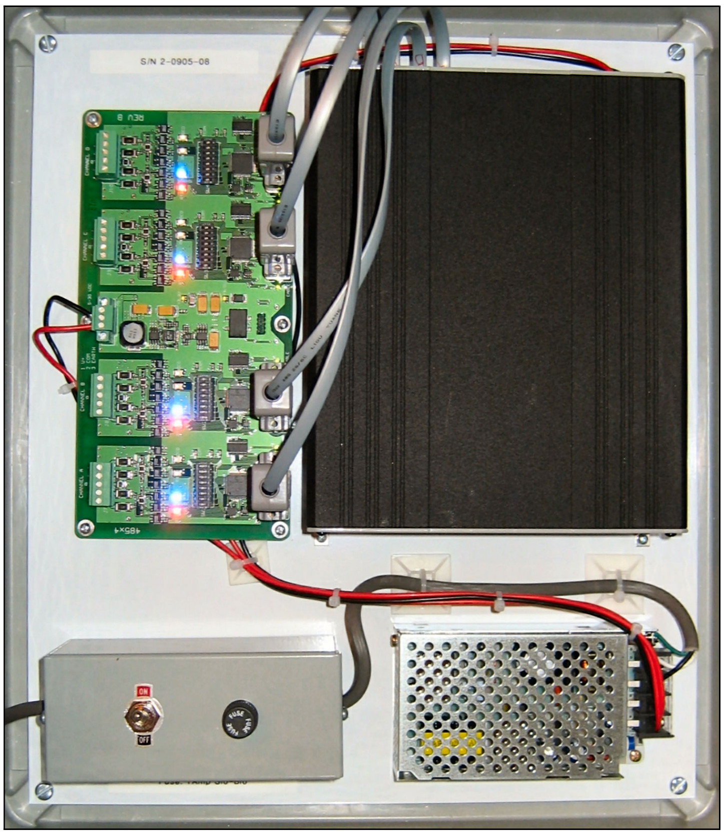
CENTAURUS PRIME

Integrations, Custom Programming, Consulting



Trane-485

Gateway Guide

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INTEGRATIONS, CUSTOM PROGRAMMING, AND CONSULTING

Trane-485 Gateway Guide

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With very special thanks to Gary Konzak

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Chapter 1

Gateway Installation Basic Information

Summary

This section will help to give a basic overview and quick summary of the procedures needed to install the Trane-485 Gateway Panel. Detailed instructions are also provided later in this guide. The Centaurus Prime Trane-485 Gateway allows any front-end system (Modbus Master or BACnet/IP) that communicates using the either industry-standard Modbus or BACnet protocols to communicate to Trane VAV, Voyager (Reliatel, Precedent), IntelliPak, Terminal Unit Controler (TUC) field equipment, older Fan Coil Units (FCUs), and wireless thermostat systems.. The Trane field devices will appear to the front-end system as a series of Modbus SLAVE devices or BACnet Devices. Real time point data from the Trane VAV/Voyager/IntelliPak/TUC controllers is then mapped to equivalent registers, coils, and bits on the Modbus system, or as AI, BI, AO, and BO objects on the BACnet system. All operations are transparent to the user and the host computer.

ICON KEY

Valuable information

Connections to the Trane-485 Gateway are simple and clearly marked. They consist of:

- Power Supply, 120 Volts AC (optionally, 220 or 240 Volts AC)
- Trane-485 VAV Device trunks (up to four)
- Ethernet for Modbus-TCP/IP Network, or BACnet/IP Network
- Local Mode Port for commissioning via Laptop Computer

All Hardware necessary to connect the Gateway to the Trane-485 devices is included in the 16” X 14” X 8” plastic cabinet that is easily mounted in a convenient location.

The BACnet/IP network is a 10-Mbaud Ethernet, only. It is connectionless, and uses UDP datagrams (standard BACnet). The Modbus TCP/IP network is also a 10-Mbaud Ethernet, but is connected, and uses the full TCP/IP protocol. The Gateway supports one TCP/IP socket connection.

Single Board Computer Basics

The Single Board Computer used in Centaurus Prime Gateways is the Ether 6 manufactured by JK Microsystems. It is made in the United States of America.

The controller is based on an Intel 386Ex processor running at 25Mhz. It is equipped with 1 megabyte of static ram organized as 512K 16-bit words. Also included are 512K bytes of flash memory organized as DOS drives A and B. A 40 Megabyte M-Systems DiskOnChip is added to the 32-pin DIP socket on the controller board, and acts as drive C: There is a switching power converter on the controller, which can accept 7-34 volts DC. Nominal current consumption is 250mA at 12 volts with 10Base-T Ethernet selected.

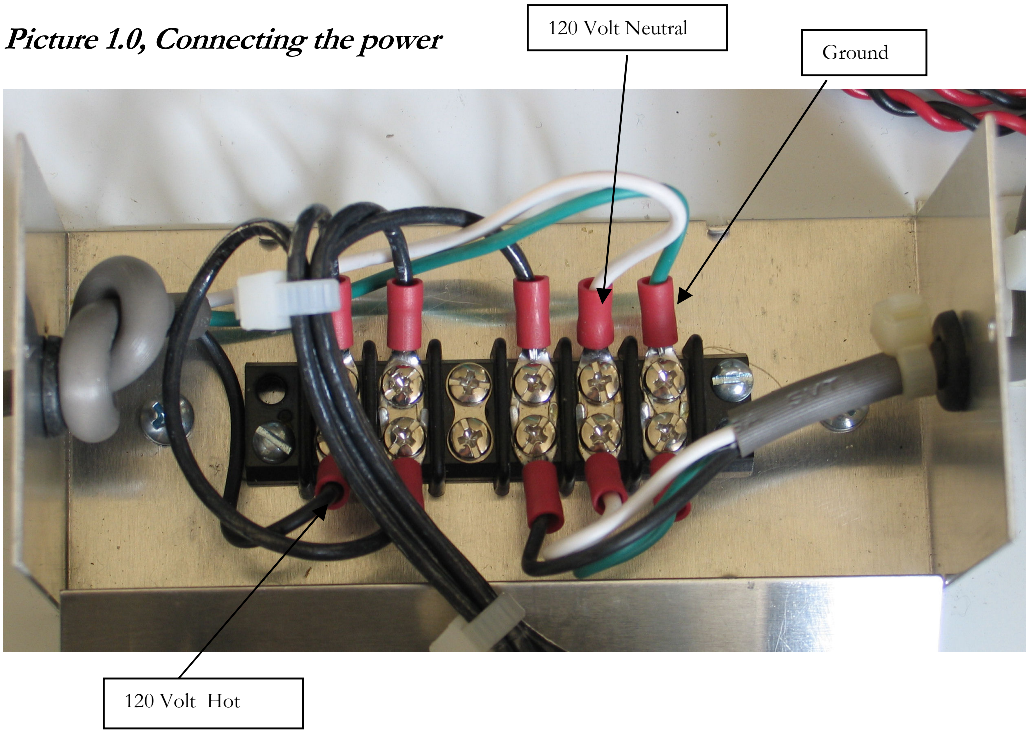
Specifications for the Ether 6 are:

Processor :	Intel 386Ex, 25MHz
Operating System :	XDOS(MS/PC DOS 3.3 compatible)
Memory :	1M SRAM, 512K Flash, 40MB Flash
Ethernet :	10BASE-T, NE2000 compatible automatic media detection, Link status and Activity LEDs
Serial Port 1 :	RS-232 with 5 handshake lines COM1, address 0x3F8, IRQ4 115200 baud maximum
Serial Port 2 :	RS-232 no handshaking or RS-485 half duplex, COM2, address 0x2F8, IRQ 3 115200 baud maximum
Serial Port 3-6 :	RS-232 with handshake lines, 16554 UART,COM3-6 115200 baud maximum 16 byte Rx and Tx FIFO
Digital I/O :	5 Bits (P1.4-P1.7 & P3.1) Pin configurable as input or output 8mA souce/sink
Watchdog :	Hardware, 1.6 second timeout Generates board wide Reset
Clock/Calendar :	Hardware, battery backup
Supply Power :	7-34V unregulated DC ±10%, 3 Watts
Humidity :	5 - 90%, non-condensing
Temperature :	-4 to +158 °F (-20 to +70 °C)
Weight :	53 oz (1.5 kg)
Dimensions :	8.30" x 6.76" x 2.28" (210.8mm x 171.7mm x 57.9mm)

Connecting Power to the Gateway

Power connections are made by removing the 2 screws on either side of the terminal block enclosure. Follow the diagram below for proper terminations.

Picture 1.0, Connecting the power

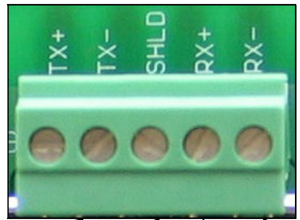


Connecting Trane Trunks to the Gateway

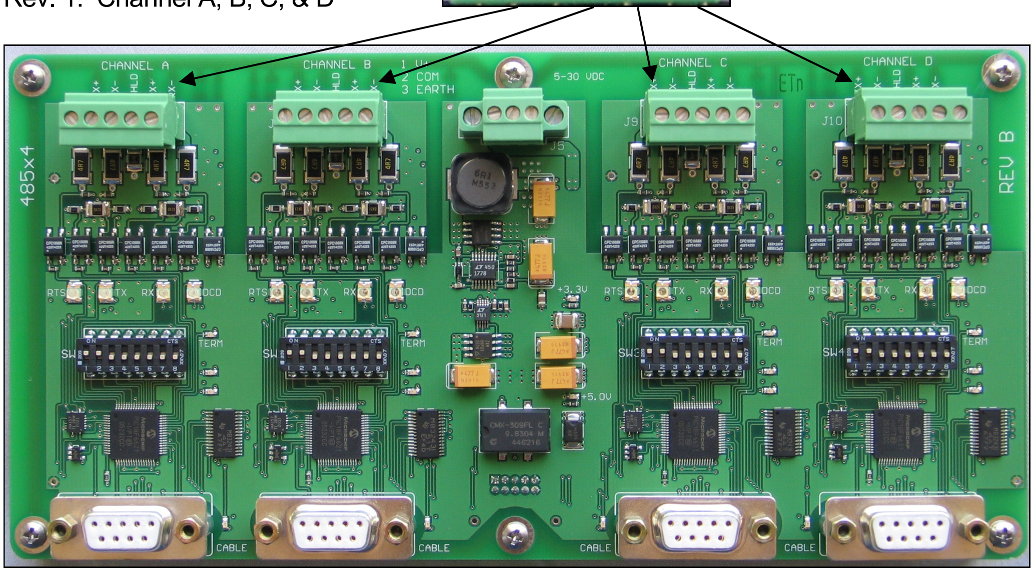
Typically, Trane device trunks (possibly several trunks) are connected to a Trane BCU ("BACnet Control Unit), with various combinations of "Com1", "Com2", "Com3", Com4" and "Com5" trunks, each via a special card in the BCU. These are NOT to be confused with PC-based "Com" ports. The Trane "Com" trunks each use different technologies (e.g., Com5 is a Echelon LON trunk; Com 1 and Com3 are the same except Com1 is non-isolated and Com3 features voltage isolation). The RS-485 "Com" trunks from the Trane BCU are removed and simply re-connected to the Centaurus Prime Trane-485 Gateway. The devices are either "Com4" only, or are devices that can be configured to be "Com4" (for example, by rotating the TCI card 90 degrees)

The trunk connections are clearly marked and each trunk is only a two-wire connection. The trunks have a "plus" and "minus" side, and also a "shield" connection that goes to cabinet (AC) ground. Be sure that the polarity is correct, and that the shields are ALL tied together and only connected to ground at ONE place (to avoid ground-loops). This is a two-wire trunk, so it does not matter if you land the field trunk wires on TX+/TX-, or on RX+/RX-. Just make sure the polarity is right!

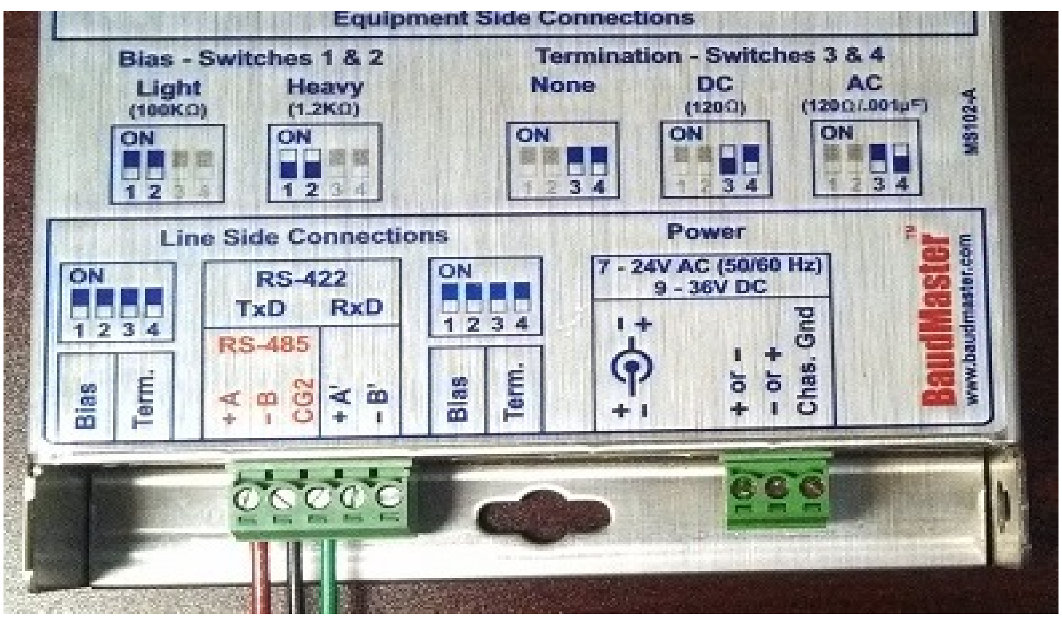
Picture 1.2, Gateway Overview and Identification



Rev. 1: Channel A, B, C, & D

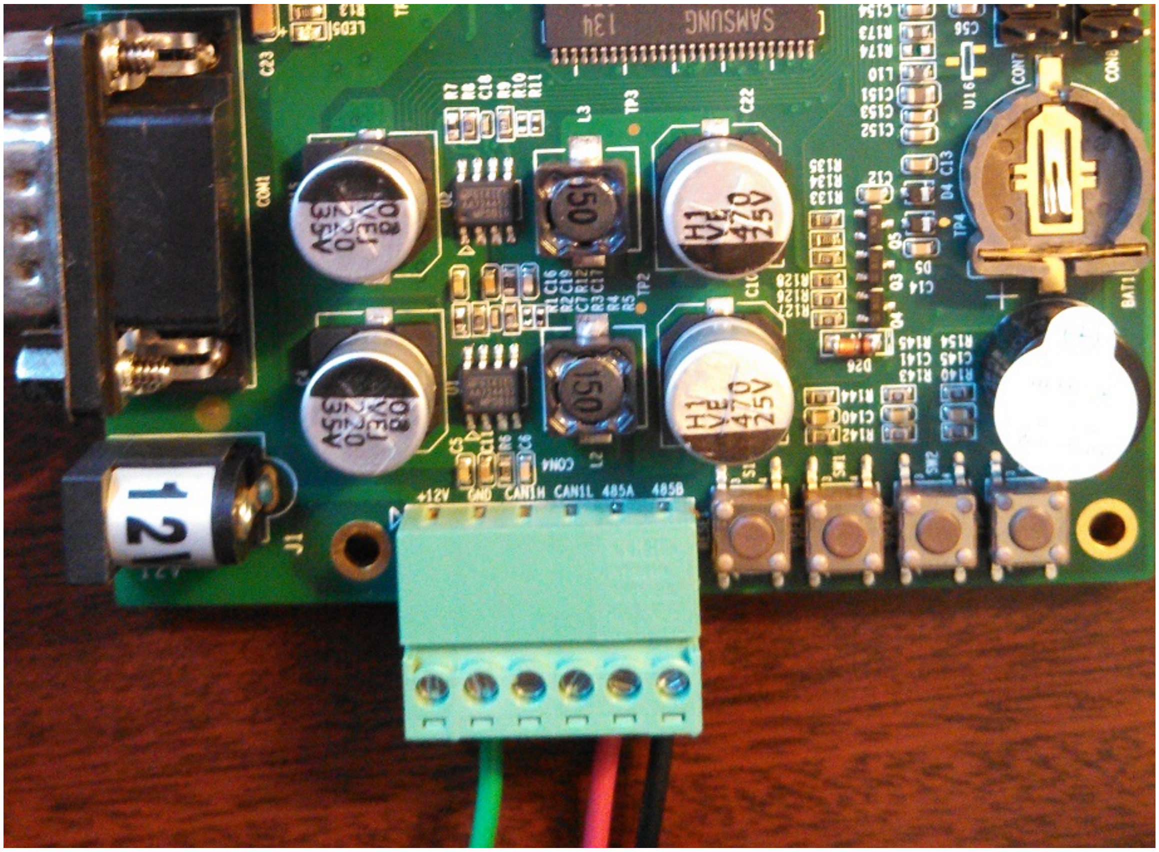


Rev. 2: Four independent RS-485 converters



Plus is RED (+A'), Minus is BLACK (-B'), and GREEN (Shield) goes to "CG2" terminal

Wireless Co-Processor: Independent Token-Pass processors to handle the Wireless Receivers:



Plus is RED (485A), Minus is BLACK (485'), and GREEN (Shield) goes to the GND terminal

<u>NOTES ON BIAS AND TERMINATION:</u>

The Revision 1 Quad RS-485 card has individual switches for each channel on the board. You would not generally change any except for the termination (factory set to NO termination and the baud-rate switches (if other than factory configuration of 9600, 9600, 9600, and 1200 baud for Trunks 1 through 4, respectively). Turning switch "6" ON for a channel will add 120 ohm DC termination to the trunk at the RS-485 converter (you will also note that a small "Term" light will appear just above the switch pack when you do this.

The Revision 2 RS-485 converter has several switches for bias and termination. The Gateway ships with the default of "light bias" and no termination. Should you need to add termination, this is done as per the drawing on the side of the RS-485 converter. Bias is unlikely to change to "Heavy" unless you have very poor Trane communications trunks. Go to this URL for the manual on the "BaudMaster" RS-485 converter: *http://www.interfaceconverter.com/wp-content/uploads/2012/05/users_manual.pdf*

The Wireless Co-Processor does not need any bias, and has no termination. If you need termination across it, use a 120 ohm resistor (the standard RS-485 line terminator).

Connecting to a Modbus TCP/IP Network

If you have ordered the Trane-485 Gateway with the optional Modbus/IP configuration, then it is simple: You plug in an 8-pin Category 5 or Category 6 cable into the Ethernet connection on the top right-hand corner of the PC. Continue with the section entitled "Configurations for Your Ethernet Network", below.

