Installation Guide

Variable Refrigerant Flow (VRF) System

VRF System Controller with BACnet

Model Number: **TVCTRLSCBB17A0**

⚠ SAFETY WARNING

Only qualified personnel should install and service the equipment. The installation, starting up, and servicing of heating, ventilating, and air-conditioning equipment can be hazardous and requires specific knowledge and training. Improperly installed, adjusted or altered equipment by an unqualified person could result in death or serious injury. When working on the equipment, observe all precautions in the literature and on the tags, stickers, and labels that are attached to the equipment.

June 2017

VRF-SVX35B-EN

Ingersoll Rand

Introduction

Warnings, Cautions, and Notices

Safety advisories appear throughout this manual as required. Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

The three types of advisories are defined as follows:

⚠WARNING Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠CAUTION Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It could also be used to alert against unsafe practices.

NOTICE Indicates a situation that could result in equipment or property-damage only accidents.

Important Environmental Concerns

Scientific research has shown that certain man-made chemicals can affect the earth's naturally occurring stratospheric ozone layer when released to the atmosphere. In particular, several of the identified chemicals that may affect the ozone layer are refrigerants that contain Chlorine, Fluorine and Carbon (CFCs) and those containing Hydrogen, Chlorine, Fluorine and Carbon (HCFCs). Not all refrigerants containing these compounds have the same potential impact to the environment. Trane advocates the responsible handling of all refrigerants—including industry replacements for CFCs and HCFCs such as saturated and unsaturated HFCs and HCFCs.

Important Responsible Refrigerant Practices

Trane believes that responsible refrigerant practices are important to the environment, our customers, and the air conditioning industry. All technicians who handle refrigerants must be certified. The Federal Clean Air Act (Section 608) sets forth the requirements for handling, reclaiming, recovering and recycling of certain refrigerants and the equipment that is used in these service procedures. In addition, some states or municipalities may have additional requirements that must also be adhered to for responsible management of refrigerants. Know the applicable laws and follow them.

⚠WARNING

Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury. All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state electrical codes. Failure to follow code could result in death or serious injury.

t

⚠WARNING

Personal Protective Equipment (PPE) Required!

Failure to wear proper PPE for the job being undertaken could result in death or serious injury. Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, MUST follow precautions in this manual and on the tags, stickers, and labels, as well as the instructions below:

- **Before installing/servicing this unit, technicians MUST put on all PPE required for the work being undertaken (Examples; cut resistant gloves/sleeves, butyl gloves, safety glasses, hard hat/bump cap, fall protection, electrical PPE and arc flash clothing). ALWAYS refer to appropriate Material Safety Data Sheets (MSDS)/Safety Data Sheets (SDS) and OSHA guidelines for proper PPE.**
- **When working with or around hazardous chemicals, ALWAYS refer to the appropriate MSDS/SDS and OSHA/GHS (Global Harmonized System of Classification and Labelling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection and handling instructions.**
- **If there is a risk of energized electrical contact, arc, or flash, technicians MUST put on all PPE in accordance with OSHA, NFPA 70E, or other country-specific requirements for arc flash protection, PRIOR to servicing the unit. NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASH CLOTHING. ENSURE ELECTRICAL METERS AND EQUIPMENT ARE PROPERLY RATED FOR INTENDED VOLTAGE.**

Copyright

Trademarks

All trademarks referenced in this document are the trademarks of their respective owners.

Revision History

The new model, TVCTRLSCBB17A0, includes software changes.

Table of Contents

Product Overview

The Trane® Variable Refrigerant Flow System Controller (VRF SC) is an Internet-based central management control device for a Trane Variable Refrigerant Flow (VRF) system that may operate as a stand-alone control system or be integrated with a BACnet®-based building automation system (BAS).

VRF SC Components

Front

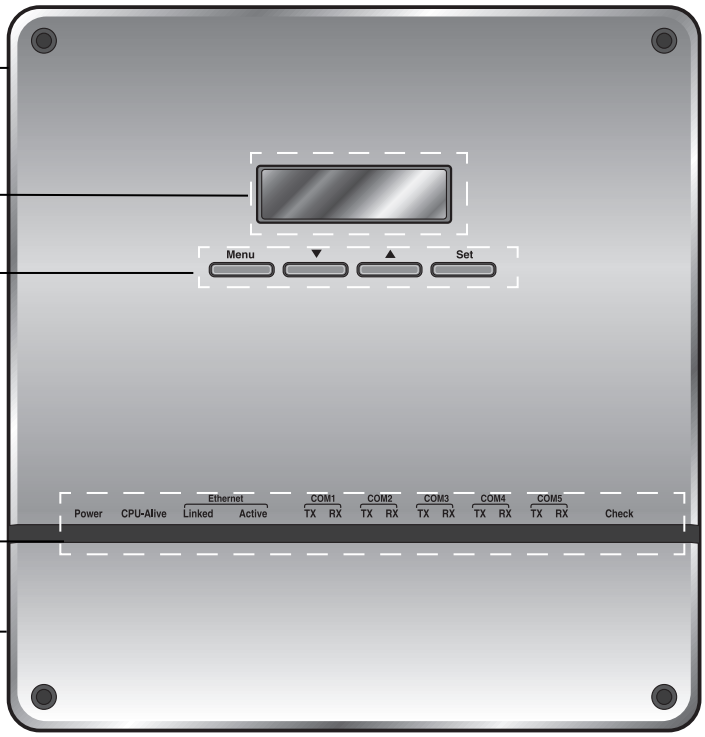
Top cover: Removal is necessary only to access screw knock-outs if additional mounting support is needed (see "Interior," p.9).

LCD panel: Shows current time and IP address. Various messages are displayed depending on button input.

LCD operation buttons:
- Menu
- Down arrow
- Up arrow
- Set

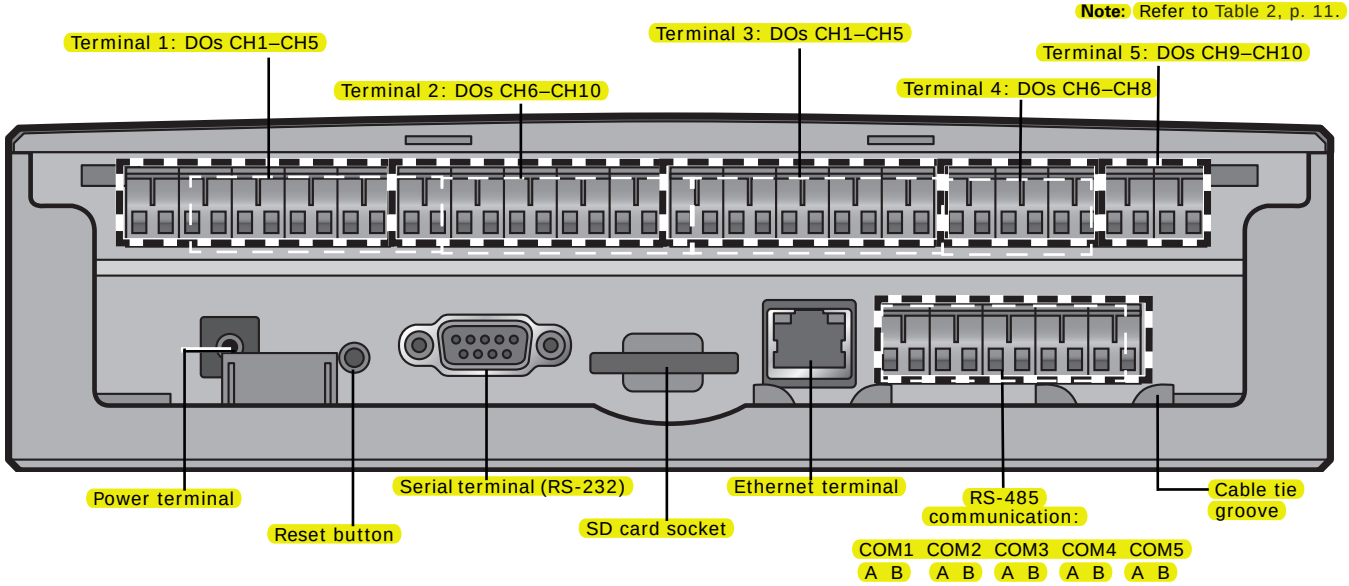
LEDs
(see Table 1, p. 10)

Bottom cover: To remove the cover, remove the two screws in the bottom corners and slide the bottom cover down.



Bottom: Terminals and associated hardware (with bottom cover removed)

Note: Refer to Table 2, p. 11.



Interior

The main board and sub-board can be viewed with the top cover removed.

Note: *Top cover removal is necessary only if additional knock-outs need to be accessed for screwing the controller to the mounting surface.*

1. Remove the two screws in the top corners.

2. Slide a small screwdriver between the cover and the body to separate them. Lift the cover off gently. The cover is attached to the interior of the body with a ribbon connector.

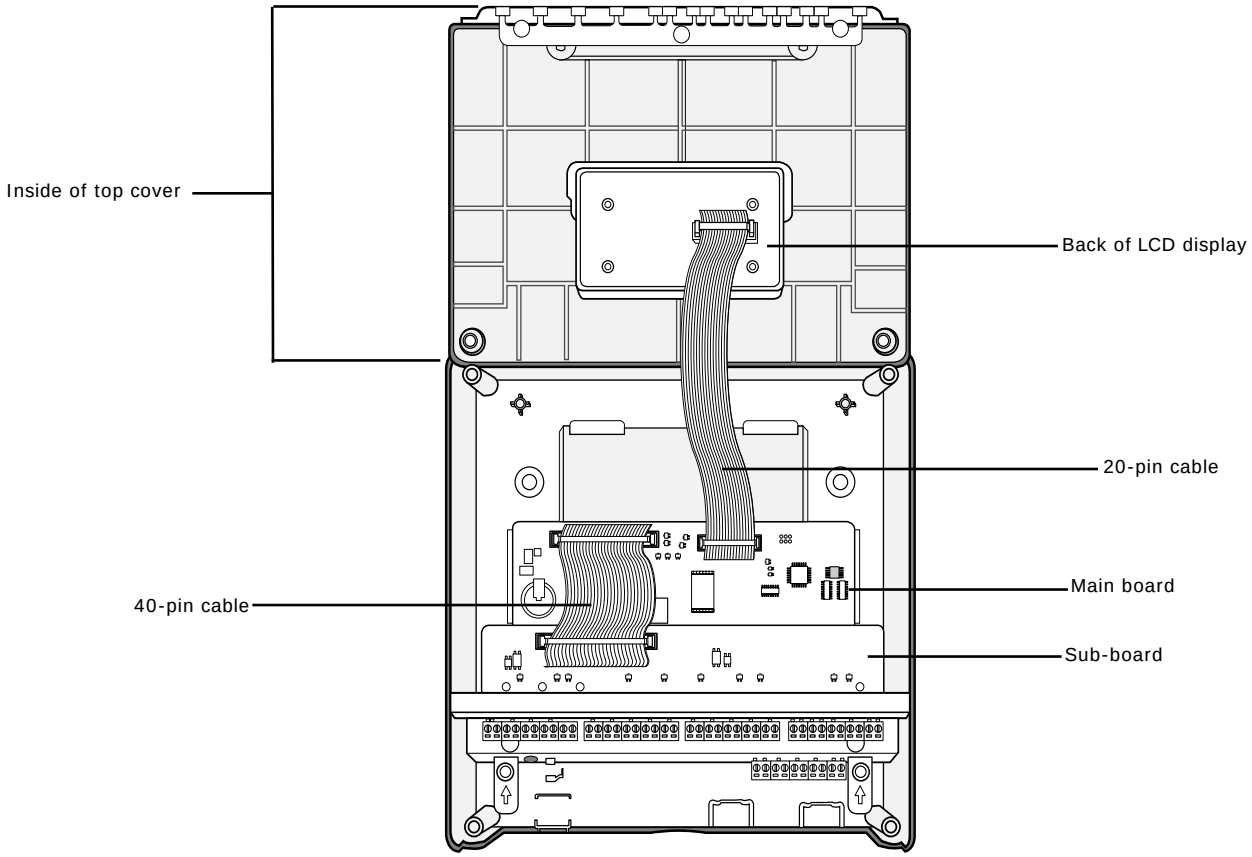


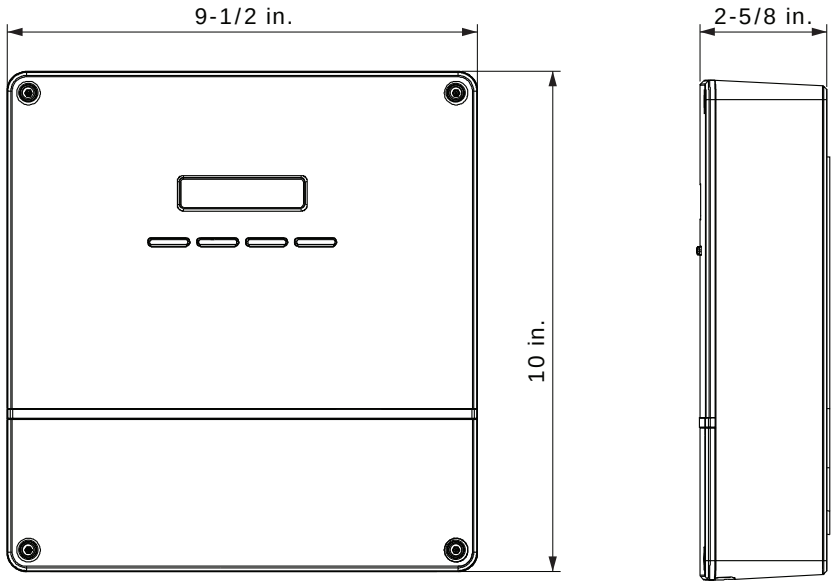
Table 1. LEDs

Name	Description	Activity
Power	Power indicator	Constantly lit (blue) when power is supplied.
CPU-Alive	Central processing unit (CPU) indicator	Flashes (orange) once per second during normal operation.
Internet: Linked	Communication link indicator	Constantly lit (green) during normal operation.
Internet: Active	Data transmission/reception indicator	Flashes (orange) during normal transmission and reception.
COM TX-RX (5 channels)	Data transmission/reception on channels 1–5 with VRF On/Off Central Control, VRF Touchscreen, and outdoor unit	Flashes (green) during normal transmission and reception.
Check	Indoor unit/Outdoor unit/communication indicator	Constantly lit (green) if notice occurs.

Table 2. Terminals and associated hardware

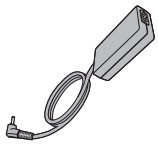
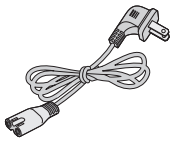
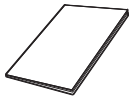
Name	Description
Terminal 1	Digital input connection terminal: Inputs 1–5
Terminal 2	Digital input connection terminal: Inputs 6–10
Terminal 3	Digital output connection terminal: Outputs 1–5
Terminal 4	Digital output connection terminal: Outputs 6–8
Reset button	Resets the system controller
Power terminal	Connection for power supply input
Serial terminal	No function.
SD card socket	For updating firmware
RS-485 communication terminals	For communication with devices such as VRF On/Off Central Control and Outdoor Unit (COM1–COM5)
Ethernet terminal	Local area network (LAN) cable connection
Cable tie groove	For arranging cables

Dimensions

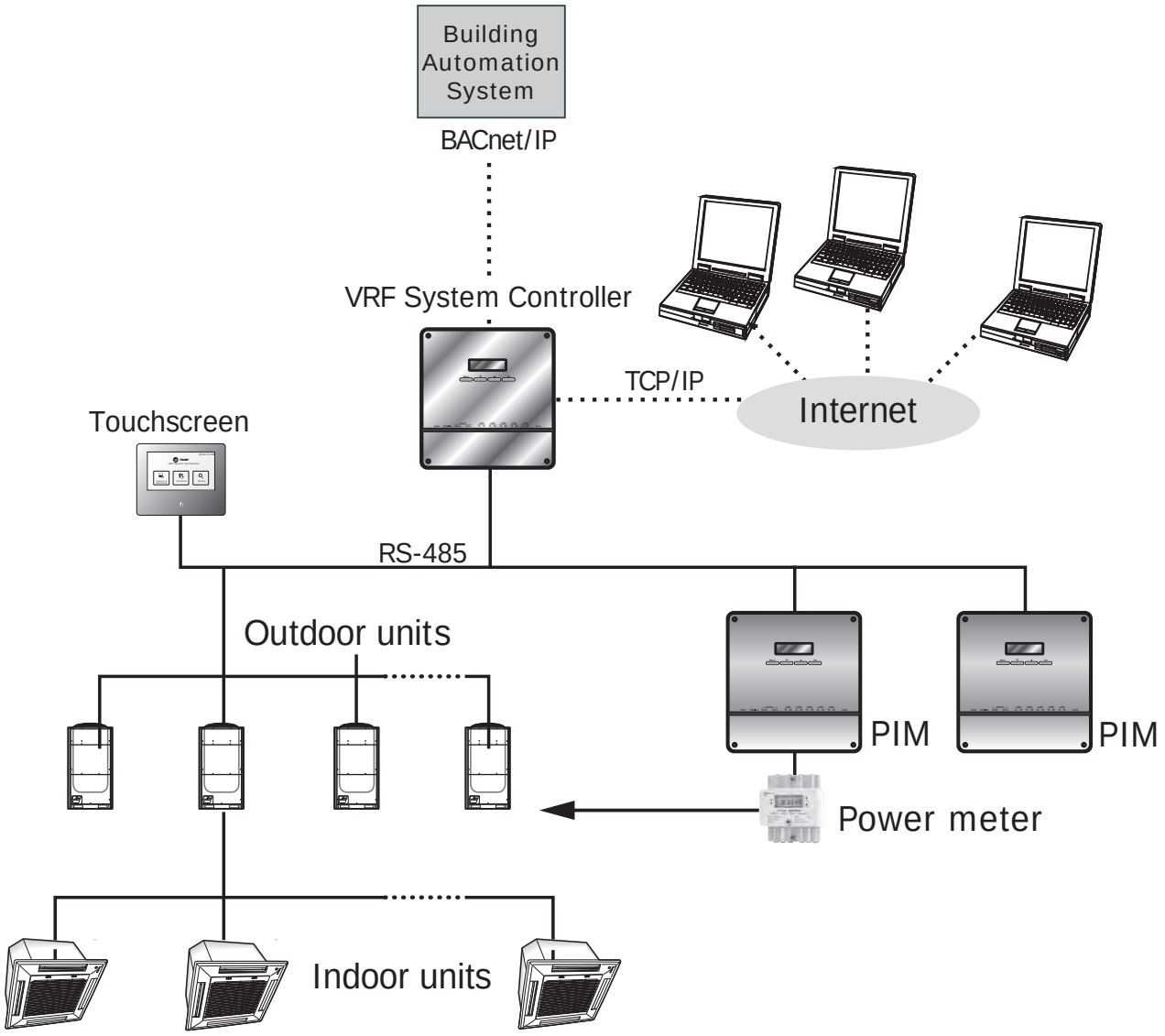


Accessories

The VRF SC is shipped with the following accessories:

Adapter	Power cable	M4x16 screws (6)	Cable ties	Manual
				

System Architecture



Compatible Devices

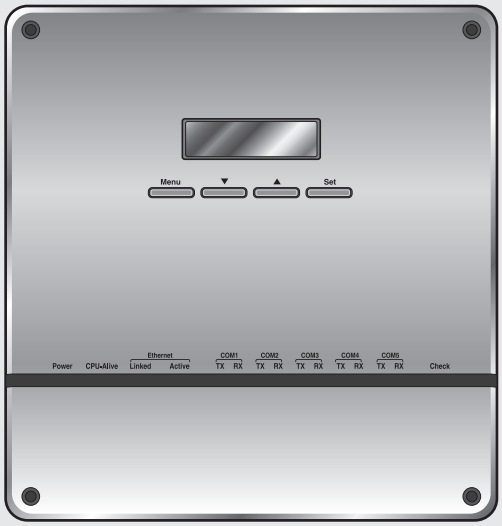
Device	Model	Note
Indoor units Outdoor units	All models	—
Power Meter Interface Module (PIM)	TVCTRLTIMB16A0	Needed for EHP power distribution
Watt-hour meter(1)	Pulse type	Connected through PIM inputs Pulse width: 20–1000 ms Pulse: 1–10,000 (Wh/pulse)

(1) Not a Trane product. Must be purchased separately.

Maximum Quantity of Devices

Device	Maximum quantity	Note
Indoor units	256	Must not exceed 128 units per each RS-485 communication terminal.
Outdoor unit	80	Must not exceed 16 units per each RS-485 communication terminal x 5 channels.
Power Meter Interface Module (PIM)	8	Contact Trane technical support to determine version compatibility which affects communication mode setting.
Watt-hour meter	64	Maximum of 8 meters can be connected to a PIM.

Specifications

Items		Description
Exterior		
Size		9-1/2 in. width x 10 in. height x 2-5/8 in. depth)
Weight		3.26 lbs.
Power	Source	DC ADAPTOR
	INPUT voltage	100-240 V 50/60 Hz 1.0 A
	OUTPUT voltage	12V 3A
Interface	RS485	5 Channels
	Ethernet	10/100 Mbps 1 Port
	SD Card	Option (Purchase SD card separately)
	DI	12V Digital Input 10 Channels
	DO	12V Digital Output 8 Channels
	Etc.	Serial Port, Reset Button
Display		16-Character X 2-Line Character LCD
Input method		Menu/Up/Down/Set 4-Tact Button

Installation

Mounting the Unit

Refer to the illustrations in Table 3 as you mount the unit.

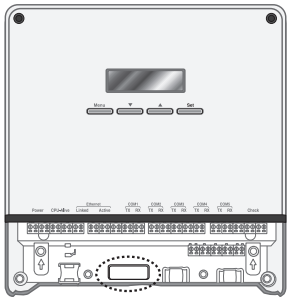
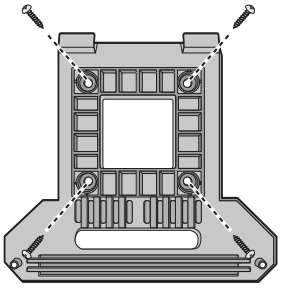
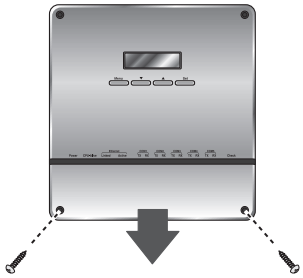
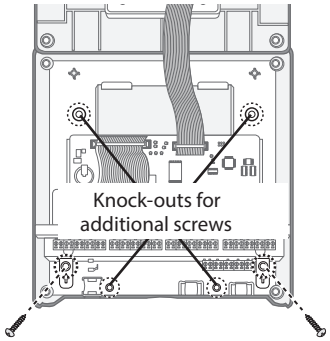
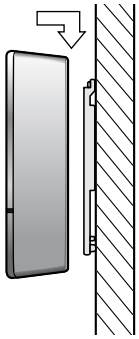
Connecting the Outdoor Unit

Notes:

- *To prevent damage to the unit, wall installation is recommended.*
- *If you need to install wiring through the back of the unit, remove the knock-out at the bottom back of the unit.*

1. Remove the installation plate from the back of the VRF SC.
2. Mount the installation plate on the wall using four of the provided screws.
3. Remove the bottom cover (remove the two corner screws and slide the cover down).
4. Hang the unit from the installation plate by sliding the tabs at the top of the installation plate into the slots in the back of the unit.
5. Use two screws in the holes provided to attach the unit to the installation plate. Use the 4 knock-outs for additional screws if more support is necessary. To access the two upper knock-outs, the top cover must be removed (see *"Interior," p.9*).

Table 3. Mounting illustrations

<table>
<tr><th>Knock-out for wires coming through the back</th><th>Removing / replacing screws on backplate</th><th>Removing bottom cover</th></tr>
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td colspan="2">Hanging the unit</td><td rowspan="2">Securing the unit with screws: two at the bottom and four knock-outs for additional support
  </td></tr>
<tr><td colspan="2">  </td></tr>
</table>

Connecting Cables

Observe the following precautions when making electrical connections.

⚠WARNING

Hazardous Voltage!

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.

NOTICE

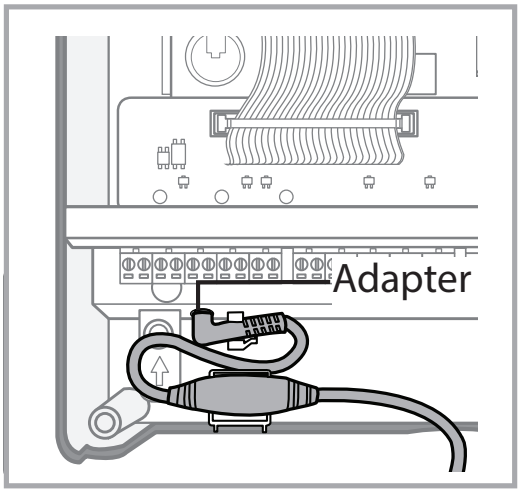
Use Copper Conductors Only!

Unit terminals are not designed to accept other types of conductors. Failure to use copper conductors could result in equipment damage.

- Make all electrical connections in accordance with electrical codes and ordinances.
- Select the power cable in accordance with relevant local and national regulations.

Power

1. Plug the adapter into the power terminal. Arrange the cord as shown in the illustration below.

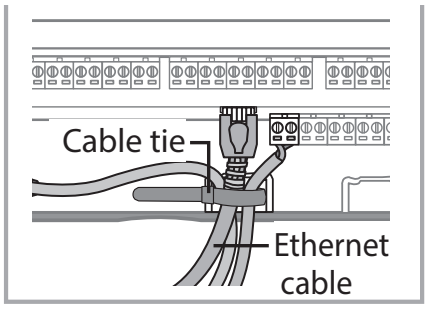


Communication

2. Remove one of the five RS-485 terminal blocks (COM1–COM5) to make wiring easier (see Figure , p. 9).
3. Connect the outdoor unit communication cable (terminals R1, R2) to the RS-485 terminal block: (R1 –> A, R2 –> B).

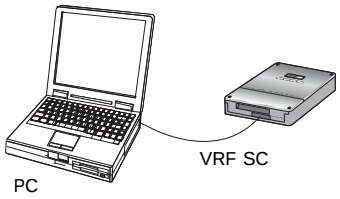
LAN Connection

4. Connect the Ethernet cable to the Ethernet terminal.

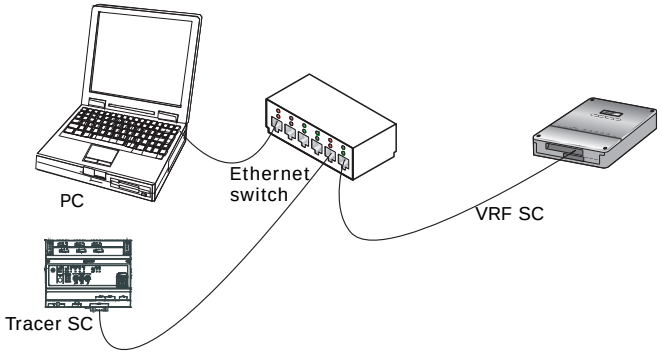


The Ethernet cable can be connected:

- Directly to a PC for access to the VRF SC Web user interface



- To an Ethernet network switch connected to the building LAN.



Power Meter Interface Module (PIM) (optional)

5. If the VRF system is to measure power through connected watt-hour meters, a PIM must be connected to the VRF SC. For installation instructions for the PIM, see VRF-SVN51*.

Final Steps

6. Secure all cables with a cable tie.
7. Replace top and bottom covers and secure with screws.

Setting Up the PC Environment

Software Requirements

The following equipment is required in order to perform all of the functions available:

- PC with LAN card
- Ethernet cable
- Required software on PC:
  - Windows 7 or later
  - Internet Explorer 11 or later
  - Microsoft Silverlight 2.0 or later

Changing IP Address of PC

To enable communication with the VRF SC via direct connection or switch, configure the PC with a static IP address as follows:

Note: *Instructions given are for Windows 7; other operating systems may use a different process.*

1. Connect the Ethernet cable from the Ethernet port on your PC to the Ethernet port on the VRF SC.
2. At the **Start** menu, type "network and sharing center" in the search box.
3. Select **Network and Sharing Center** from the displayed list.
4. In the "view your active networks section," select **Local Area Connection**.
5. In the **Local Area Connection Status** window, click the **Properties** button.
6. From the displayed list, select **Internet Protocol Version 4 (TCP/IPv4).** Then click the **Properties** button. The **Properties** dialog appears for the selected network.
7. Select "Use the following IP address" to activate the following fields:
   a. IP address field: change the IP address to **192.168.0.20**.

      Note: *The factory default for the VRF SC is* **192.168.0.100.**

   b. Subnet mask field: enter **255.255.255.0**
   c. Default gateway: Leave as is.
8. Click **OK** to close the windows.

