but after a delay. Then they will proceed to indicate as normally defined for the indicators. The power LED will be lighted (blue) any time power is applied to the unit.

The STC and STD LEDs will indicate Modbus traffic as indicated in the table below.

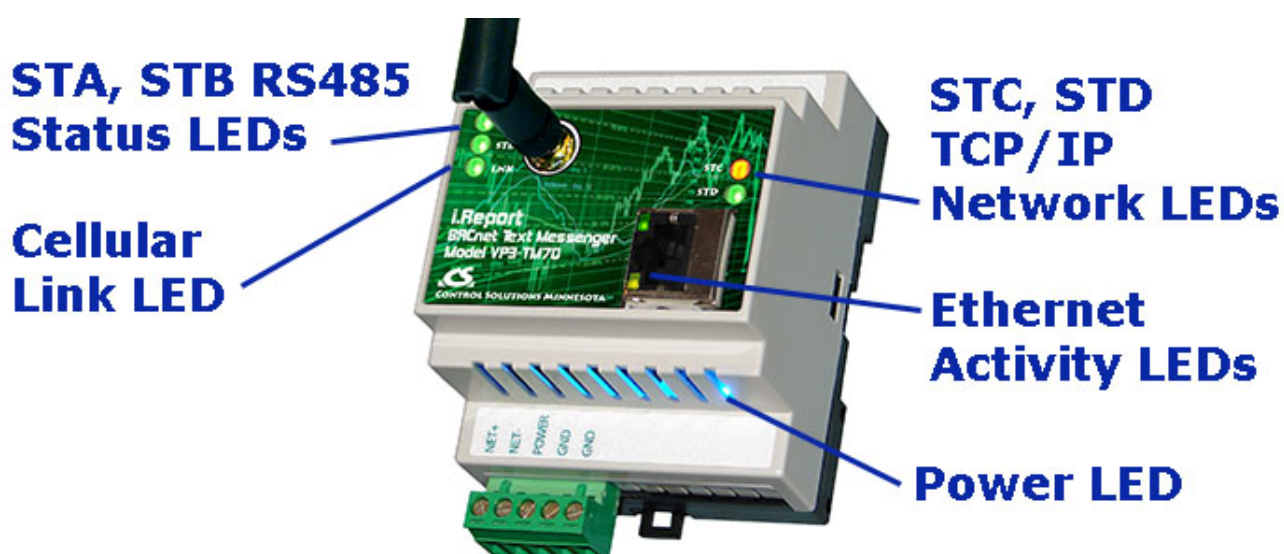
Mode	"STC" LED	"STD" LED
VP3-TM60 is Master	<p>Flash yellow each time master/client (VP3-TM60) sends a request to a remote slave/server.</p> <p>If TCP is unable to make a connection with the IP address given for the TCP slave, the request LED will not flash yellow (because no request was sent yet), but the reply LED will flash red each time the connection attempt times out or fails.</p>	<p>Flash green when master receives a good response.</p> <p>Flash red when master receives exception message from slave, or if timed out with no response from slave.</p>
VP3-TM60 is Slave	<p>Flash yellow each time slave (VP3-TM60) receives a request from external master.</p>	<p>Flash green when slave recognizes request as good/valid and sends a good reply.</p> <p>Flash red when slave receives a request that results in replying with an exception.</p>

The Ethernet activity LEDs include a green traffic LED and yellow link LED integrated into the CAT5 connector.

The Ethernet traffic LED will indicate any traffic on the Ethernet network, and does not necessarily indicate TCP traffic. The traffic LED will typically be off more than on, flashing on each time traffic is indicated. If the traffic LED is on completely solid, the server is not running (normal for a half minute or so during startup).

The Ethernet link LED will be on any time there is a connection to the network. If the Ethernet cable is unplugged, this light will go out. If Modbus TCP is failing and this light is out, check Ethernet cables.

F.5. LED Indications for BACnet IP on VP3-TM70



Power-up LED behavior: STA and STB LEDs on front panel will turn on yellow or red for half a second, then all will turn on green for half a second. The STC and STD LEDs will replicate this behavior but after a delay. Then they will proceed to indicate as normally defined for the indicators. The power LED will be lighted (blue) any time power is applied to the unit.

The STC and STD LEDs will indicate BACnet traffic as indicated in the tables below.