Connecting to a BACnet/IP Network

This is also quite simple: You plug in an 8-pin Category 5 or Category 6 cable into the Ethernet connection on the top right-hand corner of the PC. Continue with the next section:

Configurations for Your Ethernet Network

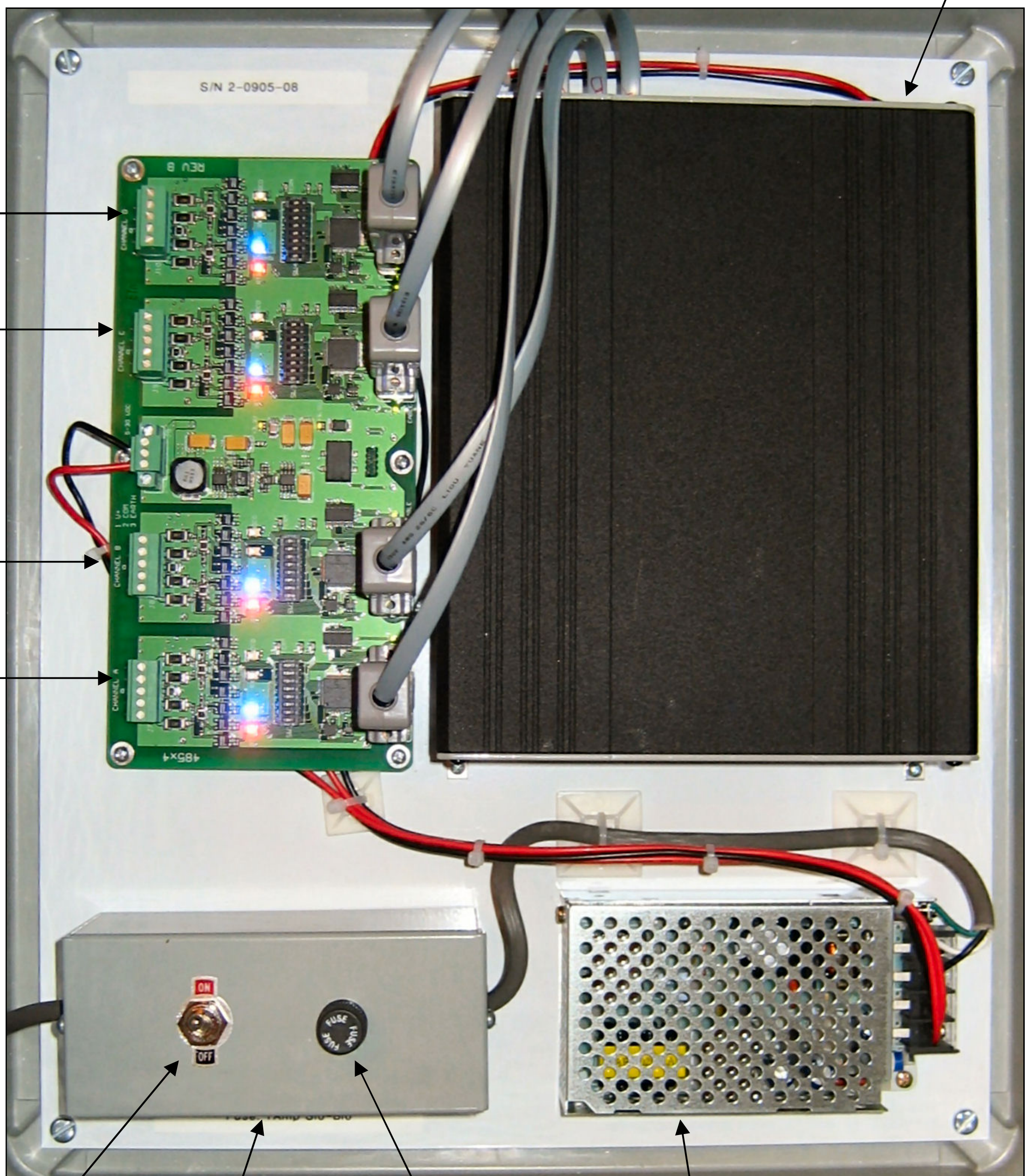
You must set the IP address of the Gateway to a static, fixed address, on the segment that you are in. This is done in two files: the SOCKET.CFG file (for the "Windows Sockets" low-level driver) the GATEWAY.INI file (for the Gateway's configuration), described in Chapter 2.

The Gateway defaults to a subnet mask of 255.255.255.0. Should you want to change it, for example, to be on a split subnet (e.g., 255.255.255.128) the SOCKET.CFG file changes, but not the GATEWAY.INI file. This is described in Chapter 2, also.

Since the Gateway does not wander off and waste time with Facebook or write blogs on the internet (that we know of, at any rate), there is no need for a "Gateway address" or DNS Name Resolution addresses. Besides, we want to protect our products from harmful pornography such as E-Bay, Facebook and Twitter. But if your IT department requires that all devices attached to their network have a Gateway address, please call or e-mail Centaurus Prime. We can help you modify the SOCKET.CFG file to add the (Internet) gateway address; it is non-obvious. But if our products then start surfing the web for porn, you have our permission to spank them.

Gateway Overview

Picture 1.3A, Gateway Overview and Identification, Revision 1:



Picture 1.3B, Gateway Overview and Identification, Revision 2:

<u>Differences from Rev 1:</u>

- Four independent RS-485 converters (rather than one four-port converter)
- Power supply has Surge/Overvoltage suppressor inside power box (for CE/UL rating)

Picture 1.3C, Gateway Overview and Identification, with two Wireless Co-Processors

Note that the first two trunks use the Wireless Co-Processors. You must order the Trane Gateway with the requisite number of Wireless Co-Processors (slight additional charge)

Chapter

2

Commissioning the Gateway with the Local User Interface

Creating and Downloading the GATEWAY.INI file

The following is an example of the GATEWAY.INI file that must be edited to match your particular installation. There are several sets of parameters in the INI file. One set of parameters deals with the BAUD rates on the four Trane trunks. Another parameter sets the Ethernet IP Address of the gateway (it must be a FIXED IP address!), if you are using either Modbus/TCP or BACnet/IP as the host protocol. And, if you are using BACnet, another set of parameters tells the gateway about several network options of BACnet.

The lines for BAUD1, BAUD2, BAUD3, and BAUD4 must be set for the respective Device baud rates which will be "**1200**" or "**9600**" (depending up whether you have older VAV or newer ones, respectively). If you have unused trunks, then the baud rate should be set to "**0**" as seen in the example below for BAUD3 and BAUD4. See "Uploading and Downloading files to the Gateway" for information on accomplishing the upload/download procedures. If you have a wireless coprocessor on a trunk, then that trunk **MUST** have its baud rate set up at **"38400"**.

The line for IP_ADDR is required only if you have the Ethernet in use (i.e., Modbus/TCP or BACnet/IP protocols in operation. You have to set up the FIXED IP Address of this gateway computer in two places: here in the GATEWAY.INI file, and also in the SOCKET.CFG file (more on that later). But just be aware that they MUST match! If the SOCKET.CFG specifies a different IP address from the GATEWAY.INI file, you will never receive anything from the Gateway!

For the BACnet/IP (Annex J) protocol, a couple other global parameters are necessary. Internally the gateway maps devices in a very simple fashion: Devices 1 through 60 on trunk 1; Devices 61 through 120 on trunk 2, Devices 121 through 180 on trunk 3, and Devices 181 through 240 on trunk 4. But you might not want to use those as your Device "Instance numbers", if you have some other addressing scheme (or a number of these gateways) on a system. The BACNET_OFFSET allows you to have these devices show up as a different set of Instances rather than just 1 to 240. The number that you specify is added to the internal device number. Hence, if your offset is 5000, and you are interested in (local) device #84 (the fourth gizmo on trunk #2), the BACnet system sees this device as Instance # 5084.

Also, if you have multiple gateways on one system, you will need to have each of them be a different Network Number (set via the BACNET_NETWORK parameter in the Gateway.ini file). This is so that there is no confusion between the devices on one gateway and any others (they all could have local device numbers be the same; by having different Network Numbers for each gateway, they become unique, as far as the underlying BACnet protocol works). Also, if the MAKE_ROUTER_DEVICE is set to TRUE, the Gateway itself will appear to your BACnet system as a "Router" device, named "Router-to-Network-***xxxx***", with ***xxxx*** being the BACNET_NETWORK parameter you have chosen. It is important for BACnet systems that there are NO duplicate BACnet networks for Gateways (not only ours, but any others you have!)

A rarely used option is to set a BACNET_PORT parameter (the default is port 47808, which is "BAC0" in hex). Add this line if necessary. There are some BACnet host systems that require another parameter setup, so that the BACnet Network Data Unit matches the Application Data Unit. You would add the line "MATCH_NPDU_APDU, TRUE" if your BACnet front end requires this.

Another rarely used option is to add a couple "special" AV points, that you can write to in the gateway, for each device. This was a special feature added for one site only (One America Plaza), so they could 'store' computed values in the controllers—due to limitations of their host system. It is NOT recommended that you ever do this, but in case it is a necessity you would add the line "MAKE_USER_AV_OBJECTS, TRUE" to the INI file.

If you have Voyager (aka Reliatel or Precedent) or Intellipak rooftop units, or TUC devices, they are subject to power disturbances, lightning, and other maladies that make them reset. After a reset, they just sit there—not running. If you want them to require user intervention to get going again, that's fine. However, some people just want the system to automatically deal with this issue. We handle this by allowing an option for you to specify this. Adding the line "ROOFTOP_RECONTROL, TRUE" in the INI file tells the gateway to re-send all controls (which are actually just one command) to the Voyager, Intellipak and TUC units every five minutes (at :00, :05, :10…:55).

One of the many complaints users have about their old Trane system is that "Occupancy" works different between the Voyager/Intelipak rooftop units and the VAV boxes. For rooftops, the OCC/UNOCC points have the sensible field values that OCC=1, UNOCC=0 (as 90% of the controls industry does). However, for VAV boxes, the native OCC/UNOCC points have this reversed (OCC=0; UNOCC=1). In talking with an old Trane engineer, he stated it was because a power-failure made everything go to zero, and thus they just "had" to have OCC = 0, so that they would default to Occupied mode after a power glitch. Somehow, other vendors were able to deal with this problem, we note. But if you want things to be switched in the software of the Trane Gateway, it can be done (yea!). Just add the line: "OCC_INVERSION, TRUE" to the INI file, and all VAV boxes will have their OCC/UNOCC points (both status and control) inverted, such that OCC=1 and UNOCC=0.

If you include the "OVERRIDE_PRI", then the gateway will use the BACnet priorities (from Priority 1, called "Manual Life Safety" to this priority setting to "force" the physical I/O points only (that is, DO-0 through DO-5, AO-6, and AO-7). Below that priority, up to BACnet priority #16, the physical I/O points will go to "automatic" control. If you do NOT have this line in your INI file, then the system expects you to use BO points 51 through 58 as command points, to set the particular I/O point into either forced- or automatic-mode, before you do your actual control adjustment.

Of course, we can't forget that the English units we know and love (that is, Degrees Fahrenheit, feet, BTUs, inches of water, PSI, etc.), are actually pretty weird, and not used in most of the world. If you want the Gateway to translate the silly English units into the more sensible Metric units, you can have it do to. This is simple: Just add the line "UNITS, METRIC" to the INI file, and the values (input and output) will be converted, used, and presented as MKS values. That is:

- Degrees F will be converted to Degrees C (all temperature objects)
- CFM will be converted to LPS (all air-flow and fluid-flow objects)
- Square Feet will be converted to Square meters (e.g. duct size objects)
- Inches-Water-Column is converted to MilliBars (for some pressure objects)
- PSI is converted to kilopascals (for the rest of the pressure objects)
- BTU/Lb is converted to kj/kg (for enthalpy objects)

Here we have to note what you can (and can't) do with Metric units. You can see actual values, always. If it says "21.47 Deg C.", that's what it is. But if you try to control a temperature setpoint to 23.70 Deg C., you will only get "close" to that value on the feedback (23.72). This is because the Trane gizmos all use natural English units (for example, a setpoint of 74.7 is 747 counts in the Trane equipment, since it uses x10 Deg F units for control and feedback). That small variation is perhaps bothersome, but as good as the field equipment can get.

And lastly, we need to talk about systems with WIRELESS RECEIVERS. If you have one or more Trane Wireless Receivers on a trunk, then that trunk is no longer doing master/slave commands (the "master" being the Trane BCU, Trane Tracer, or our Gateway). The Wireless Receivers do a multi-master "token pass" protocol between themselves and other gizmos, and hence our Gateway must also perform this multi-master "token pass". The Wireless Receiver receives into over the air from all the battery-operated thermostats, but can only get the temperature information to the thermostat by giving the VAV-IV devices direct commands. Hence, since both the Wireless Receiver are "masters" giving commands to other slave devices, the Wireless Receivers and the Gateway have to do a little packet-passing dance called a "token-pass". This happens at microsecond speed, so Centaurus Prime developed the Co-Processor card that handles the high-speed and accurate timing necessary.

The co-processor board must be the highest address possible on the token-pass network, and that is #31. Hence you MUST add this line to your GATEWAY.INI file: "MIMIC_ADDRESS, 31". If you have no Wireless Co-Processor boards on your system, you can use any other address between 0 and 31. The default is 0, if you don't even have the line.

So, say you have a couple Trane Wireless Receivers on a trunk—you need to be able to tell the Gateway what their addresses are, and how many wireless sensors they have (each can support up to 32 thermostats). You do this like so: "WIRELESS1, 3, 27". This tells the Gateway this: "WIRELESSn, X, Y", indictes the Wireless Receiver is on trunk #1, it is addressed (on the internal address switchces) to be #3, and there are 27 t'stats on it.

Here's an example of an INI file at a particular job site:

```
// "BAUD0" is used for the HOST CHANNEL Baud Rate (the Modbus RTU //Protocol) and Parity settings N=None, O=Odd, E=Even
//
BAUD0, 9600,N
//
// ------------------------------------------------------------------------
//
// Required for 4 ports: Set the baud rate (set to 0 if channel unused)
//
// Valid baud rates are:     1200 – older, VAV-1 devices and antique FCUs
//                           9600 – newer VAV devices (II, III, IV, etc.)
//                          38400 – WIRELESS Co-Processor on that trunk
//                              0 -- <means that nothing is on that trunk>
BAUD1, 1200
BAUD2, 9600
BAUD3, 38400
BAUD4, 0
//
// ------------------------------------------------------------------------
//
//   "IP_ADDR" is used for the IP address of what you want this box to be.
//      ( And it MUST match the SOCKET.CFG IP Address! )
//
IP_ADDR, 192.168.0.204
// ------------------------------------------------------------------------
//
//  "BACNET_NETWORK" is used for what BACnet network number we are on
//
BACNET_NETWORK, 1042
//
// "BACNET_OFFSET" is what we will add to the local device numbers (1..240)
//   to yield the BACnet object_ID instances of each mapped BACnet "device"
//
BACNET_OFFSET, 1042000
//
// "MAKE_ROUTER_DEVICE" is what forces the Gateway to be B-GW Compliant (Annex al)

MAKE_ROUTER_DEVICE, TRUE
//
// "OVERRIDE_PRI" = maximum priority used for PHYSICAL I/O "Force" (o/w "Auto")
//
OVERRIDE_PRI, 8
//
// "ROOFTOP_RECONTROL" means VGER/IPAK/TUCs get recommended ever 5 mins.
//
ROOFTOP_RECONTROL, TRUE
//
// "OCC_INVERSION" means that VAVs will have OCC = 1; UNOCC = 0
//
OCC_INVERSION, TRUE
//
```

```
//"WIRELESSn, X, Y",if used on trunk n,Wireless rcvr #X exists with Y sensors
//
WIRELESS3, 1, 15
//
// MIMIC_ADDRESS is what Address our Gateway uses to emulate the Trane host
//
MIMIC_ADDRESS, 31
//
```

Creating and Downloading the SOCKET.CFG file

The following is an example of the SOCKET.CFG file that must be edited to match your particular installation, if you are using the Modbus/TCP or BACnet/IP protocols. If you are not doing an Ethernet connection, this text file is irrelevant, and can be ignored and left as it comes from the factory.

ONLY ONE LINE SHOULD BE CHANGED—the line that begins with "ip address". Here is an example:

```
C:\>type socket.cfg
# SOCKET.CFG is the configuration file to be executed by SOCKETP.EXE

ip address 192.168.0.72/24

interface pdr if0 dix 1500 10 0x60
# The following line will just display the info for easy verification:
ip address
# The following lines set TCP/IP parameters (commented out in this case):
#ip ttl 15
#tcp mss 1460
#tcp window 2920
```

The "ip address 192.168.0.72" line should be modified to be whatever ***static*** IP address that the Trane-485 Gateway will have. Note that DHCP is not an option; this device requires a static, fixed, IP address. The optional "/24" at the end of this line indicates the ***subnet mask*** is 24-bits set (that is, 255.255.255.0—it's an old UNIX thing).

If you really need to have the Gateway use an IPV4 Default Gateway address (probably not, as the Gateway doesn't want to yap on the World Wide Web, and you probably don't want it to), contact Centaurus Prime. It is tricky (again, thank you, UNIX) to add the lines to the SOCKET.CFG file that are necessary, and we will assist you with it. Some IT departments are requiring this, lately, even though it is unnecessary. But the ***IT Gods*** must be appeased…

Local Mode Menu Options

Once connected via the local mode port you may press <enter> at any time to display this top level menu:

(H)elp, (S)ummary, (D)evice, (P)oint, (C)ontrol, (W)atch, (A)utoDisc, (X)-it

When you type "H" <enter> you will get the following:

```
Hit a single key to get to a submenu.  Your Options are:
   H (for Help),    which gives you this screen.
   S (for Summary), which allows you to get various status summaries.
   D (for Devices), which allows you to manage and get data on devices.
   P (for Points),  which allows you to manage and get data on points.
   C (for Control), which allows you to control various field objects.
   W (for Watch),   which allows you to watch protocol streams.
   A (for AutoDisc),which allows you to auto-discover trunks.
   X (for "X-it"),  which exits this gateway program.

(H)elp, (S)ummary, (D)evice, (P)oint, (C)ontrol, (W)atch, (A)utoDisc, (X)-it :
```

🗁 ***X – will always take you back to the top level menu options***

Auto Discovery and Database Generation

Before you can use any of the other menu options you must first create your database by using the (A) option, which will give you the following text:

```
AUT:  (A)uto-Discovery, (S)ave Discovery,  (X)-it :A

AUTODISCOVERY:  You may select a TRUNK to auto-discover.
       Enter a TRUNK NUMBER  (1 through 4) : 1

Trunk #1 will now be auto-discovered...
AUT:  (A)uto-Discovery, (S)ave Discovery,  (X)-it :

State: "AutoDiscovery" on Trunk: 1,  VAV Device #1

State: "AutoDiscovery" on Trunk: 1,  VAV Device #2

State: "AutoDiscovery" on Trunk: 1,  VAV Device #3

State: "AutoDiscovery" on Trunk: 1,  VAV Device #4

VAV-1 #  4 Discovered on Trunk #1

State: "AutoDiscovery" on Trunk: 1,  VAV Device #5
```

State: "AutoDiscovery" on Trunk: 1, VAV Device #6

State: "AutoDiscovery" on Trunk: 1, VAV Device #7

When Auto Discover is invoked the Gateway will scan for all VAV device addresses possible on the requested trunk.

As you can see in the example above, Trane-485 Device address #4 was discovered, which was a VAV-1 type device.

This process should be completed for all trunks that have Trane-485 devices. When all trunks have been Auto Discovered, you can then use the (S)ave Discovery option.

- Note 1: This is a lengthy process, taking 5-10 minutes per trunk on a 1200-baud trunk (older VAV-1s; a lot quicker with the newer 9600-baud VariTrane, Voyager, and IntelliPak devices)

- Note 2: If a controller is dead, unplugged, or not communicating when Auto-Discover is done, you can manually add the controller to the discovered data file. You must download the data file to your PC, edit it to add a line about the missing controller, and then upload the modified file back into the Gateway. **See "Uploading and Downloading files to the Gateway"**

- Files that are in the Gateway on drive C:, and their purpose, are:

STARTUP .BAT	- Startup Batch file
GATEWAY.INI	- Sets all baud rates, IP Address, BACnet parameters
SOCKET.CFG	- IP Configuration file
SOCKETP .EXE	- TCP/IP Socket stack
NE2000.COM	- Ethernet Driver
TRN_GWAY.EXE	- Does all the magic
DATABASE.DAT	- Database that is created from Save Discovery
DISC_1 .TXT	- Trunk #1 Auto Disc File
DISC_2 .TXT	- Trunk #2 Auto Disc File
DISC_3 .TXT	- Trunk #3 Auto Disc File
DISC_4 .TXT	- Trunk #4 Auto Disc File
CONFIG .TXT	- Device configuration file created when the Auto-Discovery files are merged
XPING.EXE	- Test program to verify Ethernet connectivity

(H)elp, (S)ummary, (D)evice, (P)oint, (C)ontrol, (W)atch, (A)utoDisc, (X)-it :A

AUT: (A)uto-Discovery, (S)ave Discovery, (X)-it :S

AUTODISCOVERY: You may SAVE and MERGE all trunk auto-discovery maps.
ARE YOU SURE? If so, enter "Y" for YES; and then the ENTER key.
(or any other keys if you do NOT want to merge the maps :Y

Discovery File Merging, trunk #1
Merging, VARITRANE unit #4; Trunk #1; Type = 1

Discovery File Merging, trunk #2
Discovery File Merging, trunk #3
Merging, VAV-1 unit #4; Trunk #3; Type = 0
Merging, VAV-1 unit #6; Trunk #3; Type = 0
Discovery File Merging, trunk #4
Merging, VOYAGER unit #50; Trunk #4; Type = 2
Merging, VOYAGER unit #51; Trunk #4; Type = 2

This option will merge all of the discovery files for each trunk thereby giving you a completed database for the Trane VAV devices on all trunks.