Initial Login to the VRF SC User Interface

1. Launch Internet Explorer.
2. In the address field, enter the IP address of the VRF SC. Click **Enter**.

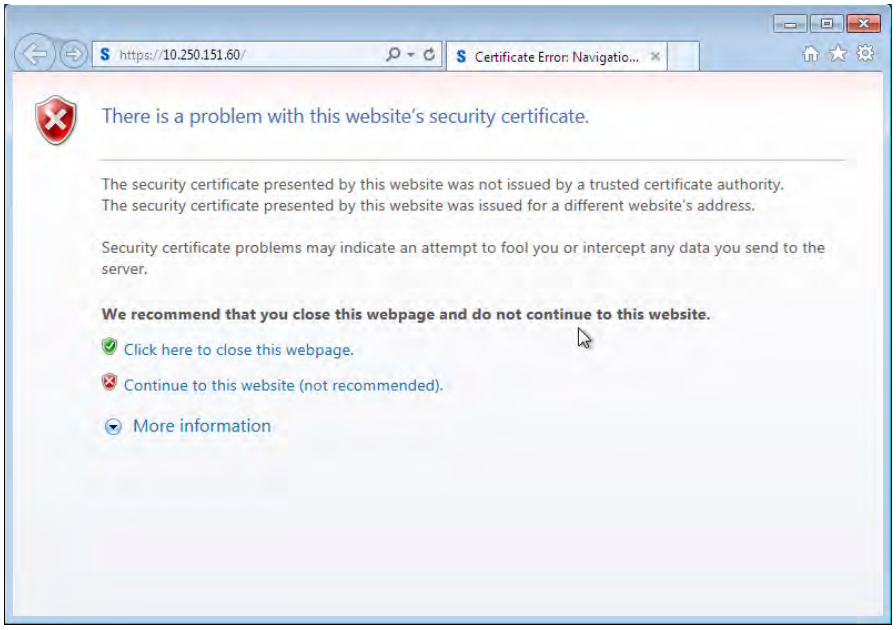
   Notes:

   - *The first time you log in, you will be prompted to install Microsoft Silverlight if you have not already done so. You can install it from http:// www.microsoft.com/silverlight/.*
   - *If you have not installed the Web browser security certificate into IE, a warning message will appear. In this case, click on "Continue to this website (not recommended)."*

   The VRF SC software opens to the log-in page.
3. Enter the administrative ID and password. The factory default ID is **admin** and the password is **ac0530**. Click **login**. You will be logged in as an administrator, which allows you access to all functions.
4. Change the ID and password to maintain security. For instructions, see "Adding a User," p.26.
5. Log out.

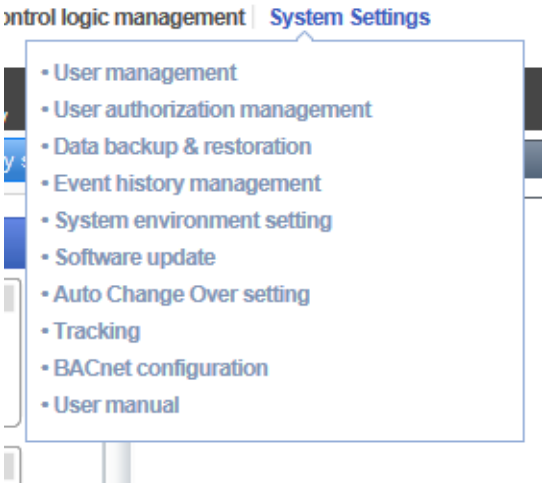
Retrieving the Security Certificate

1. Enter the VRF SC IP address into the Internet Explorer address bar.
2. The security certificate warning message appears. Select "Continue to the website (not recommended)".

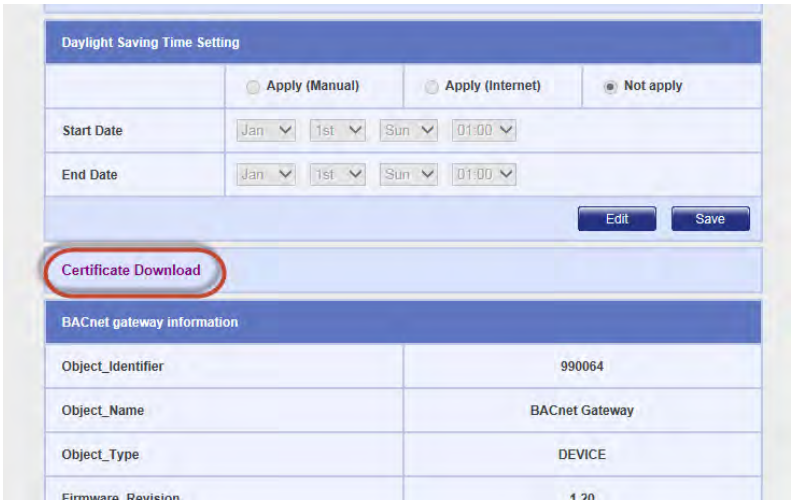


3. Log in again using your new ID and password that you set up in the previous procedure.
4. Select "Continue to this website (not recommended)." The VRF SC software opens to the home page.
5. With the cursor, hover over the **System Settings** menu to display a drop-down list. Select BACnet configuration.

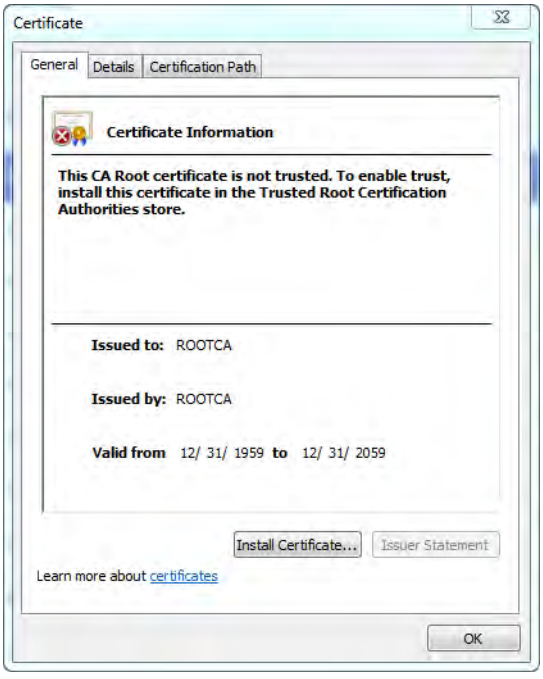
   The **Device configuration** screen is displayed.



6. At the **Device configuration** screen, click the **System Settings** tab. The **System environment setting** page will appear.
7. Scroll down to the bottom of the **System environment setting** page. Locate the **Certificate Download** target and click it. You will receive a query that asks you to either open or save the certificate.



8. If you click **Open**, the following window is displayed. Click the **Install Certificate** button and proceed to step 4 of the procedure for "Installing the Security Certificate into your Web Browser," p.20



If you click **Save**, the certificate will be transferred to the PC Download folder. To install the certificate, follow the procedure for "Installing the Security Certificate into your Web Browser," p.20.

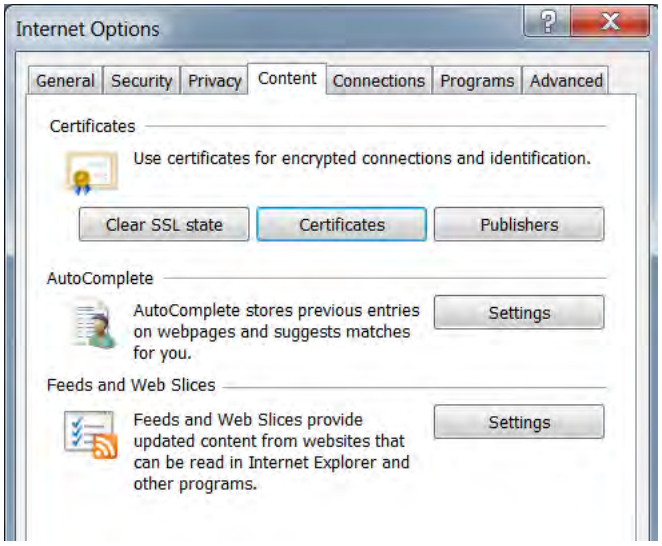
Installing the Security Certificate into your Web Browser

Important: *The VRF SC security certificate must be installed on the Web browser on your PC. It is not secure to continue to the Web site until the security certificate is installed on any PC that is connected to a VRF SC.*

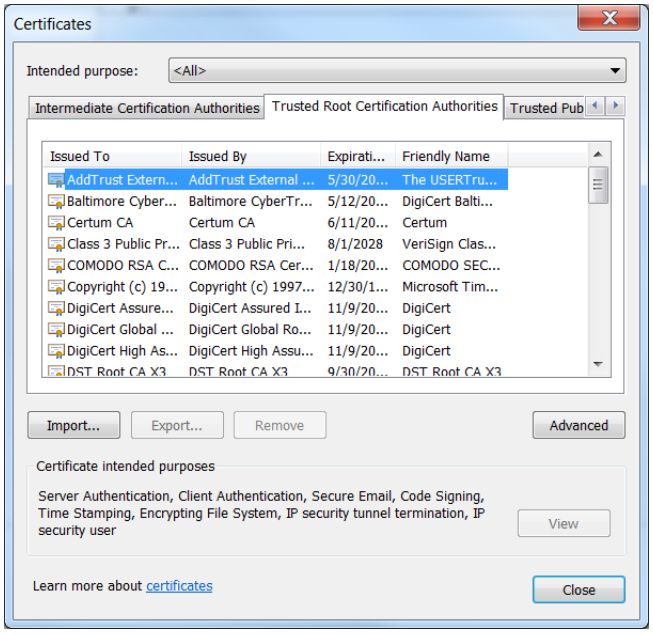
Follow this procedure to register the VRF SC certificate on your Web browser.

Note: *The following procedure is for Internet Explorer Version 11. The procedure may vary depending on your Web browser version.*

1. From the menu of Internet Explorer, select **Tools** > **Internet Options**.
2. Select the **Content** tab, then click the **Certificates** button.

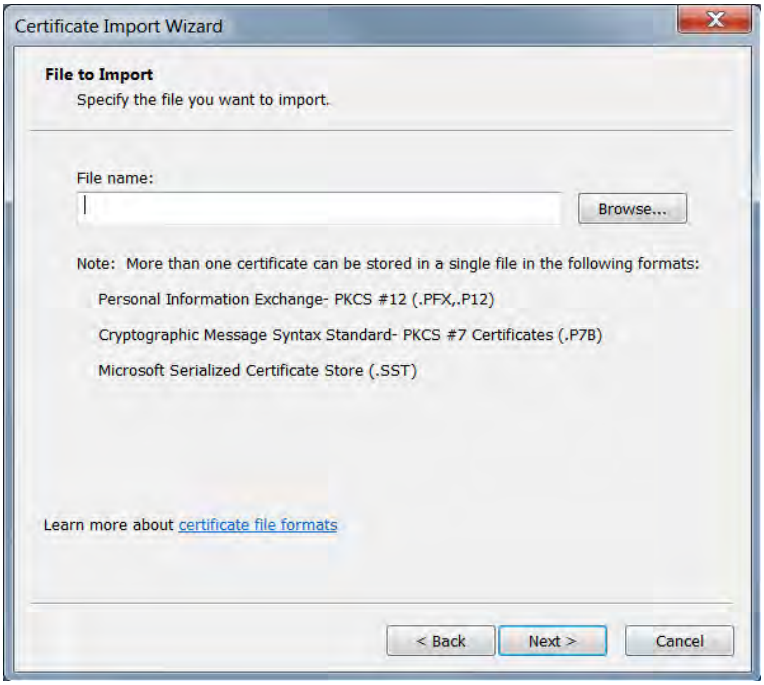


3. From the **Certificates** window, select the **Trusted Root Certification Authorities** tab and click **Import**.

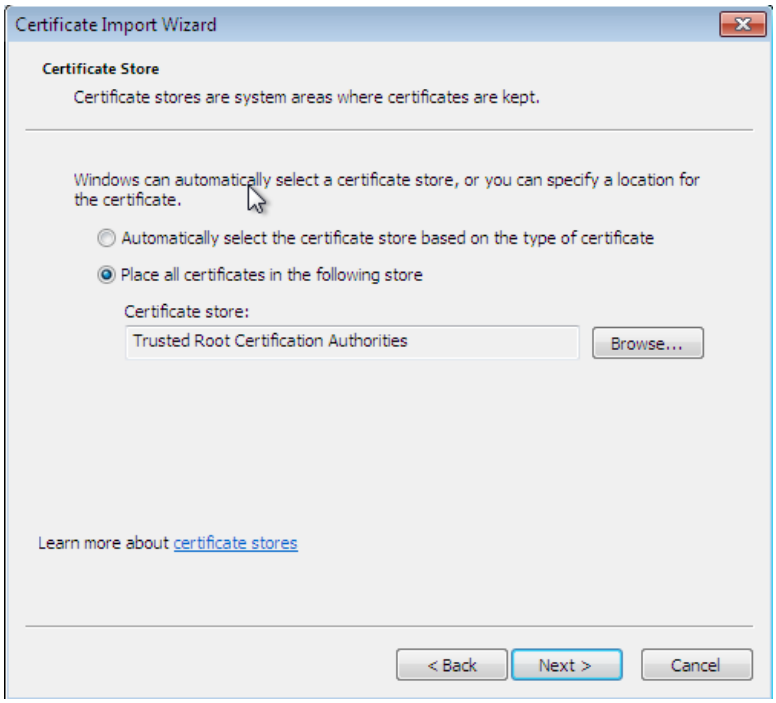


4. Click **Next**.

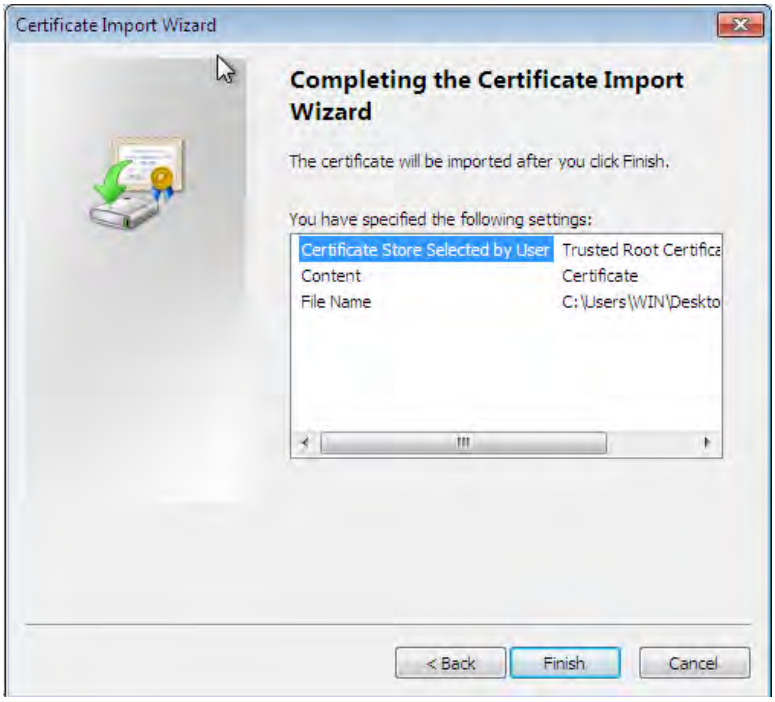
5. To the right of **File name**, select **Browse.** Then locate the VRF SC certificate and select it. Click **Next**.



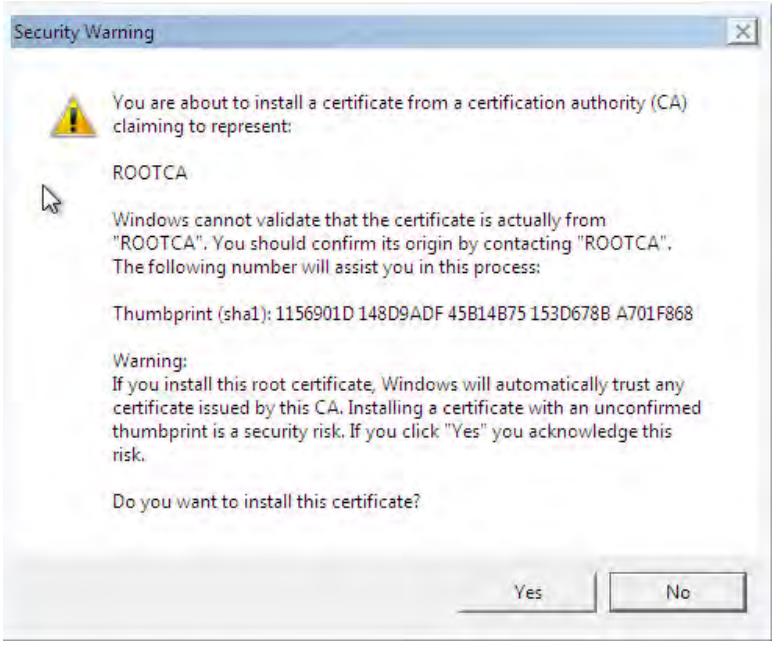
6. Select **Place all certificates in following store.** If the Certificate store field is empty, click **Browse** and select "Trusted Root Certification Authorities".Then click **Next**.



7. Click **Finish** to import the certificate..



8. Click **Yes** to install the certificate.



BACnet Network Configuration

This section provides information that is important for configuring the VRF system controller to integrate with the BACnet-based BAS. The VRF system controller supports only the BACnet/IP data link topology.

Network Number

There is no BACnet network number assigned to the IP side of the VRF system controller. The device assumes that other devices communicating with it reside on the same BACnet network. When this is the case, a BACnet network number is not required.

The BACnet network number for the virtual network defaults to "9." If multiple VRF system controllers exist on the same site, the virtual network numbers MUST be changed so that the network number is unique across the entire site.

The allowed range of network numbers is 1 to 40.

UDP Port Number

The UDP port number defaults to 47808 and is configurable. The Web browser security certificate must be installed in the Web browser in order to change the value of the UDP port.

Device ID

The VRF system controller creates a BACnet virtual device for each VRF device in the system. Once the virtual devices have been created, they can be installed in a BACnet BAS.

The VRF system controller uses a process called "tracking," in which each virtual device is created and assigned a BACnet device ID. This process is analogous to the device discovery and installation process performed by a Tracer BAS. After tracking is complete, each device is BACnet discoverable.

The device ID assigned is based on a calculation performed by the VRF system controller. The calculation uses the equipment address assigned by the DIP switches on the equipment control

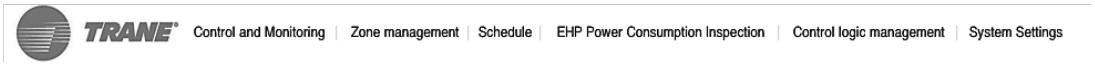
board and the VRF channel that the outdoor unit is connected to. Each time tracking is performed, the device ID is re-calculated. As long as the equipment address and channel have not been changed, the new calculated value will equal the previous value. Because of this fact, equipment that has been installed in a BAS does not need to be deleted and then re-installed should tracking be performed again.

BBMD

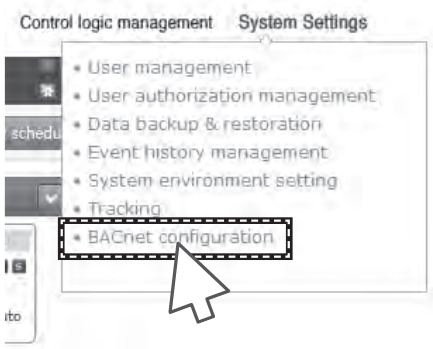
The VRF system controller does not support BACnet/IP Broadcast Management Device (BBMD) functionality.

Navigation

The Control and Monitoring page is the home screen for the application. The menu items appear as follows:



The VRF SC contains a sub-menu item, **BACnet configuration**, which is located in the **System Settings** drop-down menu as shown.



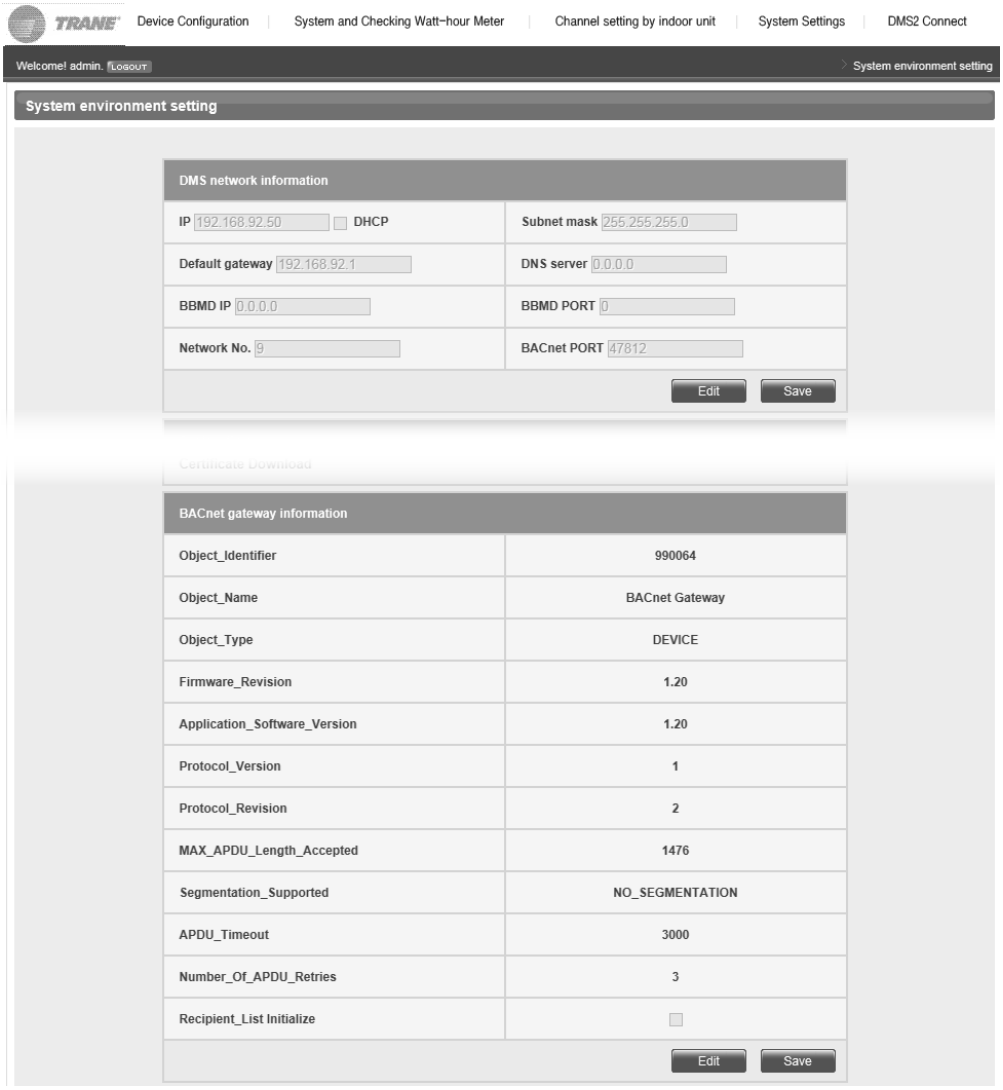
When **BACnet configuration** is selected, the menu items across the top of the page change; they provide alternate ways to navigate specific pages of the user interface.

- **Device Configuration**: This menu opens the Device Configuration page that is identical to the Tracking page that is accessible from **System Settings** > **Tracking**).
- **System and Checking Watt-hour Meter** and **Channel setting by indoor unit** are alternate ways to access pages of the same pages. These pages are also accessible as sub-menu items under **EHP Power Consumption Inspection**.
- **DMS2 Connect** provides a way to return to the **Control and Monitoring** page and restores the original menu that the UI showed before **BACnet configuration** was selected.

BACnet Information

To access BACnet information, select **BACnet configuration**, which is located in the **System Settings** drop-down menu, as described in "Navigation," p.24.

1. From the menu, select **Systems Settings**. The System environment setting page appears with the network information at the top of the page and the BACnet information at the bottom of the page.



System Settings

The System Settings menu includes:

- User management and user authorization management: Managing user access and the level of authorization each user is given. Refer to "User Management," p.26.
- Data backup and restoration, p. 28.
- Event history management, refer to p. 30.
- System environment settings, refer to p. 31.

- Tracking, refer to p. 41.
- BACnet configuration, refer to "Navigation," p.24.

Device Configuration

Devices must be tracked during installation process to verify that all installed devices are communicating with the system controller. Refer to "Device Management," p.39.

User Management

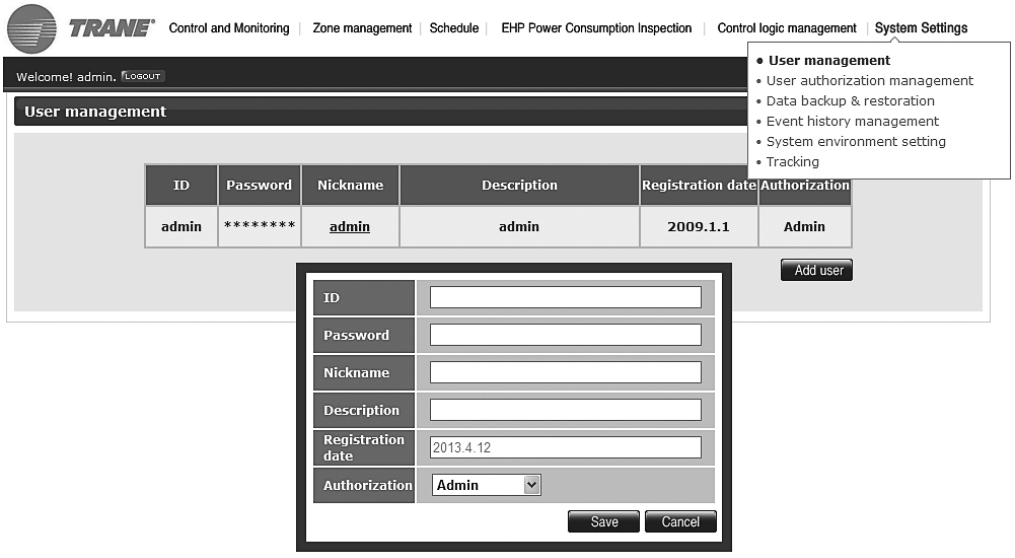
You can assign and change operator authorization levels if you have logged in as an administrator from **System Settings > User authorization management**.

Basic guidelines for administrators are as follows:

- Only administrators can change all settings for indoor/outdoor units, check which indoor/outdoor units are connected to the VRF SC, or edit and assign zone information.
- Administrator accounts cannot be modified.
- Only administrators can edit zone information and assign zone information to a manager.
- An administrator can check and control indoor/outdoor units only belonging to assigned zones.

Adding a User

Select the **System Settings** menu and the sub-menu item, **User management**, beneath it.The User management page appears.



1. Click **Add user** and the user dialog box displays.

   Note: *You can register a maximum of 256 users.*

2. Enter an **ID, Password, Nickname, Description**, and select the **Authorization** type.
   - The user ID must be a combination of between 4 and 12 lowercase letters and numbers.

- The password must be a combination of between 8 and 12 upper or lowercase letters and numbers, with no spaces.
- The nickname should be no more than 20 letters
- The description should be no more than 50 letters.
- The registration date automatically populates with the current system date.
- Authorization levels are **Admin** (all rights), **Manager** (limited rights), and **Regular** (more limited rights).

3. Click **Save**.

Editing a User

1. Click the **System Settings** menu and select the sub-menu item, **User management**. The User management page appears (refer to the figure under "Adding a User," p.26).
2. Click **admin** under the Nickname column. The user dialog box displays.
3. Edit the desired field(s). The Registration date field cannot be edited.
4. Click **Save**.

Deleting a User

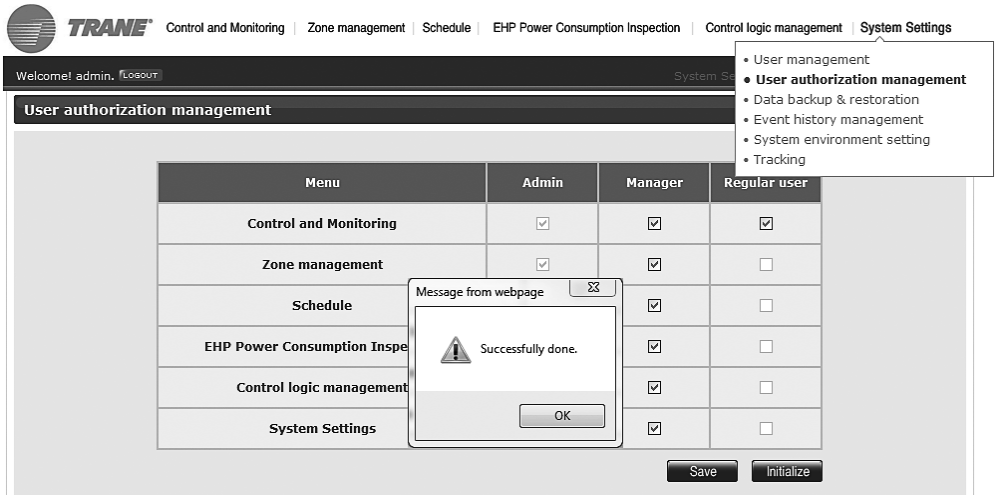
1. Click the **Systems Settings** menu and select the sub-menu item, **User management**. The User management page appears (refer to the figure under "Adding a User," p.26).
2. Click **admin** under the Nickname column. The user dialog box displays.
3. Click **Delete** to delete the user information. A confirmation dialog box displays asking, *Do you want to delete the user?*
4. Click **OK** or click **Cancel** to quit the task.

   Note: *An Admin account cannot be deleted.*

User Authorization Management

This function is available only to users with administrative authorization.

1. Click the **System Settings** menu and select the sub-menu item, **User authorization management**. The User authorization management page appears.
2. Check the box under each column to either provide or deny user access to menus.