Mode	"STC" LED	"STD" LED
VP3-TM70 is Client (Master)	Flash yellow each time VP3-TM70 sends a request to a remote server (slave).	Flash green when VP3-TM70 receives a good response. Flash red when VP3-TM70 receives error code message from server, or if timed out with no response from server.

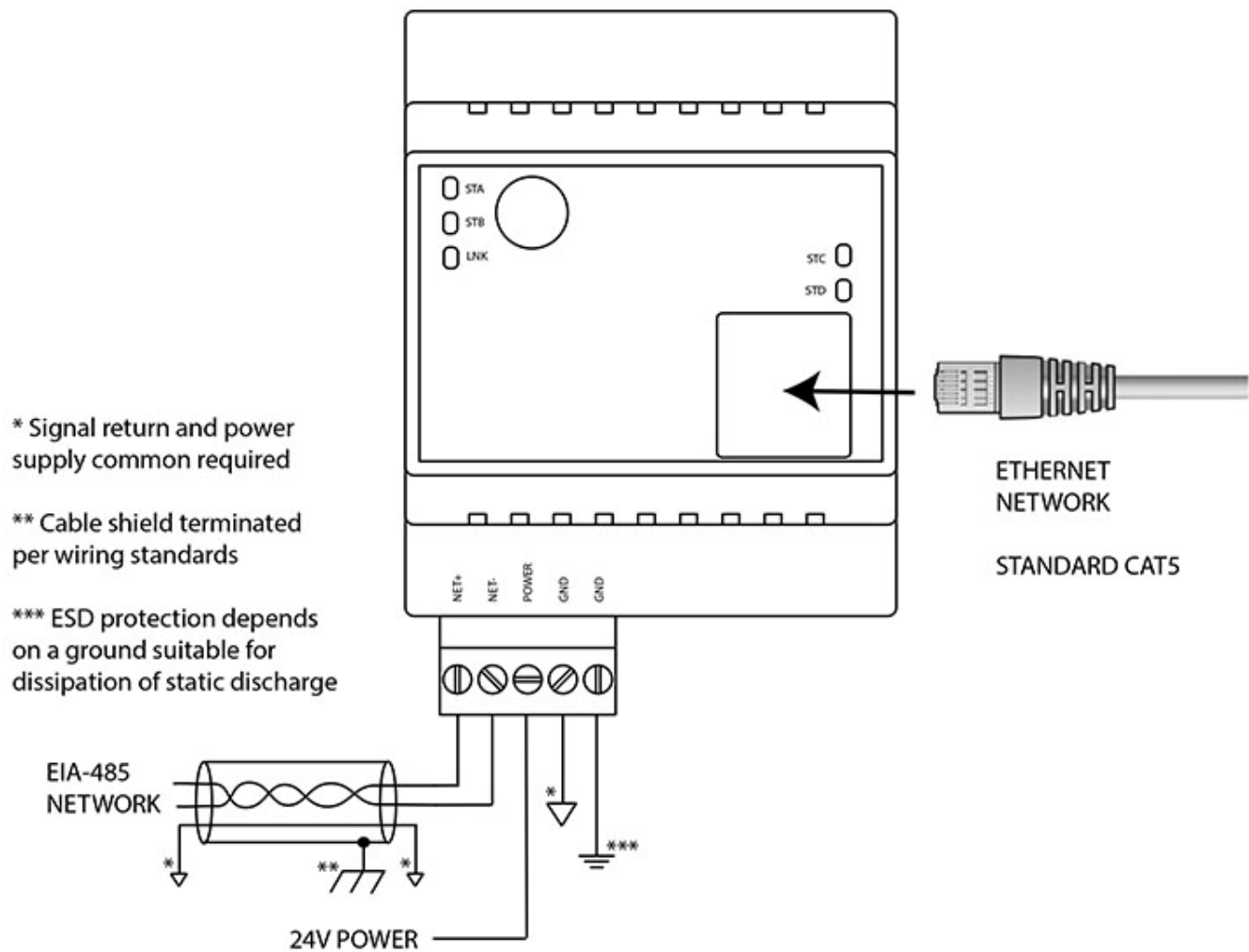
VP3-TM70 is Server (Slave)	Flash yellow each time VP3-TM70 receives a request from external client.	Flash green when VP3-TM70 recognizes request as good/valid and sends a good reply. Flash red when VP3-TM70 receives a request that results in replying with an error code.
----------------------------	--	---

The Ethernet activity LEDs include a green traffic LED and yellow link LED integrated into the CAT5 connector.