After the merge is complete, the Gateway will have created a file called DATABASE.DAT. When the Gateway is rebooted, the new Database file will be initialized and communications to the field devices will commence.

The Save Discovery option automatically assigns Modbus device numbers (slave addresses) to the Trane VAV devices it found. First, devices on trunk #1 are assigned, in order of Modbus slave devices 1 through 60 (note that there are a maximum of 60 Trane VAV's for one trunk – this is because many installations violated the "rules" about only having 32 Trane VAV's on one trunk. We accommodate systems that have more). Similarly, the Trane VAV devices found on Trunk #2 are assigned (in the order that they are discovered) to Modbus slave devices 61 through 120. And of course, Modbus slave addresses 121 to 180 are for the Trane devices found on Trunk #3, and finally Modbus slave addresses 181 to 240 are assigned to devices on Trunk #4 (in order of discovery).

A word about chillers is required. The Autodiscover sends out a "what type of Trane Gizmo are you" command, and all respond with their HARDWARE device type. But there are several kinds of chillers. Most of the chillers will be what we call "type 8", but some (most notably the "RTHD Series R" chillers are a "type 10". We cannot tell the difference from the response—all chillers respond identically. Here's where you may have to do some work. We suggest that you just try the Gateway out with the default "type 8" chillers; it probably works for about 8 of every 10 chillers you meet. If you get no data from the chillers, you have to change the type in the DATABASE.DAT file. Here's an annotated example, at a site that had two Intellipaks on trunk #1, and three Series R chillers on Trunk #2. This is the initial file that was created by our auto-discovery:

```
//  Auto-Discovery Files were Merged at 07:09:31, on Oct 14, 2019.
//
//     "DEVICE", TRNK, TRANE-UNIT, TRANE-TYPE, DEVICE#, NAME, DESC(OPT), LOC(OPT)
//
DEVICE, 1, 32, 3,  1, "INTELLIPAK #32, Trunk: 1", "Description", "Location"
DEVICE, 1, 33, 3,  2, "INTELLIPAK #33, Trunk: 1", "Description", "Location"
DEVICE, 2, 34, 8,  61, "UCP2 #34, Trunk: 2", "Description", "Location"
DEVICE, 2, 35, 8,  62, "UCP2 #35, Trunk: 2", "Description", "Location"
DEVICE, 2, 36, 8,  63, "UCP2 #36, Trunk: 2", "Description", "Location"
```

Note that the chillers had "TRANE-TYPE" set to the default, 8. Change that to 10, upload it back into the Gateway, and things will be a whole lot better in chiller-land. Like so:

```
//  Auto-Discovery Files were Merged at 07:09:31, on Oct 14, 2019.
//
```

```
//     "DEVICE", TRNK, TRANE-UNIT, TRANE-TYPE, DEVICE#, NAME, DESC(OPT), LOC(OPT)
//
DEVICE, 1, 32, 3,  1, "INTELLIPAK #32, Trunk: 1", "Description", "Location"
DEVICE, 1, 33, 3,  2, "INTELLIPAK #33, Trunk: 1", "Description", "Location"
DEVICE, 2, 34, 10,  61, "UCP2 #34, Trunk: 2", "Description", "Location"
DEVICE, 2, 35, 10,  62, "UCP2 #35, Trunk: 2", "Description", "Location"
DEVICE, 2, 36, 10,  63, "UCP2 #36, Trunk: 2", "Description", "Location"
```

"Summary" Menu Options

SUM: (D)evices, (A)larms, (C)ontrolled, (U)nreliable, (X)-it :

After the (S)ave Discovery has been completed, you can then reboot and the Gateway will begin to poll the discovered devices. The summary menu option will display further options detailed below.

(D)evices : Devices will display all the status of all devices configured for the Gateway.

```
SUM:  (D)evices,  (A)larms,  (C)ontrolled,  (U)nreliable,  (X)-it :D

TagID: "VAV#4, TRUNK 1 (MB #1)" is ON-LINE & RELIABLE
TagID: "VAV #1, TRUNK 2 (MB #61)" is OFF-LINE! <MUST INIT> (SlowScan)
TagID: "VAV #4, TRUNK 3 (MB #121)" is ON-LINE & RELIABLE
TagID: "VAV #5, TRUNK 3 (MB #122)" is ON-LINE & RELIABLE
TagID: "VAV #6, TRUNK 3 (MB #123)" is ON-LINE & RELIABLE
```

(A)larms: Not available with Modbus (does not support alarm states). With BACnet, this does have meaning, but only for points that have alarm states or limits (intrinsic alarms) defined. At the present time, the Centaurus Prime gateways do NOT support BACnet alarming, either "intrinsic" or "algorithmic".

(C)ontrolled: This command will display all controlled points for all Modbus or BACnet devices.

```
SUM:  (D)evices,  (A)larms,  (C)ontrolled,  (U)nreliable,  (X)-it :C

DEVICE #1 is field device/subdevice/type 4/0/1
  *** Gateway has NO controls to do! ***
DEVICE #61 is field device/subdevice/type 4/0/1
  *** Gateway has NO controls to do! ***
DEVICE #121 is field device/subdevice/type 4/0/1
  *** Gateway has NO controls to do! ***
DEVICE #122 is field device/subdevice/type 5/0/0
  *** Gateway has NO controls to do! ***
DEVICE #123 is field device/subdevice/type 6/0/0
  *** Gateway has NO controls to do! ***
```

(U)nreliable: This will display all unreliable points for all devices.

```
SUM:  (D)evices,  (A)larms,  (C)ontrolled,  (U)nreliable,  (X)-it :U

DEVICE #1 is field device/subdevice/type 4/0/1
 *** "PO #7 Action" is UNRELIABLE
 *** "PO #6 Action" is UNRELIABLE
 *** "COOLING Control" is UNRELIABLE
 *** "HEATING Control" is UNRELIABLE
```

"Devices" Menu Options

The Devices menu is used to display all of the configured devices (A) or to "target" a specific device and get data about it.

(A)ll: View all configured devices.

```
DEV:  (S)elect,  (A)ll,  (D)etail,  (O)ff-line,  (C)omm Stats,  (X)-it :A

TagID: "VAV #4, TRUNK 1 (MB #1)" is ON-LINE & RELIABLE
TagID: "VAV #4, TRUNK 2 (MB #61)" is OFF-LINE! <MUST INIT> (SlowScan)
TagID: "VAV #4, TRUNK 3 (MB #121)" is ON-LINE & RELIABLE
TagID: "VAV #5, TRUNK 3 (MB #122)" is ON-LINE & RELIABLE
TagID: "VAV #6, TRUNK 3 (MB #123)" is ON-LINE & RELIABLE
```

(S)elect: Target a specific device.

```
DEV:  (S)elect,  (A)ll,  (D)etail,  (O)ff-line,  (C)omm Stats,  (X)-it :S

DEV:  You may select a DEVICE to target into.
     Enter a DEVICE number (1..240 or 0 for all): 2

Device #2 is now the targeted device.
```

(D)etail: Will display the following details of selected device.

```
DEV:  (S)elect,  (A)ll,  (D)etail,  (O)ff-line,  (C)omm Stats,  (X)-it :D

DEVICE #1 is field device/subdevice/type 4/0/1
Device Name:  VAV #4, Insurance Company
Device Description: West Conference Room VAV
TagID: "VAV #4, TRUNK 1 (MB #1)" is ON-LINE & RELIABLE
I/O Trunk: 1, had last COMM at 17:13:12 on Dec 28, 2004
Scan time (secs):  14.  Device has 54 objects under it.  First link =54
```

(O)ffline: This will display the Offline status of devices. Hopefully none are, but if any are, they will be displayed in a list.

```
DEV:  (S)elect,  (A)ll,  (D)etail,  (O)ff-line,  (C)omm Stats,  (X)-it :O

TagID: "VAV #4, TRUNK 2 (MB #61)" is OFF-LINE!
```

(C)omm Stats: This will display communication statistics of the selected device.

```
DEV:  (S)elect,  (A)ll,  (D)etail,  (O)ff-line,  (C)omm Stats,  (X)-it :C

TagID: "VAV #4, TRUNK 1 (MB #1)" statistics:
    Packets Today:   463
    RX Errors Today: 0   % Error: 0.000
    TX Errors Today: 4   % Error: 0.864
    Last Comm at:  17:13:26 on Dec 28, 2002
```

"Point" Menu Options

The "Point" menu has three options, Select, All, and Detail.

```
PNT:  (S)elect,  (A)ll,  (D)etail,  (E)very, (X)-it :
```

(A)ll: This will display all points and their current values for the targeted device. What follows below is an example from a Modbus gateway. A BACnet gateway will display the BACnet object type and Instance number in the first part of each line, rather than the Modbus register number). Data is the same for both gateway "flavors", it is just the object mapping which is different in the two protocol systems (register addresses versus object type/instances).

```
PNT:  (S)elect,  (A)ll,  (D)etail, (E)very,  (X)-it :A

DEVICE #1 is field device/subdevice/type 4/0/1
  TagID: "VAV #4, TRUNK 1 (MB #1)", has 54 objects under it, 1st one at: 54
 MB Reg  30001  (AI) "Zone Temperature          "  Fld:   72 ==>     72.00
 MB Reg  30002  (AI) "Active Heating SPT Used   "  Fld:   71 ==>     71.00
 MB Reg  30003  (AI) "Active Cooling SPT Used   "  Fld:   76 ==>     76.00
 MB Reg  30004  (AI) "Occupied Heating SPT Val"    Fld:   71 ==>     71.00
 MB Reg  30005  (AI) "Occupied Cooling SPT Val"    Fld:   76 ==>     76.00
 MB Reg  30006  (AI) "UnOccupied Heat SPT Val"     Fld:   67 ==>     67.00
 MB Reg  30007  (AI) "UnOccupied Cool SPT Val"     Fld:   80 ==>     80.00
 MB Reg  30008  (AI) "Damper/Valve Pos          "  Fld:   24 ==>     24.00
 MB Reg  30009  (AI) "Maximum Flow Size         "  Fld:   16 ==>     1100.00
 MB Reg  30010  (AI) "Present CFM Flow          "  Fld:    0 ==>     0.00
 MB Reg  30011  (AI) "Max Heating Flow          "  Fld:   16 ==>     16.00
```

```
 MB Reg  30012  (AI) Min Heating Flow             "  Fld:   15 ==>     15.00
 MB Reg  30013  (AI) "Max Cooling Flow            "  Fld:   90 ==>    90.00
 MB Reg  30014  (AI) "Min Cooling Flow            "  Fld:   90 ==>    90.00
 MB Reg  30015  (AI) "Fan Ctl Offset Value        "  Fld:   90 ==>    90.00
 MB Reg  30016  (AI) "AUX Temperature             "  Fld:   74 ==>    74.00
 MB Reg  10001  (DI) "Current Fan Status          "  Fld:    0   OFF (0-state)
 MB Reg  10002  (DI) "Control Mode Status         "  Fld:    0   COOL (0-state)
 MB Reg  10003  (DI) "Heating Status              "  Fld:    0   OFF (0-state)
 MB Reg  10010  (DI) "Damper Forced Open          "  Fld:    0   NORMAL (0-state)
 MB Reg  10011  (DI) "Damper Forced Closed        "  Fld:    0   NORMAL (0-state)
 MB Reg  10012  (DI) "OCC/UNOCC Mode Ctl          "  Fld:    0   OCCUPIED (0-state)
 MB Reg  10013  (DI) "Local SPT Status            "  Fld:   16   DISABLED (1-state)
 MB Reg  10014  (DI) "Min Setpoint Forced         "  Fld:    0   NORMAL (0-state)
 MB Reg  10015  (DI) "Max Setpoint Forced         "  Fld:    0   NORMAL (0-state)
 MB Reg  10016  (DI) "Temp/Flow Mode FB           "  Fld:   64   TEMP (1-state)
 MB Reg  40004  (AO) "Occupied Heating SPT        "  Fld:   71 ==>    71.00
 MB Reg  40005  (AO) "Occupied Cooling SPT        "  Fld:   76 ==>    76.00
 MB Reg  40006  (AO) "UnOccupied Heating SPT"  Fld:   67 ==>    67.00
 MB Reg  40007  (AO) "UnOccupied Cooling SPT"  Fld:   80 ==>    80.00
 MB Reg  40011  (AO) "Max Heating Flow SPT        "  Fld:   16 ==>    16.00
 MB Reg  40012  (AO) "Min Heating Flow SPT        "  Fld:   15 ==>    15.00
 MB Reg  40013  (AO) "Max Cooling Flow SPT        "  Fld:   90 ==>    90.00
 MB Reg  40014  (AO) "Min Cooling Flow SPT        "  Fld:   25 ==>    25.00
 MB Reg  40015  (AO) "Fan Ctl Offset SPT          "  Fld:    3 ==>     3.00
 MB Reg:    10  (DO) "Damper Forced Open CTL"  Fld:    0   OFF (0-state)
 MB Reg:    11  (DO) "Damper Forced Close CTL"  Fld:    0   OFF (0-state)
 MB Reg:    12  (DO) "OCC/UNOCC Mode CTL"  Fld:    0   OCCUPIED (0-state)
 MB Reg:    13  (DO) "Local SPT Control           "  Fld:   16   DISABLED (1-state)
 MB Reg:    14  (DO) "Min Setpoint Forced         "  Fld:    0   NORMAL (0-state)
 MB Reg:    15  (DO) "Max Setpoint Forced         "  Fld:    0   NORMAL (0-state)
 MB Reg:    16  (DO) "Temp/Flow Mode CTL          "  Fld:    0   TEMP (0-state)
 MB Reg:    17  (DO) "Recalibration CTL           "  Fld:    0   OFF (0-state)
```

The display is slightly different for the BACnet flavor of this gateway, because BACnet uses Object Type/Instances rather than registers. The order is slightly different, but the data is identical. Here is the same display, in "BACyap" format:

```
PNT:  (S)elect,  (A)ll,  (D)etail,  (E)very,  (X)-it :A

DEVICE #1 is field device/subdevice/type 4/0/1
  TagID: "VAV #4, TRUNK 1 (Dev #1)", has 54 objects under it, 1st one at: 54
 BACnet ID     1 (AI)   "Zone Temperature            "  Fld:   72 ==>    72.00
 BACnet ID     2 (AI)   "Active Heating SPT Used     "  Fld:   71 ==>    71.00
 BACnet ID     3 (AI)   "Active Cooling SPT Used     "  Fld:   76 ==>    76.00
 BACnet ID 104 (AO) "Occupied Heating SPT        "  Fld:   71 ==>    71.00
 BACnet ID     4 (AI)   "Occupied Heating SPT Val"  Fld:   71 ==>    71.00
```

```
BACnet ID 105 (AO) "Occupied Cooling SPT     " Fld:   76 ==>     76.00
BACnet ID     5 (AI)   "Occupied Cooling SPT Val"  Fld:   76 ==>     76.00
BACnet ID 106 (AO) "UnOccupied Heating SPT"  Fld:   67 ==>     67.00
BACnet ID     6 (AI)   "UnOccupied Heat SPT Val"  Fld:   67 ==>     67.00
BACnet ID 107 (AO) "UnOccupied Cooling SPT"  Fld:   80 ==>     80.00
BACnet ID     7 (AI)  "UnOccupied Cool SPT Val"  Fld:   80 ==>     80.00
BACnet ID     8 (AI)  "Damper/Valve Pos            "  Fld:   24 ==>     24.00
BACnet ID     9 (AI)  "Maximum Flow Size          "  Fld:   16 ==>     1100.00
BACnet ID   10 (AI)  "Present CFM Flow             "  Fld:     0 ==>     0.00
BACnet ID 111 (AO) "Max Heating Flow SPT      "  Fld:   16 ==>     16.00
BACnet ID   11 (AI)  "Max Heating Flow             "  Fld:   16 ==>     16.00
BACnet ID 112 (AO) "Min Heating Flow SPT       "  Fld:   15 ==>     15.00
BACnet ID   12 (AI)   "Min Heating Flow             "  Fld:    15 ==>     15.00
BACnet ID 113 (AO) "Max Cooling Flow SPT      "  Fld:   90 ==>     90.00
BACnet ID   13 (AI)   "Max Cooling Flow             "  Fld:    90 ==>    90.00
BACnet ID 114 (AO) "Min Cooling Flow SPT       "  Fld:   25 ==>     25.00
BACnet ID   14 (AI)   "Min Cooling Flow              "  Fld:    90 ==>    90.00
BACnet ID 115 (AO) "Fan Ctl Offset SPT            "  Fld:     3 ==>     3.00
BACnet ID   15 (AI)   "Fan Ctl Offset Value          "  Fld:    90 ==>    90.00
BACnet ID   16 (AI)   "AUX Temperature               "  Fld:    73 ==>    73.00
BACnet ID  201 (AV)   "Analog Value 1 (User)        "  Fld:    22 ==>    22.00
BACnet ID  202 (AV)   "Analog Value 2 (User)        "  Fld:    10 ==>    10.00
BACnet ID  203 (AV)   "K-Packets TX/RX Today"  Fld:    27 ==>    27.00
BACnet ID  204 (AV)   "TX Error Rate                    "  Fld:      1 ==>    .51
BACnet ID  205 (AV)   "RX Error Rate                    "  Fld:      0 ==>    0.00
BACnet ID  301 (DI)  "Current Fan Status             "  Fld:      0    OFF (0-state)
BACnet ID  302 (DI)  "Control Mode Status          "  Fld:     0    COOL (0-state)
BACnet ID  303 (DI)  "Heating Status                  "  Fld:      0    OFF (0-state)
BACnet ID 410  (DO) "Damper Forced Open CTL"  Fld:    0   OFF (0-state)
BACnet ID  310 (DI)   "Damper Forced Open        "  Fld:     0    NORMAL (0-state)
BACnet ID 411  (DO) "Damper Forced Close CTL"  Fld:    0   OFF (0-state)
BACnet ID  311 (DI)  "Damper Forced Closed        "  Fld:    0    NORMAL (0-state)
BACnet ID 412  (DO) "OCC/UNOCC Mode CTL"  Fld:    0   OCCUPIED (0-state)
BACnet ID 312  (DI) "OCC/UNOCC Mode Ctl   "  Fld:     0   OCCUPIED (0-state)
BACnet ID 413  (DO) "Local SPT Control             "  Fld:    16  DISABLED (1-state)
BACnet ID 313 (DI)  "Local SPT Status                "  Fld:    16   DISABLED (1-state)
BACnet ID 414  (DO) "Min Setpoint Forced           "  Fld:     0   NORMAL (0-state)
BACnet ID 314  (DI)  "Min Setpoint Forced           "  Fld:      0    NORMAL (0-state)
BACnet ID 415  (DO) "Max Setpoint Forced          "  Fld:   0   NORMAL (0-state)
BACnet ID 315  (DI)  "Max Setpoint Forced           "  Fld:      0    NORMAL (0-state)
BACnet ID 416  (DO) "Temp/Flow Mode CTL      "  Fld:   0   TEMP (0-state)
BACnet ID 316  (DI)  "Temp/Flow Mode FB         "  Fld:      0   TEMP (0-state)
BACnet ID 417  (DO) "Recalibration CTL            "  Fld:    0   OFF (0-state)
BACnet ID 317  (DI)  "Recalibration Status            "  Fld:      0   OFF (0-state)
```

(E)very: will display the SAME selected point on EVERY device in the Gateway.