3. Click **Save.** A confirmation message appears.

   Note: *To restore factory defaults for user authorization, click* ***Initialize****.* A confirmation message appear*s.*

4. Click **OK**.

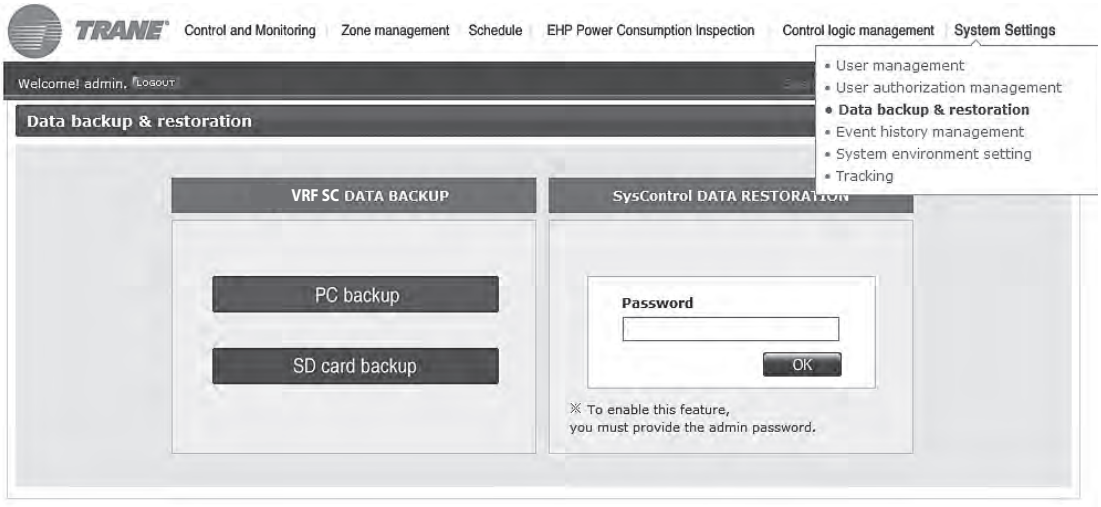
Data Backup and Restoration

You can backup and restore data to either your PC or to an SD (secure digital) card. Backup and restore guidelines are as follows:

- Backup and restoration of event history and network settings are not available.
- Ensure that the SD card is formatted as a VFAT file.
- If an SD card is already inserted, the backup function automatically operates, and the daily data is backed up onto the SD card.
- You must have Administrator authorization to perform data restoration.
- You cannot restore files bigger than 100 Mbytes.
- Restoration should be carefully executed because existing data is replaced with the data that is chosen for restoration.
- Before restoration, it is a best practice to backup your current data.

Backing up Data to a PC

1. Click the **Systems Settings** tab at the top VRF System Controller interface and select **Data backup & restoration**. The Data backup & restoration page displays.



2. Click **PC backup** and a message displays stating, *Reading data from VRF System Controller. Please wait.*

   Note: *Backup time varies depending on the amount of the data.*

3. Once backup is complete, a message displays stating, *Backup file is ready: click 'OK' to download.* Click **OK**.
4. After the file has downloaded, click **Save** and when the **Save As** dialog box displays, choose a folder location, give the backup file a meaningful name, and click **Save**.

5. Click **Close**.

   Note: *The backup data includes DB data, setting data, data related to the indoor/outdoor unit control, and various history data.*

Restoring Data to a PC

1. Click the **Systems Settings** tab at the top VRF System Controller interface and select **Data backup & restoration**. The Data backup & restoration page appears (refer to the figure under "Backing up Data to a PC," p.28).
2. Enter an **Admin** account password and click **OK**. A message displays stating, *Restore the VRF System Controller data by using the file. Do you want to proceed?* Click *OK*.
3. Click **PC restore** as shown above and a message displays stating, *Select the VRF System Controller data file to restore*.
4. Click **Browse** to locate the data file to restore. Click **Open**.
5. Click **Upload** and a message displays stating, *Restore the VRF System Controller data by using the file. Do you want to proceed?* Click **OK**.
6. Another message displays stating, *Restoration is completed.* Click **OK** to restart VRF System Controller. Click **OK**. The VRF System Controller restarts with the restored data.

Backing up Data to an SD Card

1. Click the **Systems Settings** tab at the top VRF System Controller interface and select **Data backup & restoration**. The Data backup & restoration page appears (refer to the figure under "Backing up Data to a PC," p.28).
2. Click **SD card backup** and a message displays stating, *Reading data from VRF System Controller. Please wait.*

   Note: *Backup time varies depending on the amount of the data.*
3. Once backup is complete, a message displays stating, *VRF System Controller backup completed.* The created file name is as follows: sysdataYYYYMMDDhhmmss.dms. Click **OK**.

   Note: *File format is YYYY: year, MM: month, DD: day, hh: hour, mm: minute, ss: second. If a Backup failed message displays, check if the SD card is inserted and ready for use, if it has been locked so it cannot be written to, or if it is full.*

Restoring Data to an SD Card

1. Click the **Systems Settings** tab at the top VRF System Controller interface and select **Data backup & restoration**. The Data backup & restoration page appears (refer to the figure under "Backing up Data to a PC," p.28).
2. Enter an **Admin** account password and click **OK**. A message displays stating, *Restore the VRF System Controller data by using the file. Do you want to proceed?* Click **OK**.
3. Click **SD card restore** as shown above and a message displays stating, *Select the SD card recovery file.*
4. Check the box to the left of the File name and click **OK**. A message displays stating, *Restore the VRF System Controller data by using the file. Do you want to proceed?* Click **OK**.
5. Another message displays stating, *Restoration is completed.* Click **OK** to restart VRF System Controller. Click **OK**. The VRF System Controller restarts with the restored data.

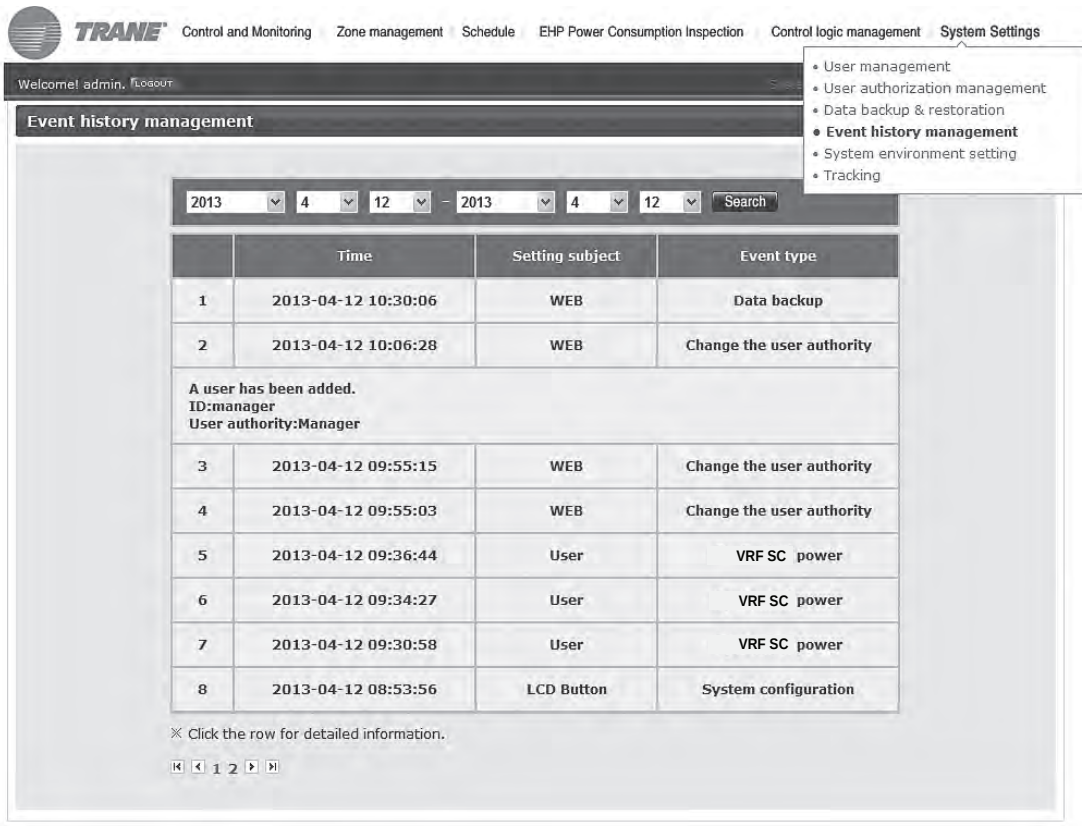
Event History Management

Use event history management to view such events as:

- VRF System Controller events related to power usage
- Schedule setting events
- Tracking
- User information modifications
- System settings
- Operation related to using the external interface

To search for information in event history:

1. Click the **Systems Settings** tab at the top VRF System Controller interface and select **Event history management**. The Event history management page displays.



2. Select the **Start/End** dates for period of event history to search.
3. Click **Search** and a list of events displays for the selected dates. Click on any event to display more details about the event.

System Environment Setting

1. Click the **System Settings** menu and select the sub-menu item, **System environment setting**. The **System environment setting** page appears.
2. Choose the section that you want to edit, and click the **Edit** button below that section.
3. Enter values for the fields in this section. (See each subsection, below, for details.)
4. Click **Save** to save your changes. A confirmation pop-up window will appear that is specific to the settings you have changed. (See each subsection, below, for details.)

System Controller Network Information

Factory default network settings for the system controller are:

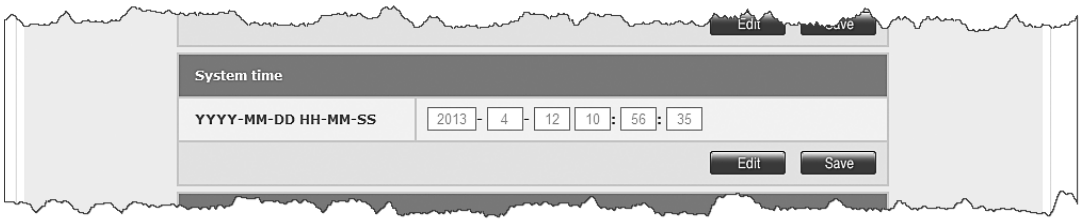
- **IP address**: 192.168.0.100
- **Subnet mask**: 255.255.255.0
- **Default gateway**: 192.168.0.1
- **DNS server**: 0.0.0.0

Guidelines for setting system network information:

- A maximum of 15 letters can be entered for each. Each item should match the PC network settings.
- If you check **DHCP**, the other text boxes in the section will be disabled.
- If you are using multiple BACnet gateways in the same network, you must use a unique **Network No.** for each (between 1 and 40).
- After you save your changes, a pop-up window will appear stating that the Web browser must restart for the changes to take effect. Click **OK** or **Cancel**; your changes will be saved in either case.

System Time

Note: *When a user logs into the system, the VRF SC compares the date and time stored in the device to the system time of the PC connecting to the device. If the date and time do not match to the minute value, a message is displayed that requests the user to set the date/time of the VRF SC.*



- Only numbers can be entered.
- Year: Enter from 1980 to 2035.
- Month: You can enter from 1 to 12.
- Day: You can enter from 1 to 31.
- Hour: You can enter from 0 to 23.
- Minute: You can enter from 0 to 59.
- Second: You can enter from 0 to 59.

- After you save your changes, a pop-up window will appear asking you if you want to proceed with making the changes. Click **OK** to proceed.

System Name

- The name of the VRF SC can have a maximum of 30 letters including special symbols.
- When the name is saved, it will appear on the top title bar of the Web browser.
- After you save your changes, a pop-up window will appear asking you if you want to proceed with making the changes. Click **OK** to proceed.

E-mail Forwarding for System Error Notifications

Note: *This function can be only used with a server that uses SSL encryption and input port 465.*

1. In the E-mail field, enter the e-mail address of the person who will receive system error notifications. (Only one address can be entered.)
2. In the ID field, enter the user name of the e-mail server account that will be used to send the e-mail.
3. In the PW field, enter the user password for the account.
4. In the SMTP server field, enter the e-mail server address for the account.
5. Click **Save** to save your settings.
6. Click the **Test** button to verify that the recipient can receive e-mail messages from the device.

Contact Control Pattern Logic Settings (optional)

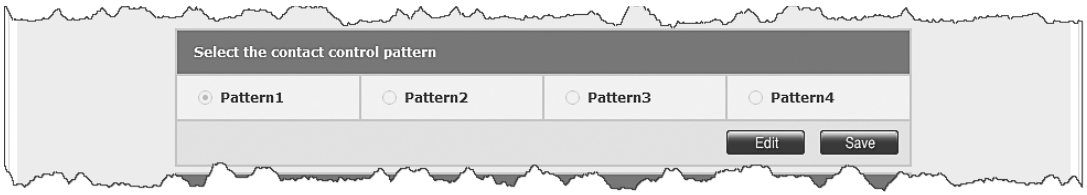
The VRF system controller has 10 digital input (DI) points. Contact control and output function is assigned to DI1 and DI2. DI3–DI10 are assigned to other functions. For proper contact control, connect using DI1 and DI2.

The VRF system controller has 8 digital output (DO) points. DO1 and DO2 are used by the system controller. DO 9 and DO10 are reserved. DO3–DO8 are available for other use.

- If at least one indoor unit is turned on, DO1 generates a contact point signal. If there is breakdown, then DO2 generates a contact point signal.
- Contact output
  - When the indoor unit is in operation, the VRF SC, that has executed tracking successfully, outputs the signal through DO1.

– If there is an unsolved breakdown in the VRF SC, the signal outputs through DO2. This can be verified through the check indicator on the VRF System Controller.

The four settings for contact control pattern logic have the following functions:



Pattern 1 (factory default): No external input

When you input contact control signal DI1, there is no response.

Pattern 2: Level input (emergency stop)

- If the contact control signal is changed to On (emergency stop status), all indoor units are given a Stop command, and the remote control will not function.
- During the emergency stop, the VRF SC will ignore any request from upper-level controllers.
- During the emergency stop, the VRF SC will ignore previously set schedules.
- When the contact control signal changes from On to Off, indoor units go into normal operation status and return to remote control status before emergency stop status.
- Even if the DI1 contact control signal changes from On to Off, there will be no change to the indoor unit.
- When you input contact control signal in DI2, there will be no response.

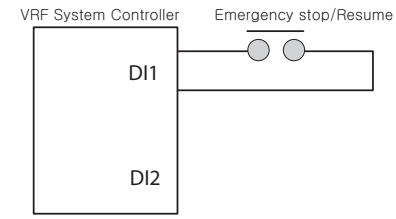
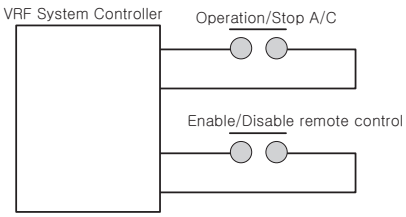
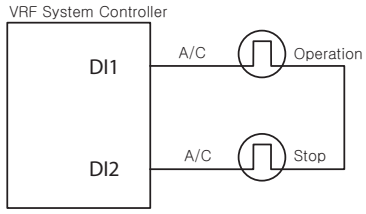
Pattern 3: Level input (Operation/Stop, Remote control Enable/Disable)

- Changes the operation/stop status of all indoor units.
- If the contact signal of DI1 changes from OFF to ON, all indoor units will be given an Operation command.
- If the contact signal of DI1 changes from ON to OFF, all indoor units will be given a Stop command.
- If the contact signal of DI2 is OFF, you cannot control all indoor units using a remote controller.
- If the contact signal of DI2 changes from OFF to ON, you can control all indoor units using a remote controller.
- If the contact signal of DI2 changes from ON to OFF, you cannot control any indoor unit using a remote controller.
- Control command from an upper-level controller will be operated regardless of the contact point status.
- Schedule control commands will be operated regardless of the contact point status.

Pattern 4: Pulse input (Operation/Stop)

- Valid pulse duration for input signal is 0.5–1.0 seconds.
- VRF SC ignores a signal that has a pulse duration shorter than 0.5 seconds and longer than 1.0 seconds.
- When the pulse input signal of DI1 is On, all indoor units are given an Operation command.
- When the pulse input signal of DI2 is On, all indoor units are given a Stop command.
- An indoor unit control command from an upper-level controller will be executed regardless of a pulse input signal.

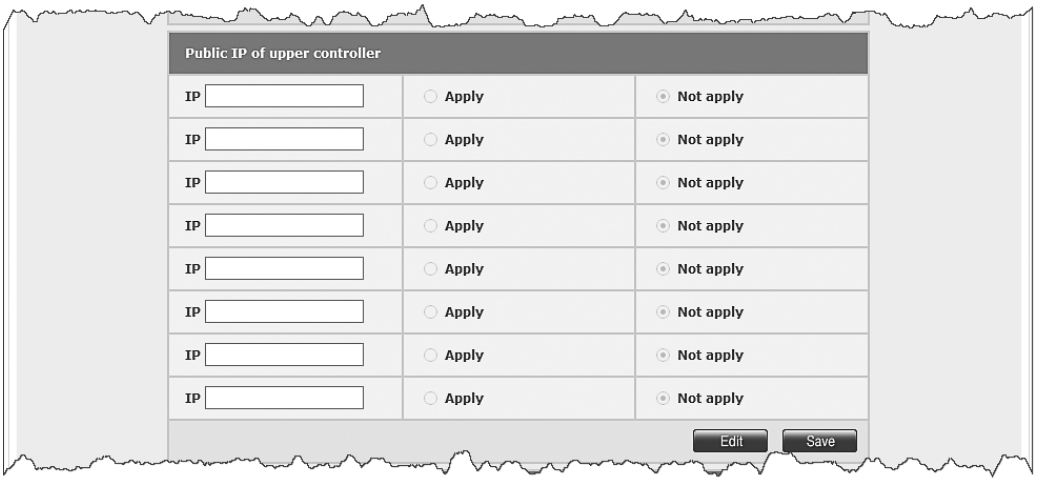
- Schedule control commands will be executed regardless of a pulse input signal.

DI circuitry according to contact control pattern logic settings		
Pattern 2: Used for connection with shutdown contact input	**Pattern 3: External contact signal control**	**Pattern 4: Pulse signal control**
		

Setting Enable Public IP

Select whether to use Public IP or not. When you select 'Enable', you must register the Public IP of PCs or network devices to access VRF SC from the PCs or network devices.

Public IP Address of Upper-Level Controller

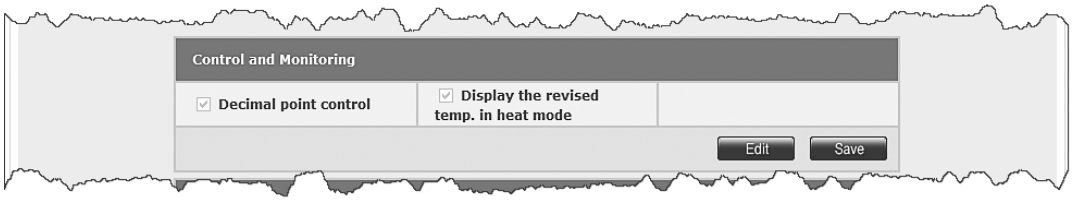


Enter the IP address of any upper-level controllers, such as VRF Enterprise Management Software, that are connected to the system. Select **Apply** or **Not apply**.

Note: *If the upper-level controller uses a public IP address, you must set the public IP address of the upper-level controllers to access the VRF SC from that controller. If the upper-level controller uses a private IP address, you can access VRF SC from that controller without setting its IP address.*

- *Private IP range: 10.0.0.0–10.255.255.255, 172.16.0.0–172.31.255.255,192.168.0.0–192.168.255.255.*
- *BACnet communications between the VRF SC and BACnet-based building automation system controllers must use a private IP address on a common subnet. If the BAS and the VRF SC reside on different subnets, BACnet BBMD functionality is required for communication. The VRF SC does not support BBMD, a third party BBMD device is required.*

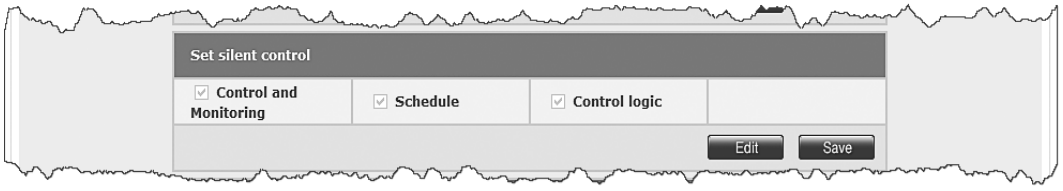
Settings for Control and Monitoring



- **Decimal point control**, if selected, controls the indoor unit in 0.1°C increments. If not selected, the temperature will be adjusted in 1°C increments. The Fahrenheit temperature can be adjusted only in 1°F increments.
- **Display the revised temp. in heat mode**, if selected, displays the revised (adjusted) temperature for the current temperature in heat mode. This temperature offset is configured at the indoor unit.

Setting Silent Control

The indoor unit can be configured so that the chime is silent when operational changes occur.

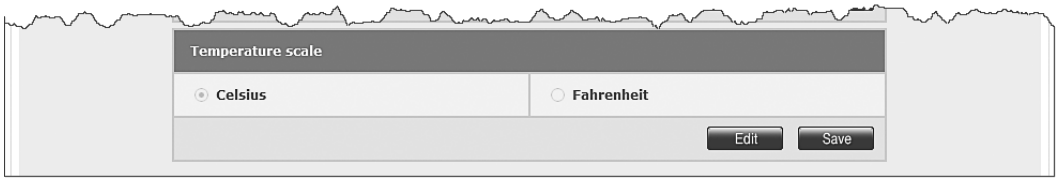


Setting Level Control

If selected, **Include the OnOff controller**, restricts controlling the system from the Central On/Off Control as well as the wired and wireless remote controls.

Setting the Temperature Scale

Select either **Celsius** or **Fahrenheit** for the unit for temperature values that are displayed.



Setting the Time on the Wired Remote Controller

Time setting is available only wired remote controllers that support a time setting function through the VRF SC.

Activating Daylight Saving Time Setting

To activate the automatic Daylight Saving Time function, a VRF SC must be connected to the Internet. The time on the VRF SC will be synchronized through communication with an external time server.

To apply the automatic Daylight Saving Time function:

1. Set the VRF SC to the present time.
2. Select **Apply (Internet)**.

If the VRF SC is not connected to the Internet:

1. Set the VRF SC to the present time.
2. Select **Apply (Manual)**.
3. Enter the start date and end date for Daylight Saving Time.

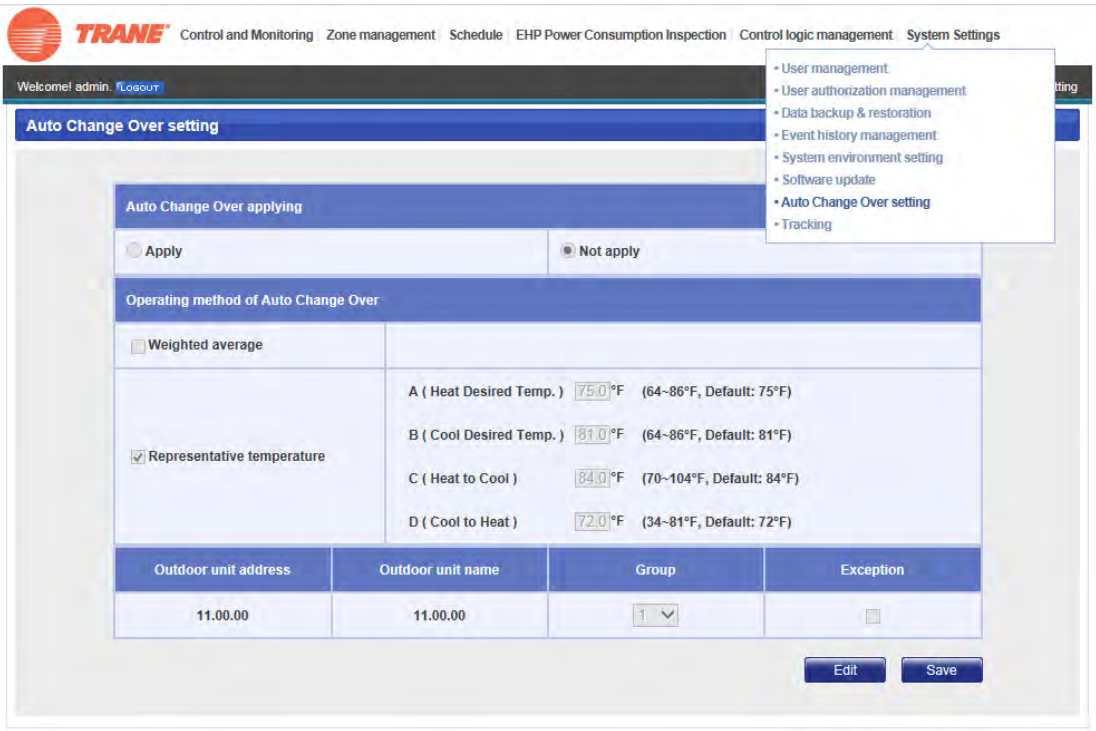
Activating Extra Functions

1. Click **System Settings** > **System environment setting** when the VRF SC web page menu screen appears.
2. To display a pop-up window when you log in to the VRF SC if your PC time differs from the VRF SC time, turn on: **Alert when PC time differs from VRF SC time**.

Initializing the System Controller

Refer to "System Setting Initialization," p.102.

Setting Auto Changeover



1. Click **System Settings** > **Auto Change Over setting** when the VRF SC web page menu screen appears.
   - The Auto Changeover function enables the VRF SC to control indoor units to initiate auto cooling or auto heating.
   - When using auto cooling or heating, the VRF SC operates the Fan, Cool, or Heat Auto modes in order.
2. Click **Edit** to configure the Auto Changeover settings.
   a. **Apply/Not apply**

      While using the Auto Changeover function, **A** appears in the **Control and Monitoring** screen on the indoor unit, and the indoor unit cannot control its operation mode separately.

   b. **Weighted average:** Configure the settings so that indoor units automatically switch between cooling and heating modes according to the set temperature, current temperature, and cooling/heating capacity of the indoor units that are turned on.

      Let us assume, for example, that indoor units of the same capacity have been installed.

      If a larger number of the units have desired temperature lower than the current temperature, all of the units automatically switch to cooling mode. If a larger number of the units have the set temperature higher than the current number, all of the units automatically switch to heating mode.

   c. **Representative temperature**: Sets to run auto cooling or heating operation, according to the average temperature of the turned-on indoor units.

- VRF SC sets the indoor units to the auto cooling mode and keeps the temperature according to 'B (Heat DesiredTemp)' when the average temperature of the units currently running is higher than 'C (Heat to Cool)'.

  VRF SC also sets the indoor units to the auto heating mode and keeps the temperature according to 'A (Cool DesiredTemp)' when the average temperature of the units currently running is lower than 'D (Cool to Heat)'.

d. Outdoor unit setting

- Only Heat Pump outdoor units that support new communication mode appear in the list. However, not listed in the list are the Heat Pump outdoor units that are connected to cooling only indoor unit, as these units are not applicable for Auto Change Over.
- The following outdoor units are not displayed in the list: the outdoor units designed solely for cooling and the outdoor units connected to the heating/cooling change-over switch if the switch is set to the cooling only mode or to the heating only mode.
- Heat Recovery outdoor units do not appear in the list, as these units are not applicable for Auto Change Over.
- Auto Change Over works for each group.
- All indoor units in a single group become the targets for weighted average or representative temperature, and are controlled to equally run auto cooling or auto heating.
- If you select **Exception**, the outdoor unit cannot use the Auto Change Over function despite being grouped, and indoor units connected to the outdoor unit are excluded from the targets of weighted average or representative temperature.
- If the outdoor unit is set to cooling or heating only mode, the Auto Change Over function is not available.

3. Click **Save** after finishing the setup.

Note: *When the VRF SC is installed in VRF System Touchscreen or wired/wireless remote controllers simultaneously, the indoor unit with the Auto Change Over function cannot control operation modes VRF System Touchscreen or the wired/wireless remote controller.*

Device Management

Devices must be tracked during installation process to verify that all installed devices are communicating with the system controller.

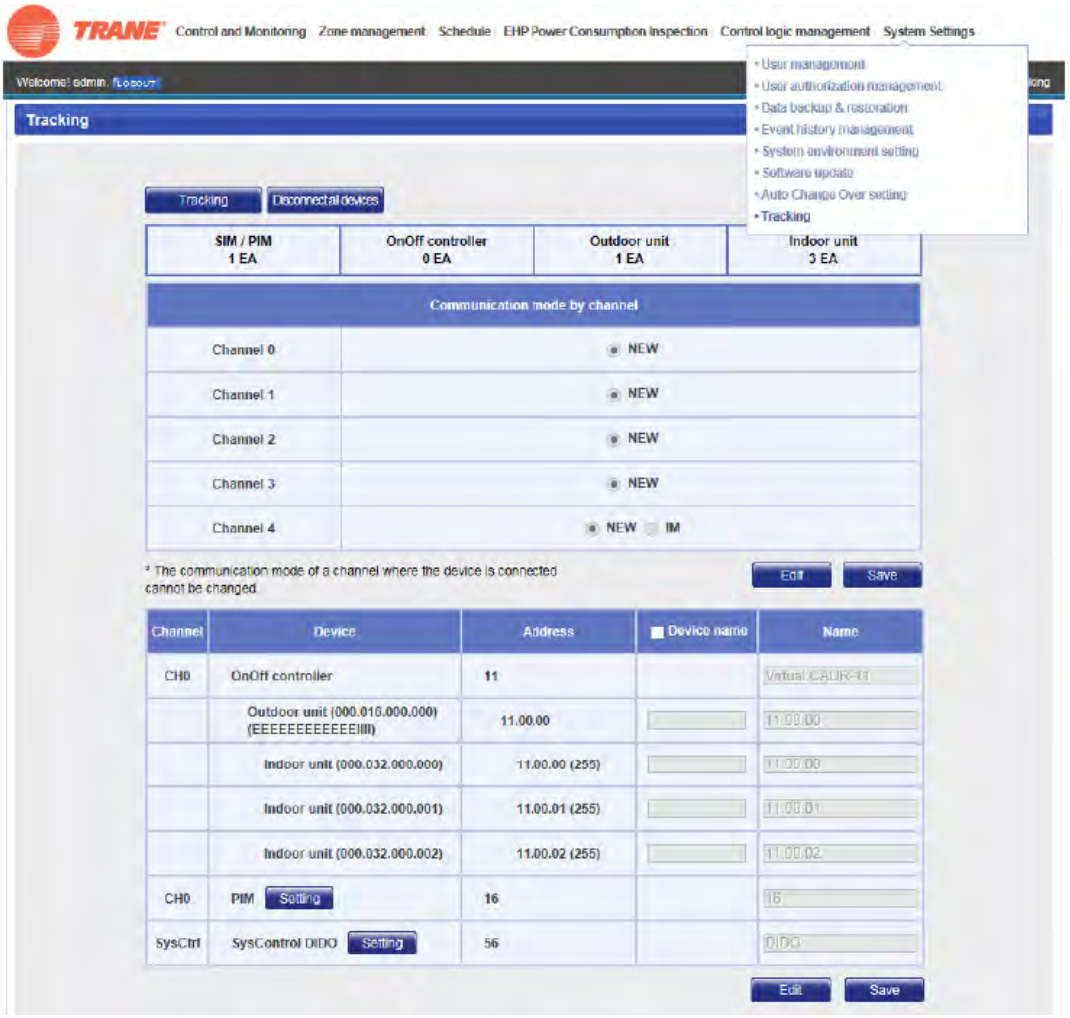
Device management includes:

- Setting communication mode by channel
- Tracking (device discovery)
- Verifying device information
- Renaming devices
- Disconnecting devices
- Setting digital input/ output points (DI/DO ports)
- Setting power meter interface modules (PIMs)

To access this Web page:

1. In the top right corner, select **System Settings**. From the drop-down menu, select **Tracking.** The **Tracking** page appears.