The Ethernet traffic LED will indicate any traffic on the Ethernet network, and does not necessarily indicate BACnet IP traffic. The traffic LED will typically be off more than on, flashing on each time traffic is indicated. If the traffic LED is on completely solid, the server is not running (normal for a half minute or so during startup).

The Ethernet link LED will be on any time there is a connection to the network. If the Ethernet cable is unplugged, this light will go out. If BACnet IP is failing and this light is out, check Ethernet cables.

F.6. Wiring Connections



Wire the VP3-TMxx as illustrated above. Follow all conventional standards for wiring of EIA-485 networks when connecting the EIA-485 (RS485) network. This includes use and termination of shield, termination of the network, and grounding.

IMPORTANT: Although EIA-485 (RS485) is thought of as a 2-wire network, you **MUST** include a third conductor connected to GND or common at each device so that all devices are operating at close to the same ground potential. Proper grounding of equipment should ensure proper operation without the third conductor; however, proper grounding often cannot be relied upon. If large common mode voltages are present, you may even need to insert optically isolated repeaters between EIA-485 devices.

Use standard CAT5 cables for Ethernet connections. Use control wire as applicable for local electrical codes for connecting the 24V (AC or DC) power supply. (Denoted as most commonly used 24V here, can vary per specification.)

Note that in addition to connecting power supply common to a GND terminal, you must also connect a GND terminal to earth ground in order to ensure proper ESD protection.

Antenna Connection

The standard antenna connected to the front of the VP3-TMxx will be suitable for many applications. However, if the VP3-TMxx is placed inside a metal control panel, for example, the cellular signal may be degraded if not outright blocked. In this case, it is suggested that an RF cable with SMA connectors be used to extend the reach of the antenna to outside of the control panel. Additional antenna options are available for remote mounting. Contact Control Solutions technical support.



F.7. Opening the VP3-TMxx Device

ESD Protective Measures

WARNING: Opening any electronic device for any reason including positioning of jumpers can cause damage or destruction of the device if proper ESD handling procedures are not followed!

WARNING: Always remove power from device before opening it! This is for the protection of the device. You will not be harmed by the low voltage present, but you may cause damage or destruction of the device by opening it with power connected.

Recommended Procedure

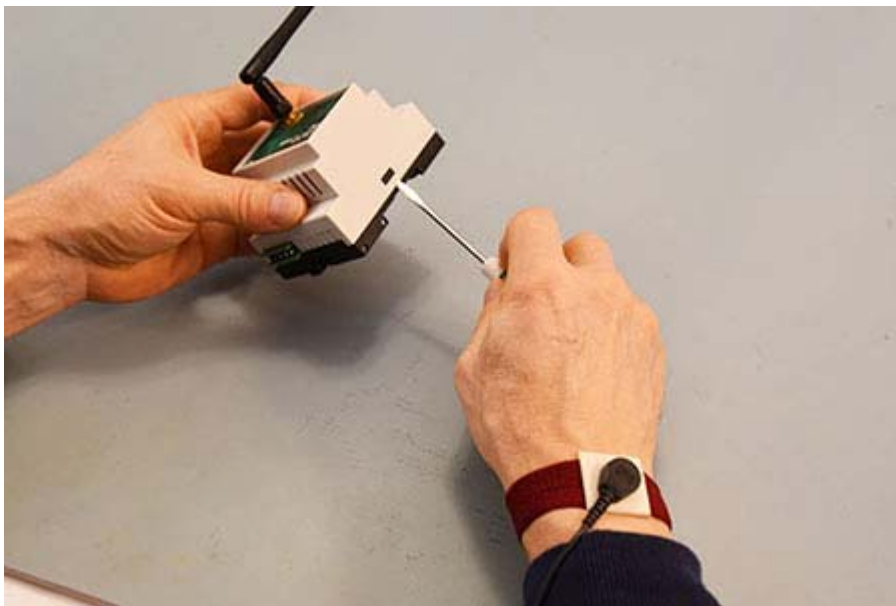
You should be working at an ESD safe workstation that includes grounded static mat and grounded wrist strap, and you should be wearing the wrist strap connected to the grounded static mat while opening and working with the opened device. For field service purposes, a portable static mat and wrist strap are available at this link: <http://www.digikey.com/product-detail/en/16475/16-1235-ND>