(S)elect: With Select, you can target a specific point for the Device that you have targeted using the "Devices" menu.

```
PNT:  (S)elect,  (A)ll,  (D)etail,  (E)very, (X)-it :S

PNT:  You may select an OBJECT ID to target into.
      Enter a valid, existing, Object ID (1 to 49999) : 30001

The object at ID #30001 is now selected.
```

(D)etail: will display details associated with the selected point, for MODBUS points:

```
PNT:  (S)elect,  (A)ll,  (D)etail,  (E)very, (X)-it :D

  MB Address: 30001,  Type = AI, "Zone Temperature"
  Field Unit / Subunit :    4 /    0    Field Address :30001
  Object Flags / Errors :    0   /  0
  Field In / Out Counts :    0 /    0    Field Value :   0.000
  Field Lo / Hi Range :   0.000 /   255.000
  Eng. Units : Deg F.
```

(D)etail: will display details associated with the selected point, for BACnet points, in a format like this:

```
PNT:  (S)elect,  (A)ll,  (D)etail, (E)very, (X)-it :D

  BACnet Object ID = 12,  Type = AI
  Object Name: "Conf Room  Zone Temp"
  Object Description: "West wall temp sensor, 1st floor Conf. Room"
  Field Unit / Subunit :    4 /    0    Field Address :30001
  Object Flags / Errors :    0   /  0
  Field In / Out Counts :    0 /    0    Field Value :   0.000
  Field Lo / Hi Range :    0.000 /   255.000
  Eng. Units : Deg F.
```

"Control" Menu Options

This is slightly different for Modbus and BACnet. In BACnet, you control things at sixteen different priority levels, and you can "release" control from any particular level.

Let's consider the simpler, Modbus case first. Control just "happens" when you select a point and give it a new value. No priorities at all. The last control to a point "wins", and stays until some other control is given to that point.

Now, before you can control a point object you must first have selected a device number and point number (see Modbus point map, Chapter 3).

(S)elect: Use this to select a valid point. Here is the Modbus variant:

```
CTL:  (S)elect,  (C)ontrol,  (D)etail,  (X)-it :S

CTL:  You may select an OBJECT ID to target into.
      Enter a valid, existing, Object ID (0 to 49999) : 11

The object at ID #11 is now selected.
```

And, here is the BACnet variation on the same theme:

```
CTL:  (S)elect, (P)riority, (C)ontrol,  (R)elease, (D)etail,  (X)-it :S

 CTL:  You may select an OBJECT ID to target into.
      Enter a valid, existing, BACnet Object TYPE/ID (0 to 4), (1 to 16000): 1,114

The object with Type 1 and  Instance #114 is now selected.
```

(C)ontrol: (MODBUS version). This option will let you control the selected point. Here is a simple MODBUS example of a digital point control to "off" (zero):

```
CTL:  (S)elect,  (C)ontrol,  (D)etail,  (X)-it :C

CTL:  You may enter a new value to set the selected object to.
      Enter a field value (0 or 1 for digitals; valid number for analogs) : 0

The new value of the object will be : 0
Adding to Control Queue, at #2.   MB #1, Register: 1
Queued Control;  Trunk #1,  MB #1, Register: 1 -- to:    0.000
```

OK…so much for simple. Now let's talk about BACnet (alias BADnet). There are sixteen priorities. These are given below:

Priority	BACnet Default	Comments
1	Manual Life-Safety	Trane: User-Emergency
2	Automatic Life-Safety	Trane: Critical! (Programmatic; no mins)
3	Miscellaneous	Trane: "Minimum on/off"
4	Miscellaneous	Trane: "User-High"
5	Critical Equipment Control	Trane: Custom Programming—High
6	Minimum On/Off	Trane: Miscellaneous
7	Custom Programming—High	Trane: Demand Limiting
8	Manual Operator	Trane: Miscellaneous

9	VAV Air Systems	Trane: VAV Air Systems
10	Chiller Plant Control	Trane: Chiller Plant Control
11	Area Control	Trane: Area Control
12	Manual Operator—Low	Trane: User-Low
13	Miscellaneous	Trane: Miscellaneous
14	Timed-Override	Trane: Timed-Override
15	Time-of-Day Scheduling	Trane: Time-of-Day Scheduling
16	Custom Programming—Low	Trane: Custom Programming—Low
N/A	Relinquish Default	Relinquish Default

Note in the "Comments" we have given what the Tracer Summit "Default" was for the priorities in question. This is informational only, but might help some of you who were used to an old Tracer system.

Each controllable point in BACnet (that is, an AO or a BO) has a "priority array" which is generally sparsely populated. Nothing in a particular priority level is specified by "Null", which means that priority level is unused.

As an example, consider a warehouse exhaust fan which is turned on and off by a time schedule at priority 15. In a demand-limiting situation, this point may also have control at priority 7 (shut down ancillary systems in energy peak situations). But programmatically, a logic block that detects a fire might want to override everything and keep the fan on in order to pressurize an area and keep the fire from spreading, so that might be at priority 2. When control is "released" from the higher levels, the next lowest control is issued. Hence, after the fire is over, the fan that was overridden ON might go OFF from its priority 7 demand-limiting shutdown. But if that priority 7 control had been released, then the control descends to the priority 15 time-schedule control. You have to know what your plant's priority system is, and what each point's capabilities and control options are—this is not a trivial control philosophy!

The "Relinquish Default" value, if any is specified, is the control that is given out to a point if there is NOTHING in this priority array (that is, all 16 levels of control have been released). If there is no "Relinquish Default" value, then the point just sits there, at it's last control.

Now, before you can control a point object you must first have selected a device number , a point type/instance, and a priority. Then you can set the control value, and that value will go into the object's priority-array. That does NOT mean that control will be issued, remember, since you may be at a lower priority level than what is controlling the point right now.

(P)riority: (BACnet ONLY) Use this to select the priority that you will issue subsequent control and release operations at.

```
CTL:  (S)elect,  (P)riority,  (C)ontrol,  (R)elease,  (D)etail,  (X)-it :P

PRI:  Enter a PRIORITY to do your controls at (1 to 16): 4

Control and Release Operations will now be done at Priority 4.
```

(C)ontrol: (BACnet version) This option will let you control the selected point, at whatever priority level you are currently at.

```
CTL:  (S)elect,  (P)riority,  (C)ontrol,  (R)elease,  (D)etail,  (X)-it :C

CTL:  You may enter a new value to set the selected object to.
      Enter a field value (0 or 1 for digitals; valid number for analogs) : 70

The new value of the object will be : 0
Adding to Control Queue, at #2.   Device #6, AO #114
Queued Control;  Trunk #1,  Device #6, AO #114 -- to:    70.000  pri = 4
```

(R)elease: This option will let you release control for the selected point at your selected priority level (valid for the BACnet variant of the Gateway, only!):

```
CTL:  (S)elect,  (P)riority,  (C)ontrol,  (R)elease,  (D)etail,  (X)-it :R

RLS:  Are you sure that you want to RELEASE this object?
         ARE YOU SURE?  If so, enter Y for Yes, and then the ENTER key.
         (or any other keys if you do NOT want to RELEASE the object) : Y

The object AO #114 has been released from Priority #4.
```

(D)etail: will display details associated with the selected point.. Let's first look at a Modbus version of an object's detail:

```
CTL:  (S)elect,  (P)riority,  (C)ontrol,  (R)elease,  (D)etail,  (X)-it :D

   MB Address: 30001,  Type = AI, "Zone Temperature"
  Field Unit / Subunit :    4 /    0    Field Address :30001
  Object Flags (bits) :       0    Error Counter :0
  Field In / Out Counts :    0 /    0    Field Value :    0.000
  Field Hi / Lo Range : 255.000 /    0.000    Eng. Units : Deg F.
```

And this is what is displayed for an example BACnet controllable object that has been released from all controls (note the line that says "No elements in priority/control array":

```
CTL:  (S)elect,  (P)riority,  (C)ontrol,  (R)elease,  (D)etail,  (X)-it :D

BACnet Obj_ID 113,  Type = AO, "Max Cooling Flow SPT"
  No elements in priority/control array
  Field Unit / Subunit :        4  /    0    Field Address :30001
  Object Flags / Errors :            0  /   0
  Field In / Out Counts :            0  /   0    Field Value :   0.000
  Field Hi / Lo Range : 10000.000 /   0.000
  Engineering Units :     Percnt
```

Had any priorities have controls in them, it would have displayed the priority and the control value, for EACH priority level.

"Watch" Menu Options

The "Watch" menu will let you select various methods for monitoring the real time data from the field.

(Q)uiet: Use the (Q) key to halt any of the following monitoring options.

(1),(2),(3),(4) to Watch Trunks: Enter a Trane VAV trunk to monitor. This will display the field scan of all Trunk devices and the status of their points in real time. What is displayed below is the Modbus variant (it shows the register numbers in the second column); the BACnet variation is the same except it shows the BACnet object instances in the second column:

```
WCH:  (Q)uiet, (1),(2),(3),(4) to watch trunks; (V)erbose, (M)odbus, (X)-it :1

*** TRUNK 1 is now being MONITORED ***
-- SCAN: Trunk #1, TRANE #4  Device # 1  Type: 0
AI  30001       Zone Temperature Counts:     72 =     72.00
AI  30002 Active Heating SP Used Counts:     71 =     71.00
AI  30003 Active Cooling SP Used Counts:     76 =     76.00
AI  30003 Active Cooling SP Used Counts:     76 =     76.00
AO  40004   OCCUPIED Heating SPT Counts:     71 =     71.00
AI  30004      OCC Heating Value Counts:     71 =     71.00
AO  40005   OCCUPIED Cooling SPT Counts:     76 =     76.00
AI  30005      OCC Cooling Value Counts:     76 =     76.00
AO  40006 UNOCCUPIED Heating SPT Counts:     67 =     67.00
AI  30006    UNOCC Heating Value Counts:     67 =     67.00
AO  40007 UNOCCUPIED Cooling SPT Counts:     80 =     80.00
AI  30007    UNOCC Cooling Value Counts:     80 =     80.00
AI  30008       Damper/Valve Pos Counts:     24 =     24.00
AI  30009    Maximum Flow (Size) Counts:     16 =   1100.00
AI  30010       Present CFM Flow Counts:      0 =      0.00
AO  40011   Max Heating Flow SPT Counts:     16 =     16.00
AI  30011       Max Heating Flow Counts:     16 =     16.00
AO  40012   Min Heating Flow SPT Counts:     15 =     15.00
AI  30012       Min Heating Flow Counts:     15 =     15.00
AO  40013   Max Cooling Flow SPT Counts:     90 =     90.00
AI  30013       Max Cooling Flow Counts:     90 =     90.00
AO  40014   Min Cooling Flow SPT Counts:     25 =     25.00
AI  30014       Min Cooling Flow Counts:     90 =     90.00
AO  40015     Fan Ctl Offset SPT Counts:      3 =      3.00
AI  30015   Fan Ctl Offset Value Counts:      3 =      3.00
DI  10001     Current Fan Status Raw Value:   8 ==> OFF
DI  10002    Control Mode Status Raw Value:   0 ==> COOL
DI  10003         Heating Status Raw Value:   8 ==> OFF
DO     10  Damper Force Open CTL Raw Value:   0 ==> NORMAL
...etc…
```

(V)erbose: When (V) is pressed while in monitor mode, the full protocol data packets will be displayed as well for each scanned device.

```
*** Now in VERBOSE MODE (full packets) for monitored trunks
 -- SCAN: Trunk #1, TRANE #4  Device # 1  Type: 0
 --TO Trunk 1:  00 04 01 00 1C AA 3D
 -- Set up TIMEOUT, Trunk #1, to be 6153193,  TMO @baud = 100
-FRM Trunk 1: <Incomplete>
TIMEOUT" on Trunk: 1, error count = 0
--TO Trunk 1: 00 04 01 00 1C AA 3D
--FRM Trunk 1:00 84 01 00 1C 08 00 11 01 1C  00 00 00 18 00 19 47 4C 47 4C
              19 5A 0F 03 43 50 00 00 10 40  AA AA 3D 85 0F <Valid>
AI  30001       Zone Temperature Counts:     72 =     72.00
AI  30002 Active Heating SP Used Counts:     71 =     71.00
AI  30003 Active Cooling SP Used Counts:     76 =     76.00
AI  30003 Active Cooling SP Used Counts:     76 =     76.00
AO  40004   OCCUPIED Heating SPT Counts:     71 =     71.00
AI  30004      OCC Heating Value Counts:     71 =     71.00
AO  40005   OCCUPIED Cooling SPT Counts:     76 =     76.00
AI  30005      OCC Cooling Value Counts:     76 =     76.00

…etc…
```

(M)odbus: When (M) is pressed while in monitor mode, the full Modbus RTU data packets will be displayed as well for each scanned device (Modbus version only).

(B)ACnet: When (B) is pressed while in monitor mode, the full BACnet protocol data packets (addressed globally or to this gateway only) will be displayed in real-time. Note that this significantly slows down the BACnet channel, and we recommend that this mode NOT be utilized for any length of time.

SPECIAL NOTE FOR VAVs, BO point #14 (Recalibration):

This point is, according to Trane, the "recalibration" point for a VAV box. It is pathetically slow in acting. The Trane manual errata sheet says that you must control the point ON for five minutes, then turn it OFF. The actual feedback from the point does show ON, but only for about 20 seconds, so the feedback is fairly useless (and, in fact, we suggest that you NOT define it!). However, the Trane documentation also says that it takes up to 15 minutes to drive the damper full closed to do the calibrations. It has been found that in real life, it takes sometimes 20 to 25 minutes to actually do the physical damper motion and recalibration. Have patience!

SPECIAL NOTE FOR INTELLIPAKs and VOYAGERs:

The Intellipak is configurable for many different applications (as an AHU, as a VAV system, as just a big air-blower), and has many options (power exhaust, economizer, etc.) They can be cooling only, or have a number of stages of electric or gas heat. Because of this, you must be careful in determining which points to bring out. In cooling-only units, for example, the heating setpoints are irrelevant (and indeed, they come back as the Trane "undefined" value of 3276.7

degrees for OCC, UNOCC, and S/A heating setpoints! So, don't bring those points out. If the unit doesn't have OCC/UNOCC control (for example, if it is just a big air-blower, and only has AUTO/SHUTDOWN modes, then the OCC/UNOCC control is meaningless (but you could bring it in as a BI object, and the OCC/UNOCC follows the AUTO/SHUTDOWN command).

Similarly true, but to a lesser extent, you should only bring the Voyager points out that are meaningful. For instance, on a CCP replacement system, the Voyager does not static pressure control (that is done by the CCP or "communicating damper"), so those points in the Voyager are meaningless and potentially confusing—don't put them in your system!

Also, it is important to set the Intellipaks and Voyagers to REMOTE "Tracer (ICS)" rather than "LOCAL" control, via their setup mode from the front panel of the rooftop unit. If the unit is in LOCAL control, it will never take orders from the Gateway! And, in fact, the setpoints will be verrrrry odd (the usual Trane "undefined" value of 3276.7 degrees; might be toasty!)

Uploading and Downloading files to the Gateway

In order to commission and upload/download files to the Gateway, you will need to use a VT-100 Terminal emulator (Hyperterminal or the like). We like "Tera Term", which is easy to use (and a free dwnload!). You will need to set it up to use a Comm Port (Comm1 typically) and use the following settings: Baud=9600, Databits=8, Stop bits=1, Parity=None, and no Flow Control.

The standard baud rate is 9600, but some (most) people find this to be too slow, especially when watching the field trunks being scanned (they are VERY wordy!). More on this later, but you can rename a file and from that point in time on, the Gateway operates at 19200 baud--the fastest that it can handle n the console port.

The Gateway has two utilities for transferring files. UP.COM is used to send files to the Gateway and DOWN.COM is used to received files from the gateway.

When you are connected to the gateway in local mode, hit X-it once or twice and you will be asked to type "YES" to quit the program which will take you to DOS prompt.

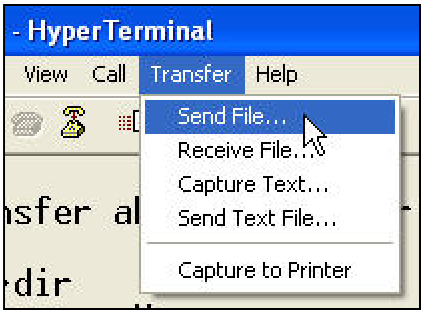
Sending a file to the Gateway (uploading)

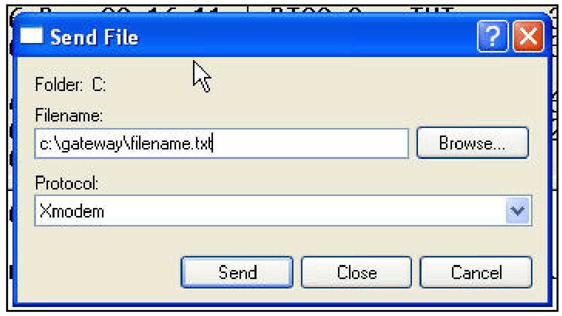
From the dos prompt, you must type "UP filename" (filename being the name of the file to send with extension). The response will look like the following.

```
C:\>up test.txt
Ready, start X-modem upload now,
 Press CNTL-C to abort...
……
```

In Hyperterminal, start the file transfer by selecting Transfer/Send and follow the following sequence below.

Click Transfer > Send File: Browse for file to send and make sure that Xmodem is selected. Click the send button and the file will be sent to the Gateway.



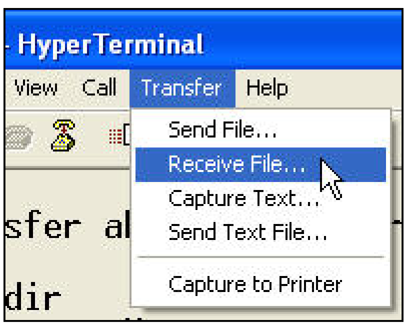


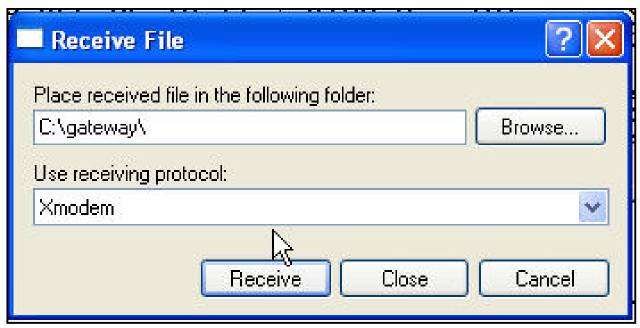
Receiving a file from the Gateway (downloading)

From the dos prompt, you must type "DOWN filename" (filename being the name of the file to receive with extension). The response will look like the following.

```
C:\>down disc_1.txt
Ready, start X-modem download now...
```

In Hyperterminal, start the file transfer by selecting Transfer/Send and follow the following sequence below.





Click Transfer > Receive File: Enter the location to save the file and make sure that Xmodem is selected and then click the Receive button. The next dialog box will ask you to specify a filename and when you click "OK" the file will be received from the Gateway.

There are a few "hints" that make this quicker and easier:

(1) When UPLOADING ("UP") to the Gateway, take out the Ethernet cable. The Ethernet interrupts can hog the processor, and make the transfer to the Gateway very slow.