   Note: *An alternate way to access this page is to select **System Settings** > **BACnet configuration**. The Device Configuration page appears, which is identical to the Tracking page. (In BACnet configuration, the menus at the top of the page change. To return to the original mode, select **System Settings**.*



Communication Mode by Channel

Before tracking, select the proper communication mode for each of the communication channels, COM1–COM5. If tracking has already been executed, the settings on this page are disabled.

1. On the **Device Configuration** page, in the table titled **Communication mode by channel**, select **NEW** for all connected devices.

   After setting the communication mode to **NEW**, a virtual VRF Central On/Off Control address will be assigned as follows:
   - Channel 0: Virtual Central On/Off Control 11
   - Channel 1: Virtual Central On/Off Control 12
   - Channel 2: Virtual Central On/Off Control 13
   - Channel 3: Virtual Central On/Off Control 14
   - Channel 4: Virtual Central On/Off Control 15
2. Click **Save**.

Tracking (Device Discovery)

Tracking (also called *device discovery*) refers to the function of recognizing the devices that are connected to the VRF SC and verifying that they are able to communicate. Tracking is part of the installation process.

Note: *Tracking is executed only on the channels (COM1–COM5) that have had their communication mode set.*

1. On the **Tracking** (or **Device Configuration**) page, click the **Tracking** button.
2. A pop-up confirmation window opens. Click **OK** to continue the procedure.

   Another pop-up window opens, stating that tracking is in progress.
3. When tracking is complete, a pop-up window offers an opportunity to select:
   - No initialization
   - Individual initialization: By indoor unit Main address
   - Group initialization: By indoor unit RMC address (applies if Central On/Off Control is present)
4. Make a selection or leave as is and click **OK**.

5. After the **Tracking** (or **Device Configuration**) page refreshes, examine the tracking results to verify that they match the actual installation information.

Note: *If more than one device has the same address, only the first discovered device will be tracked.*

Channe	Device	Address	Name	Object ID	Error
CH0	On/Off controller	11	CAUR-11	901164	
	Outdoor unit (000.016.001.000)	11.01.00	11.01.00		
	Indoor unit (000.032.001.001)	11.01.01 (255)	11.01.01	957701	
	Indoor unit (000.032.001.002)	11.01.02 (255)	11.01.02	957702	
	Indoor unit (000.032.001.005)	11.01.05 (255)	11.01.05	957705	
	Indoor unit (000.032.001.006)	11.01.06 (255)	11.01.06	957706	
	Indoor unit (000.032.001.008)	11.01.08 (255)	11.01.08	957708	
	Indoor unit (000.032.001.009)	11.01.09 (255)	11.01.09	957709	
	Indoor unit (000.032.001.010)	11.01.10 (255)	11.01.10	957710	
	Indoor unit (000.032.001.011) (AHU)	11.01.11 (255)	11.01.11	957711	
	Indoor unit (000.032.001.012) (ERVPLUS)	11.01.12 (255)	11.01.12		
	Indoor unit (000.032.001.013) (AHU)	11.01.13 (17)	11.01.13	957713	
	Indoor unit (000.032.001.014) (MINIAHU)	11.01.14 (255)	11.01.14	957714	
SysCtr	SysControl DI-DO Setting	56	DMS DI-DO	930864	

Edit Save

Renaming Devices

Device names (in the "Name" column) are saved in the VRF SC and are viewable by operators of the system controller.

1. Below the list of tracked devices, click **Edit**. The **Edit** button changes to **Cancel**.
2. In the **Name** column, enter a name for each device that indicates the location of the device. Names can contain a maximum of 16 characters with no special symbols.

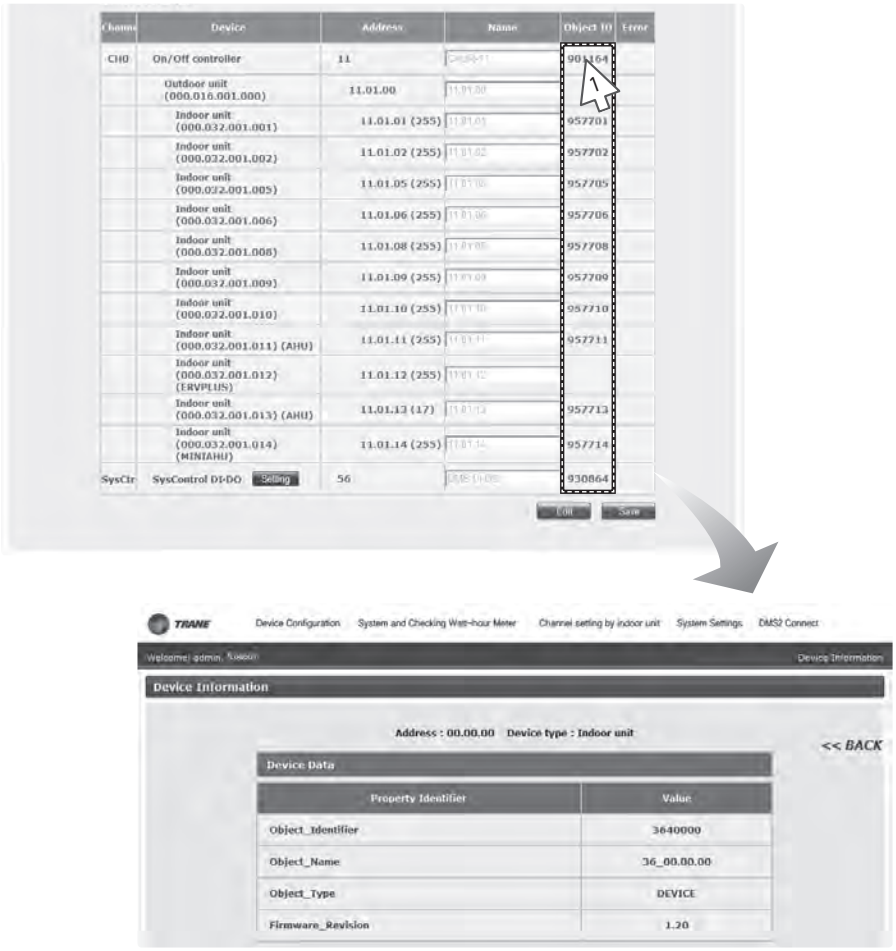
   Note: *If you want to chancel changes, click **Cancel**. The changed names will be restored to their original names and the button will change to **Edit**.*
3. Click **Save**.

Verifying Device Information

Note: *Refer to the BACnet Point List to check the configuration data for each device.*

To view device information:

1. Select one of the Object IDs from the Object ID column. Detailed information will be displayed in a new page called **Device Information**.



Analog data of the selected device is displayed in Analog data.

- Object ID: Displays ID of the corresponding object.
- Type: Displays type of the corresponding object.
  - AI: Input (Read Only)
  - AO: Output (Read/Write)
  - AV: Value (Read/Write)
- Object Name: Displays the name of the corresponding object.
- Value: Displays the current value of the corresponding object.

Binary data of the selected device will be displayed in Binary data.

- Object ID: Displays ID of the corresponding object.
- Type: Displays type of the corresponding object.
  - BI: Input (Read Only)
  - BO: Output (Read/Write)
  - BV: Value (Read/Write)
- Object Name: Displays the name of the corresponding object.

- Value: Displays the current value of the corresponding object as either On or Off.

Multi-state data of the selected device will be displayed in Multi-state data.

- Object ID: Displays ID of the corresponding object.
- Type: Displays type of the corresponding object.
  - MI: Input (Read Only)
  - MO: Output (Read/Write)
  - MV: Value (Read/Write)
- Object Name: Displays the name of the corresponding object.
- Value: Displays the current value of the corresponding object.

Clearing All System Data

Use the **Disconnect all devices** button to clear all system data from the software database. This function is useful if you are using a laptop to connect to different systems in different buildings or sites. You should backup site information (refer to "Backing up Data to a PC," p.28) before using this function.

1. On the **Tracking** (or **Device Configuration**) page, click the **Disconnect all devices** button.
2. A message displays offering you the opportunity to cancel. To continue, click **OK**.
3. After disconnection is complete, it is a best practice to execute tracking again.

Setting Digital Input/Output (DI/DO) Points

1. On the Device Configuration (or Tracking) page, select the **Setting** button on the bottom left of the page to the right of **DMS DIDO**.

2. Click **Edit** to enable fields.
3. Edit the desired fields.
4. Click **Save** at the bottom of the page. The page refreshes showing changes.

Setting PIMs

1. On theTracking (or Device Configuration) page, select the **Setting** button to the right of **PIM**.The **PIM Setting** page appears.

2. Select a field from the list at the top of the page. Click **Edit** to enable the field.
3. Edit desired fields.
4. Click **Save**.

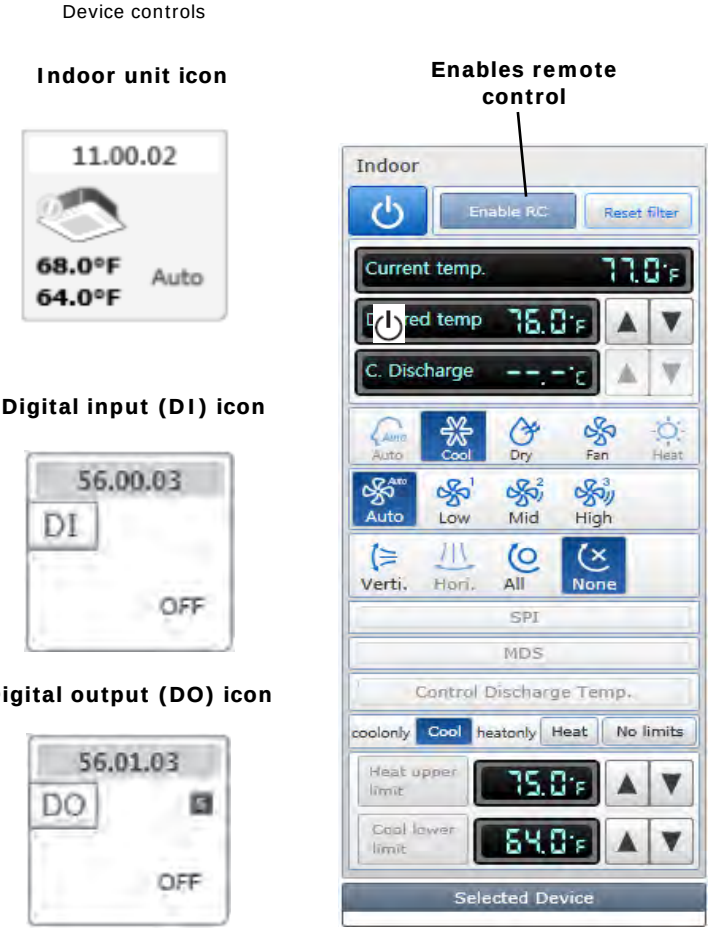
Control and Monitoring

This section explains how to control and monitor the various devices managed by the VRF SC.

The VRF SC Interface

Figure 1 shows an example of individual device controls as they appear on the VRF SC along with the corresponding indoor unit status indicators and controls that appear on the right side of the Web page.

Figure 1. VRF SC interface controls



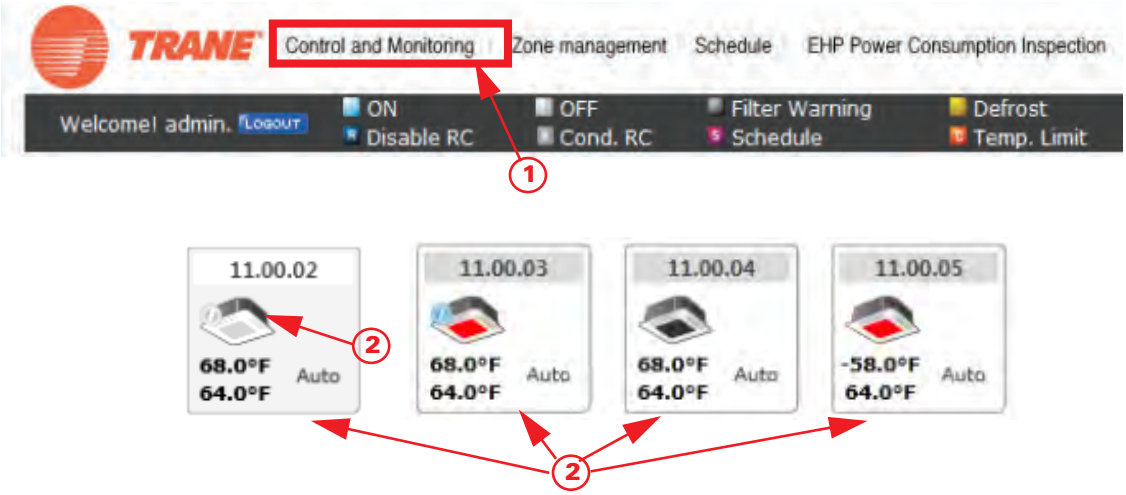
Note: *When users select multiple types of devices,* ***Basic Control*** *is displayed on the screen.*

Monitoring Indoor Unit Operational Status

You can monitor the operational status of all indoor units installed in your system.

1. Click **Control and Monitoring** when the VRF SC Web page menu screen appears.
   The Control and Monitoring screen appears when you log in to the VRF SC Web page.
2. To monitor the status of an indoor unit, select the indoor unit icon.

Figure 2. Control and Monitoring Web page



3. If the outdoor unit is in emergency operation or the MTFC is operating, the siren icon appears as shown in the following figure:

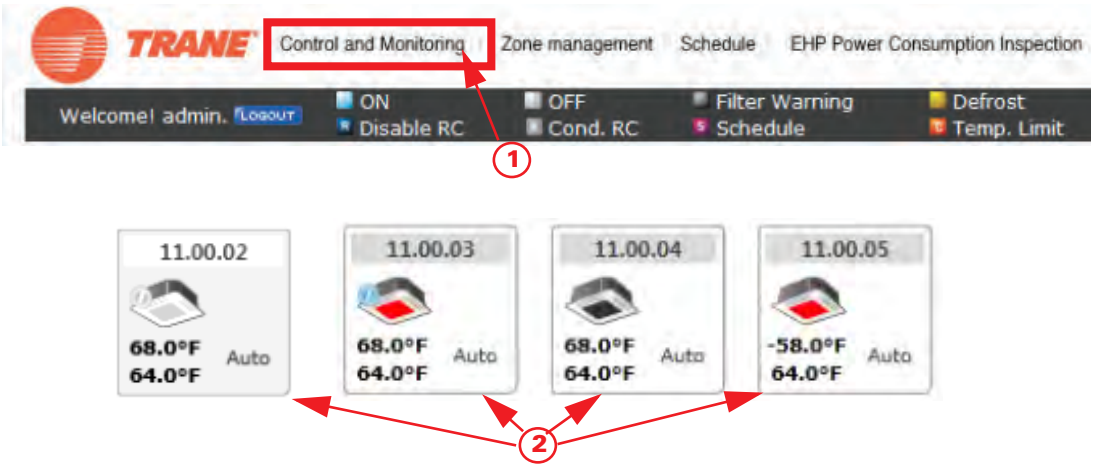
Notes:

- *When the advanced functions (such as Sleep mode or the Energy saving function) are selected through wired/wireless remote controllers or indoor unit panel, the operation mode that is set on the remote controllers and VRF SC may be displayed differently. Also, when controlling by VRF SC, additional functions will be canceled.*
- *Depending on the model of indoor unit, Horizontal/All air flow direction control may not be possible. In this case, vertical or fixed flow will be displayed depending on the indoor unit's basic operational specification.*
- *Device panels are displayed on the Web page only when the corresponding devices are installed.*

Controlling an Indoor Unit

Complete the following steps to control indoor units.

Figure 3. Status display window on the Control and Monitoring Web page



1. Click **Control and Monitoring** when the VRF SC Web page menu screen appears.

   The Control and Monitoring screen appears when you log in to the VRF SC Web page.

2. To control an indoor unit, select the indoor unit icon. If the selected indoor unit is switched on, the remote controller panel will automatically be activated.

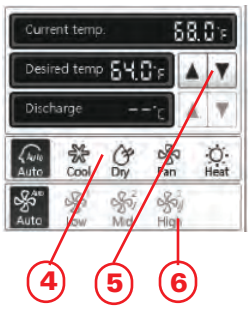
3. Turn the indoor unit on by clicking the **power button** (shown at left).

   The remote controller panel is activated.

4. Select the **operation mode**.

   You can select Auto, Cool, Dry, Fan or Heat operation mode.

5. Click to set the desired **temperature**.



   - Each time you press the buttons, the temperature will be adjusted by 1 or 0.1°C (or by 1°F).
   - If Auto/Cool/Dry mode is in operation, you can adjust the desired temperature in the range of 18°C (64°F)–30°C (86°F).

     Note: *When the operation mode of an indoor unit is Cool or Dry mode, you cannot set the desired temperature lower than the lower limit temperature if the lower limit is enabled.*

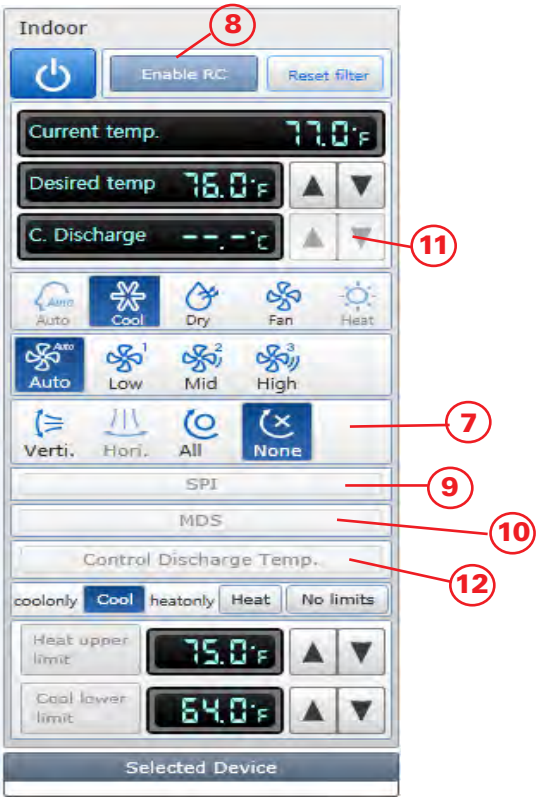
   - If Heat mode is in operation, you can adjust the desired temperature in the range of 16°C (61°F)–30°C (86°F).

     Note: *When the operation mode of indoor unit is Heat mode, you cannot set the desired temperature higher than the upper limit temperature if the upper limit is enabled.*

   - You cannot adjust the desired temperature in Fan mode.

6. Select the **fan speed**.
   - You can select Auto, Low, Mid and High.
   - If Auto/Dry mode is in operation, fan speed will be set as Auto fan speed.
   - If Fan mode is in operation, you cannot select Auto fan speed.
   - When the Turbo fan speed is available, the Turbo icon is displayed and you can select and control the Turbo fan speed.

Figure 4. Air flow direction selections



7. Select the **air flow**.
   You can select Vertical, Horizontal, All and None air flow direction.
   When the 360 Cassette air conditioner is connected, icons are changed to Spot, Mid, Wide, and Swing.
8. Set **remote controller settings**.
   - You can select **Enable RC**, **Disable RC**, and **Cond. RC**.
   - When selecting Disable RC, indoor unit control by wired/wireless remote controller and indoor unit panel is not possible. Indoor unit control is only available from the VRF SC Web page.
   - Click the **power icon** (shown at left) when you want to use wired remote controller in each room.

9. Select **SPI setting**.
   You can set SPI through button activation / non activation.
10. Select **MDS setting**.
    You can set MDS (Motion Detection Sensor) through button activation / non-activation.

11. Set **cooling/heating discharge temperature** by clicking the up arrow and down arrow (shown at left).
    - When the indoor unit is in Cool mode, you can adjust cooling discharge temperature and when the indoor unit is in Heat mode, you can adjust the heating discharge temperature.
    - Cooling discharge temperature can be set in the range of 8°C (46°F)–18°C (64°F).
    - Heating discharge temperature can be set in the range of 30°C (86°F)–43°C (109°F).

- When the indoor unit is in Auto, Dry or Fan mode, you cannot adjust the discharged temperature.

12. Select **Control Discharge Temp.**

    You can click the enable/disable button to decide whether to use discharge temperature adjustment.

Finally, be aware of the following considerations:

- If the filter warning sign is displayed, select the indoor unit and click **Reset filter** to release the filter warning.

- Each indoor unit must be turned on to control.
- Selecting remote controller, reset filter, operation mode limits, setting lower/upper temperature limits is possible even if the power of indoor unit is off.
- Some air flow direction options may be restricted depending on the indoor unit model.
- SPI, MDS and discharge temperature functions can be operated normally when corresponding optional functions are installed to the selected indoor unit.

Indoor Operation Mode Limit

You can monitor the operation status of all indoor units or have individual or whole control of the indoor units.

1. Click **Control and Monitoring** when the VRF SC Web page menu screen appears.

   The Control and Monitoring screen appears when you login to VRF SC Web page. (Refer to Figure 3, p. 49.)

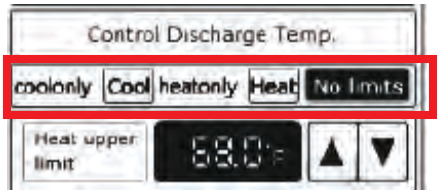
2. Select an indoor unit to control.
3. Check the indoor unit status through status display window.

   When the selected indoor unit is switched on, the remote controller panel will be automatically activated.

4. Set **operation mode limit**.

   You can select [coolonly (Cool)], [heatonly (Heat)], and [No limits]. (Refer to Figure 1, p. 47 for a full view of the VRF SC interface.)

Figure 5. Operation mode limit setting



Notes:

- *You can use cool only and heat only with No Limits.*
- *If you set the operation mode limit, the VRF SC will automatically change the operation mode limit setting of all the indoor units connected to same outdoor unit.*
- *If the indoor unit is a cooling only model, you cannot set the operation mode limit to "heat only."*

Setting the Lower/Upper Temperature Limit of an Indoor Unit

You can monitor the operation status of all indoor units, and control the indoor units as a whole, or as individual units.

1. Click **Control and Monitoring** when the VRF SC Web page menu screen appears.

   The Control and Monitoring screen will appear when you login to the VRF SC Web page. (Refer to Figure 3, p. 49.)
2. Select an indoor unit to control.
3. Check the indoor unit status through status display window.

   When the selected indoor unit is switched on, the remote controller panel will be automatically activated.
4. Set **upper temperature limit** by pressing the up and down arrows.

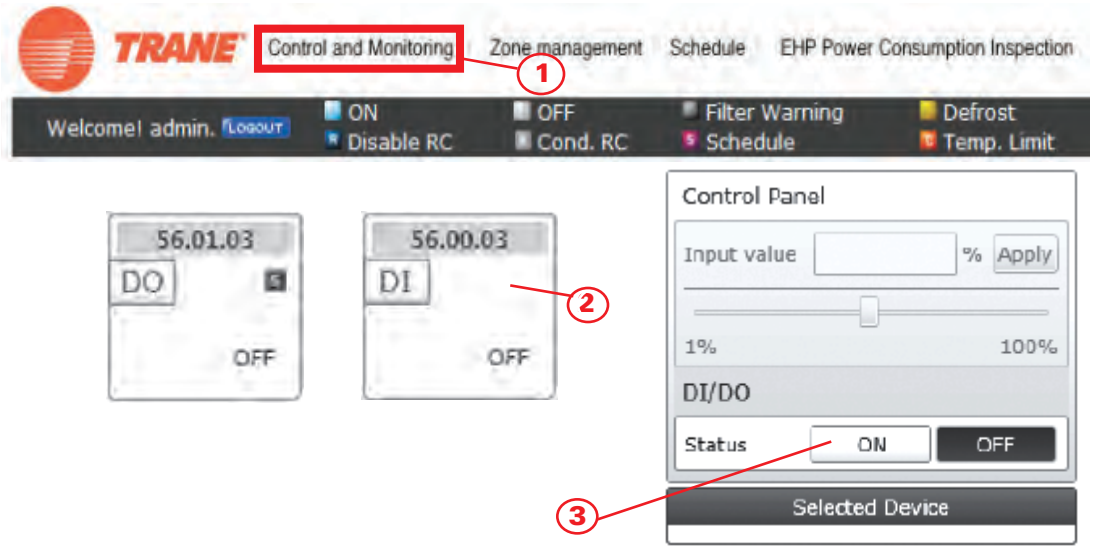
   Figure 6. Temperature limit settings

5. Click **Heat upper limit** to apply the upper temperature limit setting.
   - Upper temperature limit can be set in the range of 61°F to 86°F (16°C to 30°C).
   - When an indoor unit is operating in Heat mode and the upper temperature limit is applied, you cannot set the desired temperature higher than the upper temperature limit.
6. Set **lower temperature limit** by pressing the up and down arrows.
   - You can set lower temperature limit by clicking 'Cool lower limit'.
   - Lower temperature limit can be set in the range of 64°F to 86°F (18°C to 30°C).
   - When indoor unit is operating in Cool or Dry mode and the low temperature limit is applied, you cannot set the desired temperature lower than the lower temperature limit.

Monitoring VRF SC DI/DO Operation Status

Figure 7. Monitoring operation status



1. Click **Control and Monitoring** when the VRF SC Web page menu screen appears.
   The Control and Monitoring screen appears when you login to VRF SC Web page.
2. Check the current status of DI and DO device.
3. Monitor the device through the control panel.

Notes:

- *Entering OnOff becomes impossible for DI device.*
- *Entering OnOff becomes possible for DO device.*
- *Entering control value becomes impossible for DI/DO device.*
- *You can control and monitor DI/DO, which is built-in to the VRF SC. However, DI 1, 2 and DO 1, 2, 9, 10 are excluded from controlling and monitoring because they are used for the internal functions of VRF SC.*

Controlling VRF SC DO

1. Click **Control and Monitoring** when the VRF SC Web page menu screen appears. (See Figure 7.)
   The **Control and Monitoring** screen appears when you log-in to the VRF SC Web page.
2. Select a DO device to control when the Control and Monitoring screen appears.
   Check the status of DI or DO device.
3. Turn on the DO device by clicking the **ON/OFF** buttons on the control panel.
   Remote controller setting is not possible for a DI/DO device.

Monitoring the Operational Status of Multiple Devices

You can monitor the operational status of one or more devices.

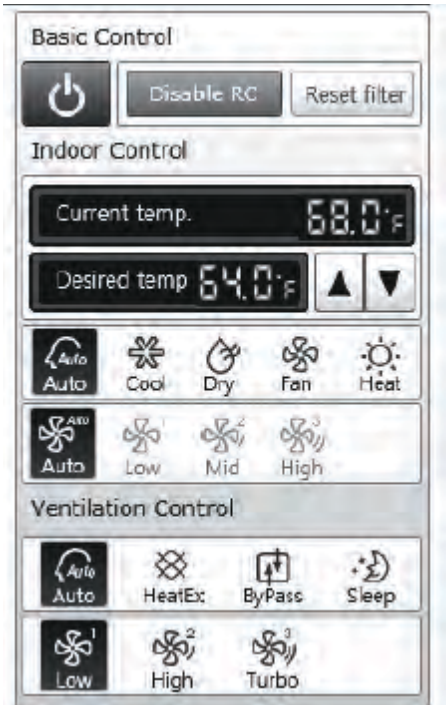
1. Click **Control and Monitoring** when the VRF SC Web page menu screen appears. (See Figure 3, p. 49.)

   The Control and Monitoring screen appears when you log-in to the VRF SC Web page.
2. Select the devices you want to monitor.
3. Check the status of the selected multiple devices.
4. Check the status of an indoor unit through the status display window.

   When the selected devices are switched on, the remote controller panel is automatically activated.

   Note: *When users select multiple devices of different types, 'Basic Control' is displayed on the screen.*
5. The current status of the last selected indoor unit type devices are displayed on the Indoor control group.
6. The list of the selected multiple devices is displayed on the Selected Device group.