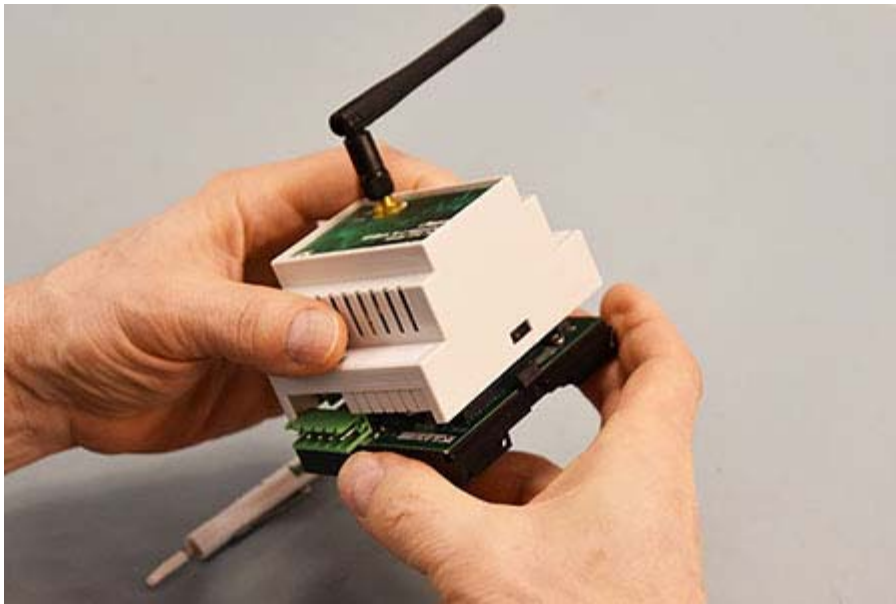
Emergency Backup Plan:

Follow this practice if you do not have proper ESD equipment on hand but must open the device anyway. Find something that is a solid ground like metal water pipe or grounded metal electrical conduit. Touch ground to discharge static on your body before touching the internal parts of the device. Ideally you should connect a ground wire to the GND terminal of the device and make simultaneous contact between the GND terminal, yourself, and the source of earth ground. Make certain no power is connected to the device while grounding it, opening it, or working with it. If you set the device down, be sure to repeat the discharge of static on your body before touching the device again.

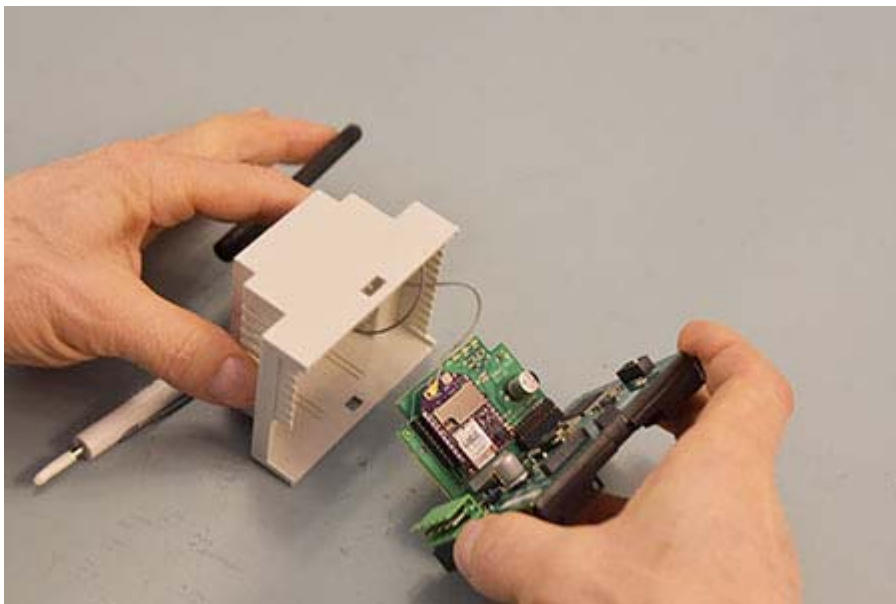
WARNING: The LED indicators on the daughter cards are fragile. Do not handle by edges such that you come in contact with the LEDs. They will potentially break off the board.