(2) You might want to run your terminal emulator at 19200 baud, and the Gateway at the same speed, to make it seem faster (especially when you are doing "Watch" mode operations. If so, you can go into the DOS mode of the gateway and give the following command:

COPY START_FAST.BAT START.BAT <then hit the ENTER key>

This will add a line to the batch file that starts up the Gateway up (A "MODE" command forcing the console port to 19200 baud). Reboot, and voila, twice as fast. (some people say that the slower speed is "half-fast", but we would never say that…)

Setting up the Modbus Driver

After the Gateway is ready to go and you have your database configured, one of the last steps is to make sure that you have the Modbus driver settings for the Host/Master setup correctly. The following information should be kept in mind when configuring the driver

Modbus commands that are accepted by the Gateway are:

1 - Read Coils	(0000's)
2 - Read Discretes	(10000's)
3 - Read Holding Registers	(40000's)
4 - Read Input Registers	(30000's)

5 - Force Single Coil
6 - Preset Single Register
7 - Read Exception Status (Status is 0 if OK; o/w internal error-code)
15 - Force Multiple Coils
16 - Preset Multiple Registers
17 - Report Slave ID (Emulates Modicon Micro-84)

Most Modbus drivers have many setup options and each vendor is different. Following are some limits with the Modbus Gateway that you need to consider when setting up your driver.

```
MAXIMUM number of coils read at once (CMD #1) is 64
MAXIMUM number of discretes read at once (CMD #2) is 64
MAXIMUM number of holding registers read at once (CMD #3) is 32
MAXIMUM number of input registers read at once (CMD #4) is 32
MAXIMUM number of coils forced at once (CMD #15) is 8
MAXIMUM number of registers preset at once (CMD #16) is 8

TIMEOUT for a command should be a minimum of 350 milliseconds (500 ms
recommended)

TIME BETWEEN commands should be a minimum of 50 milliseconds (100 ms
recommended)
```

```
NUMBER OF TIMEOUTS before "slow polling" should be a minimum of 3 (3
recommended)
```

Setting up the BACnet System

After the Gateway is ready to go and you have your database configured, one of the most important steps is to make sure that you have your BACnet system configured properly to communicate with the Centaurus Prime Gateway.

The most important parameter that some BACnet systems need to know is whether a device supports READ-MULTIPLE and WRITE-MULTIPLE services. The Centaurus Prime Gateways only support READ-MULTIPLE, not WRITE-MULTIPLE services. All Centaurus Prime Gateways conform to the BACnet "PICS" statement published and available on our web site, www.CentaurusPrime.com.

There is some difference in the way many host systems work. Some require our gateway to be on a separate network number (e.g., ALC); some prefer the gateway to be on the same network (e.g., Alerton), and some don't care (most). In the GATEWAY.INI you should change the parameter "BACNET_NETWORK" to an appropriate value. The 2017 BACnet Addendum ***al*** ("Gateway Best Practices") does <u>REQUIRE</u> that all gateways have UNIQUE BACnet network numbers. For "future proofing" your site, we HIGHLY RECOMMEND a unique network number!

Typically, installers have chosen the BACNET_NETWORK to be a certain number, and then made the BACNET_OFFSET to be 1000 times that number; so that the BACnet instance numbers of the devices are all prefixed by the network number. As an example, if you set the BACNET_NETWORK number to 333 and the BACNET_OFFSET to 333000, then you would end up with BACnet device numbers 333001, 333002, 333003, etc., on network #333. Makes it simple, no? Just a suggestion1

DO NOT over-tax the BACnet network! At about 30 BACnet/IP packets per second directed ***TO THE GATEWAY***, the Gateway will saturate; any more packets than that, and they are lost. Any more than that will cause retries and actually SLOW DOWN the BACnet system! This is because BACnet/IP is a "connectionless" system—the requestor sends a packet to the Gateway, and the network gives it a "best effort" to deliver it. If the network is saturated, and our Gateway does not receive the packet, the requestor has to time-out, and then retries its request packet. This may mean that control logic will "stall" (depending upon the software implementation in the controller) until that retry occurs.

A Few Words About Controls

The Trane devices are not state-of-the-art: they were designed in the 1980's and 1990's. Older VAV-1 devices are 1200 baud (slow!), and the newer devices are only 9600 baud (OK, but not great). As such, their controls are "leisurely" and have several limitations. We want you to be aware of these limits when you design your logic and controls in your front-end system.

First, you should NOT just continuously write output values to the controllers. Most of the parameters you WRITE (that is, AO and BO points) are not only changing things within the RAM of the Trane controller, but that value is also written to EPROM. This is "safe", because the last thing you wrote to a Trane device it remembers (usually), and that value is what is used when it has a power-bump or failure and reboots. But, the EPROM used in some of the Trane device designs was never designed to take more than 100,000 writes (but they would usually last 250,000 to 500,000). Now, if you write to a parameter once per minute, that is 1440 times per day, or 525,600 times per year. Ooops…it's easy to see that continuously bumping a setpoint is a bad idea: the EPROM can fail in less than a year. We think that you should write to EPROM only on a "significant" change, and only when really necessary.

Second, many of the parameters are "modes", and are mapped as several BI/BO points. For example, the Occupied and Unoccupied modes for a VAV is really controlling the fan, modulating dampers, turning heating and cooling ON as needed, etc. There are several "force" BO points (Damper forced open, Damper forced closed, Minimum Setpoint forced, Maximum Setpoint forced, etc.), and if the Trane device is in NONE of the "force" modes, then it is in AUTOMATIC. This is very important to remember: Trane devices have "automatic" as their default control mode. Note also that if you try to FORCE it into several of these "force" modes at once, the results are nonsense (actually, the last command wins). We also have noted that there is some time-lag between telling the Trane device to go to a mode and it actually happening. Further, controls should be written so that the "force" points are taken off (which means that it goes into AUTO mode), then, after a minimum of one minute, you can "force" it into another mode. Too-fast operations changing modes may possibly not only confuse the Trane devices, but it has been known to cause them to reset or fail.

Third, there is a way to override any physical I/O point, independent of what "mode" the controller is in. You can "force" a physical I/O point, via one of two mechanisms. From then on, all controls and adjustments that you do to that physical I/O point will go straight out, and any automatic controls that would otherwise control the point are thwarted. Then, you can set that physical I/O point back into "auto", and the automatic controls, as computed by the controller, will then go out.

So how to do this force/auto? In MODBUS systems, there are eight "force/auto" points (coils 51 through 58, for DO-0 through DO-5, AO-6, and AO-7, respectively) that you must set to 1 to set the physical I/O point into "forced" mode. Then you can do your controls to the control points (coils 1 through 6, and output register 40009 and 40010, respectively). When you are done, and want to go back to automatic, then set coils 51 to 58 back to 0, and the point(s) will go back to automatic mode.

Speed of Controls is of enormous interest when designing your controls. Controls are the FIRST priority of the Gateway, ahead of scanning. We have implemented a queue of 1000 controls (yes, one thousand!). But you need to be aware that all controls in the queue have to be done before scanning will re-commence. There will usually be a lot of controls from your host system (sending initial controls upon re-connection to each device). But DO NOT program your system to re-control anything on a regular basis (e.g., every five minutes). Say you control a half-dozen points in 100 VAV field devices (setting modes, some setpoints, etc). That is 500 controls. As the Gateway can do about 1 to 3 controls per second (remember, these are slow serial-trunks!) It may take several minutes (if we use a rate of 2 controls per second, that would be 250 seconds;

over four minutes). It would mean that all your controls are preventing the Gateway from scanning, 90% of the time. Bad news! Over-control of points is the most common problem with the implementation of these Gateways. Beware!!!!

Now, in BACnet systems, we have implemented the full 16-level priority scheme of BACnet. This allows you to control a point at various priorities (higher priorities, closer to 1 for critical controls like emergency shutdowns). As you RELEASE the controls at various priorities, the Gateway will "walk down" the list of controls, and do the next-lower priority control.

Now, two BIG WORDS about the BACnet "Relinquish Default" for analog output objects: IMPLEMENT THEM. The way BACnet works, you send a command to an AO point at a certain priority (say, operator, priority 8), and perhaps some logic controls it to another value, say a time schedule at priority 12). Release from 8, and the control at priority 12 is sent. Release from ALL control priority, and the BACnet Relinquish Default" value is sent out. But what if your system never had a Relinquish Default value for an analog output point? Then "Null" is the value sent out to the real world, which could be a VERY bad thing. Of course, the same issue applies to Binary Output points.. This is just standard BACnet operations, so become familiar with this operation!

However, we have implemented a "catch" for this BACnet issue. When all controls have been release, but there is no Relinquish Default value (i.e., it is "Null") we just leave the object where it is at (that is, we d no controls to it). Better to stay put than go to some weird value!

More words, about controlling Rooftop Units (RTUs). Intellipaks, when they are being talked to by the Gateway, will be in REMOTE (called "Tracer" or "ICS" by Trane people) mode, rather than LOCAL (control by local devices and setpoints). So, when an Intellipak is communicating to the Gateway, it should automatically be in REMOTE mode. You can't change it—that's just the way it is. But not so with Voyagers RTUs (Reliatel/Precident/whatever). They power-up in LOCAL, and you have to set them to REMOTE (BO point 410). So, for Voyagers, you MUST control BO point 410 to REMOTE (1). We recommend that you also control the OCC/UNOOC points (BO point 412) and the FAN MODE (BO Point 411) point, along with any relevant setpoints that you will require (e.g., AO 104 and 105, the OCC Heating and Cooling setpoints).

A Lot of Words About VariTrac-II CCP and VAV Command Unit-II Controls ("Wireless")

There were two Trane controllers which had optional "wireless" sensors: older "VAV Command Unit II" controllers and the newer "VariTrac-II Central Control Panel" controllers. While they had slightly different configurations, they both did the same thing: They could control a line of VAV boxes (and wireless sensors) and control a bypass damper. Generally they had a supply air sensor, but few had the optional relay output board to control a heat pump or up to two stages of heating/cooling. They also rarely had optional inputs for occupied, cooling, and manual control. These controllers really did not very much in the way of control, and were stand-alone or attached to ancient TRACER systems, generally. Many people want to eliminate these two devices, and attach the trunks that they had (with VAV's, Voyagers, and Wireless temperature sensors) to a new, state-of-the-art BACnet system. The Trane Gateway allows you to do that. Here's how:

In laying out the transition from these two controllers (VT-II CCP or VAV-CU-II or CCP2, for short—but let's just call them just ***CCP***s, to make it easier), there are a few things to look for:

(1) Be aware that you will need to replace whatever minimal I/O and logic that the CCP had. The I/O <u>can</u> include occupancy switches, S/A temp, duct static pressure and damper control, at least (see below for Note 6 about older CCPs, and Note 7 about the "Damper Box" on newer CCP2's). CCP logic handles the damper control, occupied/unoccupied mode, etc. Review with your customer what the CCP does now, and what you want to do in the future. Remember, you are bringing this link of VAVs (and perhaps the RTU, if there is one) into a much more modern system with tremendously more powerful programming than the old system had.

(2) You will remove the CCP, but might want it around if you change the wireless sensors out (if you don't have the hand-held "Wireless Receiver Setup Tool" to do that directly to the Wireless Receiver). If so, you should put a switch between the trunk and the CCP and Gateway. If you need to change the serial numbers in the Wireless Receiver, you can then do that through the RS-232 (terminal mode) of the CCP. This is inferior to changing the serial numbers directly in the Wireless Receiver with the Setup Tool, but for some sites, this may be the only way (e.g., nobody purchased the Setup Tool).

(3) For wireless sensors, instead of AI1 for the zone temp (which still works for the hardwired stats, you will use AI27 for the zone temp of the VAVs that use wireless sensors. This is the last value that the Wireless Receiver sent to the VAV, and it is what it "thinks" the zone temperature is.

(4) The Wireless Receiver is a token-passing device, and as such is not the old master/slave communication that the VAV-1's, through VAV-III's use. For this reason, you have to order the Centaurus Prime Trane Gateway with the optional "Token-pass Co-Processor" card instead of the normal (master/slave) RS-485 converter card. This is on a PER-TRUNK Basis, and if you only need it on a couple trunks, just order the Trane Gateway that way (because the Co-Processors do cost a bit more).

(5) While there technically could be more than one Wireless Receiver on a CCP, it is unlikely you will encounter this situation. The Centaurus Prime "Token-pass Co-Processor" has been implemented to handle multiple Wireless Receivers, and we have tested it with three wireless receivers on one trunk; the maximum is four on one trunk.

(6) On older CCP systems, the Duct Static pressure ("velocity") sensor and the bypass damper control (open/close pulses) are directly attached to the CCP motherboard. That has to be replaced with a controller of your own. The pressure sensor has a range of 0 to 3.5 inches, on a 0 to 10 volt signal. The open and close signals are 24 VAC control signals. The Trane manual says in one place the signals move the damper 6% with a one-second pulse, and 5% to 8% in other documents. You will really need to time it yourself, for the dampers that are installed in your building. (Time it full-close to full-open, and make sure it's the same as full-open to full-close).

(7) On most VariTrac CCP2 systems, there is a special "Damper Box" (also known as the "VariTrac Damper" or the "Communicating Sensor/Bypass Damper Controller" in the Trane literature). This device is brainless, but has these points:

a. Bypass damper control and feedback

b. Duct Static Pressure sensor

c. Discharge (Supply) Air Temperature Sensor

Trane sets these up as the UCM device #97. The Gateway discovers this as a Varitrane VAV box, but it is NOT; it is very special. You will have to manually edit your CONFIG.TXT file to change the device type from #2 to #9, as in this line:

DEVICE, 1, 97, 9, 22, "DAMN-PER, Trunk 1", "Damper Box", "Under Vger"

Great! So now you have control of the damper itself. You must now write some software that modulates the damper to maintain a static air pressure around some setpoint. Remember, do NOT overcontrol the Gateway! Perhaps every 2-5 minutes, figure out if the damper is too open (static too low) or too closed (static too high), and adjust the output accordingly. Note that the control is only integer percent, so use a 2% to 5% deadband, accordingly. Of course, this means that the Voyager's own S/A pressure, and pressure setpoint (AI points 15, 16, 17, and AO point 17) are unused.

(8) Most VariTrac CCP systems have a Trane Voyager (or "Reliatel" or "Precedent") Rooftop unit that the CCP controls. However, the CCP can control non-Trane Rooftop units, too, with an optional Binary Output board in the CCP. Be careful when you are installing the Gateway, and you will have to write software in your host control system to control a non-Trane gizmo with your own binary outputs (fan, electric heat, 2 compressors, etc.)

(9) Voyagers that are under a CCP are not like normal Voyagers, in that they do NOT auto-discover. Of course, some regular V'gers also have firmware that does not implement the "Who-R-U" command. So, you will have to look on the TCI3 board's DIP switches and

see what address they have. For the most part, we have seen the Voyagers be address #81 on older CCP systems, and either #50 or #51 on newer CCP2 systems.

(10) Controlling the Supply (Discharge) Air Temperature from in a system that replaces the CCP:

(a) It appears that most Voyager units are set up to have the FAN OFF in "idle" mode (not calling for heating or cooling). You may want this, but it is generally undesirable for a VAV system: We highly recommend that the Supply Fan Mode control be set to FORCED ON (1). But beware: This means that the fan runs all the time (even in UNOCC mode). If you want to switch the unit off during unoccupied times, you should put the Supply Fan Mode back to AUTO with the UNOCC command.

(b) There seem to be two ways to control the Discharge Temperature, and you have to emulate what the CCP did in its tiny little mind.

- One way to accomplish this is to control the # of cooling (and heating, if any) stages that the unit can work with. If everything is good, set the number of cooling stages, AO #20, to zero; the compressors go off. If you need some cooling, set the # of cooling stages to 1, and one compressor comes on. More cooling needed? Set the number of stages to 2; both compressors will be on. Set it to 3? Well, you only have two compressors, Cowboy, it won't grow another compressor! Here's what you have to do: YOU have to write logic to do this, and you MUST be careful to avoid short-cycling the compressors (a ten minute recalculation is appropriate; it is up to you). The VAV's take care of the zones; all you have to do is figure out what zones need cooling, and how bad off those zones are (and perhaps weight them: big cheeses' offices are more important than employee lounges!) The Trane CCP had a voting system, based on how many boxes needed cooling or heating, or how many VAVs were way off on cooling/heating, and would enable/disable compressors, accordingly. It was never a good system, and worked poorly much of the time. You can do better than the CCP!

- On SOME Trane Voyager/Reliatel/Precedent rooftop units (but not all), there is a special output point in the Voyager (see the point map, below), AO #34. You must do what the VariTrac CCP unit did, and control this point to tell the rooftop unit what to do. This is an analog point with very specific STATES (0, 2, 4 ONLY). Set this to 0 to turn off the fan ("idle"). Then set to 2 to turn on the fan, but have no compressors running. Set to 4 to run the compressors. You MUST write code to look at the Damper Box's Discharge Air Temp and determine what to do, with SIGNIFICANT deadbands and avoiding short-cycling the compressors. We recommend 10 minute re-controls for this, since that seems to be about what the CCP does.

- It is important to have your Discharge Air temperature control software by the time you put the system on-line, or it may either not run (default is zero), or keep the compressors on forever (in which case people will get very cold…).

- It is not intuitively obvious which kind of controls, described above, will work for a particular unit. You must try both kinds, and see which one works for your particular unit. And then, happy programming!

- By the way, this also means that the Voyager's own S/A temperature, and S/A temperature setpoint (AI points 13, 16, 17, and AO point 14) are unused.

(c) For CCP systems, there is NO static pressure control on the Voyagers; that is done by the "Damper Box". Hence, you MUST NOT USE AI/AO#17 on CCP systems; it will affect the STATES (shown above), and really mess up the building!

A Few More Words About Wireless T'Stats

The GATEWAY.INI file will have extra lines in them for each trunk that has Wireless Receiver, to tell it what the Unit Number of the Wireless Receiver is, and how many sensors there are on it. Here's an example from one site that had four trunks, each with a Wireless Receiver (WR) on them:

```
// "WIRELESSn, X, Y", if used: on trunk n, Wireless rcvr #X exists with Y sensors
//
WIRELESS1, 6, 25
WIRELESS1, 20, 14
WIRELESS2, 1, 12
WIRELESS3, 1, 10
```

This example shows that there are 25 wireless thermostats on WR #6, and 14 wireless thermostats on WR #20, both on Trunk #1. On trunk #2, the Wireless Receiver is at address 1, and there are 12 wireless thermostats. And so on. Pretty simple!

What this does is tell the Trane Gateway to set up "extra" devices for the Wireless Receivers. They become devices 241, 242, 243, …up to 248, in order of definition. Hence, you can only put eight Wireless Receivers on one Gateway, but they can be in any trunk arrangement and order. It also sets up four points per wireless sensor/thermostat: the zone temperature and setpoint, of course, plus two other "goodness" parameters: the time since it last transmitted and the RSSI—Receiver Signal Strength Indicator.

You can see these devices in the "local mode" when you do a (**A**)ll display from the **DEV** (Device) menu:

#241 TagID: "Wireless_Rcvr_2/1" is ON-LINE & RELIABLE
#242 TagID: "Wireless_Rcvr_2/2" is ON-LINE & RELIABLE
#243 TagID: "Wireless_Rcvr_2/3" is OFF-LINE!
#244 TagID: "Wireless_Rcvr_2/4" is ON-LINE & RELIABLE

This example shows you that, for the BACnet network 2 (the "Wireless_Rcvr_2" part of the device name), trunks 1, 2, and 4 are good, and the Wireless Receiver on trunk #3 is bad (not communicating).