Figure 8. Display of multiple devices



Controlling Multiple Devices

1. Click **Control and Monitoring** when the VRF SC Web page menu screen appears.
2. Control and Monitoring screen will appear when you login to SysControl Web page. (See Figure 3, p. 49.)

   The Control and Monitoring screen appears when you log-in to the VRF SC Web page.
3. Select the devices you want to monitor.
4. Check the status of the selected multiple devices.
5. Check the status of an indoor unit through the status display window.

   When the selected devices are switched on, the remote controller panel is automatically activated.
6. Turn the selected devices on by clicking the power button. (See Figure 8, p. 54.)

   The remote controller panel will be activated.
7. Select the desired temperature by clicking the up and down buttons. (See Figure 8, p. 54.)
   - Each time you press the buttons, the temperature will be adjusted by 1 or 0.1°C (or by 1°F).
   - If Auto/Cool/Dry mode is in operation, you can adjust the desired temperature in the range of 18°C (64°F)–30°C (86°F).

     Note: *When the operation mode of an indoor unit is Cool or Dry mode, you cannot set the desired temperature lower than the lower limit temperature if the lower limit is enabled.*
   - If Heat mode is in operation, you can adjust the desired temperature in the range of 16°C (61°F)–30°C (86°F).

     Note: *When the operation mode of indoor unit is Heat mode, you cannot set the desired temperature higher than the upper limit temperature if the upper limit is enabled.*
   - You cannot adjust the desired temperature in Fan mode.
8. Select the operation mode.

   You can select Auto, Cool, Dry, Fan and Heat mode.
9. Select the fan speed.
   - You can select Auto, Low, Mid and High.
   - If Auto/Dry mode is in operation, fan speed will be set as Auto fan speed.
   - If Fan mode is in operation, you cannot select Auto fan speed.
10. When controlling certain types of devices in detail, select the device you want to control on the list of the 'Selected Device'.

    Notes:
    - *If the indoor unit type devices are not on the list of the 'Selected Device', Indoor control will not be activated.*
    - *You can select power OnOff, Disable RC, Reset filter, and Indoor Control (Desired temp, operation mode, fan speed) in the 'Basic control' group.*
    - *Power OnOff, Disable RC and Reset filter are controlled to all the devices.*
    - *When selecting multiple devices, the list of the selected devices is displayed at the bottom of the remote controller. When selecting the device you want to control, the remote control panel of the selected device is activated and you can control the selected device in detail. However, no other devices cannot be controlled simultaneously.*

Checking Installation Information

You can check the installation status of a currently connected device.

1. Click [Control and Monitoring] when SysControl Web page menu screen appears.
   Control and Monitoring screen will appear when you login to VRF SC Web page.
2. Click **Install.Info** tab at the bottom left of the screen.

Figure 9. Install.Info tab on the VRF SC Web page

3. Check installation status of currently connected device in the installation information tab.
   You can check installation information by pressing the up and down buttons.

View Control History and Power Consumption for a Selected Device

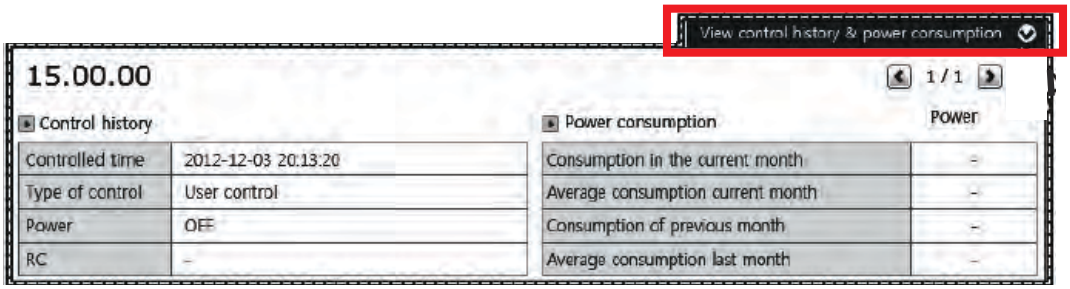
You can select a device and view control history and power consumption information.

1. Click **Control and Monitoring** when VRF SC Web page menu screen appears.
   Control and Monitoring] screen appear when you log in to the VRF SC Web page.
2. Select a device for which you want to view control history and power consumption.
3. Click **View control history & power consumption** in the lower right of the window. (See Figure 9.)
   Results are returned from VRF SC after a short interval. A "data received" message appears on the bottom right of the tab.
4. When the data is returned from the VRF SC, check control history and power consumption of selected device.

Notes:

- *You can check power control and remote controller usage status in Control history.*
- *Operation mode, desired temperature, air flow and fan speed control displays only the controlled time and type of control.*
- *Power consumption information is displayed only when PIM is installed.*

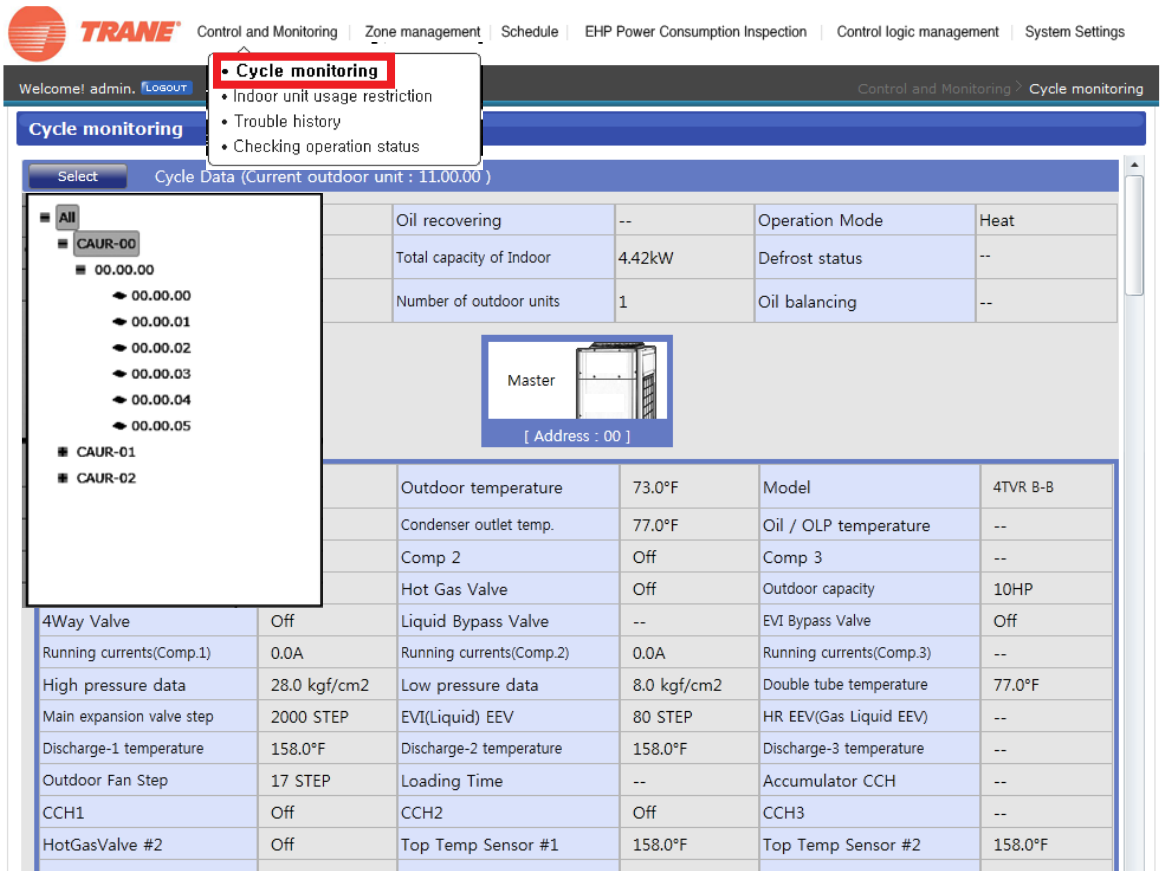
Figure 10. Power consumption results



Cycle Monitoring

You can select an indoor unit and then check cycle information.

Figure 11. Cycle monitoring



1. Click **Control and Monitoring > Cycle Monitoring** when the VRF SC Web page menu screen appears.
2. Click **Select**.

   VRF SC installation information is displayed.
3. Select a device to check cycle information.

- If you select OnOff controller, its subordinate outdoor unit which has the earliest address is selected.
- If you select an outdoor unit, all the information of the module (that is connected to the selected outdoor unit) is displayed.
- If you select indoor unit, upper outdoor unit is selected.

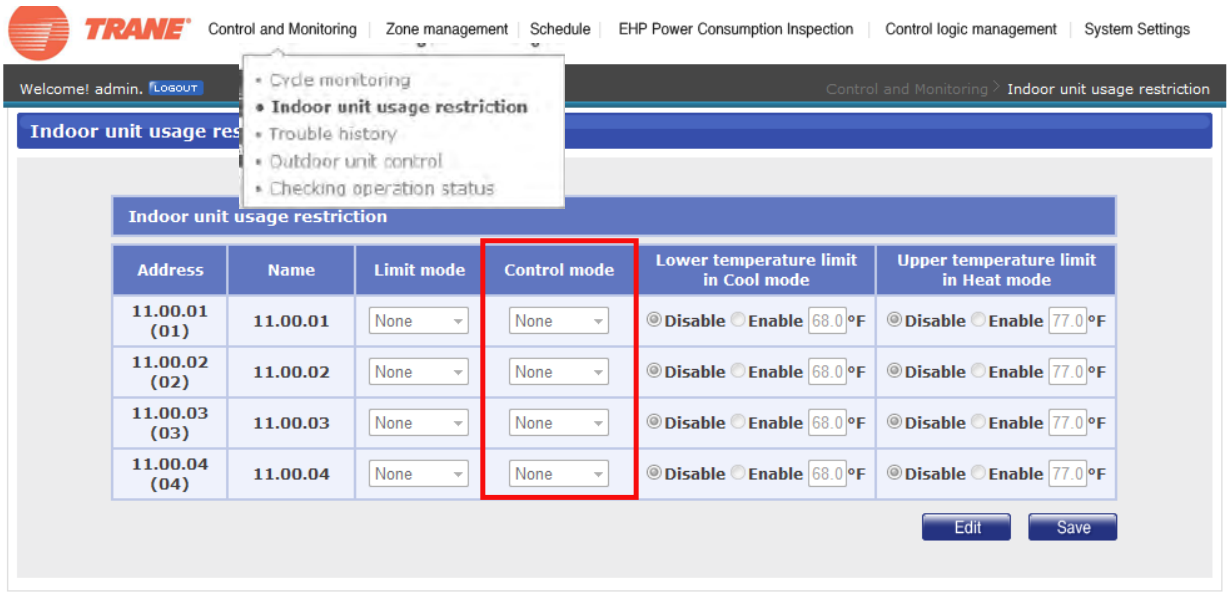
4. Cycle information of selected outdoor unit and subordinate indoor units.

   If the status of outdoor unit and indoor unit is changed, status value turns blue.

Indoor Unit Usage Restriction—Operation Limit

You can set the operation of indoor unit as cooling only and heating only.

Figure 12. Indoor unit usage restriction



1. Click **Control and Monitoring > Indoor unit usage restriction** when VRF SC Web page menu screen appears.
2. Press **Edit** button.
3. Set the limit mode.
   - You can select 'Cool-only', 'Heat-only' or 'None'.
   - For cooling only indoor unit, you can select cool, dry and fan modes only.
   - For heating only indoor unit, you can select heat and fan modes only.
4. Set the control mode.

Notes:

- Control mode is used by VRF SC to set either 'cool only' or 'heat only' mode to indoor and outdoor units.
- Mixed operation can occur even if you set limit mode.
- If the indoor unit with operation mode limit is in mixed operation, VRF SC solves the problem automatically by controlling it in control mode.

- When you set the operation mode limit, and if the outdoor unit is HP (Heat pump) type, VRF SC automatically changes the operation mode limit setting of all the indoor units connected to the same outdoor unit.
- If the indoor unit is cooling only model, you cannot set the operation mode limit to 'heatonly'.

Indoor Unit Usage Restriction—Temperature Limit in Cool/Heat Mode

You can set temperature lower/upper temperature limit in cool/heat mode.

1. Click **Control and Monitoring > Indoor unit usage restriction** when the VRF SC Web page menu screen appears.
2. Press the **Edit** button.
3. Set the lower/upper temperature limit.
   - You can set lower/upper temperature limit by selecting 'Enable'/'Disable'.
   - Lower temperature limit range: 18°C (64°F)–30°C (86°F)
   - Upper temperature limit range: 16°C (61°F)–30°C (86°F)
4. Click **Save**.

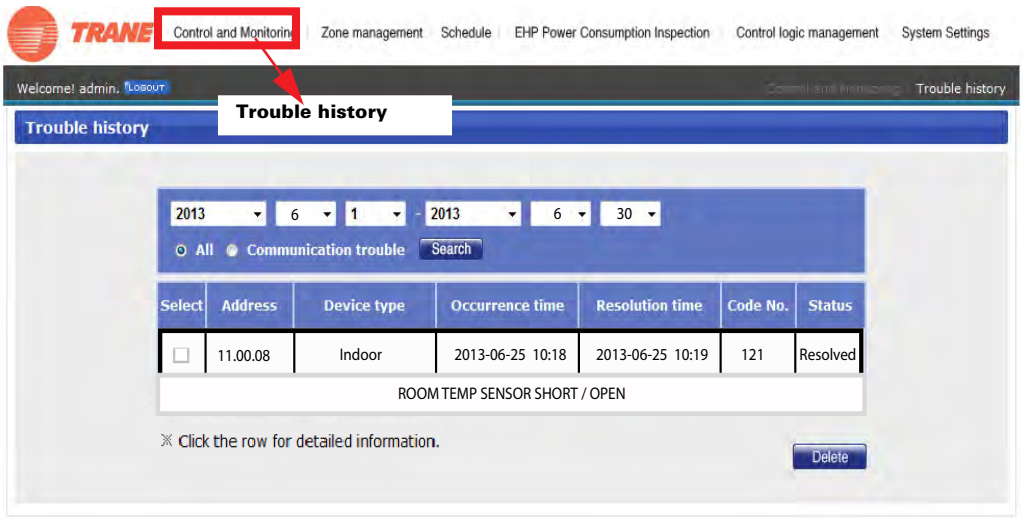
   The indoor unit usage restriction setting is saved.

Checking the Trouble History

You can check the following information in the trouble history:

- Address, device type, occurrence time, resolution time, code number and status.
- Detailed information on trouble history by selecting the item in the list.

Figure 13. Trouble history



1. Click **Control and Monitoring > Trouble history** when the VRF SC Web page menu screen appears.
2. Check the trouble history.

   Notes:

   - *VRF SC saves a maximum of 1024 cases of trouble history. If the number of cases exceeds 1024, VRF SC will delete the oldest case first.*

- *If the same trouble code is detected repeatedly in the same device on the same day, the trouble history case is shown as a single case. If it occurs more than two times, the* **Resolution time** *may change every time you check. The number of repetitions are displayed in the* **Status** *column.*

Checking the Trouble History by Date

You can view trouble reports for a select date or date range.

1. Click **Control and Monitoring > Trouble history** when the VRF SC Web page menu screen appears.
2. Enter the time period you want to check by entering the year/month/day in order.
3. Click **Search**.

You can check the following information in the trouble history:

- Address, device type, occurrence time, resolution time, code number and status for the entered time period.
- Detailed information on trouble history by selecting the item in the list.

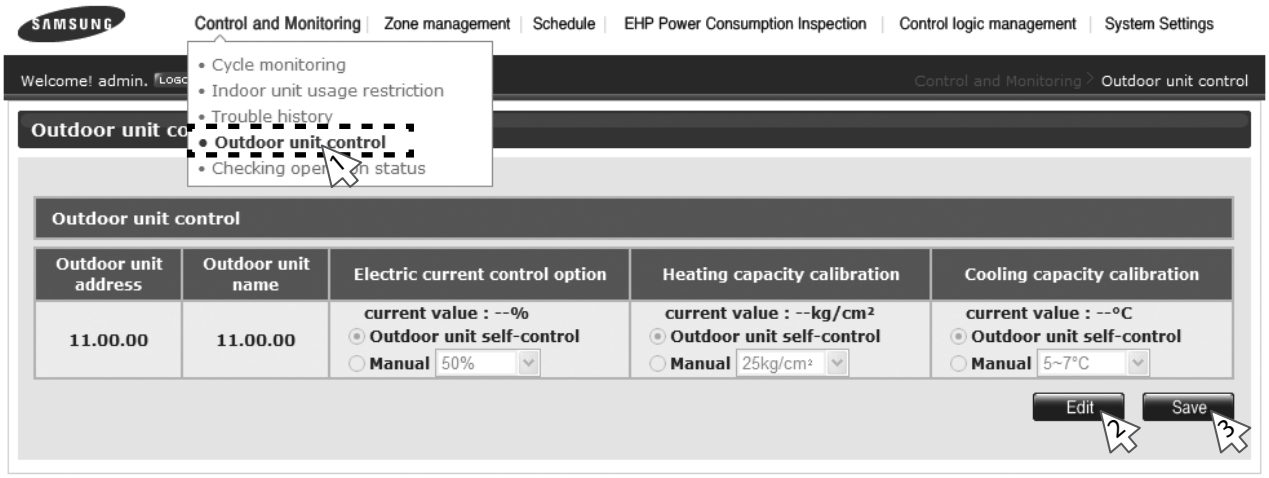
VRF SC saves maximum 1024 trouble histories. If the number of history exceeds 1024, VRF SC deletes the oldest history first. (See Figure 13, p. 59.)

Deleting Trouble History Items

1. Click **Control and Monitoring > Trouble history** when the VRF SC Web page menu screen appears. (See Figure 13, p. 59.)
2. Select the check box to the left of the trouble history item you want to delete.
3. Click **Delete**.
4. Click **OK** from the confirm window. Selected trouble history will be deleted.

Outdoor Unit Control

Note: *The outdoor unit control is supported on certain models only, and the Outdoor unit control page only appears on those supported models.*



1. Click **Control and Monitoring > Outdoor unit control** when the VRF SC Web page menu screen appears.
2. Click **Edit** and select the desired setting for Electric current control option, Heating capacity calibration, and Cooling capacity calibration.
   - Outdoor unit self-control: Outdoor unit controls the value itself.
   - Manual: Outdoor will be controlled at value set by the user.
3. Click **Save** and the outdoor unit will be controlled at set value.

   If the value was set manually on the VRF SC, the outdoor unit will always operate at set value.

Control for Occupied/Vacant Room

1. Click **Control and Monitoring** > **Occupied/Vacant room control** when the VRF SC web page menu screen appears.
2. Click **Edit** and select the desired setting for Mode, Desired temperature, and Fan speed. Click **Apply**.
3. Click **Save** and the unoccupied room will be controlled at set value.

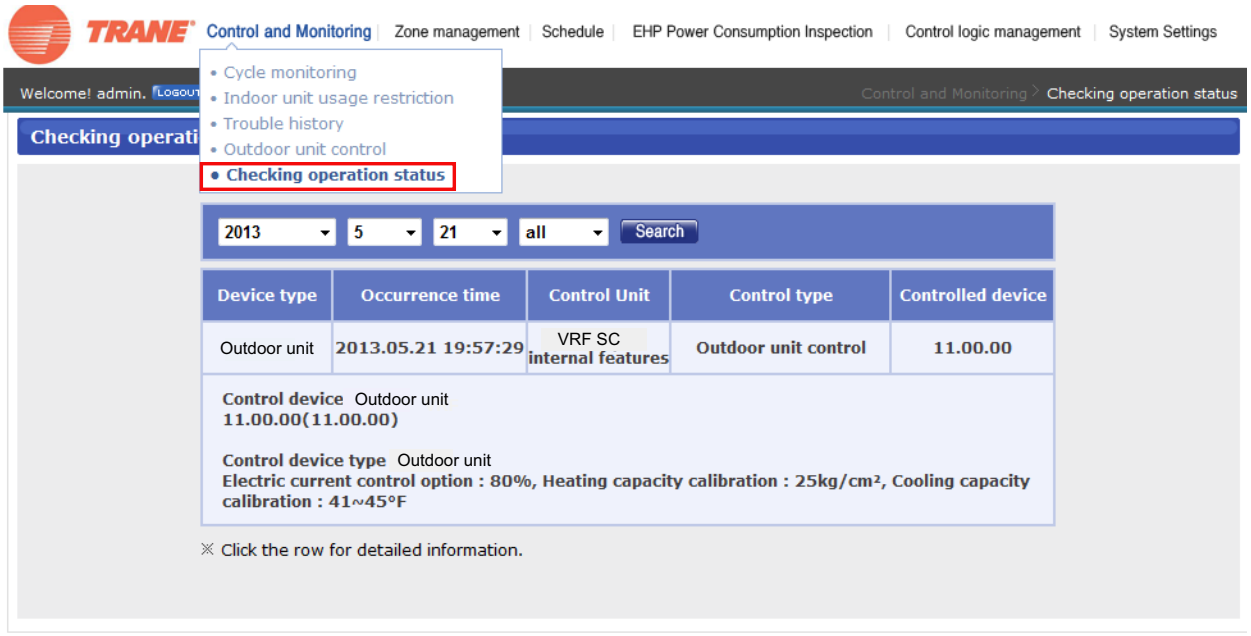
Notes:

- *The Occupied/Vacant room control page appears only on those supported models.*
- *If the indoor unit is unoccupied, this symbol ( ) will appear on the indoor unit icon on the **Control and Monitoring** screen.*

Checking the Operation Status

You can check the operation status of indoor unit which is controlled by the VRF SC.

Figure 14. Checking operation status



1. Click **Control and Monitoring > Checking operation status** when the VRF SC Web page menu screen appears.
2. Check the operation history.

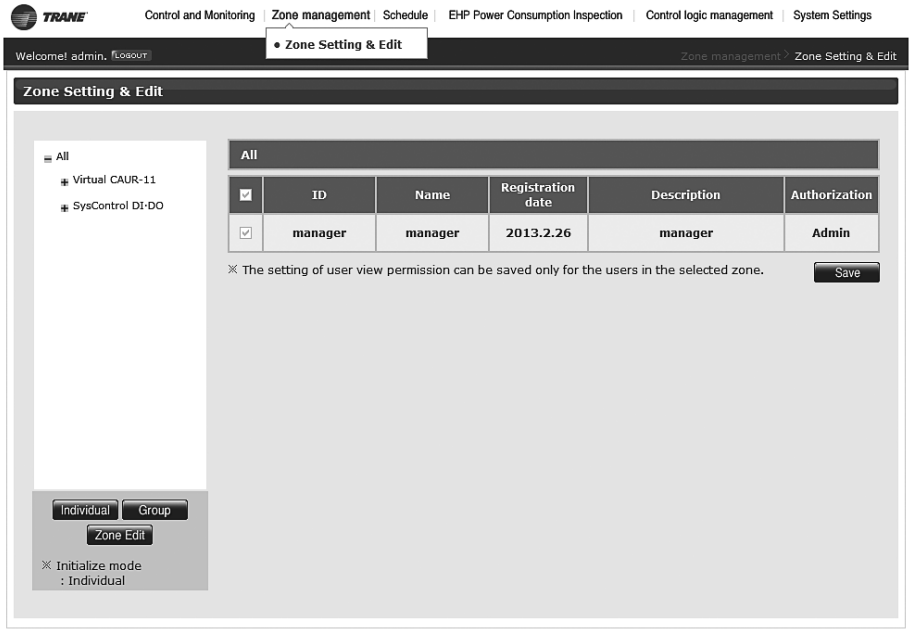
   You can check the device type, occurrence time, control unit, control type, and controlled device address of indoor unit which is controlled by the VRF SC and a subordinate controller.
3. Check operation status by entering the year/month/day then clicking **Search**.

   You can then check the control history that occurred on the entered date.
4. Check detailed control history which is controlled by the command by pressing control history in the list.

Note: *VRF SC saves the operation history information for 180 days. However, retention time can vary depending on the available storage space on the VRF SC.*

Zone Management

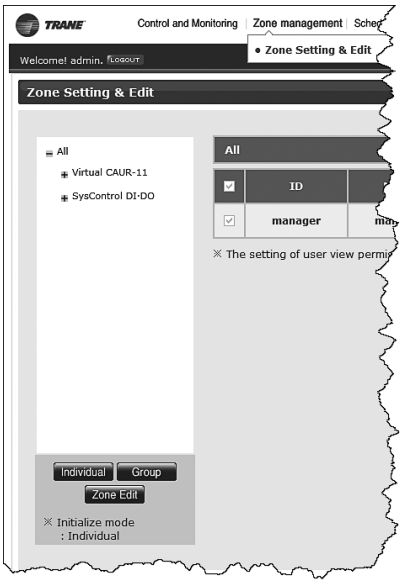
Zone management allows you to set the user authorization to control and monitor zones and to create, edit, and remove zones, as needed. Zone management functions are performed on the Zone Setting & Editing page as shown below.



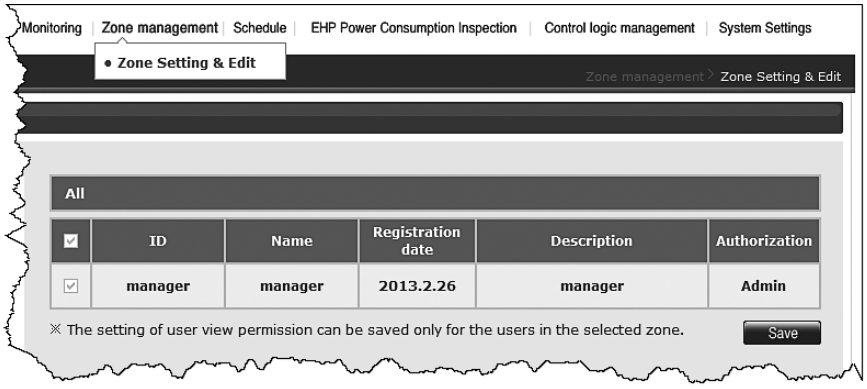
Setting Individual or Group Initialization

1. Click the **Zone management** tab at the top of VRF System Controller interface and select **Zone Setting & Edit**. The Zone management page displays.
2. Choose to initialize the indoor unit organization as either **Individual** or **Group**.
   - Individual initialization reorganizes a connected indoor unit based on installation address.
   - Group initialization reorganizes a connected indoor unit based on the RMC address.

   Note: *After group initialization, indoor units are displayed as one device when upper zone is selected in the Control and Monitoring screen. When editing a zone after group initialization, you can only move in groups. After group initialization, subordinate devices cannot be moved individually to the other zones. Only authorized users have access to the initialization feature.*

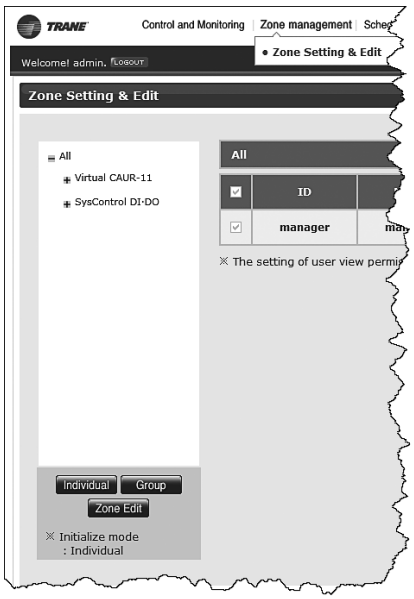


Setting Zone Management Authorization



1. Click the ***Zone management*** tab at the top of VRF System Controller interface and select **Zone Setting & Edit**. The Zone management page displays.
2. Choose a zone from the left-hand task pane and check the box to set user authorization. Observe the following when setting authorization:
   - Some users may be restricted from setting authorization for controlling and monitoring certain zones. Those zones allowed display with a check mark.
   - Set authorization when adding users, otherwise the zone(s) do not display when the user logs in.
   - Setting user authorizations are valid only for the zone displayed on the screen. If selecting another zone setting without clicking Save, the user authorization for the previously selected zone is lost.
   - When first initializing a zone, all rights are given to all users.
3. Click **Save**.

Editing a Zone



1. Click the **Zone management** tab at the top of VRF System Controller interface and select **Zone Setting & Edit**. The Zone management page displays.
2. Click **Zone Edit** at the bottom of the left-hand task pane. The Zone Edit page displays.
3. Click on the Name drop-down list and select from the following options to edit the viewing option:
   - Name
   - Address
   - Address & Name

   Table 4 describes each editable field.

Table 4. Zone Edit List

Field Name	Description
Create in the above	Create a new zone on top of the selected zone.
Create in the below	Create a new zone under the selected zone.
Create in the sub zone	Create a zone one step lower than the user selected. **Note:** Creating a zone under 5 steps is not allowed.
Remove	Remove the selected zone. **Note:** If the selected zone includes a device, the device moves to the top step.
Move up	Move up the selected zone or indoor unit one step.
Move down	Move down the selected zone or indoor unit one step.
Move to upper level	Move the selected zone or indoor unit to the upper level.
Rename	Rename the selected zone or indoor unit. **Note:** Maximum of 16 letters allowed.
Cut	Cut to move the selected zone or indoor unit.
Paste	Move the cut zone or indoor unit to the selected zone.