Use a very small screw driver to slide the cover up and over the black tabs located one on each side of the VP3-TMxx.



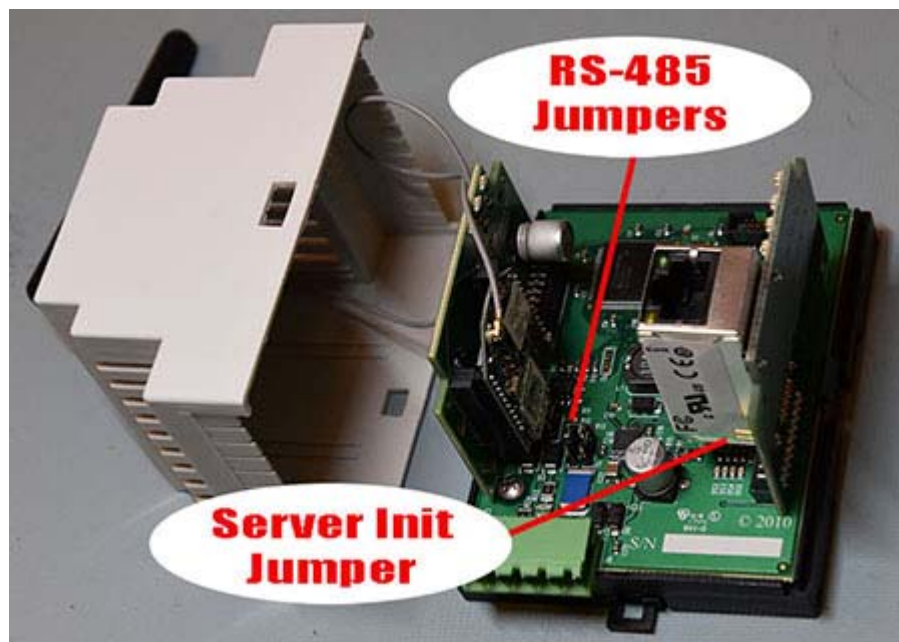
Carefully lift the cover straight up and away from the base. Be careful to not exert side-way force on the daughter card. DO NOT try to move the cover more than 4 inches away from the base. Avoid touching the LEDs.

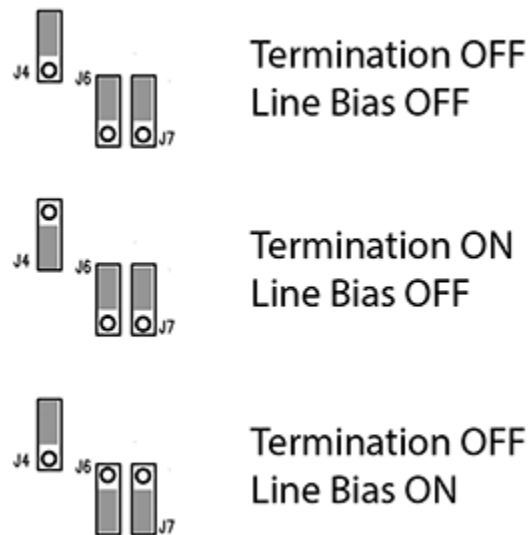


The antenna is attached internally to the modem on the daughter card with a delicate RF cable. DO NOT disconnect this cable. The UFL connector on the modem is not designed for repeated removal and reattachment.

Carefully reverse this procedure when closing the device.

F.8. Jumper Settings





Enable line termination only when this device is placed at the end of the network. Termination should only be enabled at two points on the network, and these two points must be specifically the end points.