If you select device #242, say, you would be targeted to the Wireless Receiver on Trunk #2. From the "local mode" menu system, if you did a display of (**A**)ll points from the **PNT** (Point) menu, you would see something like this:

```
DEVICE #241 is field device/subdevice/type 3/0/6
 TagID: "Wireless_Rcvr_10/241", has 128 objects under it, 1st one at: 5771
--BACnet ID   1 (AI) "       Wireless_002E63_Temp"  Fld:  726 ==>   72.60
--BACnet ID   2 (AI) "     Wireless_002E63_SetPnt"  Fld:  700 ==>   70.00
--BACnet ID   3 (AI) "       Wireless_002E63_RSSI"  Fld:  152 ==>  152.00
--BACnet ID   4 (AI) "     Wireless_002E63_TxTime"  Fld:   21 ==>  210.00
--BACnet ID   5 (AI) "       Wireless_003616_Temp"  Fld:  742 ==>   74.20
--BACnet ID   6 (AI) "     Wireless_003616_SetPnt"  Fld:  717 ==>   71.70
--BACnet ID   7 (AI) "       Wireless_003616_RSSI"  Fld:  196 ==>  196.00
--BACnet ID   8 (AI) "     Wireless_003616_TxTime"  Fld:   17 ==>  170.00
--BACnet ID   9 (AI) "       Wireless_003438_Temp"  Fld:    0 ==>    0.00
--BACnet ID  10 (AI) "     Wireless_003438_SetPnt"  Fld:    0 ==>    0.00
--BACnet ID  11 (AI) "       Wireless_003438_RSSI"  Fld:    0 ==>    0.00
--BACnet ID  12 (AI) "     Wireless_003438_TxTime"  Fld:  211 ==> 2110.00
--BACnet ID  13 (AI) "       Wireless_003409_Temp"  Fld:  707 ==>   70.70
--BACnet ID  14 (AI) "     Wireless_003409_SetPnt"  Fld:  875 ==>   87.50
--BACnet ID  15 (AI) "       Wireless_003409_RSSI"  Fld:  172 ==>  172.00
--BACnet ID  16 (AI) "     Wireless_003409_TxTime"  Fld:   20 ==>  200.00
--BACnet ID  17 (AI) "       Wireless_004281_Temp"  Fld:  715 ==>   71.50
--BACnet ID  18 (AI) "     Wireless_004281_SetPnt"  Fld:  719 ==>   71.90
--BACnet ID  19 (AI) "       Wireless_004281_RSSI"  Fld:  128 ==>  128.00
--BACnet ID  20 (AI) "     Wireless_004281_TxTime"  Fld:   23 ==>  230.00
--BACnet ID  21 (AI) "       Wireless_00344D_Temp"  Fld:  737 ==>   73.70
--BACnet ID  22 (AI) "     Wireless_00344D_SetPnt"  Fld:  830 ==>   83.00
--BACnet ID  23 (AI) "       Wireless_00344D_RSSI"  Fld:  181 ==>  181.00
...Etc...
```

Note that there are four AI point values per wireless sensor, and that the NAME of each includes the serial number of the sensor (so you can verify that it is correctly matching the job site documentation and what you expect to be inside of the Wireless Receiver's "brain"). These AI points are:

1. The temperature, last read from the wireless sensor.
2. The thermostat setting , also read from the wireless sensor
3. The Receiver Signal Strength Indicator (RSSI), indicating the sensor's "health".
4. How long it has been since the sensor last transmitted (to the nearest 10 seconds).

In this example, Note that there are many "sets" of points (AI1, AI2, AI3, and AI4 for the first sensor, AI5, AI6, AI7, and AI8 for the second sensor, etc.) They all look pretty good, if you look at the RSSI "health" (pretty much, 80 and above is "good", and means the batteries are OK), except for the third thermostat (AI9, AI10, AI11, and AI12). Notice the bad temperature and setpoint (both zero) and the RSSI is also nada. This generally means that the battery in the wireless sensor took a dive, or somebody took the t'stat off the wall. While Trane says in their literature, "The battery life is expected to be 1.5+ years depending on the environment in which the sensor is installed." And "The more frequently the sensor transmits its information the shorter the battery life". As an aside: The Trane documentation then goes on with a lot of mumbo-jumbo about when and why it would transmit the temperature, without giving any hard facts. In reality, do not expect any battery to last more than a year. Keep a lot on hand!

But the thing to notice here is that you can use the RSSI value as a nice alarm! If it goes below some number, (say, 80 or 90), issue an alert to your operators that the battery is getting weak. If it really drops (say, below 20), you pretty much have a dead wireless sensor. While 99% of the time popping in a new battery fixes the issue, in the rare instance that one completely croaked (or got fried by some user abuse), you will have to change the serial number in the Wireless Receiver. That's when you will either have to flip the switch back to the CCP, or use the Wireless Receiver Setup Tool directly plugged into the Wireless Receiver to modify the serial number.

There are some diagnostic lights on the Co-Processor board that are of interest: From top to bottom they are:

- Lights to indicate a command from the Gateway, going on the peer-to-peer Trane Trunk.
- Lights to indicate a reception from a Trane field device, going back to the Gateway.
- Lights when Sending out a packet on the Trane field bus (lights up a LOT!)
- Lights when Receiving a packet from the Trane field bus (lights up even LOTSER)

These lights flash at a nice rhythmic rate. Mesmerizing, really, with the lights off. Good for date-night. We suggest you ply your date with: a nice bottle of chardonnay, pillows (filter boxes are not comfortable), soft music (or at least loud enough to cover up the pumps and chillers in the mechanical room). Cheers!

More on Modbus (The Good, Bad, and Ugly; and what we did about the Ugly)

Modbus is very fast at getting data, a compact and well-understood protocol, and so easy to use. That's the good. The bad of Modbus is that there is no real "reliability", no names for the objects, no properties, etc. The ugly is analog ranging, which must be done in your host. Not so ugly, you say, well, you just don't know how convoluted Trane can be…therein lies a story.

A simple VAV box, but of course Trane makes it "different" (read: "difficult"). There is a "CODE" for the size of the box. Perhaps it's 7, meaning 900 CFM maximum, or 30, for a 4000 maximum CFM box. To really range things right, you need to know this, and range ALL the CFM analog inputs by 0 to this maximum. Not too hard, you say? What about controls to the associated Holding Registers? It is done in percentage down to the Trane VAV box, so now you have a different ranging for those points. If you want the user to do things in CFM (as users might expect), then you have to have logic behind "virtual points" that do the percentage-conversion and send it down to the proper Holding Register.

Even simple points like temperatures are actually sent to/from the Trane gizmos in tenths of units. So, you have to know that, and range things accordingly in your host's Modbus driver.

Yuk. Ugly. No amount of lipstick makes this Pig into Madonna.

But your good buddies at Centaurus Prime figured a way out of this conundrum, so you can do everything in Engineering Units, as God Intended. This is via a set of "shadow" registers that present all the data and allow you to do controls in real-number format. [As an aside, there is no "standard" for Modbus reals. Since Modbus began in the Pliocene Era where memory was "Big-Endian", most of the first implementations of real numbers used a MSB-first approach to sending four bytes of a real number up in two 16-bit registers is the most common, worldwide]. These shadow registers start at 45001 (Holding Registers) and 35001 (Floating Registers).

Let's dispense with the leading 3 or 4; the mapping works the same with inputs or outputs. The first register is 1; the first shadow register is 5001. The second register, 2; is mapped to shadow register 5003 (remember, it takes two register entries to send a real value). So, it's simple:

Standard Modbus Registers	Shadow Modbus Registers	Typical Usage
30001	**35001**	**VAV: Zone temp**
30002	**35003**	**Active Heating SPT**
30003	**35005**	**Active Cooling SPT**
30004 / 40004	**35007 / 45007**	**OCC Heating SPT**
30005 / 40005	**35009 / 45009**	**OCC Cooling SPT**

etc…	**etc…**	**etc…**
30xxx / 40xxx	**35yyy / 45yyy**	**yyy = (xxx * 2) - 1**

In your Modbus driver, just set it up so that these shadow registers are the ones you use, and ignore the standard analog 30000 and 40000 register set. You will get values in engineering units, perfectly. The holding registers you don't have to mess with at all: just send down the real-value, in engineering units, and the Gateway takes care of all the ugliness for you. These shadow registers makes it so easy to use Modbus, it's almost scary.

TEMPLATE Files

Centaurus Prime Gateways allow serious customization. You can to download to the Gateway and "regular" and "custom" templates that will be used in your building. Maybe you don't like the set of standard points that are created for your VAV box. Maybe you have so many devices that you run over the 10,000 point limit in the Gateway (yikes!). Maybe you hate the names we made up. Maybe you want to make each Voyager have different names for their points. You can do all this, and more, by creating your own templates and downloading them to the Gateway.

If you just want to replace the "standard" set of points that the Gateway creates upon startup, create a template for a device type, and download it. The templates are named as follows, and MUST use these names:

1. VAV1 VAV boxes: TPL_VAV1.CSV
2. VARITRANE VAVs: TPL_VARI.CSV
3. Voyagers/Reliatels: TPL_VGER.CSV
4. Intellipak Roof-Top Units: TPL_IPAK.CSV
5. Terminal Unit Controllers (TUCs): TPL_TUC.CSV
6. Fan Coil Units (FCUs): TPL_FCU.CSV
7. Comm 4 Chillers (UCP2): TPL_UCP2.CSV
8. VariTrac CCP "Damper Box" TPL_DMPR.CSV

We will give an example for a VARITRANE (TPL_VARI.CSV) template file, but the concept is the same for all the other devices. This example CSV file shows you all the points that WOULD be created, and those that are not desired are "commented out" by putting a double-slash ("//") at the beginning of the line. Here it is:

```
// VARITRANE Template --  Maintain the ORDER of these lines.
// Line Deletions are OK; Additions are NOT recommended
//
//
BO, 19, Air Valve CTL, HEAT, COOL,  ,  , Air Valve Action Control,
BI, 19, Air Valve FB, HEAT, COOL,  ,  , Air Valve Action Feedback,
//BI, 18, Local O-ride Active, DISABL, ENABLE,  ,  , Local Override Active,
//BI, 17, Recal Status, OFF, ON,  ,  , Recalibration Status,
BO, 17, Recal CTL, OFF, RECAL,  ,  , Recalibration Control,
//BI, 14, Force MaxHeat FB, NORMAL, FORCED,  ,  , Force MaxHeat Status,
BO, 14, Force MaxHeat CTL, NORMAL, FORCED,  ,  , Force MaxHeat Control,
//BI, 13, Local SPT FB, DISABL, ENABLE,  , , Local Setpoint FB,
BO, 13, Local SPT CTL, DISABL, ENABLE,  , , Local Setpoint CTL,
//
// NOTE: reverse "OCC, UNOCC" if you have "OCC_INVERSION, TRUE" in GATEWAY.INI_
BI, 12, OCC/UNOCC Mode FB, OCC, UNOCC,  ,  , Occupancy Mode FB,
BO, 12, OCC/UNOCC Mode CTL, OCC, UNOCC,  ,  , Occupancy Mode CTL,
//
//BI, 11, Dmpr ForceClose FB, NORMAL, FORCED,  ,  , Damper ForceClose Status,
BO, 11, Dmpr ForceClose CTL, NORMAL, FORCED,  ,  , Damper ForceClose Control,
//BI, 10, Dmpr ForceOpen FB, NORMAL, FORCED,  ,  , Damper ForceOpenStatus,
BO, 10, Dmpr ForceOpen CTL, NORMAL, FORCED,  ,  , Damper ForceOpen Status,
```

```
BI, 3, Heat Status, OFF, ON,  ,  , Heating Output,
BI, 2, Control Mode, COOL, HEAT,  ,  , Control Mode,
BI, 1, Fan Status, OFF, ON,  ,  , Fan Output,
//
//AI, 28, Flow Calib Factor, 0.000, 2.55, Factor, None, Flow Calibration Factor,
//AO, 28, Flow Calib CTL, 0.000, 2.55, Factor, None, Flow Calibration Control,
//AI, 27, Wireless Temp, 0.000, 255.000, Deg F, None, Wireless Temperature Sensor,
AI, 26, T-Stat Temp, 0.000, 255.000, Deg F, None, Thermostat Temp Setting,
AI, 25, Actual Min Flow, 0.000, 255.000, CFM, None, Actual Minimum Flow,
AI, 24, Actual Max Flow, 0.000, 255.000, CFM, None, Actual Maximum Flow,
//AI, 23, Aux Temp, 0.000, 255.000, Deg F, None, Auxillary Temperature Sensor,
//AI, 22, Control Offset FB, 0.000, 255.000, Deg F, None, Actual Fan Control Offset,
//AO, 22, Control Offset SPT, 0.000, 255.000, Deg F, None, Fan Control Offset Setpoint,
//AI, 21, Heating Offset FB, 0.000, 255.000, Deg F, None, Heating Offset Value,
//AO, 21, Heating Offset SPT, 0.000, 255.000, Deg F, None, Heating Offset Setpoint,
//AI, 20, UNOCC OA Min Flow FB, 0.000, 255.000, CFM, None, UnOccupied OA Minimum Flow FB,
AO, 20, UNOCC OA Min Flow SPT, 0.000, 255.000, CFM, None, UnOccupied OA Minimum Flow STPT
//AI, 19, OCC OA Min Flow FB, 0.000, 255.000, CFM, None, Occupied OA Minimum Flow FB,
AO, 19, OCC OA Min Flow SPT, 0.000, 255.000, CFM, None, Occupied OA Minimum Flow STPT
//AI, 18, Heat High Limit FB, 0.000, 255.000, CFM, None, Heating High Heat Limit FB,
AO, 18, Heat High Limit SPT, 0.000, 255.000, CFM, None, Heating High Limit Setpoint,
//AI, 17, Heat Low Limit FB, 0.000, 255.000, CFM, None, Heating Low Limit FB,
AO, 17, Heat Low Limit, 0.000, 255.000, CFM, None, Heating Low Limit Setpoint,
//AI, 16, Cool High Limit FB, 0.000, 25,000, CFM, None, Cooling High Heat Limit FB,
AO, 16, Cool High Limit SPT, 0.000, 255.000, CFM, None, Cooling High Limit Setpoint,
//AI, 15, Cool Low Limit FB, 0.000, 255.000, CFM, None, Cooling Low Limit FB,
AO, 15, Cool Low Limit SPT, 0.000, 255.000, CFM, None, Cooling Low Limit Setpoint,
//AI, 14, Min Cool Flow FB, 0.000, 5000, CFM, None, Minimum Cooling Flow,
AO, 14, Min Cool Flow SPT, 0.000, 5000, CFM, None, Min Cooling Flow Setpoint,
//AI, 13, Max Cool Flow FB, 0.000, 5000, CFM, None, Maximum Cooling Flow,
AO, 13, Max Cool Flow SPT, 0.000, 5000, CFM, None, Max Cooling Flow Setpoint,
//AI, 12, Min Heat Flow, 0.000, 5000, CFM, None, Minimum Heating Flow,
AO, 12, Min Heat Flow SPT, 0.000, 5000, CFM, None, Min Heating Flow Setpoint,
AI, 10, Actual Flow, 0.000, 5000.000, CFM, None, Current Flow Rate,
AI, 9, Max Flow, 0.000, 5000.000, CFM, None, Maximum Flow Size,
//AO, 9, Max Flow (CODE), 0.000, 255.000, CODE, None, Maximum Flow CODE,
AI, 8, Dmpr/Valve Pos, 0.000, 255.000, %, None, Damper/Valve Position,
//AI, 7, UNOCC Cool Spt FB, 0.000, 255.000, Deg F, None, UnOccupied Cooling Spt FB,
AO, 7, UNOCC Cool Spt CTL , 0.000, 255.000, Deg F, None, UnOccupied Cooling Spt CTL,
//AI, 6, UNOCC Heat Spt FB, 0.000, 255.000, Deg F, None, UnOccupied Heating Spt FB,
AO, 6, UNOCC Heat Spt CTL, 0.000, 255.000, Deg F, None, UnOccupied Heating Spt CTL,
//AI, 5, OCC Cool Spt FB, 0.000, 255.000, Deg F, None, Occupied Cooling Spt FB,
AO, 5, OCC Cool Spt CTL, 0.000, 255.000, Deg F, None, Occupied Cooling Spt CTL,
//AI, 4, OCC Heat Spt FB, 0.000, 255.000, Deg F, None, Occupied Heating Spt FB,
AO, 4, OCC Heat Spt CTL, 0.000, 255.000, Deg F, None, Occupied Heating Spt CTL,
AI, 3, Active Cooling SP used, 0.000, 255.000, Deg F, None, Active Cooling Value,
```

Things to note in this example:

Let's take a look at a few features of this template file:

1. This is for ALL the Varitrane VAV devices. If you want one (or more) to be special, you can create a unique template file for it -- and so that template file will have a unique TPL name (e.g., TPL1_22.CSV, if it was Device #22 on trunk #1).

2. The order of the points in the template file is "reversed" (lowest number at the end). This is important to maintain the correct order on the diagnostic displays (which is lowest number first).

3. The "NA" line is not used in this template, so the device will use the names from the CONFIG.TXT file (created when you SAVED the AUTODISCOVERY files from the four trunks). You of course fiddled with that file so that the device names would be more meaningful than "VAV1 #31 on Trunk #2", right? You can use the NA line to make a unique name, if this is for a UNIQUE TPL (see note 1).

4. Note what points are commented out: Feedback for some of the control points; the CODE point for the box size; wireless temperatures, calibration points. You should work with your owner/users to decide what they will really want, without being redundant and just "data-spew". Make sure that what you are getting out of each device is reasonable and interesting; not displayed "just because you can".

Note the extension: CSV means "comma separated variable", which is a standard text-type spreadsheet file. Because it is a text file, you can edit these files with either a simple text editor or a spreadsheet program. If you do edit it with a spreadsheet, some spreadsheets (like Excel) will give you the option to save the file in their own internal format (e.g., .XLS format). DO NOT DO THIS! Keep the file in text format (.CSV), so that it is transferable and readable by the Gateway. Otherwise, you will have a lot of "quadruple" quotes you have to make into mere "double" quotes. *Caveat Spreadsheet!*

Centaurus Prime can help: We can give you some example TEMPLATE files (like the one above) or help you create your own. You can contact us, either by e-mail or telephone, and we will e-mail any that you need back to you.

One philosophy is to put all points in the Gateway (i.e., keep these files just as they are and download them to the Gateway), and just NOT map the ones that you don't want. The other philosophy is to DELETE the points you will never want to expose from these template files, before you download them to the Gateways. The good point of the first philosophy is that all the points are there, if you ever want to map them later; the bad news is that the Gateway has to scan these points, and that affects performance in a bad way. The good point of the second philosophy is that the scan is quicker, and you are only getting the data you want; the bad news is that if you want to add points in the future, you will need to download modified TEMPLATE files to the Gateway in order to add those points. Our personal opinion is that the speed improvement far outweighs the minor inconvenience of downloading new templates, if ever they are needed.