Table 5. Zone Properties

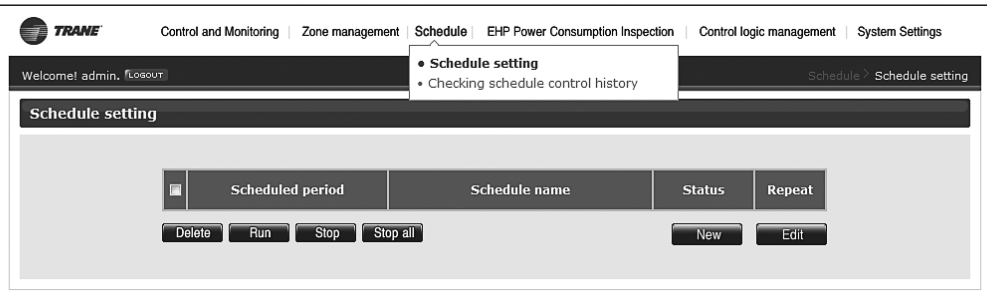
Field Name	Property name	Description	Name
Individual initialization mode	General	• Virtual group which is managed by installation address, not by RMC address. • The user can create and delete zone.	—
	Group	Not applicable. (Only supported in group initialization mode.)	Not applicable. (Only supported in group initialization mode.)
	AHU	• Virtual group which manages AHU kit in general zone. • The user can create and delete.	• It will be displayed as single device in the control and monitoring screen, and it can be controlled as single device. • You cannot move subordinate device to the other zone.
Group initialization mode	General	• Virtual group which is set and managed by the user. • The user can create and delete.	—
	Group	• Virtual group which is managed by installation address, not by RMC address. • The user cannot create and delete. • VRF System Controller creates it automatically.	• It is displayed like as one device in the control and monitoring screen and can be controlled. • You cannot move subordinate device to the other zone.
	AHU	• Virtual group that manages the AHU kit in general zone. • The user can create and delete.	• It is displayed like as one device in the control and monitoring screen and can be controlled. • You cannot move subordinate device to the other zone.

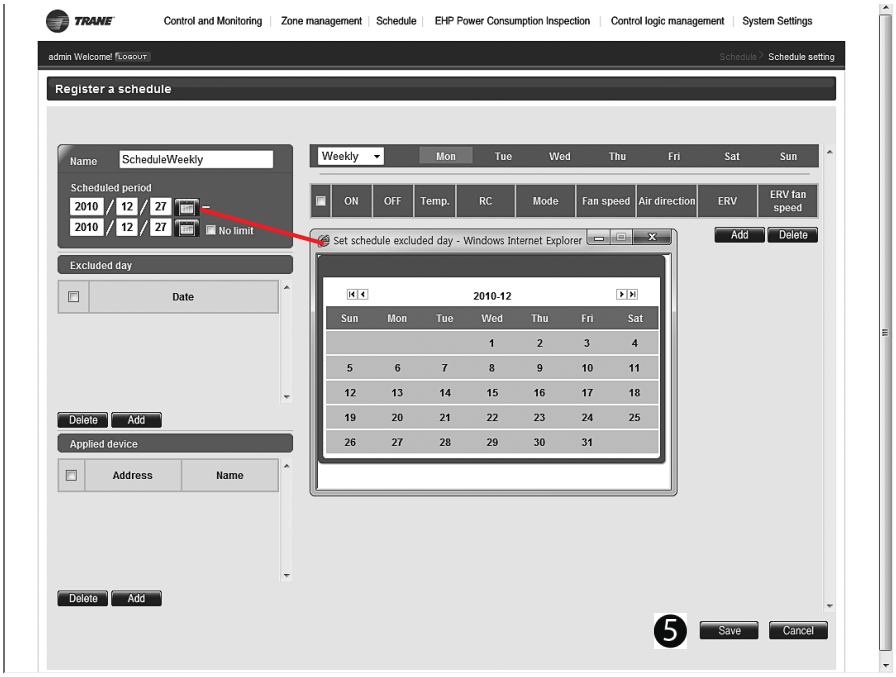
Schedule

Use the scheduling function to create, edit, and delete schedules. In addition, you can select and run/stop schedules or view schedule history for various controllers.

Note: *Tracking (device discovery) must be completed before schedule creation is possible.*

Creating Schedules

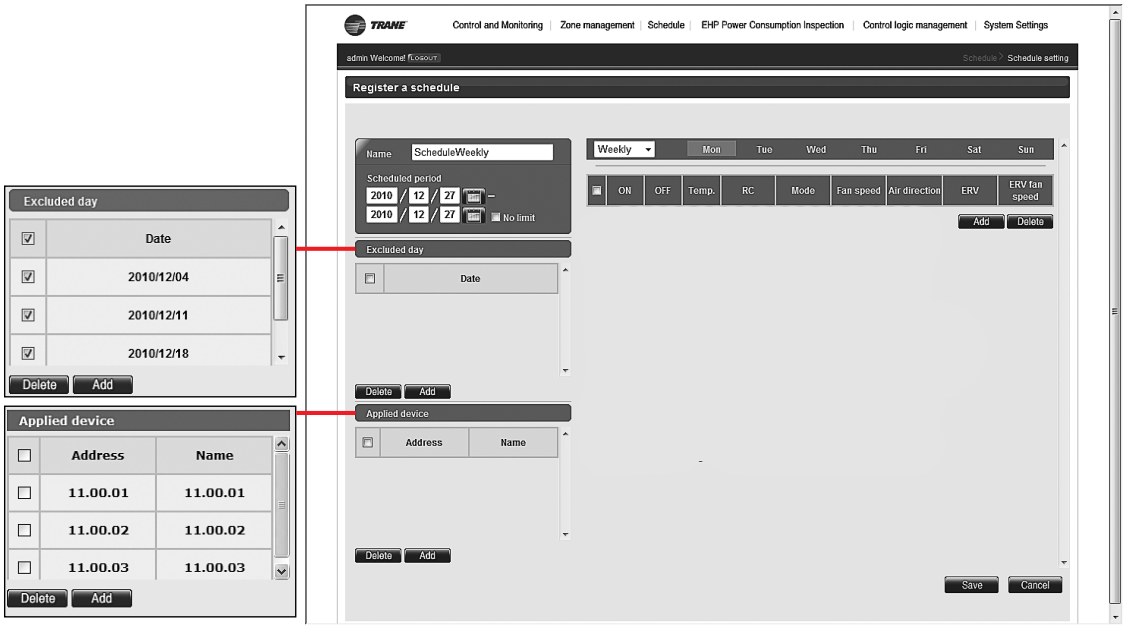




1. Click the **Schedule** tab at the top VRF System Controller interface and select **Schedule setting**. The Schedule setting page displays.
2. Click **New**. The **Register a schedule** page appears.
3. Enter a meaningful schedule name.
4. Click to display the pop-up calendar window and select start/end dates.

   Note: *If you choose to keep the No limit default setting for the end date, the system displays an end of Dec 31, 9999. You are allowed to create and save a maximum of 365 exception dates.*
5. Click **Save** to save the new schedule.

Setting an Exception Date and Applying a Schedule



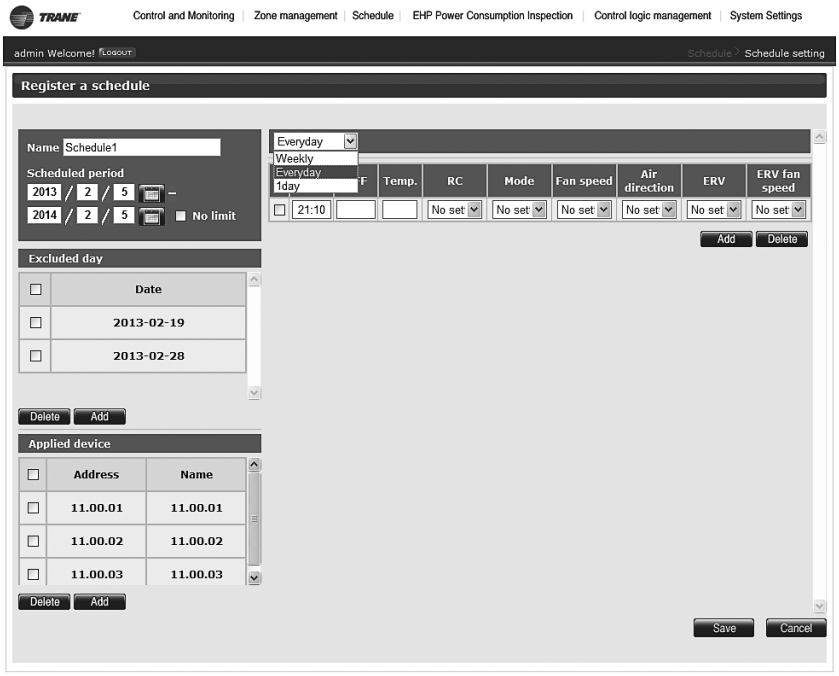
1. To set an exception date for the scheduled period, click **Add** to display the calendar window.
2. Select an exception date.

   Note: *To delete an exception date, check the box next to the exception date it and click* **Delete**.
3. To apply a schedule to a device, click **Add** under *Applied device*. A list of all the connected devices displays.
4. Click **Save** to save the settings.

   Notes:

   - *You can also create a schedule for system controller digital output (DO) points.*
   - *To delete a device, check the box next to the device and click* **Delete**.

Setting a Schedule Event



1. Click on the drop-down arrow to set a schedule event as follows:
   - Choose either **Weekly**, **Everyday**, **1day**.

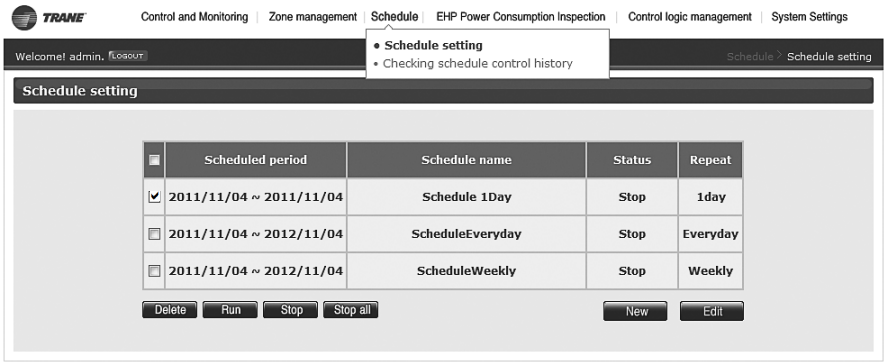
     Note: *If choosing 1day, the start/end dates should be set to the same day.*
   - Enter 4 digits for the On/Off times. For example, if the time is 8:00 a.m or p.m., enter 0800.
   - Temp: the operable ranges are:
     - 61°F to 86°F (16°C to 30°C), heating mode
     - 64°F to 86°F (18°C to 30°C), cooling mode
   - Select one of the following remote controller (RC) settings:
     - **Enable RC:** allows controlling the indoor unit using a wired or wireless remote controller or by using an indoor unit panel in each room.
     - **Disable RC:** does not allow controlling the indoor unit using a wired or wireless remote controller or by using an indoor unit panel in each room.
     - **Cond. RC:**
       ON by VRF System Controller allows controlling the indoor unit using a wired or wireless remote controller or by using an indoor unit panel in each room.
       OFF by VRF System Controller does not allow controlling the indoor unit using a wired or wireless remote controller or the indoor unit panel in each room.
   - Mode: select either **Auto** (fan speed always set to Auto), **Fan** (cannot control as Auto), or **Dry** (fan speed always set to Auto).
   - Fan speed: select the fan speed.
   - Air direction: select the air direction.

   Note: *You are allowed a maximum of 70 events for Everyday schedules, 10 event for Weekly schedules, and 10 events for 1day schedules. When creating additional scheduled events, only the earliest scheduled event is enabled.*

2. Click **Add** and then click **Save**.

   Note: *To delete an event, check the box next to the event and click* ***Delete****.*

Managing Schedules



Editing Schedules

1. Click the **Schedule** tab at the top VRF System Controller interface and select **Schedule setting**. The Schedule setting page displays.
2. Check the box next to the schedule to edit.

   Note: *You can only select the current operating schedule.*
3. Click **Edit**.
4. Edit the desired field(s) as listed under the section, "Setting a Schedule Event," p.69.

Deleting Schedules

1. Click the **Schedule** tab at the top VRF System Controller interface and select **Schedule setting**. The Schedule setting page displays.
2. Check the box next to the schedule to delete as shown above.
3. Click **Delete** and then click **OK** to confirm deletion.

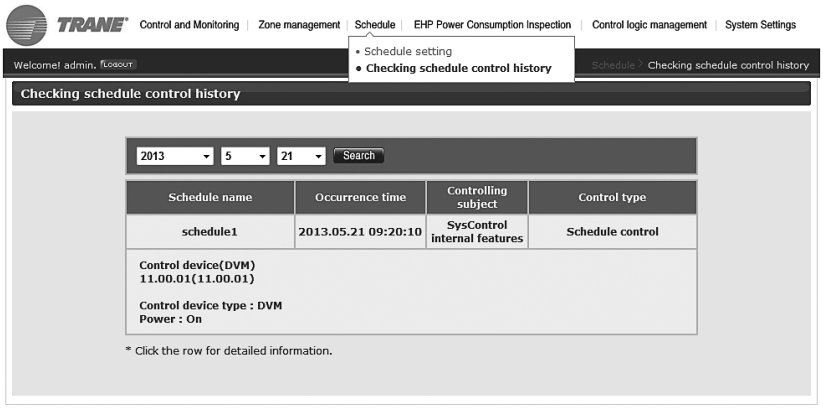
   Note: *You can only delete a schedule that is in Stop status. To delete the currently applied schedule, you must Stop the schedule first.*

Running Schedules

1. Click the **Schedule** tab at the top VRF System Controller interface and select **Schedule setting**. The Schedule setting page displays.
2. Check the box next to the desired schedule that you want to run.

   Note: *You can check multiple schedules to run.*
3. Click **Run** to run schedule(s) and **Stop** or **Stop All** to stop schedules currently scheduled to run.

Checking Schedule Control History



1. Click the **Schedule** tab at the top VRF System Controller interface and select **Check schedule control history**. The Check schedule control history page displays.
2. Click **Search** and select a date to view the schedule control history. Click on the **Schedule name** row to view more detailed information.

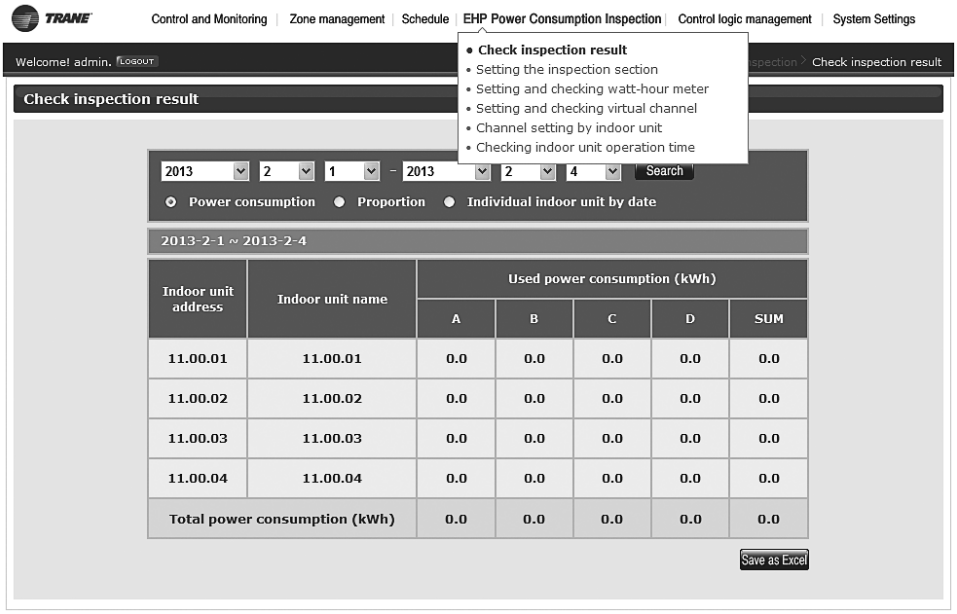
   Note: *You can only search executed schedules. The system can store up to 180 days of history, depending on the amount of storage space on your system.*

Effective Horsepower (EHP) Consumption Inspection

EHP consumption inspection allows you to:

- Check inspection results with or without the power meter interface module (PIM)
- Set inspections
- Set and check watt-hour meter and check kilowatt history
- Set and check virtual channel
- Set channels by indoor unit
- Check indoor unit operation time
- Check kilowatt, history, and power consumption for each indoor unit.

Checking Inspection Results (With PIM)



1. Click the **EHP Power Consumption Inspection** tab at the top VRF System Controller interface and select **Check inspection result**. The Check inspection result page displays.
2. Select the **Start/End** dates and choose either **Power consumption**, **Proportion**, or **Individual indoor unit by date**.

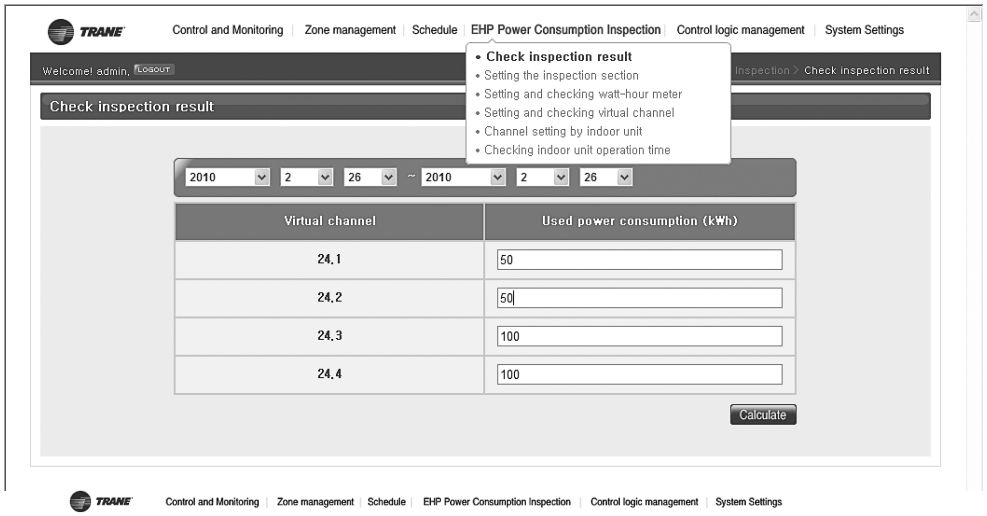
   Note: *You can search up to 365 days.*
3. Click **Search** to displays results.

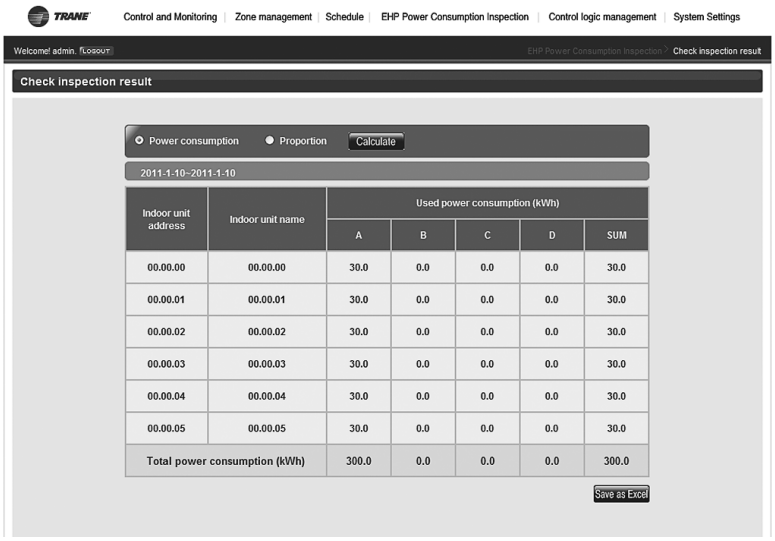
   Note: *You can check power consumption only with a connected watt-hour meter. If there is no connected meter, then you can check only the operating proportion by the indoor unit.*

4 Click **Save as Excel** to save the results as a Microsoft™ Excel file format.

Note: *For data management, Trane™ recommends periodically saving indoor unit inspection results. Power consumption inspection results are for reference only and should not be used for official financial transactions.*

Checking Inspection Results (Without PIM)





1. Click the **EHP Power Consumption Inspection** tab at the top VRF System Controller interface and select Check inspection result. The Check inspection result page displays.

   Note: *Channel setting by indoor unit must be done in advance.*

2. Select the **Start/End** dates, then enter a power consumption value for the date range.

   Note: *You can search up to 365 days. The virtual channel value is set in the channel setting by the indoor unit.*

3. Click **Calculate** to displays results.

4. Analyze the power consumption results.

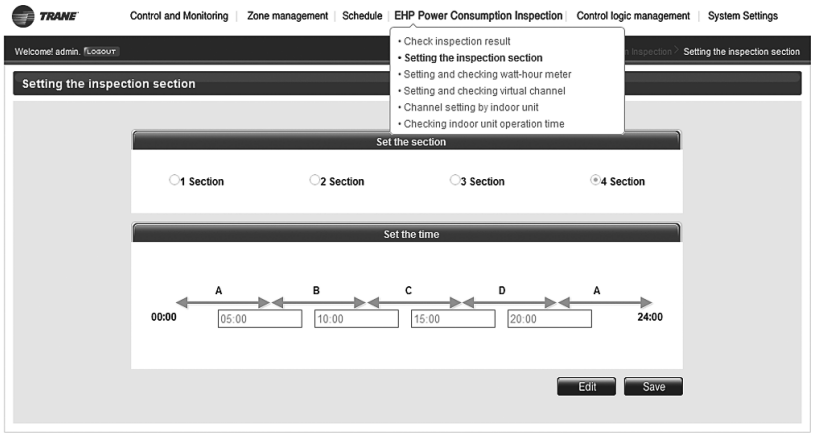
   Note: *Actual values are rounded up or down and the actual input value versus the resulting value may differ.*

5. Click **Save as Excel** to save the results as a Microsoft™ Excel file format.

   Note: *For data management, Trane™ recommends periodically saving indoor unit inspection results. Power consumption inspection results are for reference only and should not be used for official financial transactions.*

Setting Inspections

Time segmentation is used to divide 24 hours into different sections and to distribute power according to each section. This function is used when the power consumption fee is different according to different time slots or when a building is charged differently depending on the consumption time.



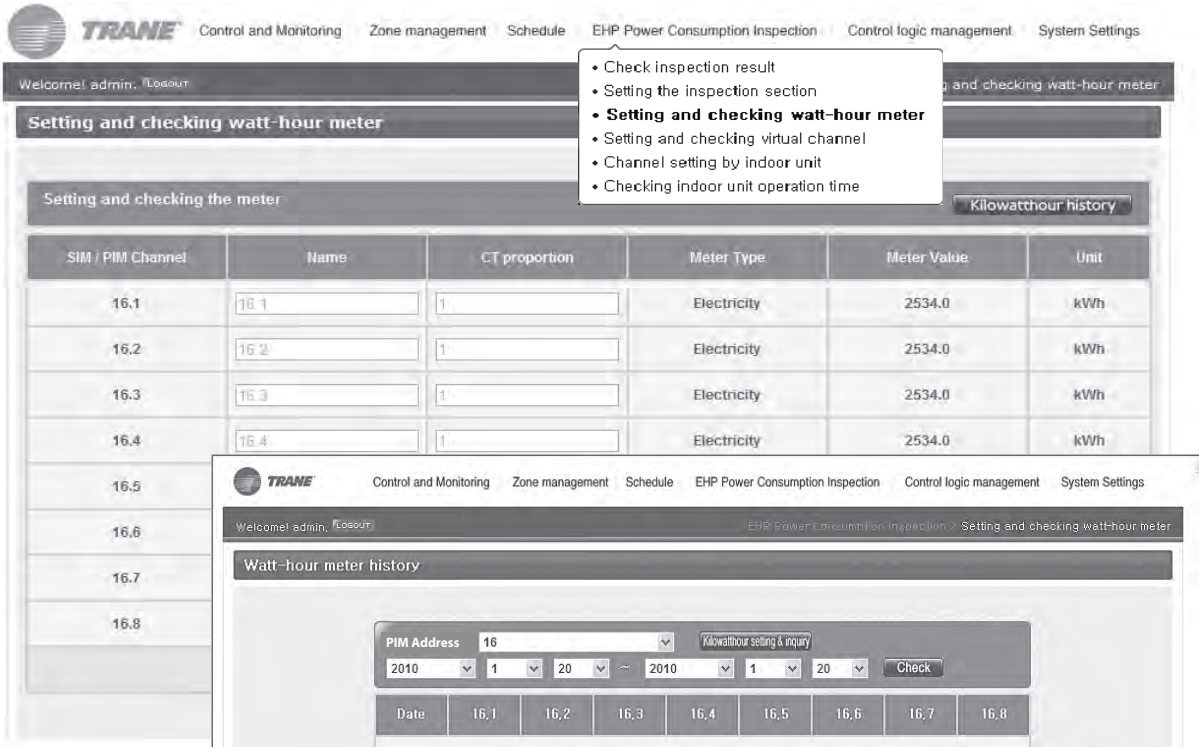
1. Click the **EHP Power Consumption Inspection** tab at the top VRF System Controller interface and select **Setting the inspection section**. The Setting the inspection section displays.
2. Click **Edit**.
3. Select a section (1 section is default).

   Note: *In 1 section, setting time A is set as 24 hours. The factory default setting is set as 1 section. The 24 hour time span can also be divided into 2 sections (A,B,A), 3 sections (A,B,C,A) or 4 sections (A,B,C,D,A). The VRF SC shows the result of the power distribution for each section you set.*
4. Enter the time of day (HH:MM) for the inspection section. For example, if the time is 4:30 a.m., enter 04:30 and if the time is 4:30 p.m., enter 16:30.

   Note: *If choosing 2 Section, set the time in B. For 3 Section, set the time in B and C. For 4 section, set the time in B, C, and D.*
5. Click **Save**.

Note: *If communication error occurs between the VRF SC and the lower level controllers, actual power consumption and the result of the power distribution value may not be the same. Make sure to solve communication error status. For example, a communication error could occur between the VRF SC and Power Meter Interface Module (PIM) and watt hour meter/VRF SC and outdoor unit/indoor and outdoor units.*

Setting Watt-Hour Meter and Checking Kilowatt Hour History



Setting Watt-Hour Meter

1. Click the **EHP Power Consumption Inspection** tab at the top VRF System Controller interface and select **Setting and checking watt-hour meter**. The Setting and checking watt-hour meter page displays.

   Note: *Setting watt-hour meter is possible only with an installed PIM.*

2. Click **Edit**. CT proportion default is set to 1.
3. Enter a meaningful name (maximum of 16 letters) and a value for the CT proportion (value can be any positive number between 1 and 5,000).
4. Click **Save**.

   Note: *The watt-hour meter value shows the actual value of the currently connected watt-hour meter. This value updates automatically. When using current transformer (CT) watt-hour meter, there can be difference with actual power consumption by as much as the CT ratio error.*

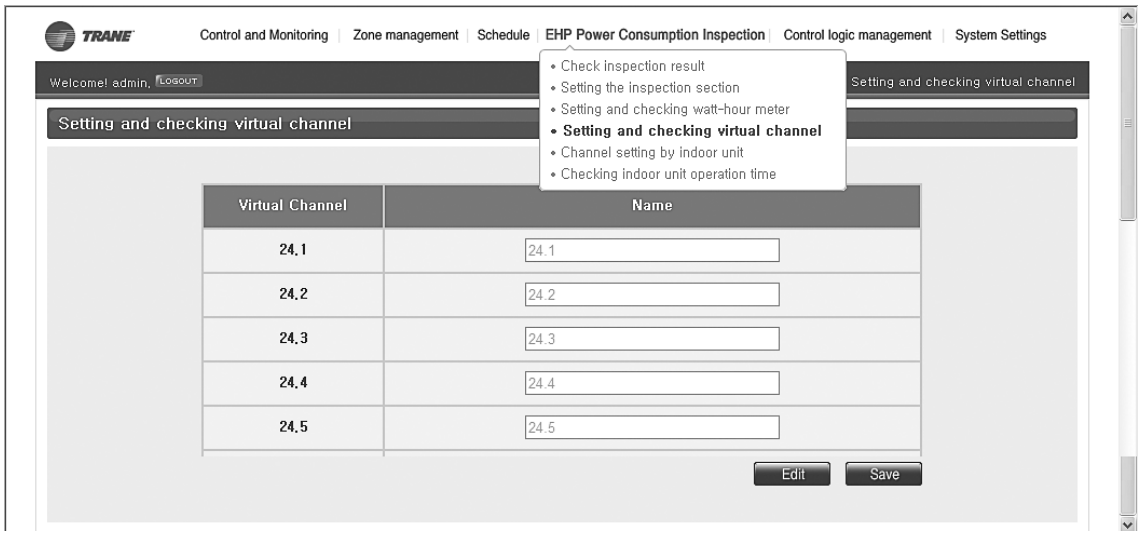
Checking Kilowatt Hour History

1. Click the **EHP Power Consumption Inspection** tab at the top VRF System Controller interface and select **Setting and checking watt-hour meter**. The Setting and checking watt-hour meter page displays.
2. At the top of this page, click on **Kilowatthour History**. The Watt-hour meter history page displays.
3. Select the **Start/End** dates, then select the **PIM Address**.