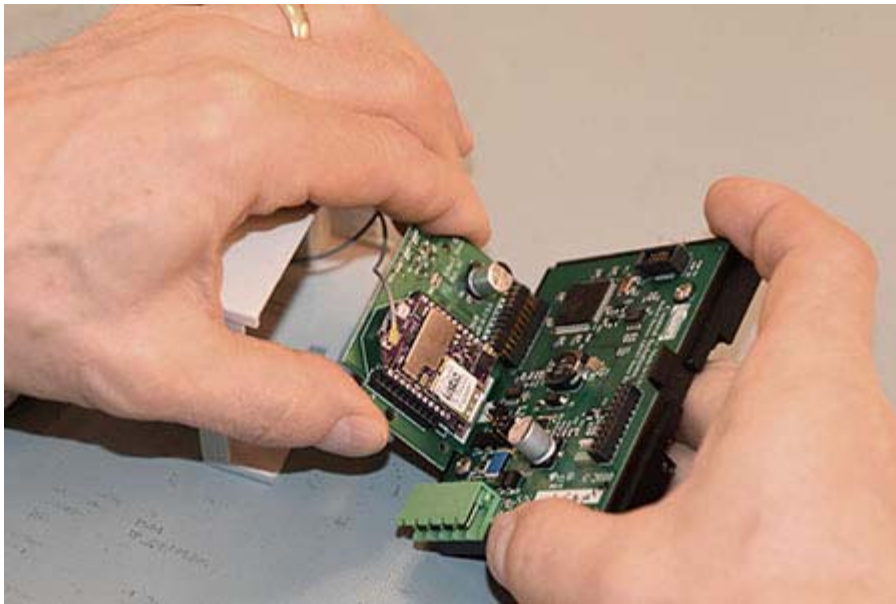
Enable line bias when needed. Line bias should only be enabled at one point on the network, and does not have to be the end point. Line bias holds the line in a known neutral state when no devices are transmitting. Without bias, the transition from offline to online by a transmitter can look like a false start bit and cause loss of communication.

The line conditioning options are enabled when the respective shunt is moved to the position indicated in the drawing above.

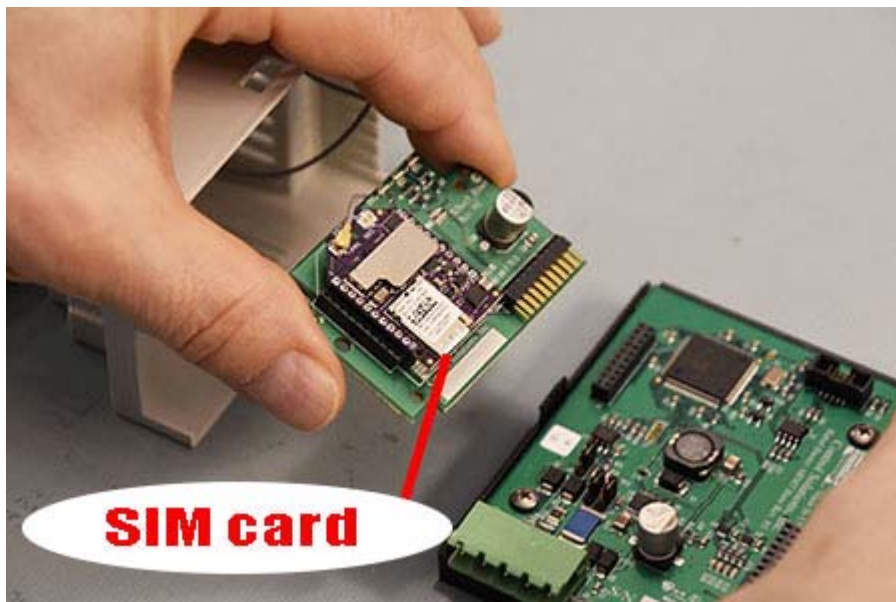
The "Init" jumper on the server module should only be used when advised by tech support. Installing this jumper prior to power-up causes the server to go into firmware update mode.

F.9. SIM Card Replacement

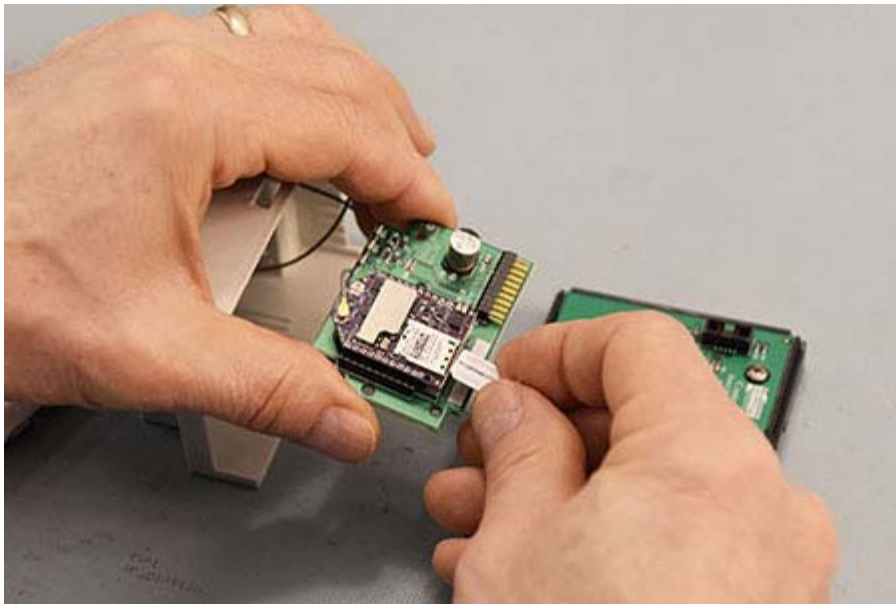
Refer first to Appendix section F.7 regarding proper handling and opening the VP3-TMxx device.