Chapter

3

Modbus & BACnet Point Mapping

Device Point Mapping for VAV-1s and VariTranes:

Monitor Reg # / Inst. #	Control Reg # / Inst. #	Older (VAV-1's) Usage	Newer VAV's (II-V) Usage	Ranges & Notes
ANALOGS:				
30001 / 1		Zone Temp	Zone Temp	Deg F; Range Note 1
30002 / 2		Active Heating Setpoint	Active Heating Setpoint	Deg F; Range Note 1
30003 / 3		Active Cooling Setpoint	Active Cooling Setpoint	Deg F; Range Note 1
30004 / 4	40004 / 104	Occupied Heating Setpoint	Occupied Heating Setpoint	Deg F; Range Note 1
30005 / 5	40005 / 105	Occupied Cooling Setpoint	Occupied Cooling Setpoint	Deg F; Range Note 1
30006 / 6	40006 / 106	Unoccupied Heating Setpoint	Unoccupied Heating Setpoint	Deg F; Range Note 1
30007 / 7	40007 / 107	Unoccupied Cooling Setpoint	Unoccupied Cooling Setpoint	Deg F; Range Note 1
30008 / 8		Damper/Valve Position	Damper/Valve Position	Pct; Range Note 2
30009 / 9	40009/109	Maximum Flow (Box Size)	Maximum Flow (Box Size)	CFM; Range: Note 3
30010 / 10		Current Flow, CFM	Current Flow, CFM	CFM; Range Note 2
30012 / 12	40012 / 112	Minimum Heating Flow	Minimum Heating Flow	CFM Flow; Note 2
30013 / 13	40013 / 113	Maximum Cooling Flow	Maximum Cooling Flow	CFM Flow; Note 2
30014 / 14	40014 / 114	Minimum Cooling Flow	Minimum Cooling Flow	CFM Flow; Note 2
30015 / 15	40015 / 115	Fan Control Setpoint	Cooling Low Limit	Deg F; Range Note 1
30016 / 16	40016 / 116	AUX Temperature (Deg F)	Cooling High Limit	Deg F; Range Note 1
30017 / 17	40017 / 117		Heating Low Limit	Deg F; Range Note 1
30018 / 18	40018 / 118		Heating High Limit	Deg F; Range Note 1
30019 /19	40019 / 119		Occupied OA Min Flow	CFM Flow; Note 2
30020 / 20	40020 / 120		Unoccupied OA Min Flow	CFM Flow; Note 2
30021 / 21	40021 / 121		Heating Offset Value	Deg F; Range Note 1
30022 / 22	40022 / 122		Control Offset Value	Deg F; Range Note 1
30023 / 23			Aux Temperature	Deg F; Range Note 1
30024 / 24			Current Maximum Flow	CFM Flow; Note 2
30025 / 25			Current Minimum Flow	CFM Flow; Note 2
30026 / 26			Thermostat Temp (Position)	Deg F; Range Note 1
30027 / 27			Wireless Temp (if used)	Deg F; Range Note 1
30028 / 28	40028 / 128		Flow Calibration Factor	%, Nominally 1.00
30029 / 29			Damper Motor Drive Time	Seconds

Monitor Reg # / Inst. #	Control Reg # / Inst. #	Older (VAV-1's) Usage	Newer VAV's (II-V) Usage	Ranges & Notes
DIGITALS:				
10001 / 301		Fan Status/Ctl	Fan Status/Ctl	0=Off; 1= On
10002 / 302		Control Mode Status/Ctl	Control Mode Status/Ctl	0=Cool; 1= Heat
10003 / 303		Heating Status/Ctl	Heating Status/Ctl	0=Off; 1= On
10010 / 310	10 / 410	Damper Forced Open	Damper Forced Open	0=Normal; 1= Forced
10011 / 311	11 / 411	Damper Forced Closed	Damper Forced Closed	0=Normal; 1= Forced
10012 / 312	12 / 412	OCC/UNOCC Mode Control	OCC/UNOCC Mode Control	0 = OCC; 1 = UNOCC
10013 / 313	13 / 413	Local Setpoint Control	Local Setpoint Control	0=Host CTL 1=Thumbwheel CTL
10014 / 314	14 / 414	Min. Setpoint Forced	Maximum Heating Forced	0=AUTO; 1=FORCED
10015 / 315	15 / 415	Max. Setpoint Forced		0=AUTO; 1=FORCED
10016 / 316	16/ 416	TEMP/FLOW Mode		0=TEMP; 1=MODE
10017 / 317	17/ 417	Recalibration Mode (!)	Recalibration Mode (!)	0=AUTO; 1=FORCED
10018 / 318			Local Override Active	0 = NOT ACTIVE 1 = ACTIVE
10019 / 319	19 / 419	Air Valve Control Action	Air Valve Control Action	0 = COOLING 1 = HEATING
10020 / 320	20 / 420	Heat/Cool Mode Control	Heat/Cool Mode Control	0 = COOLING 1 = HEATING
10021 / 321			Pressure Independent (Flow Sensor Failure)	0 = PRS-IND 1 = FAIL
10022 / 322	22 / 422		Reheat Lockout CTL	0 = Normal; 1 = Lockout (Disabled)

Note that all these tables are for Modbus points (the first two columns specify the **Modbus register / BACnet instance** numbers you will use. For BACnet, the objects have an "Object Type" and an "Instance Number". Well, it is very simple to translate from Modbus to BACnet—just use the following simple "secret decoder ring":

Modbus Register Set	BACnet Type/Instance #	Comments
XX (e.g. 24)	DO / XX	Modbus Coils are BACnet DOs
100XX (e.g. 10021)	DI / XX	ModbusBits are BACnet DIs
300XX (e.g., 30013)	AI / XX	Modbus Registers are BACnet AIs
400XX (e.g., 40011)	AO / XX	Modbus Holdings are BACnet AOs

For our example, we might have four BACnet points , with the following unique IDs: DO #414, DI #302 , AI #3, and AO #111.

NOTES:

Range Note 1: For VAV-1's, this is a count value, 0 to 255, representing degrees F, in integer format. In the Modbus case, use Low-Range = 0, and High-Range = 255. For VAV-II's and newer, this is a value in TENTHS of degrees. In the Modbus case, use Low-Range = 0, and High-Range = 25.5 (on a 255 counts scale) or High-Range = 409.5 (on a 4095 counts scale)

Range Note 2: Actually, the Trane equipment used percentage points, which are sent back as 0 to 100 counts representing 0 to 100 percent, in integer format, of the VAV box's maximum flow rate. This is then translated to CFM (cubic feet per minute), given the scale associated with the box (see AI/AO #9, the CFM maximum of the box, commonly called the "box size). In the Modbus case, use Low-Range = 0, and High-Range = maximum box size.

Range Note 3: This is a set of "sizes" which are the maximum design flow. The AI point is in actual CFM. The AO point is the "code" which sets the size of the VAV box. Refer to the Trane documentation for the different sizes available for your VAV type, and their codes. The "standard" codes and sizes are as follows (note the English units here, but if you are using Metric Units, the display for these points will be in LPS; but the "code" remains still a silly number) :

VAV-1 Devices:

Code 0 = 300 CFM	Code 4 = 2400 CFM
Code 1 = 600 CFM	Code 5 = 3200 CFM
Code 2 = 1100 CFM	Code 6 = 4200 CFM
Code 3 = 1700 CFM	Code 7 = 5000 CFM

VARITRANE Devices:

Code 0 = 200 CFM	Code 11 = 1000 CFM	Code 22 = 2100 CFM
Code 1 = 250 CFM	Code 12 = 1050 CFM	Code 23 = 2300 CFM
Code 2 = 300 CFM	Code 13 = 1200 CFM	Code 24 = 2400 CFM
Code 3 = 350 CFM	Code 14 = 1300 CFM	Code 25 = 2800 CFM
Code 4 = 400 CFM	Code 15 = 1350 CFM	Code 26 = 3000 CFM
Code 5 = 450 CFM	Code 16 = 1400 CFM	Code 27 = 3100 CFM
Code 6 = 500CFM	Code 17 = 1500 CFM	Code 28 = 3200 CFM
Code 7 = 600 CFM	Code 18 = 1600 CFM	Code 29 = 3400 CFM
Code 8 = 650 CFM	Code 19 = 1700 CFM	Code 30 = 4000 CFM
Code 9 = 700 CFM	Code 20 = 1800 CFM	Code 31 = 5200 CFM
Code 10 = 800 CFM	Code 21 = 2000 CFM	Code 32 = <Unused>

Device Point Mapping for VOYAGERs and INTELLIPAKs:

Monitor Reg # / Inst. #	Control Reg # / Inst. #	Voyager Usage	Intellipak Usage	Ranges & Notes
ANALOGS:				
30001 / 1		Zone Temp	Zone Temp	Deg F; Range Note 1
30002 / 2		Active Heating Setpoint	Active Heating Setpoint	Deg F; Range Note 1
30003 / 3		Active Cooling Setpoint	Active Cooling Setpoint	Deg F; Range Note 1
30004 / 4	40004 / 104	Occupied Heating Setpoint	Occupied Heating Setpoint	Deg F; Range Note 1
30005 / 5	40005 / 105	Occupied Cooling Setpoint	Occupied Cooling Setpoint	Deg F; Range Note 1
30006 / 6			UnOCC Heating Setpoint	Deg F; Range Note 1
30007 / 7			UnOCC Cooling Setpoint	Deg F; Range Note 1
30008 / 8		Economizer Damper Position	Economizer Damper Position	Pct; Range Note 2
30009 / 9	40009/109	Economizer Minimum Position	Economizer Minimum Position	Pct; Range Note 2
30010 / 10		Supply Air Temp	Supply Air Temp	Deg F; Range Note 1
30011 / 11		Return Air Temp	Return Air Temp	Deg F; Range Note 1
30012 / 12		Outside Air Temp	Outside Air Temp	Deg F; Range Note 1
30013 / 13		Supply Air Actual Setpoint	Supply Air Actual Setpoint	Deg F; Range Note 1
30014 / 14	40014 / 114	Supply Air Cooling Setpoint	Supply Air Cooling Setpoint	Deg F; Range Note 1
30015 / 15		Supply Air Pressure	Supply Air Pressure	IWC; Range Note 3
30016 / 16		Active Supply Air Pressure Setpoint	Space Air Pressure	IWC; Range Note 3
30017 / 17	40017 / 117	Supply Air Pressure Setpoint (non-CCP)	Supply Air Pressure Setpoint	IWC; Range Note 3
30018 /18	40018 / 118	VFD Speed Control	Space Air Pressure Setpoint	Percent; Range Note 2
30019 / 19	40019 /119	Power Exhaust Setpoint	Supply Air Heating Setpoint	Voyagers: Percent. Intellipaks: Deg F.
30020 / 20	40020 / 120	Control : Number of Cooling Stages to be Used	Morning Warmup Setpoint	Voyagers: 0 to 3. Intellipaks: Deg F.
30022 / 22		# Compressors ON	Circuit 1 Evaporator Temp	Deg F; Range Note 1
30023 / 23		# Heating Stages ON	Circuit 1 Condenser Temp	Deg F; Range Note 1
30024 / 24		Local Heating Setpoint	Circuit 2 Evaporator Temp	Deg F; Range Note 1
30025 / 25		Local Cooling Setpoint	Circuit 2 Condenser Temp	Deg F; Range Note 1
30026 / 26			Outside Air Humidity	Pct; Range Note 2
30027 / 27			Outside Air Enthalpy	BTU/Lb; Range Note 4
30029 / 29			Return Air Humidity	Pct; Range Note 2
30030 / 30			Return Air Enthalpy	BTU/Lb; Range Note 4
30031 / 31	40031 / 131		Computed Host Setpoint	Range is dependent
30032 / 32			Vane Position (% open)	Pct; Range Note 2
30033 / 33	40033 / 133		Daytime Warmup Setpoint	Deg F; Range Note 1
30034 / 34	40034 / 134	CCP Control (ONLY!)		"Mode": See CTL Note
30035 / 35			Supply Fan Speed Output	Pct; Range Note 2
30036 / 36			Exhaust Fan Output	Pct; Range Note 2
30037 / 37			Heating Output	Pct; Range Note 2

Monitor Reg # / Inst. #	Control Reg # / Inst. #	Voyager Usage	IntelliPak Usage	Ranges & Notes
DIGITALS:				
10001 / 301		Fan Status/Ctl	Fan Status/Ctl	0=Off; 1= On
10002 / 302		Diagnostic: Reset Required	Diagnostic: Reset Required	0=OK; 1= Reset Reqd
10003 / 303		Compressor A Status	Compressor A Status	0=Off; 1= On
10004 / 304		Compressor B Status	Compressor B Status	0=Off; 1= On
10005 / 305			Compressor C Status	0=Off; 1= On
10006 / 306		Override Requested	Compressor D Status	0=Off; 1= On
10007 / 307			Economizer Active	0=Normal; 1= ECON
10008 / 308		Compressor A Condition		0=Off; 1= FAULT
10009 / 309		Compressor B Condition		0=Off; 1= FAULT
10010 / 310	10 / 410	Control Source	Shutdown Mode Control	V'gers: 1 = Remote I'Paks: 1 = Shutdown
10011 / 311	11 / 411	Supply Fan Mode	Supply Fan Mode	0 = AUTO; 1 = ForceOn
10012 / 312	12 / 412	OCC/UNOCC Mode Control	OCC/UNOCC Mode Control	0 = OCC; 1 = UNOCC
10013 / 313	13 / 413	Economizer Mode Enable	Morning WarmUp Enable	0 = Off; 1 = Enabled
10014 / 314	14 / 414	Compressors Enabled	Daytime Warmup Enable	0 = Off; 1 = Enabled
10015 / 315	15 / 415	Heating Enabled	Economizer Mode Enable	0 = Off; 1 = Enabled
10016 / 316	16 / 416	Aux Heating Enabled	Heating Enable	0 = Off; 1 = Enabled
10017 / 317	17 / 417	Force Heating		0=Normal; 1= Forced
10018 / 318	18 / 418	Force Cooling		0=Normal; 1= Forced
10019 / 319		Compressor A High-Pressure Cutoff	Circuit A Comp. Fail	0=Normal; 1= Fail
10020 / 320		Compressor B High-Pressure Cutoff	Circuit B Comp. Fail	0=Normal; 1= Fail
10021 / 321		Filter Status	Filter Status	0=Clean; 1= Dirty
10022 / 322		Emergency Stop	Emergency Stop	0=Normal; 1= E-stop
10023 / 323		Heat Failure	Heat Failure	0=Normal; 1= Fail
10024 / 324		Supply Fan Failure	Supply Fan Failure	0=Normal; 1= Fail
10025 / 325			Exhaust Fan Failure	0=Normal; 1= Fail
10026 / 326			Exhaust Fan Status	0=Off; 1= On
10027 / 327			Freeze Stat	0=Normal; 1= Fail
10028 / 328			Heating Stage 1 Status	0=Off; 1= On
10029 / 329			Heating Stage 2 Status	0=Off; 1= On
10030 / 330			Heating Stage 3 Status	0=Off; 1= On
10031 / 331	31 / 431		Cooling Enable	0 = Off; 1 = Enabled
10032 / 332			Circuit A Refr. Fail	0=Normal; 1= Fail
10033 / 333			Circuit B Refr. Fail	0=Normal; 1= Fail

NOTES:

Range Note 1: This is a real-number value. BACnet uses this directly. In the Modbus case, use values in TENTHS of degrees: Low-Range = 0.0, High-Range = 409.5 (on a 4095 counts scale)

Range Note 2: : This is a real-number value. BACnet uses this directly. In the Modbus case, use Low-Range = 0.0, and High-Range = 100.0.

Range Note 3: This is a pressure measurement, in units of "inches of water column". BACnet uses this directly. In the Modbus case, use Low-Range = 0.0 and High-Range = 10.0 (inches).

Range Note 4: This is an Enthalpy measurement, in units of "BTU/pound of dry air". BACnet uses this directly. In the Modbus case, use Low-Range = 0.0 and High-Range = 50.0 (BTU/lb).

INTELLIPAK CONTROL NOTE: On many Intellipaks, the OCC/UNOCC does NOT work, and you have to use the AUTO/SHUTDOWN point (BO #10) instead. It all depends on how the Intellipak is configured. Also note that the "Computed Host Setpoint" is what controls the Intellipak's "***Active Morning Warmup from Tracer***" and "***Active Uncc Zone Sensor Input from Tracer***" setpoints, together.

VOYAGER CONTROL NOTE: On VariTrac CCP systems, you do NOT set any temperature setpoints in the Voyager/Precedent/Reliatel unit(s). You MUST control AO #34 according to what you want it to. See the discussion in the section on VariTrac CCP replacement. ON ALL OTHER SYSTEMS, do NOT bring out or control this point!

Device Point Mapping for TUCs:

Monitor Reg # / Inst. #	Control Reg # / Inst. #	TUC (2- or 4-pipr Fan-Coils, Or Unit-Vents) Usage	TUC (Water Source Heat Pump) Usage	Ranges & Notes
ANALOGS:				
30001 / 1		Zone Temp	Zone Temp	Deg F; Range Note 1
30002 / 2		Active Heating Setpoint	Active Heating Setpoint	Deg F; Range Note 1
30003 / 3		Active Cooling Setpoint	Active Cooling Setpoint	Deg F; Range Note 1
30004 / 4	40004 / 104	Occupied Heating Setpoint	Occupied Heating Setpoint	Deg F; Range Note 1
30005 / 5	40005 / 105	Occupied Cooling Setpoint	Occupied Cooling Setpoint	Deg F; Range Note 1
30006 / 6	40006 / 106	Unoccupied Heating Setpoint	Unoccupied Heating Setpoint	Deg F; Range Note 1
30007 / 7	40007 / 107	Unoccupied Cooling Setpoint	Unoccupied Cooling Setpoint	Deg F; Range Note 1
30008 / 8		Damper Minimum Position	Damper Minimum Position	Pct; Range Note 2
30010 / 10		Discharge Air Temp	Discharge Air Temp	Deg F; Range Note 1
30011 / 11		Heating Capacity	Heating Capacity	Pct; Range Note 2
30012 / 12		Cooling Capacity	Cooling Capacity	Pct; Range Note 2
30013 / 13		Valve 1 Position (AO)	Valve 1 Position (AO)	Pct; Notes 2 and 5
30014 / 14		Valve 2 Position (AO)	Valve 2 Position (AO)	Pct; Notes 2 and 5
30015 / 15	40015 / 115	Heating Setpoint High Limit	Heating Setpoint High Limit	Deg F; Range Note 1
30016 / 16	40016 / 116	Heating Setpoint Low Limit	Heating Setpoint Low Limit	Deg F; Range Note 1
30017 / 17	40017 / 117	Cooling Setpoint HighLimit	Cooling Setpoint High Limit	Deg F; Range Note 1
30018 / 18	40018 / 118	Cooling Setpoint Low Limit	Cooling Setpoint Low Limit	Deg F; Range Note 1
30019 / 19	40019 / 119	Outside Air Temp (Ctld)	Outside Air Temp (Ctld)	Deg F; Notes 1 and 3
30020 / 20	40020 / 120	Supply Water Temp (Ctld)	Supply Water Temp (Ctld)	Deg F; Notes 1 and 3
30021 / 21		Computed Offset/Needed Temp	Computed Offset/Needed Temp	Deg F; Notes 1 and 4
30022 / 22		Valve 1 Position (2 DO)	Valve 1 Position (2 DO)	Pct; Notes 2 and 5
30023 / 23		Valve 2 Position (2 DO)	Valve 2 Position (2 DO)	Pct; Notes 2 and 5
30024 / 24	40024 / 124	Cooling Maximum	Cooling Maximum	Pct; Notes 2 and 6
30025 / 25	40025 / 125	Heating Maximum	Heating Maximum	Pct; Notes 2 and 6
30026/ 26		Thermostat Temp (Position)	Thermostat Temp (Position)	Deg F; Range Note 1
30027 / 27		Diagnostics Code (Active)	Diagnostics Code (Active)	Code; See Note 7
30028 / 28		Return Air Temperature	Return Air Temperature	Deg F; Range Note 1
30029 / 29		Entering Water Temperature	Entering Water Temperature	Deg F; Range Note 1
30030 / 30		Leaving Water #1 Temperature	Leaving Water #1 Temperature	Deg F; Range Note 1
30031 / 31		Leaving Water #2 Temperature	Leaving Water #2 Temperature	Deg F; Range Note 1
DIGITALS:				
10001 / 301		Fan Status	Fan Status	0=Off; 1 = On
10002 / 302		Heating Mode Status	Heating Mode Status	0=Off; 1 = Heating
10003 / 303		Cooling Mode Status	Cooling Mode Status	0=Off; 1 = Cooling
10004 / 304		Control Status	Control Status	0=Off; 1 = Running
10010 / 310	10 / 410	Control Source	Control Source	0=Local; 1 = REMOTE
10012 / 312	12 / 412	OCC/UNOCC Mode Control	OCC/UNOCC Mode Control	0 = OCC; 1 = UNOCC
10017 / 317	17 / 417	Fan Forced ON	Fan Forced ON	0=Normal; 1 = Forced
10018 / 318	18 / 418	Fan Forced OFF	Fan Forced OFF	0=Normal; 1 = Forced

10019 / 319	19 / 419	Exhaust Fan Forced ON	Exhaust Fan Forced ON	0=Normal; 1 = Forced
10020 / 320	20 / 420	Exhaust Fan Forced OFF	Exhaust Fan Forced OFF	0=Normal; 1 = Forced
10021 / 321	21 / 421	Valve V1 Forced OPEN	Valve V1 Forced OPEN	0=Normal; 1 = Forced
10022 / 322	22 / 422	Valve V1 Forced CLOSED	Valve V1 Forced CLOSED	0=Normal; 1 = Forced
10023 / 323	23 / 423	Valve V2 Forced OPEN	Valve V2 Forced OPEN	0=Normal; 1 = Forced
10024 / 324	24 / 424	Valve V2 Forced CLOSED	Valve V2 Forced CLOSED	0=Normal; 1 = Forced
10025 / 325	25 / 425	Exhaust Fan ENABLE/DISABLE	Exhaust Fan ENABLE/DISABLE	0=Disable; 1 = Enable
10026 / 326	26 / 426	Heat/Cool Mode	Heat/Cool Mode	0=Local; 1 = REMOTE
10027 / 327	27 / 427	Tracer (Remote) Heating/Cooling	Tracer (Remote) Heating/Cooling	0=Heating; 1 = Cooling
10028 / 328		Latched Diagnostics in Unit	Latched Diagnostics in Unit	0=OK; 1 = FAILURE
	29 / 429	Reset Diagnostics (Output Only)	Reset Diagnostics (Output Only)	control ON to RESET
10030 / 330		Filter Status	Filter Status	0 = OK; 1 = DIRTY
10031 / 331		Freeze Status	Freeze Status	0 = OK; 1 = FAILURE
10032 / 332		Smoke Alarm	Smoke Alarm	0 = OK; 1 = SMOKE

NOTES:

Range Note 1: This is a real-number value. BACnet uses this directly. In the Modbus case, use values in TENTHS of degrees: Low-Range = 0.0, High-Range = 409.5 (on a 4095 counts scale)

Range Note 2: : This is a real-number value. BACnet uses this directly. In the Modbus case, use Low-Range = 0.0, and High-Range = 100.0.