   Note: *You can search up to 365 days.*

4. Click **Check** to display kilowatthour history.

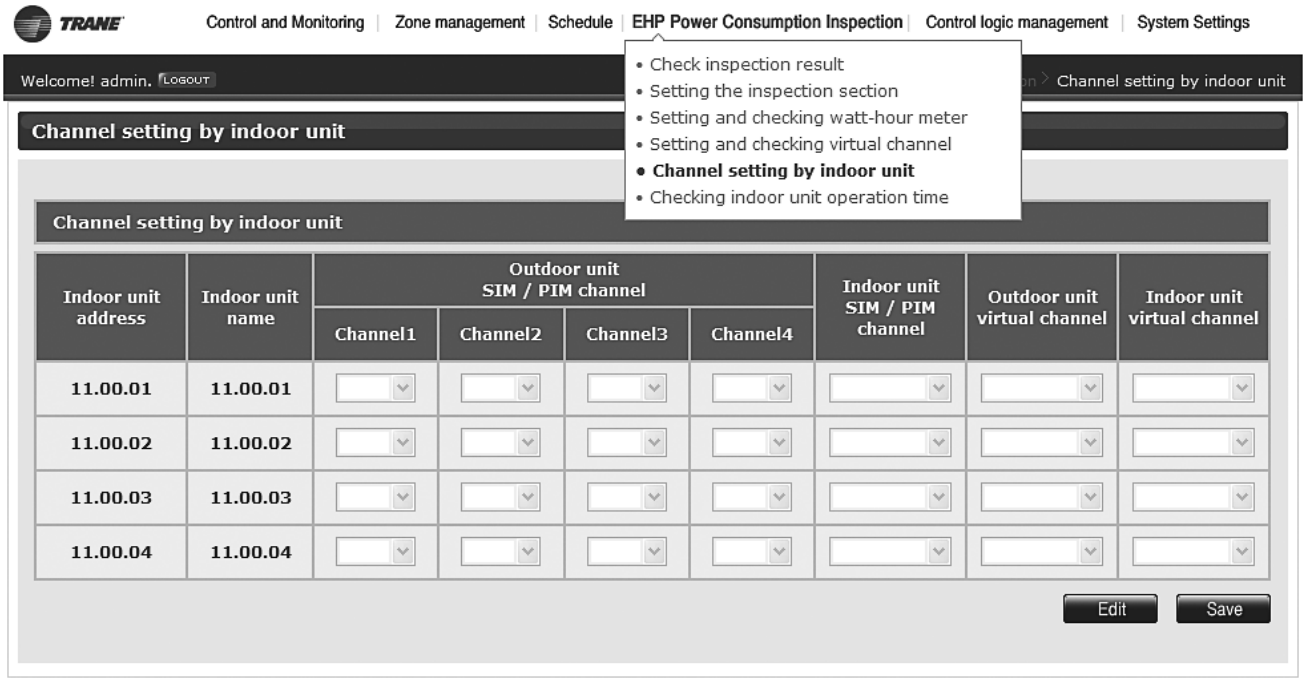
Setting/Checking Virtual Channel



1. Click the **EHP Power Consumption Inspection** tab at the top VRF System Controller interface and select **Setting and checking virtual channel**. The Setting and checking virtual channel page displays.
2. Click **Edit**.
3. Enter a meaningful virtual channel name (maximum of 16 letters).

   Note: *You can set a maximum of 128 virtual channels. A virtual channel is written in the following format: (24 – 31).(1 – 16). For example, 24.1, 25.2, 31.8.*
4. Click **Save**.

Channel Setting by Indoor Unit



1. Click the **EHP Power Consumption Inspection** tab at the top VRF System Controller interface and select **Channel setting by indoor unit**. The Channel setting by indoor unit page displays.
2. Click **Edit**.
3. Check the PIM address and channel information connected to watt-hour meter.

   Note: *If 0–7 PIM units execute tracking, it displays as 16–23 in the VRF System Controller. Channel 1 is on the far left side and 8 channels are arranged in a line.*
4. Check the information of indoor/outdoor unit connected to watt-hour meter.

   Note: *Information of watt-hour meter connected to indoor/outdoor unit should be accurate. If not, an error may occur in the power distribution result.*
5. Check the PIM channel (watt-hour meter) information of the indoor/outdoor unit. You can set the channel when the PIM is installed in the VRF System Controller.

   Note: *Power distribution is automatically executed automatically. You do not need to check the watt-hour meter value.*
6. Check the virtual channel information of the indoor/outdoor unit. To execute power distribution without the PIM, set virtual channel. When bringing the power of the indoor unit power from outdoor unit, only set the Outdoor unit virtual channel information.

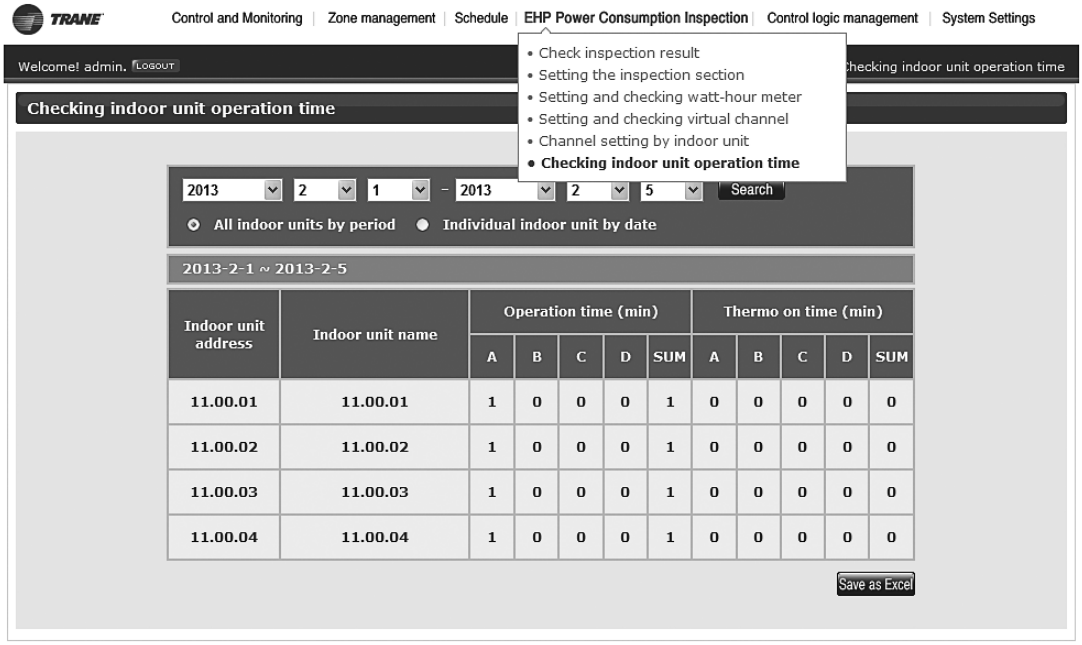
   Note: *Outdoor unit virtual channel refers to the watt-hour meter connected to outdoor unit. Setting the PIM channel information in the indoor unit in order to execute the power distribution. If the information is changed, consult with the installation engineer.*

   When bringing the power of the indoor unit from the other device (not from outdoor unit), set the Outdoor unit virtual channel and Indoor unit virtual channel information.

   The number of virtual channels varies depending on the number of outdoor unit. To execute power distribution, manually check the watt-hour meter value. Power distribution when using a PIM is more accurate than using the indoor/outdoor unit virtual channel. Therefore, it is recommended to execute power distribution using a PIM.

7. Set indoor unit to execute power distribution. If you do not set the watt-hour meter information, the power distribution result of the indoor unit displays as 0.
8. Click **Save**.

Checking Indoor Unit Operation Time



1. Click the **EHP Power Consumption Inspection** tab at the top VRF System Controller interface and select **Checking indoor unit operation time**. The Checking indoor unit operation time page displays.
2. Select the **Start/End** dates and choose either **All indoor units by period** or **Individual indoor unit by date**.

   Note: *You can search up to 365 days.*
3. Click **Search** to display results.
4. Click **Save** as Excel to save the results as a Microsoft™ Excel file format.

   Note: *For data management, Trane® recommends periodically saving indoor unit inspection results.*

Control Logic Management

Control logic management can be used to control cooling or heating operation in specific conditions. For example, if the current temperature of a space is higher than 84°F (29°C), you can control the cooling operation or if the current temperature of a space is lower than 50°F (10°C), you can control the heating operation. Specific conditions can be controlled for a certain period, day, or time.

Control logic management allows you to:

- Set new control logic
- Edit, copy, and delete control logic
- Enable/disable control logic
- Check control logic history

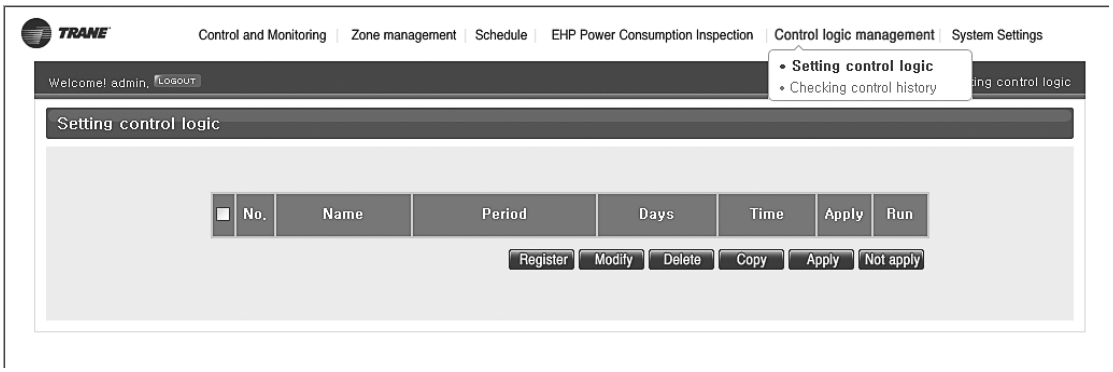
Setting Control Logic

Control logic has the following basic guidelines:

- They consist of a factor, a comparison operator, a standard value, and a duration time.
- You can enter up to three (3) control logic input items connected by compound factors.
- A control logic output item consists of a factor and a command value.
- You can enter up to 20 control logic output items and create up to 256 control logics.

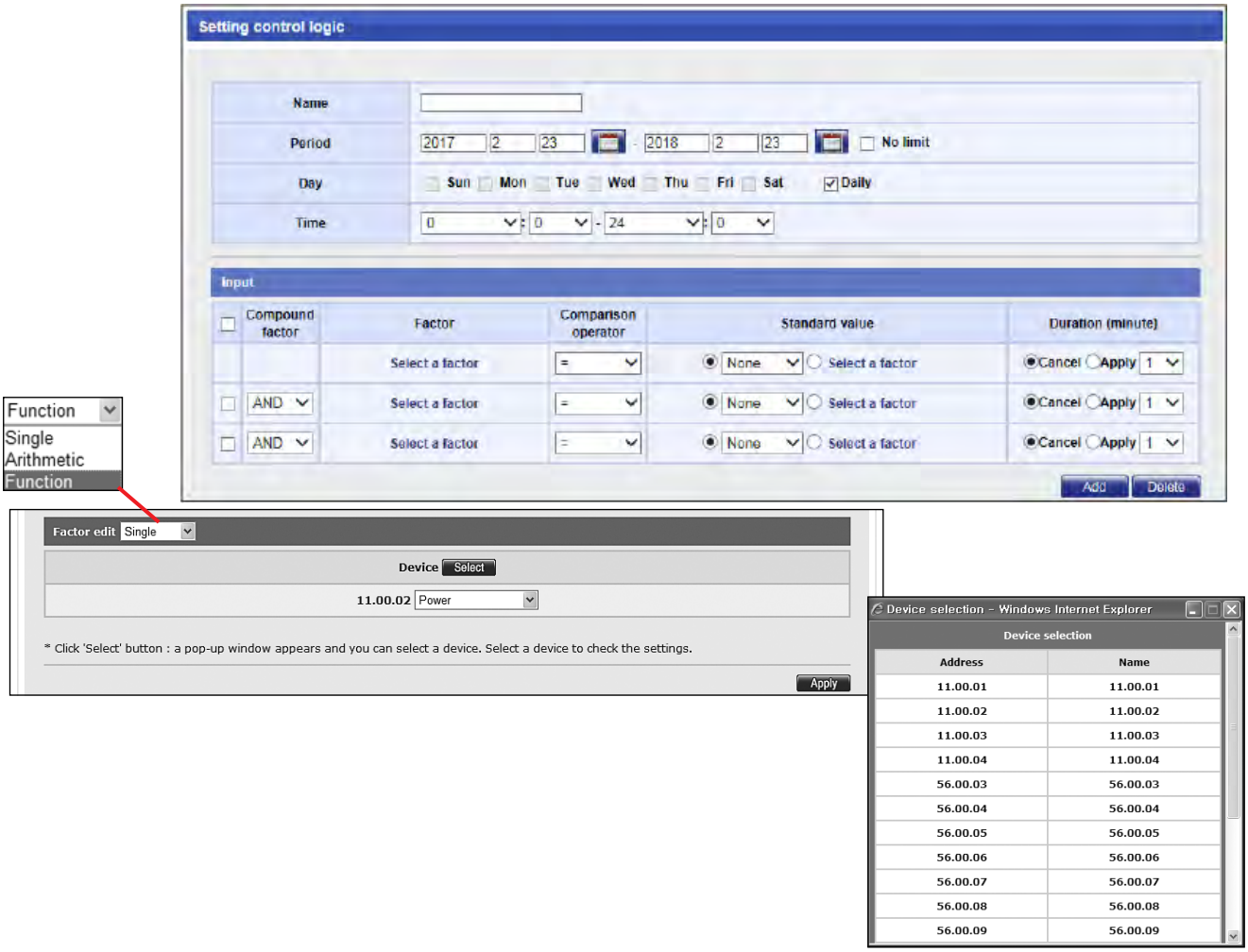
When setting up control logic, the Setting control logic page is divided into the following sections:

- Name, Start/End dates, and time
- Factor edit
- Input
- Output



1. Click the **Control logic management** tab at the top VRF System Controller interface and select **Setting control logic**. The Setting control logic page displays.
2. Click **New** to show the page with the four main sections listed above.

Note: *On the far right of this page,* ***Apply*** *indicates the control logic usage status and* ***Run*** *indicates whether the control logic is applied and if operating conditions are met. For example, if the current indoor temperature is higher than 84°F (29°C), the unit is set to cooling mode. The system displays Yes if the indoor temperature is higher than 84°F and No if the indoor temperature is lower than 84°F.*



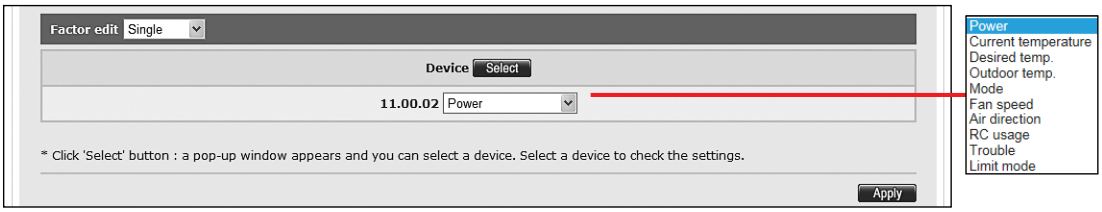
Name, Start/End Dates, and Time

3. Enter a meaningful control logic name (maximum of 16 letters) in the Name field.
4. Select the period **Start/End** dates, choose which day(s) to run, and select the time of day.
5. Click **Select a factor** under the Input section and the Factor edit section is displayed above the Input section. A factor is the target to control or the standard item of the logic decision.

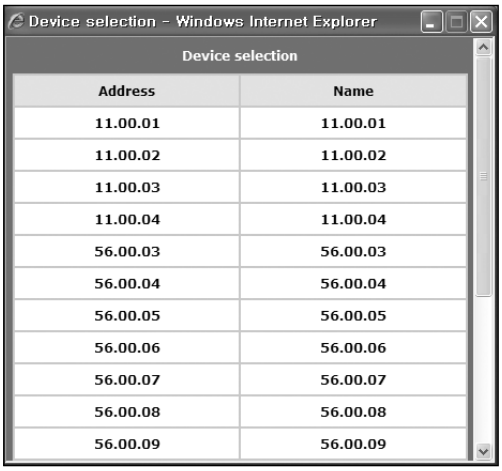
Factor Edit and Input

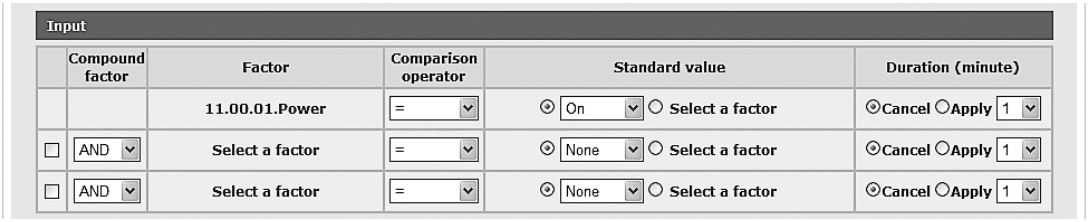
6. Select the type of factor under the Factor edit section: either **Single** (1 device), **Arithmetic** (2 devices connected by an arithmetic operator), or **Function** (several devices using a function such as Average).
   - Example of an Arithmetic factor: Temp of indoor unit 1 - Temp of indoor unit 2
   - Example of a Function factor: Average(Current temp of indoor unit 1, Current temp of indoor unit 2, Current temp of indoor unit 3)

7. Click **Select** and the Device selection dialog displays.



Type	Item	Value	Remarks
Indoor unit	Power	On, Off	-
	Current temp.	Number	Control impossible
	Desired temp.	Number	-
	Outdoor temp.	Number	Control impossible
	Operation mode	Auto, Cool, Dry, Fan, Heat	-
	Fan speed	Auto, Low, Mid, High	Turbo is available when the device supports the Turbo fan speed.
	Air direction	Vertical, Horizontal, All, None	In case of the 360 Cassette air conditioner, it is changed to Spot, Mid, Wide, and Swing.
	RC usage	Enable RC, Disable RC, Cond. RC	-
	Error detection	True, False	Control impossible
	Limit operation mode	None, Cool only, Heat only	-

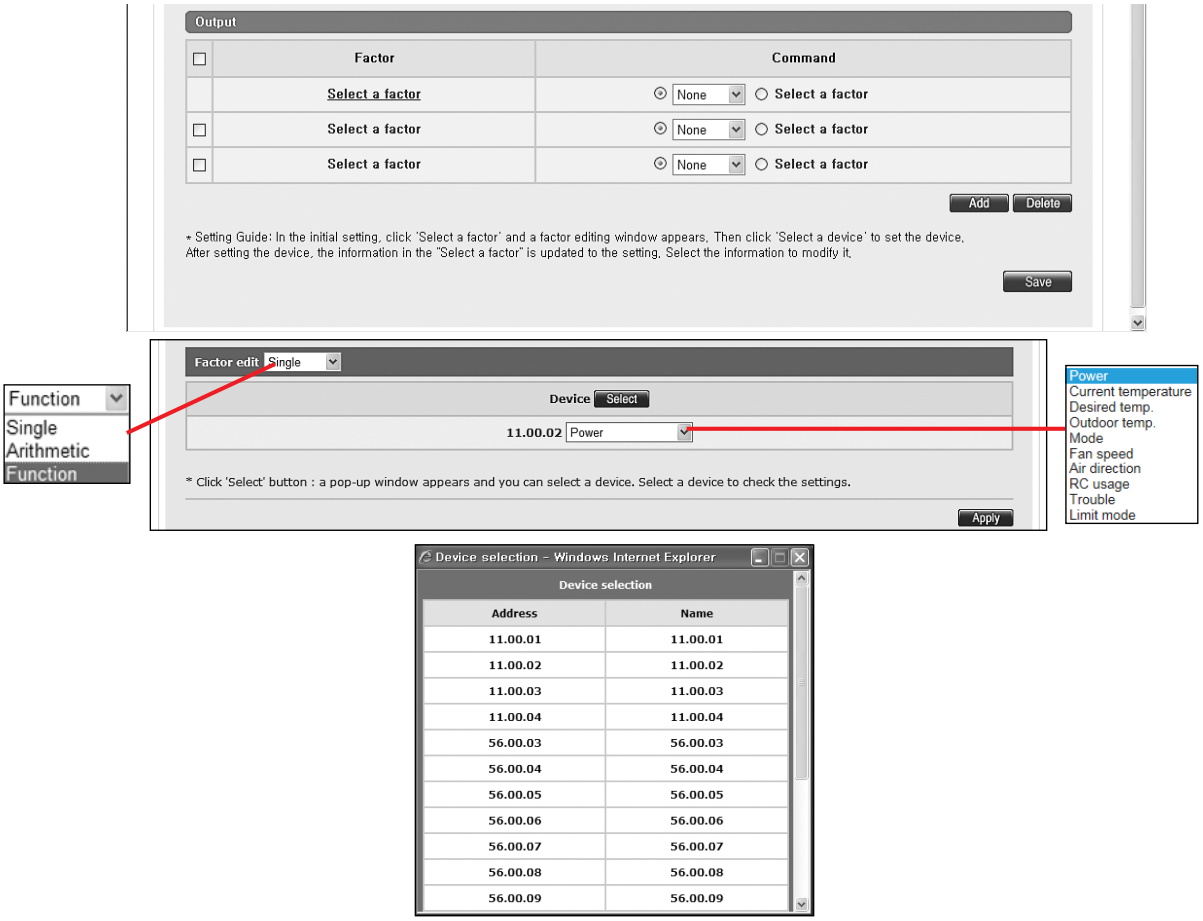




8. Click on a device to use as a factor from the Device selection dialog box. A list of control and monitoring items display depending on the selected device as shown above.
9. Click on the drop-down list to show a list of associated items available for the device selected in Step 8.
10. Click **Apply**.
11. In the Input section, select a **Comparison operator** to compare a factor to a standard factor. Valid operators are, =, =<, =>, <, >, ≠.
12. Select the **Standard value**. The value varies depending on the factor under the Factor column. For example, if the item under the Factor column is Current temp of indoor unit 1, then enter 29 for the Standard value. When selecting a Standard value factor, it must coincide with the item under the Factor column. For example, if the Standard value factor is Power of indoor unit 2, then the item under the Factor column must be Power of indoor unit 2.
13. Select the **Duration**. The duration time is the time in which the comparison condition satisfies TRUE (by selecting Apply). The time can be set between 1 and 60 seconds.

    Note: *Only one (1) duration time can be set per control logic. The tolerance range of the duration time is 1 minute. If setting a duration time of 2 minutes, then the operation starts between 2 and 3 minutes.*

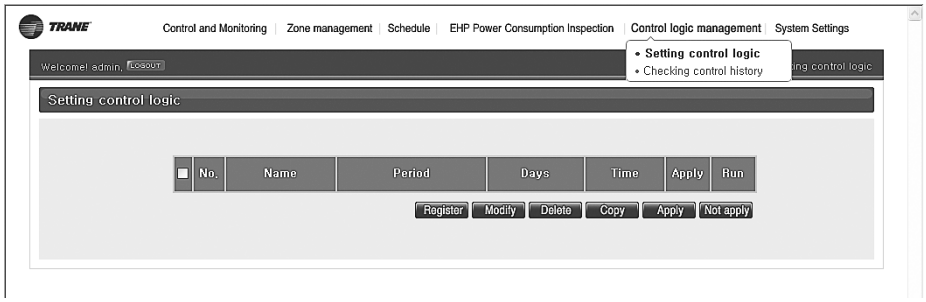
14. Select the **Compound factor**. Use a Compound factor to apply conditions to 2 or more factors. Select AND if all factors should be set to TRUE and select OR if just one factor needs to be set to TRUE. Using Compound factors are applied in the order selected.



15. In the Output section, select **Select a factor**.
16. Select the type of factor, either **Single** (1 device), **Arithmetic** (2 devices connected by an arithmetic operator), or **Function** (several devices using a function such as Average).
17. Click **Select and the Device** selection dialog displays.
18. Click on a device to use as a factor. The control and monitoring items display depending on the selected device.
19. Click **Select** to show a list of associated items available.
20. Click on an item from the list and click **Apply**.
21. Select a value under the Command column. The value varies depending on the factor under the Factor column. Again, you can select either Single (1 device), Arithmetic (2 devices connected by an arithmetic operator), or Function (several devices using a function such as Average).
22. Click **Add**.

    Note: *To delete an event, check the box to the left of the Factor item.*
23. Click **Save**.

Editing, Copying, and Deleting Control Logic

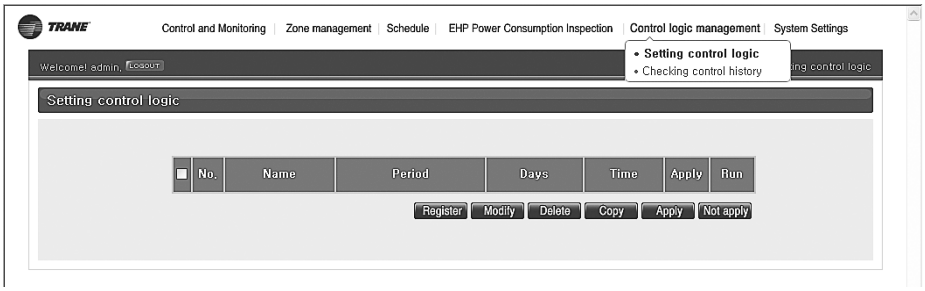


1. Click the **Control logic management** tab at the top VRF System Controller interface and select **Setting control logic**. The Setting control logic page displays.
2. To edit a control logic item, determine which control logic to edit and check the box to the left of the No. column. Click **Edit** to edit any of the settings from the previous section.

   To copy a control logic item, determine which control logic to copy and check the box to the left of the No. column. Click **Copy**.

   To delete a control logic item, determine which control logic to delete and check the box to the left of the No. column. Click **Delete**.

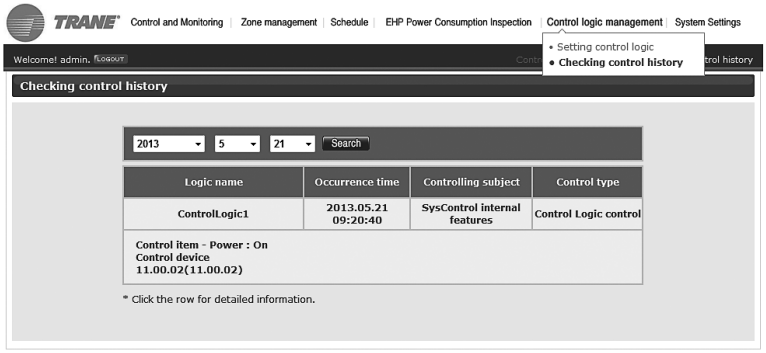
Apply/Not Apply Control Logic



1. Click the **Control logic management** tab at the top VRF System Controller interface and select **Setting control logic**. The Setting control logic page displays.
2. To apply a control logic, determine which control logic to apply and check the box to the left of the No. column. Click **Apply**.

   To not apply a control logic, determine which control logic and check the box to the left of the No. column. Click **Not apply**.

Checking Control Logic History



1. Click the **Control logic management** tab at the top VRF System Controller interface and select **Checking control history**. The Checking control history page displays.
2. Select the date of when the control logic screen displays.

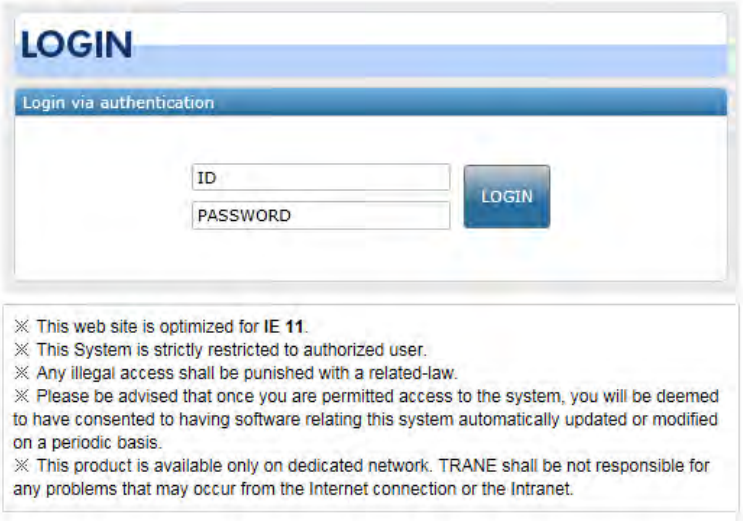
   Note: *You can check up to a maximum of 180 days of control history and only by one date at a time.*
3. Click **Search**.
4. Select an item in the list to view more details.

VRF System Controller Software

Confirming the Software Version

To confirm the software version, type the IP address of the VRF System Controller (for example, 192.168.0.100) into the address bar of an Internet Explorer (32-bit) window.The IP address is displayed on the leftmost tab of the login window.The current software version is displayed on the other tab.

Notes: *Microsoft Silverlight installation is required to support this user interface.*



Updating the Software Version

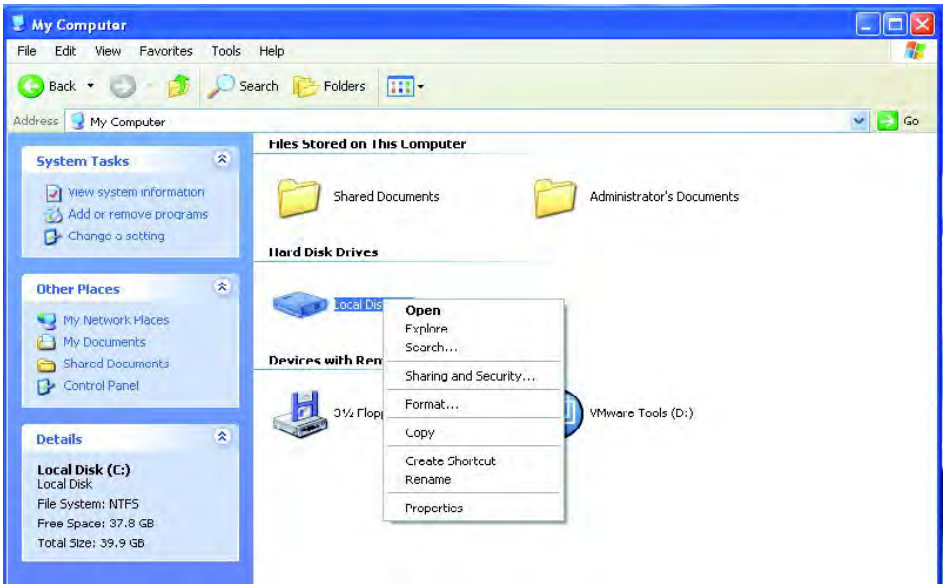
Use theTrane Download page orTrane Updater application to obtain a software revision.Typically, a software update is provided in a zip file that must be unzipped and the contents copied to an SD card prior to inserting the card into the VRF System Controller.