It is necessary to unplug the daughter card from the main board in order to remove or insert the SIM card. Be sure you are following ESD precautions noted above when doing this. The daughter card format has been used successfully for multiple wireless technologies. Unfortunately, when adopting this same format for cellular, the location of the SIM card slot suffered. Because the SIM card is difficult to access, it is preferred that VP3-TMxx devices be shipped with the SIM card pre-installed.



The SIM card slot is located at the bottom of the daughter card.



Gently push in on the SIM card to unlatch it and remove it. It has a toggling latching mechanism. You will feel a "click" when pushing the card in to remove or to insert. The electrical contacts on the SIM card should face down (toward circuit board) and the beveled corner of the card should be toward the outside.

Be very careful when returning the daughter card to its position on the main board. See that the pins are aligned correctly. Failure to do so will result in hardware failure. Do not force pin insertion. The connector will slide in easily if aligned correctly.

Copyright © 2019 Control Solutions Minnesota, Inc.



Appendix G. Virtual Objects

G.1. Virtual Objects in Modbus Devices

Virtual objects allow another object's reliability code (or fault code) to be treated as a data value, or allow device error counts to be treated as a data value.

Virtual object numbers are as follows:

2001-2100	Object reliability code (Modbus fault code) for objects 1..100
2200	Internal modem temperature, degrees Celsius
2201	Internal modem temperature, degrees Fahrenheit
3001-3247	Modbus no-response count by RTU slave ID when VP3-MTM is master
4001-4020	Modbus no-response count by TCP device number

Only the no-response counts will be provided as object links. Exceptions will be reported via object reliability code and reflect a configuration error that must be corrected. The no-response count can indicate a latent problem in the field with a device becoming disconnected or non-functional after some period of correct operation. Therefore, monitoring no-response counts as a data point is a valid means of determining equipment failure.

G.2. Virtual Objects in BACnet Devices

Virtual objects allow another object's reliability code to be treated as a data value, or allow device error counts to be treated as a data value.

Virtual object numbers are as follows:

2001-2100	Object reliability code (BACnet reliability) for objects 1..100
2200	Internal modem temperature, degrees Celsius
2201	Internal modem temperature, degrees Fahrenheit



Appendix H. API Mode

Enter API mode using "sys apimode" Once in API mode, only the API commands are recognized, and mostly they will forward command strings directly to the cellular modem operating in API mode.

DO NOT attempt to use API mode without first consulting Control Solutions technical support. You could cause the cellular modem to become inoperable with an incorrect sequence of AT commands.

apiexit

Will exit API mode and return console to normal command processing

cmd ...

Will send a single AT command. This requires that the iReport exit data mode with +++, maintain guard time, and send the command. Maximum guard time is 1.7 seconds, defaulting to 1 second as shipped. The command timeout defaults to 10 seconds, but firmware will exit command mode with the ATCN command instead of wait. A carriage return is appended to each command before sending.

data ...

Will send data to the modem that will then automatically open a data connection and send the data string provided. A carriage return (0x0d) is appended to the string provided, and the ATTD=D must have been used to set the terminator to carriage return. (Firmware includes the ATTD command and it is automatically send setting the delimiter to 0x0D.)

Note: Without a terminator, the modem will potentially send the message in fragments.)

Note: The data string is NOT delimited with quotes like most other strings in configuration use.

The following sequence will send an SMS message:

```
cmd,ATIP=2  
cmd,ATP#=16514264410  
cmd,ATTD=D  
data>Hello World
```

Note that ATAP=0 is the default setting and is assumed to be in effect. Without ATAP=0, commands cannot be sent.