Note 3: This is used by systems that send the OSA temp down to the TCUs.

Note 4: The TUC computes how far off it is from setpoint and what it would take to bring the point into setpoint control. See the Trane TUC manual.

Note 5: Use AO/AI 13 & 14 for Analog Output Valves. Use AO/AI 22 & 23 for valves that use UP and DOWN binary outputs.

Note 6: The Controlled Maximums for Cooling and Heating are the maximum values that the TUC will use. Set to 0% for "disabling" the Cooling or Heating.

Diagnostic Codes, Note 7: There are tons of diagnostic codes for the TUCs, and we will not present them all here. These are the most common, but if you get another not in this list, please consult your Trane TUC Operations Manual.

```
0   Code 0:    No diagnostics present.  Everything is fine!
1   Code 1:    External Interlock Engaged
2   Code 72:   Low Discharge Air Temperature
3   Code 119:  Defrost Mode Failure
4   Code 139:  Condensate Overflow
5   Code 155:  Leaving Water Sensor #1 Failure
6   Code 156:  Leaving Water Sensor #2 Failure
7   Code 157:  Leaving Water Sensor #3 Failure
8   Code 158:  Leaving Water Sensor #4 Failure
9   Code 160:  Zone or Discharge Air Temperature Sensor Failure
```

```
Code 161:  Fan Failure; Electric Heat has been Disabled
Code 181:  Low Pressure Cutout #1 Failure
Code 182:  Low Pressure Cutout #2 Failure
Code 183:  Low Pressure Cutout #3 Failure
Code 198:  Low Leaving Water Temperature
Code 200:  High Entering Water Temperature
Code 203:  Low Entering Water Temperature
Code 206:  Fan Failure, General
Code 200:  Freeze Stat Alarm
Code 211:  Low Discharge Air Temperature
Code 212:  Smoke Alarm
Code 213:  High Discharge Air Temperature
Code 245:  High Pressure Cutout #1 Failure
Code 246:  High Pressure Cutout #2 Failure
Code 247:  High Pressure Cutout #3 Failure
Code 254:  High Return Air Temperature
```

Device Point Mapping for CCP Damper Controllers:

Monitor Reg # / Inst. #	Control Reg # / Inst. #	TUC (2- or 4-pipr Fan-Coils, Or Unit-Vents) Usage	Ranges & Notes
ANALOGS:			
30001 / 1	1 / 401	Damper Position & Control	%; Range Note 1
30002 / 2		Discharge Air Temperature	Deg F; Range Note 2
30003 / 3		Duct Static Pressure	IWC; Range Note3

Range Note 1: This is a real-number value. BACnet uses this directly. In the Modbus case, use Low-Range = 0.0, and High-Range = 100.0.

Range Note 2: This is a real-number value. BACnet uses this directly. In the Modbus case, use values in TENTHS of degrees: Low-Range = 0.0, High-Range = 409.5 (on a 4095 counts scale)

Range Note 3: This is a pressure measurement, in units of "inches of water column". BACnet uses this directly. In the Modbus case, use Low-Range = 0.0 and High-Range = 10.0 (inches).

Device Point Mapping for FCU (1200 baud):

Monitor Reg # / Inst. #	Control Reg # / Inst. #	Fan Coil Units (older) Usage	Ranges & Notes
ANALOGS:			
30001 / 1		Zone Temp	Deg F; Range Note 1
30002 / 2		Active Heating Setpoint	Deg F; Range Note 1
30003 / 3		Active Cooling Setpoint	Deg F; Range Note 1
30004 / 4	40004 / 104	Occupied Heating Setpoint	Deg F; Range Note 1
30005 / 5	40005 / 105	Occupied Cooling Setpoint	Deg F; Range Note 1
30006 / 6	40006 / 106	Unoccupied Heating Setpoint	Deg F; Range Note 1
30007 / 7	40007 / 107	Unoccupied Cooling Setpoint	Deg F; Range Note 1
30008 / 8		Cooling Valve Position	Pct; Range Note 2
30009 / 9		Heating Valve Position	Pct; Range Note 2
30017 / 17	40017 / 117	Cooling Setpoint Low Limit	Deg F; Range Note 1
30018 / 18	40018 / 118	Heating Setpoint High Limit	Deg F; Range Note 1
30019 / 19		Electric Heating Output	Pct; Range Note 2
DIGITALS:			
10001 / 301		Fan LOW Status	0=(N/A); 1= LOW
10002 / 302		Fan MEDIUM Status	0=(N/A); 1= MEDIUM
10003 / 303		Fan HIGH Status	0=(N/A); 1= HIGH
10004 / 304	4 / 404	FCU Status and Control	0 = ENABLED; 1 = OFF (Disabled)
10009 / 309	9 / 409	Fan FORCED to LOW	0=Normal; 1= Forced
10010 / 310	10 / 410	Fan FORCED to MEDIUM	0=Normal; 1= Forced
10011 / 311	11 / 411	Fan FORCED to HIGH	0=Normal; 1= Forced
10012 / 312	12 / 412	OCC/UNOCC Mode Status/Control	0 = OCC; 1 = UNOCC
10013 / 313	13 / 413	Local Setpoint Control Mode	0 = REMOTE; 1= LOCAL
10014 / 414	14 / 414	Local Fan Control Mode	0 = REMOTE; 1 = LOCAL

NOTES:

ACT HEAT/COOL SPTS: Point 2, Point 3: When in “Local Setpoint” control is in LOCAL (point 13), these two points read the setpoint knob on the thermostat (with a three degree deadband). When the “Local Setpoint” control is in REMOTE (point 13), then the active cooling and heating setpoints are what is sent down to the FCU (in points 4,5 or 6,7).

MODES Note: Point 4: This is the “Unit Enable/Disable” feature in Summit, which is numerically 1 or 2, respectively, on the old system. Point 13: This is FORCED (to use point 12’s control values), or AUTO (0 on the Trane system) to allow the FCU auto control. The OCC/UNOCC control and status (point 12) basically switches the unit to OCC or UNOCC setpoints, but only if the Local Setpoint control mode (point 13) is REMOTE.

Range Note 1: For Fan Coil Units, this is a count value, 0 to 255, representing degrees F, in integer format. In the Modbus case, use Low-Range = 0, and High-Range = 255.

Range Note 2: The Trane FCU equipment uses percentage points, which are sent back as 0 to 100 counts representing 0 to 100 percent, in integer format.

Device Point Mapping for UCP2 (Chiller) Controllers:

Monitor Reg # / Inst. #	Control Reg # / Inst. #	Chiller point Usage	Chiller Types And Notes	Ranges & Notes
ANALOGS:				
30001 / 1	40001/101	CHW Temperature Setpoint	All types	Deg F; Range Note 1
30002 / 2	40002/102	Current Limit Setpoint	All types	Pct; Range Note 2
30003 / 3		Evaporator Entering Water Temp	All types	Deg F; Range Note 1
30004 / 4		Evaporator Leaving Water Temp	All types	Deg F; Range Note 1
30005 / 5		Condenser Entering Water Temp	All types	Deg F; Range Note 1
30006 / 6		Condenser Leaving Water Temp	All types	Deg F; Range Note 1
30007 / 7		Saturated Condenser Water Temp		Deg F; Range Note 1
30008 / 8		Compressor Discharge Water Temp		Deg F; Range Note 1
30009 / 9		Saturated Evaporator Refr. Temp		Deg F; Range Note 1
30010 / 10	40010 / 110	Outside Air Temperature	All (Control, Note 5)	Deg F; Range Note 1
30011 / 11		Discharge Superheat Temp	NOT on Centrifugal	Deg F; Range Note 1
30012 / 12		Evaporator Approach Temp	All types	Deg F; Range Note 1
30013 / 13		Condenser Approach Temp	All types	Deg F; Range Note 1
30014 / 14		Expansion Valve or IGV Position	(See AI #11:Note 6)	Pct; Range Note 2
30015 / 15		A-Line current %RLH	All types	Pct; Range Note 2
30016 / 16		B-Line current %RLH	All types	Pct; Range Note 2
30017 / 17		C-Line current %RLH	All types	Pct; Range Note 2
30018 / 18		Evaporator Refrigerant Pressure		PSIG; Range Note 2
30019 / 19		Condenser Refrigerant Pressure		PSIG; Range Note 2
30020 / 20		Number of Starts	All types	#Starts, Integer, Note 3
30021 / 21		Run Time Hours	All types	Hours, Integer, Note 3
30022 / 22		Compressor Speed	All types	RPM, Range Note 4
30023 / 23		Compressor Motor Winding A Temp	All types	Deg F; Range Note 1
30024 / 24		Compressor Motor Winding B Temp	All types	Deg F; Range Note 1
30025 / 25		Compressor Motor Winding C Temp	All types	Deg F; Range Note 1
30026 / 26		Voltage, Phase A	All types	Volts, Range Note 1
30027 / 27		Voltage, Phase B	All types	Volts, Range Note 1
30028 / 28		Voltage, Phase C	All types	Volts, Range Note 1
30029 / 29		Bearing Temp #1	All types	Deg F; Range Note 1
30030 / 30		Bearing Temp #2	All types	Deg F; Range Note 1
30031 / 31		Oil Pressure, Low Side	All types (Note 7)	PSIG; Range Note 2
30032 / 32		Oil Pressure, High Side	All types (Note 7)	PSIG; Range Note 2
30033 / 33		Oil Pressure, Differential	All types (Note 7)	PSIG; Range Note 2
30034 / 34		Purge Liquid Temperature	All types	Deg F; Range Note 1
30035 / 35		Line Current Imbalance	Most types	Amps; Range Note 1
30036 / 36		Capacity	Most types	% or Tons; Range Note 8
30037 / 37		Oil Tank Temperature	Centrifugal ONLY	Deg F; Range Note 1
30038 / 38		Power Consumption	Most types	kW; Range Note 1
30039 / 39		CHW Entering Pressure	Some types	PSIG; Range Note 2
30040 / 40		CHW Leaving Pressure	Some types	PSIG; Range Note 2
30041 / 41		CHW Flow	Some types	GPM; Range Note 2
30042 / 42		Diagnostics Code	Al Types (Note 9)	Code; see table, below
30043 / 43	40043 / 143	Base Load Current Limit SPT	Centrifugal ONLY	Pct; Range Note 2

30044 / 44		Water Flow	Some types	GPM; Range Note 2
30045 / 45		Power Factor	Most types	PF, as %; Range Note 2
DIGITALS:				
10001 / 301	1 / 401	CHW Pump Status/Control	All types	0=Auto; 1= Forced
10002 / 302	2 / 402	CDW Pump Status/Control		0=Auto; 1= Forced
10003 / 303	3 / 403	OCC/UNOCC Mode Status/Control	All types	0 = OCC; 1 = UNOCC
10004 / 304	3 / 405	Aux Relay Status/Control	NOT on Centrifugal	0 = OFF; 1 = ON
10005 / 305		Evaporator Flow Proof	All types	0 = NO-FLOW, 1 = FLOW
10006 / 306		Chilled Water Flow Proof	All types	0 = NO-FLOW, 1 = FLOW
10007 / 307		Chiller Run Status	All types	0 = ASLEEP, 1 = RUNNING

NOTES:

Range Note 1: For Chillers, Temperatures, KiloWatts, Amps and Volts are sent back in TENTHS of a Degree-F, kW, Amps, or Volt. Range is simple: Each count represents 0.1 degrees F, or Volt, in integer format. In the Modbus case, use Low-Range = 0, and High-Range = 255, for a 0 to 2550 counts range.

Range Note 2: For Percentage and PSIG, Trane UCP2 equipment uses percentage points, in tenths, which are sent back as 0 to 1000 counts representing 0 to 100.0 percent. Note that we use PSIG, but that the Chiller's front-panel can be set for display in PSIA or PSIG; don't be confused by this.

Range Note 3: The Trane UCP2 stores starts as an integer number. Trane run-time is stored in seconds. We translate that to an integer value, so the number we present in AI-21 of run-hours only. This is from the time of the unit's birth, at the Trane Factory. Just don't ask who the mid-wife was...

Range, Note 4: The Trane UCP2 gives back both Hz and RPM for the compressor speed. We have arbitrarily selected RPM as the value to present. This ranges from 0 to 6000 RPM.

Control, Note 5: Most units do not have their own outside air temperature sensor, and rely on the host system (namely, YOUR controls) to send down the OSA temperature once every so often. We recommend 5 minutes, which is what the Trane systems are usually set up for, but a better value would be to take 10 one-minute-readings and create **an average OSA temp**, and send that down once every ten minutes.

AI #11, Note 6: For Scroll and Absorber Chillers, this is the Expansion Valve Position. For Centrifugal Chillers, this is the Inlet Guide Vane (IGV) Position on the compressor.

Pressures, Note 7: For Centrifugal chillers, these have special meaning: The "low-side" is Oil Tank Pressure; the "high-side" is the Oil Pump Pressure, and the "Differential" is still just the difference between them.

Range Note 8: This value is in tenths, but may be in TONS or %-of-maximum. We have had reports of both, but it is unclear if this is by chiller type or software version. Try percentage first, but be aware that it could be in tons.

Diagnostic Codes, Note 8: There are tons of diagnostic codes for these chillers, and we will not present them all here. These are the most common, but if you get another not in this list, please consult your Trane Chiller Operations Manual.

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0   Code 0:    No diagnostics present.  Everything is fine!
1   Code 138:  Chilled Water Flow Failure
2   Code 142:  Evaporator Entering Water Temp Sensor Failure
3   Code 143:  Condenser Refrigerant Temp Sensor (Circuit 1) Failure
4   Code 144:  Condenser Refrigerant Temp Sensor (Circuit 2) Failure
5   Code 147:  Evaporator Refrigerant Temp Sensor (Circuit 1) Failure
6   Code 148:  Evaporator Refrigerant Temp Sensor (Circuit 2) Failure
7   Code 154:  Condenser Entering Water Temp Sensor
8   Code 155:  Condenser Leaving Water Temp Sensor
9   Code 160:  Zone Temp Sensor Failure
10  Code 161:  Outdoor Air Temp Sensor Failure
11  Code 171:  Evaporator Leaving Water Temp Sensor Failure
12  Code 181:  Low Pressure Cutout (Circuit 1) Failure
13  Code 182:  Low Pressure Cutout (Circuit 2) Failure
14  Code 186:  Overload Trip on Compressor A
15  Code 187:  Overload Trip on Compressor B
16  Code 188:  Overload Trip on Compressor C
17  Code 189:  Overload Trip on Compressor D
18  Code 190:  High Pressure Cutout on Compressor C
19  Code 191:  High Pressure Cutout on Compressor D
20  Code 197:  Low CHW Temperature, Unit OFF
21  Code 188:  Low CHW Temperature, Unit ON
22  Code 215:  Over-Voltage Condition
23  Code 216:  Under-Voltage Condition
24  Code 237:  Chilled Water Flow Interlock Failure
25  Code 245:  High Pressure Cutout on Compressor A
26  Code 246:  High Pressure Cutout on Compressor B
27  Code 253:  Emergency Stop Condition (Local Input)
28  Code 400:  Low Superheat Temperature (Circuit 1)
29  Code 401:  Low Superheat Temperature (Circuit 2)
30  Code 404:  Low Evaporator Refrigerant Temperature (Circuit 1)
31  Code 405:  Low Evaporator Refrigerant Temperature (Circuit 2)
32  Code 408:  Low Oil Flow on Compressor A
33  Code 409:  Low Oil Flow on Compressor B
34  Code 410:  Low Oil Flow on Compressor C
35  Code 411:  Low Oil Flow on Compressor D
36  Code 412:  Phase Loss on Compressor A
37  Code 413:  Phase Loss on Compressor B
38  Code 414:  Phase Loss on Compressor C
39  Code 415:  Phase Loss on Compressor D
40  Code 416:  Power Loss on Compressor A
41  Code 417:  Power Loss on Compressor B
42  Code 418:  Power Loss on Compressor C
43  Code 419:  Power Loss on Compressor D
44  Code 421:  Oil Flow Problem on Compressor A
45  Code 422:  Oil Flow Problem on Compressor B
46  Code 423:  Oil Flow Problem on Compressor C
47  Code 424:  Oil Flow Problem on Compressor D
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48 Code 425: Low Differential Pressure (Circuit 1)
49 Code 426: Low Differential Pressure (Circuit 2)
50 Code 454: High Differential Pressure (Circuit 1)
51 Code 455: High Differential Pressure (Circuit 2)
52 Code 467: Compressor Suction Temp Sensor Failure (Circuit 1)
53 Code 468: Compressor Suction Temp Sensor Failure (Circuit 2)
54 Code 477: High Oil Temperature on Compressor A
55 Code 478: High Oil Temperature on Compressor B
56 Code 479: High Oil Temperature on Compressor C
57 Code 480: High Oil Temperature on Compressor D
58 Code 481: Oil System Failure on Compressor A
59 Code 482: Oil System Failure on Compressor B
60 Code 483: Oil System Failure on Compressor C
61 Code 484: Oil System Failure on Compressor D
62 Code 485: Entering Oil Temp Sensor Failure on Compressor A
63 Code 486: Entering Oil Temp Sensor Failure on Compressor B
64 Code 487: Entering Oil Temp Sensor Failure on Compressor C
65 Code 488: Entering Oil Temp Sensor Failure on Compressor D
66 Code 673: Condenser VFD Fault (Circuit 1)
67 Code 674: Condenser VFD Fault (Circuit 2)
68 Code 677: High Purge Liquid Level
69 Code 912: BAS Communications not established
70 Code 920: BAS Communications lost
71 Codes in the 1000 to 1200 range: Communications lost between modules (refer to the Trane manual for which module is affected).

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