Copying the new software files from your PC to an SC card

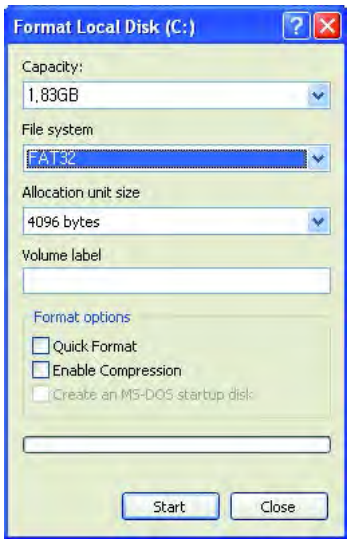
Begin with this procedure:

1. Connect theVRF System Controller to the PC and then insert the SD card into the SD card reader on the PC.

2. Right-click on the newly created removable storage device and select Format.



3. Select the FAT32 file system and click **Start**.



4. After formatting is completed, copy the four application files to the SD card.
5. Remove the SD card from the PC after copying is finished.

Copying the new software files from the SC card to the VRF System Controller

Follow with this procedure:

1. Insert the SD card.

2. Push the **Reset** button once to reset the system.

The system is reset and the application begins the update process. After the updating process is complete, the screen displays “UPDATE COMPLETE, REBOOT NOW ...”

3. Push in the SD card to release it, and then remove the card.
4. Push the Reset button.
5. To confirm the software version, refer to "Configuring the VRF Software," p.87.

Configuring the VRF Software

After confirming that the VRF software version is correct, proceed to log in to the VRF System Controller.

For details, refer to earlier sections of the manual:

- "Initial Login to the VRF SC User Interface," p.17
- "BACnet Network Configuration," p.23
- "BACnet Information," p.25

Troubleshooting

Refer to the following table for solutions to common problems.

Problem	Check	Solution
The system controller is not working.	Is there an electricity failure?	Verify that the power is connected to another interface module besides the Central On/Off Control.Then try again.
	Is there a communication error in the other interface modules besides the Central On/Off controller?	Check the connection of communication cable. Then try again.
	Are the adapter and power cable connected?	Check the connection of adapter and power cable. Then try again.
Web pages are not accessible.	Is Microsoft Silverlight installed?	Check the installation status. Refer to **Start > Control Panel > Add/Remove Programs**.
	Is Microsoft Silverlight installed properly?	Microsoft Silverlight Version 2.0 or more recent should be installed.
Web page are not accessible from the public Internet.	Are the network settings set?	Contact the network manager first.
	Is the firewall active?	
Monitoring the installed Central On/Off Control is not functioning.	Are the communication cables of the system controller (R1, R2) properly connected?	Verify that system controller communication cables (R1, R2) are connected properly. Note that they are polarity sensitive.
Power distribution is not executed properly.	Is system controller power disconnected?	To use the power distribution function properly, system controller power should be connected all the times.
IP address has been forgotten.	Press the **Menu** button from the main menu and “1. IP Config“ will appear. Then press the **Set** button.	The factory setting of the system controller IP address is 192.168.0.100.
Indoor unit turned On/Off automatically.	Is the schedule control in operation?	If schedule control is operating, it is normal operation for the indoor unit can be turned On or Off automatically.
	Is the system controller time different from current time?	Set the system controller time according to current time.
DI (digital input) external contact point function is not working.	Is the external circuit wired correctly?	Check if the external circuit is wired correctly.
	Is the contact control pattern set to 1?	Verify that the control pattern setting complies with the control pattern that you want.
Tracking is not functioning.	Does it show “Tracking Fail”? Are no indoor units discovered?	This indicates tracking failure. Execute tracking again.

BACnet™ Protocol Implementation Conformance Statement (PICS)

Date: 2016. 01.11

Vendor Name: TRANE

Product Name: VRF System Controller+BACnet

Product Model Number: TVCTRLTIMB17A0

Application Software Version: 1.20 **Firmware Revision:** 1.20
BACnet Protocol Revision: 2.0

Product Description:

This product supports BACnet/IP and provide functions to monitor and control status of air conditioners.

BACnet Standardized Device Profile (Annex L):

☐ **BACnet Operator Workstation (B-OWS)**
☐ **BACnet Advanced Operator Workstation (B-AWS)**
☐ **BACnet Operator Display (B-OD)**
☐ **BACnet Building Controller (B-BC)**
☐ **BACnet Advanced Application Controller (B-AAC)**
■ **BACnet Application Specific Controller (B-ASC)**
☐ **BACnet Smart Sensor (B-SS)**
☐ **BACnet Smart Actuator (B-SA)**

List all BACnet Interoperability Building Blocks Supported (Annex K):

	SUPPORTED BIBBS	BIBB NAME	SUPPORTED	REMARKS
Data Sharing	DS-RP-A	Data Sharing-ReadProperty-A	☐	
	DS-RP-B	Data Sharing-ReadProperty-B	■	
	DS-RPM-A	Data Sharing-ReadPropertyMultiple-A	☐	
	DS-RPM-B	Data Sharing-ReadPropertyMultiple-B	■	
	DS-RPC-A	Data Sharing-ReadPropertyConditional-A	☐	
	DS-RPC-B	Data Sharing-ReadPropertyConditional-B	☐	
	DS-WP-A	Data Sharing-WriteProperty-A	☐	
	DS-WP-B	Data Sharing-WriteProperty-B	■	
	DS-WPM-A	Data Sharing-WritePropertyMultiple-A	☐	
	DS-WPM-B	Data Sharing-WritePropertyMultiple-B	■	
	DS-COV-A	DataSharing-COV-A	☐	
	DS-COV-B	DataSharing-COV-B	■	
	DS-COVP-A	DataSharing-COVP-A	☐	
	DS-COVP-B	DataSharing-COVP-B	☐	
	DS-COVU-A	DataSharing-COV-Unsolicited-A	☐	
	DS-COVU-B	DataSharing-COV-Unsolicited-B	☐	

BACnet PICS: Page 2

	SUPPORTED BIBBS	BIBB NAME	SUPPORTED	REMARKS
Alarm and Event Management	AE-N-A	Alarm&Event-Notification-A	☐	
	AE-N-I-B	Alarm&Event-Notification Internal-B	■	Optional Support
	AE-N-E-B	Alarm&Event-Notification External-B	☐	
	AE-ACK-A	Alarm&Event-ACK-A	☐	
	AE-ACK-B	Alarm&Event-ACK-B	☐	
	AE-ASUM-A	Alarm&Event-Summary-A	☐	
	AE-ASUM-A	Alarm&Event-Summary-B	☐	
	AE-ESUM-A	Alarm&Event-Enrollment Summary-A	☐	
	AE-ESUM-B	Alarm&Event-Enrollment Summary-B	☐	
	AE-INFO-A	Alarm&Event-Information-A	☐	
	AE-INFO-B	Alarm&Event-Information-B	☐	
	AE-LS-A	Alarm&Event-LifeSafety-A	☐	
	AE-LS-B	Alarm&Event-LifeSafety-B	☐	
Scheduling	SCHED-A	Scheduling-A	☐	
	SCHED-I-B	Scheduling-Internal-B	☐	
	SCHED-E-B	Scheduling-External-B	☐	
Trending	T-VMT-A	Viewing and Modifying Trends-A	☐	
	T-VMT-I-B	Viewing and Modifying Trends Internal-B	☐	
	T-VMT-E-B	Viewing and Modifying Trends External-B	☐	
	T-ATR-A	Automated Trend Retrieval-A	☐	
	T-ATR-B	Automated Trend Retrieval-B	☐	
	T-VMMV-A	Viewing and Modifying Multiple Values-A	☐	
	T-VMMV-I-B	View and Modifying Multiple Values Internal-B	☐	
	T-VMMV-E-B	View and Modifying Multiple Values External-B	☐	
	T-AMVR-A	Automated Multiple Value Retrieval-A	☐	
	T-AMVR-B	Automated Multiple Value Retrieval-B	☐	
Device and Network Management	DM-DDB-A	Dynamic Device Binding-A	☐	
	DM-DDB-B	Dynamic Device Binding-B	■	
	DM-DOB-A	Dynamic Object Binding-A	☐	
	DM-DOB-B	Dynamic Object Binding-B	■	
	DM-DCC-A	DeviceCommunicationControl-A	☐	
	DM-DCC-B	DeviceCommunicationControl-B	☐	
	DM-TM-A	Text Message-A	☐	
	DM-TM-B	Text Message-B	☐	
	DM-TS-A	Time Synchronization-A	☐	
	DM-TS-B	Time Synchronization-B	■	
	DM-UTC-A	UTCTime Synchronization-A	☐	
	DM-UTC-B	UTCTime Synchronization-B	☐	
	DM-RD-A	ReinitializeDevice-A	☐	
	DM-RD-B	ReinitializeDevice-B	☐	
	DM-BR-A	Backup&Restore-A	☐	
	DM-BR-B	Backup&Restore-B	☐	

BACnet PICS: Page 3

	SUPPORTED BIBBS	BIBB NAME	SUPPORTED	REMARKS
Device and Network Management	DM-R-A	Restart-A	☐	
	DM-R-B	Restart-B	☐	
	DM-LM-A	List Manipulation-A	☐	
	DM-LM-B	List Manipulation-B	☐	
	DM-OCD-A	Object Creation & Deletion-A	☐	
	DM-OCD-B	Object Creation & Deletion-B	☐	
	DM-VT-A	Virtual Terminal-A	☐	
	DM-VT-B	Virtual Terminal-B	☐	
	NM-CE-A	Connection Establishment-A	☐	
	NM-CE-B	Connection Establishment-B	☐	
	NM-RC-A	Router Configuration-A	☐	
	NM-RC-B	Router Configuration-B	☐	

Segmentation Capability:

☐ **Segmented requests supported Window Size** _____

☐ **Segmented responses supported Window Size** _____

Standard Object Types Supported:

Object-Type	Supported	Dynamically Creatable	Dynamically Deletable	Writeable Properties
Analog Input	☑	☐	☐	
Analog Output	☐	☐	☐	
Analog Value	☑	☐	☐	Present value
Binary Input	☑	☐	☐	
Binary Output	☑	☐	☐	Present value
Binary Value	☑	☐	☐	Present value
Calendar	☐	☐	☐	
Command	☐	☐	☐	
Device	Yes	n/a	n/a	n/a
Event Enrollment	☐	☐	☐	
File	☐	☐	☐	
Group	☐	☐	☐	
Loop	☐	☐	☐	
Multi-state Input	☑	☐	☐	Present value
Multi-state Output	☐	☐	☐	
Multi-state Value	☑	☐	☐	Present value
Notification Class	☑	☐	☐	Recipient_List
Program	☐	☐	☐	
Schedule	☐	☐	☐	

BACnet PICS: Page 4

Data Link Layer Options:

■ **BACnet IP, (Annex J)**

☐ **BACnet IP, (Annex J), Foreign Device**

☐ **ISO 8802-3, Ethernet (Clause 7)**

☐ **ANSI/ATA 878.1, 2.5 Mb. ARCNET (Clause 8)**

☐ **ANSI/ATA 878.1, RS-485 ARCNET (Clause 8), baud rate(s)** _____

☐ **MS/TP master (Clause 9), baud rate(s):** _____

☐ **MS/TP slave (Clause 9), baud rate(s):** _____

☐ **Point-To-Point, EIA 232 (Clause 10), baud rate(s):** _____

☐ **Point-To-Point, modem, (Clause 10), baud rate(s):** _____

☐ **LonTalk, (Clause 11), medium:** _____

☐ **BACnet/ZigBee (ANNEX O)**

☐ **Other:** _____

Device Address Binding:

Is static device binding supported? (This is currently necessary for two-way communication with MS/TP slaves and certain other devices.) ☐Yes ■ No

Networking Options:

☐ Router, Clause 6 - List all routing configurations, e.g., ARCNET-Ethernet, Ethernet-MS/TP, etc.

☐ Annex H, BACnet Tunneling Router over IP

☐ BACnet/IP Broadcast Management Device (BBMD)

Does the BBMD support registrations by Foreign Devices? ☐ Yes ☐ No

Does the BBMD support network address translation? ☐ Yes ☐ No

Character Sets Supported:

Indicating support for multiple character sets does not imply that they can all be supported simultaneously.

■ ANSI X3.4 ☐ IBM™/Microsoft™ DBCS ☐ ISO 8859-1

☐ ISO 10646 (UCS-2) ☐ ISO 10646 (UCS-4) ☐ JIS 0208

If this product is a communication gateway, describe the types of non-BACnet equipment/ networks(s) that the gateway supports:

This gateway switches TRANE air conditioner protocol to BACnet protocol to make RS-485 communication possible with the air conditioners connected to gateway.

BACnet PICS: Page 5

Devices

The following table shows a detailed description of BACnet objects:

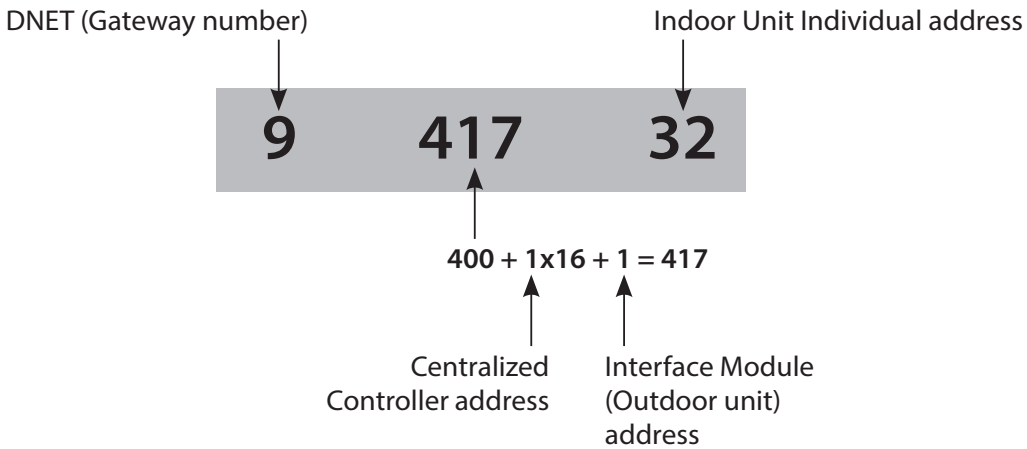
Item	DNET – Range [Digit 2]	CPP – Range [Digit 3]	INDOOR – Range [Digit 2]
Central On/Off Controller	1–40	000–015	64
PIM	1–40	100–115	64
VRF SC+BACnet DI/DO	1–40	300–315	64
Outdoor unit	1–40	400–655 (16 x 16)	64
Indoor Unit, AHU kit	1–40	400–655	0–63
Gateway	1–40	900	64

Ex) Indoor Unit

DNET (Gateway number): 9

Indoor Unit Address: 01.01.32

Device ID: 941732



Object of device

Refer to BACnet point List

Command Priorities

Supports 1 – 16 Priority Level

Recommends 8 Priority Level

BACnet PICS: Page 6

Indoor Unit

Single indoor unit has following point list.

Instance Number	Object	Object Type	Object Name	Unit	Status value			
				Inactive	Active			
				Text-1	Text-2	Text-3	Text-4	Text-5
1	Indoor Temperature	AI	AC_RoomTemp_xx_xxxxxx	°C				
2	Set temperature	AV	AC_Temp_Set_xx_xxxxxx	°C				
3	Setting lower temperature limit	AV	AC_Cool_LimitTemp_xx_xxxxxx	°C				
4	Setting upper temperature limit	AV	AC_Heat_LimitTemp_xx_xxxxxx	°C				
5	The power value of an indoor unit after the basic date	AI	AC_Baseline_kWh_xx_xxxxxx	kWh				
6	The number of hours usage of an indoor unit after the basic date	AI	AC_Baseline_Minute_xx_xxxxxx	Minute				
7	Power value within period	AI	AC_Period_kWh_xx_xxxxxx	kWh				
8	The number of hours usage of an indoor unit within period	AI	AC_Period_Minute_xx_xxxxxx	Minute				
** 9	Power On/Off	BV	AC_Power_xx_xxxxxx	Off	On			
10	Applying lower temperature limit setting	BV	AC_Cool_Limit_set_xx_xxxxxx	False	True			
11	Applying upper temperature limit setting	BV	AC_Heat_Limit_set_xx_xxxxxx	False	True			
** 12	Filter sign status	BI	AC_FilterSign_xx_xxxxxx	False	True			
** 13	Filter sign reset	BO	AC_FilterSign_Reset_xx_xxxxxx	False	True			
** 14	Operation mode status	MV	AC_Operation_Mode_xx_xxxxxx	Auto	Cool	Heat	Fan	Dry
* 15	Fan speed status	MV	AC_FanSpeed_xx_xxxxxx	Auto	Low	Mid	High	Turbo
* 16	Air flow direction status	MV	AC_FanFlow_xx_xxxxxx	1: None, 2: Vertical, 3: Horizon, 4: All, 5: Spot, 6: Mid, 7: Wide, 8: Swing				
** 17	Operation mode limit status	MV	AC_Mode_Limit_xx_xxxxxx	No Limit	Cool Only	Heat Only		
** 18	Remote controller limit status	MV	AC_Remocon_Limit_xx_xxxxxx	Enable RC	Disable RC	Conditional RC		
** 19	Integrated error code of both indoor unit and outdoor unit	AI	AC_Error_Code_xx_xxxxxx	Refer to list of error code				
* 20	SPI setting	BV	AC_SPI_xx_xxxxxx	False	True			
* 21	HumanSensor setting	BV	AC_MDS_xx_xxxxxx	False	True			
* 22	Discharge cooling set temperature	AV	AC_DisCoolTemp_Set_xx_xxxxxx	°C/F				
* 23	Discharge heating set temperatrue	AV	AC_DisHeatTemp_Set_xx_xxxxxx	°C/F				
* 24	Discharge current temperature	AI	AC_DisCurrentTemp_xx_xxxxxx	°C/F				
** 25	AC Indoor Notify	NC	AC_Notify_xx_xxxxxx	When the error occurred, send event to list of destination in the recipient_list. (Max : 8)				

- Temperature setting range can be different depending on the model and the common range is as follows:

  Auto: 64.4°F–86°F
  Cool: 64.4°F–86°F
  Heat: 60.8°F–86°F
  Fan: Temperature cannot be adjusted
  Dry: 64.4°F–86°F

* Support of this object is dependent on the equipment type.

**Supported by a DOAS unit.

BACnet PICS: Page 7

AHU Kit

Single AHU unit has following point list.

Instance Number	Object	Object Type	Object Name	Unit	Status value			
				Inactive	Active			
				Text-1	Text-2	Text-3	Text-4	Text-5
1	Indoor Temperature	AI	AHU_RoomTemp_xx_xxxxxx	℃				
2	Set temperature	AV	AHU_Temp_Set_xx_xxxxxx	℃				
3	Setting lower temperature limit	AV	AHU_Cool_LimitTemp_xx_xxxxxx	℃				
4	Setting upper temperature limit	AV	AHU_Heat_LimitTemp_xx_xxxxxx	℃				
5	The power value of an indoor unit after the basic date	AI	AHU_Baseline_kWh_xx_xxxxxx	kWh				
6	The number of hours usage of an indoor unit after the basic date	AI	AHU_Baseline_Minute_xx_xxxxxx	Minute				
7	Power value within period	AI	AHU_Period_kWh_xx_xxxxxx	kWh				
8	The number of hours usage of an indoor unit within period	AI	AHU_Period_Minute_xx_xxxxxx	Minute				
9	Power On/Off	BV	AHU_Power_xx_xxxxxx	Off	On			
10	Applying lower temperature limit setting	BV	AHU_Cool_Limit_set_xx_xxxxxx	False	True			
11	Applying upper temperature limit setting	BV	AHU_Heat_Limit_set_xx_xxxxxx	False	True			
12	Filter sign status	BI	AHU_FilterSign_xx_xxxxxx	False	True			
13	Filter sign reset	BO	AHU_FilterSign_Reset_xx_xxxxxx	False	True			
14	Operation mode status	MV	AHU_Operation_Mode_xx_xxxxxx	Auto	Cool	Heat	Fan	Dry
15	Operation mode limit status	MV	AHU_Mode_Limit_xx_xxxxxx	No Limit	Cool Only	Heat Only		
16	Remote controller limit status	MV	AHU_Remocon_Limit_xx_xxxxxx	Enable RC	Disable RC	Conditional RC		
17	Integrated error code of both indoor unit and outdoor unit	AI	AHU_Error_Code_xx_xxxxxx	Refer to list of error code				
* 18	Discharge cooling set temperature	AV	AHU_DisCoolSetTemp_xx_xxxxxx	℃				
* 19	Discharge heating set temperature	AV	AHU_DisHeatSetTemp_xx_xxxxxx	℃				
* 20	Discharge current temperature	AI	AHU_Dis_CurrentTemp_xx_xxxxxx	℃				
* 21	Humidification setting	BV	AHU_Humidification_xx_xxxxxx	Off	On			
* 22	Outdoor air intake setting	BV	AHU_OAIntake_xx_xxxxxx	Off	On			
* 23	Outdoor cooling setting	BV	AHU_OutdoorCool_xx_xxxxxx	Off	On			
* 24	Fan speed status	MV	AHU_FanSpeed_xx_xxxxxx	Low	Mid	High		
* 25	Set humidity status	MV	AHU_SetHumidity_xx_xxxxxx	Low	Mid	High		
* 26	Current humidity status	MI	AHU_CurrentHumidity_xx_xxxxxx	Low	Mid	High		
27	AHU Notify	NC	AHU_Notify_xx_xxxxxx	When the error occurred, send event to list of destination in the recipient_list. (Max : 8)				

* Optional.

BACnet PICS: Page 8

PIM

A single PIM has the following point list:

Instance Number	Object	Object Type	Object Name	Status value
1	PIM error code	AI	SIM_Error_Code_xx_xx	Refer to list of error code
2	PIM Notify	NC	SIM_Notify_xx_xx	When the error occurred, send event to list of destination in the recipient_ list. (Max : 8)

Central On/Off Control

A single Central On/Off Control has the following point list:

Instance Number	Object	Object Type	Object Name	Status value
1	Central On/Off Control error code	AI	Central_Error_Code_xx_xx	Refer to the list of the integrated error code
2	Central On/Off Control notify	NC	Central_Notify_xx_xx	When the error occurred, send event to list of destination in the recipient_list. (Max : 8)

BACnet PICS: Page 9

Outdoor unit

A single outdoor unit has following point list:

Instance Number	Object	Object Type	Object Name	Unit	Status value			
				Inactive	Active			
				Text-1	Text-2	Text-3	Text-4	Text-5
1	Outside temperature	AI	ODU_Outside_Temp_xx_xxxx	℃				
* 2	Cool capacity compensation	AV	ODU_Cool_Compensation_xx_xxxx	0 : 5~7℃ / 1 : 7~9℃ / 2 : 9~11℃ / 3 : 10~12℃ / 4 : 11~13℃ / 5 : 12~14℃ / 6 : 13~15℃ / 14 : Auto control (from ODU)				
* 3	Heat capacity compensation	AV	ODU_Heat_Compensation_xx_xxxx	0 : 25kg/cm^2 / 1 : 26kg/cm^2 / 2 : 27kg/cm^2 / 3 : 28kg/cm^2 / 4 : 29kg/cm^2 / 5 : 30kg/cm^2 / 6 : 31kg/cm^2 / 7 : 32kg/cm^2 / 8 : 33kg/cm^2 / 14 : Auto control (from ODU)				
4	Compressor status	BI	ODU_Comp_Status_xx_xxxx	False	True			
5	Outdoor unit error code	AI	Repeater_Error_Code_xx_xxxx	Refer to the list of the integrated error code				
6	Outdoor unit notify	NC	IM_Notify_xx_xxxx	When the error occurred, send event to list of destination in the recipient_list. (Max : 8)				

(*) Mark is optionally supported.

VRF System Controller+BACnet

VRF System Controller+BACnet has following point list:

Instance Number	Object	Object Type	Object Name	Status Value
1	All device OFF	BO	ALL_OFF_xx	Inactive : All devices Off
2	VRF SC +BACnet status	AI	DMS2_Status_xx	0: Normal, 8: Emergency stop, 105 : Tracking in progress, 108 : Tracking failed 109 : VRF SC+BACnet↔BACnet Communication failed
3	BACnet error code	AI	BACnetApp_Error_Code_xx	BACnet error code
4	Gateway Notify	NC	GW_Notify_xx	When the error occurred, send event to list of destination in the recipient_list. (Max : 8)

BACnet PICS: Page 10

DDC

DDC has following point list.

Instance Number	Object	Object Type	Object Name	Unit	Status value			
				Inactive	Active			
				Text-1	Text-2	Text-3	Text-4	Text-5
1	Digital Input 1	BI	DI_01_xx_xx (BACnet Gateway Reserved)	Off	On			
2	Digital Input 2	BI	DI_02_xx_xx (BACnet Gateway Reserved)	Off	On			
3	Digital Input 3	BI	DI_03_xx_xx	Off	On			
4	Digital Input 4	BI	DI_04_xx_xx	Off	On			
5	Digital Input 5	BI	DI_05_xx_xx	Off	On			
6	Digital Input 6	BI	DI_06_xx_xx	Off	On			
7	Digital Input 7	BI	DI_07_xx_xx	Off	On			
8	Digital Input 8	BI	DI_08_xx_xx	Off	On			
9	Digital Input 9	BI	DI_09_xx_xx	Off	On			
10	Digital Input 10	BI	DI_10_xx_xx	Off	On			
11	Digital Output 1	BO	DO_01_xx_xx (BACnet Gateway Reserved)	Off	On			
12	Digital Output 2	BO	DO_02_xx_xx (BACnet Gateway Reserved)	Off	On			
13	Digital Output 3	BO	DO_03_xx_xx	Off	On			
14	Digital Output 4	BO	DO_04_xx_xx	Off	On			
15	Digital Output 5	BO	DO_05_xx_xx	Off	On			
16	Digital Output 6	BO	DO_06_xx_xx	Off	On			
17	Digital Output 7	BO	DO_07_xx_xx	Off	On			
18	Digital Output 8	BO	DO_08_xx_xx	Off	On			

Note: If a communication error occurs on devices such as PIM/Central On/Off Control/Outdoor unit, other functions such as power distribution may also be examined for problems. The BAS must check the errors action must be taken immediately.

BACnet PICS: Page 11

Object setting when there is communication error

If any communication error occurs between the air conditioner devices, the property will be set as below.

1. Reliability property will be set as COMMUNICATION_FAILURE.
2. Fault / Alarm flag of Status_Flags property will be set as TRUE.
3. Present_Value property is readable but the value is not guaranteed.

Object setting when there is general error

If any air conditioner related error occurs, the property will be set as below.

1. The Reliability property value of each object will be set as UNRELIABLE_OTHER.
2. FAULT / Alarm flag of Status Flags property will be set as TRUE.

Main service

Time setting

Time synchronization Service is a service that allows the time of BACnet Gateway to be synchronized with the time of PC.

COV (Change Of Value)

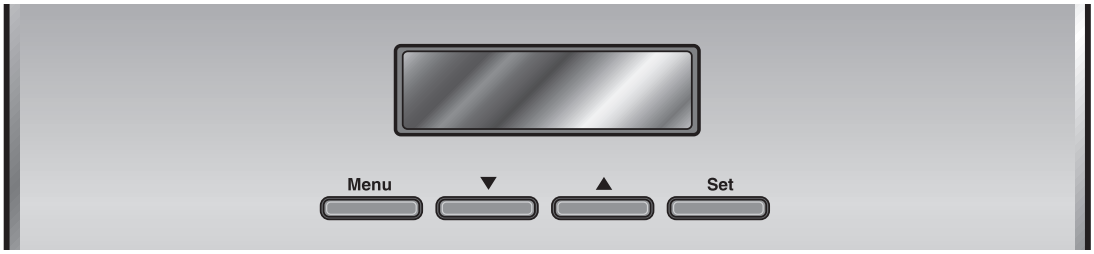
COV service is supported and you can set confirmed or unconfirmed COV.
You can set lifetime value.

NOTE: COV registration information will disappear when a VRF SC+BACnet is switched off. The reserved value caused by the power supply problem is not guaranteed according to the BACnet regulation.

Appendix: Using the LCD Panel

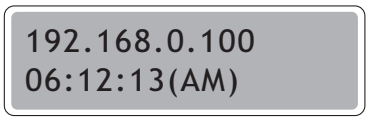
The Liquid Crystal Display (LCD) panel is mounted on the VRF SC for installation and for the convenience of the user. The LCD can be used to perform the operations described in this section as an alternative to the system controller Web pages:

- Search the menu and change settings using up and down arrow buttons. If you press and hold the up and down arrow buttons in some menus such as IP setting, you can scroll through the values more quickly.
- Press the **Menu** button to go to the upper menu or to cancel.
- Press the **Set** button to go to the sub-menu or to select or save.



Main Menu

1. Press **Menu** or **Set** to display the IP address and current time.



2. Press the up/down arrow buttons to display the following menu items:

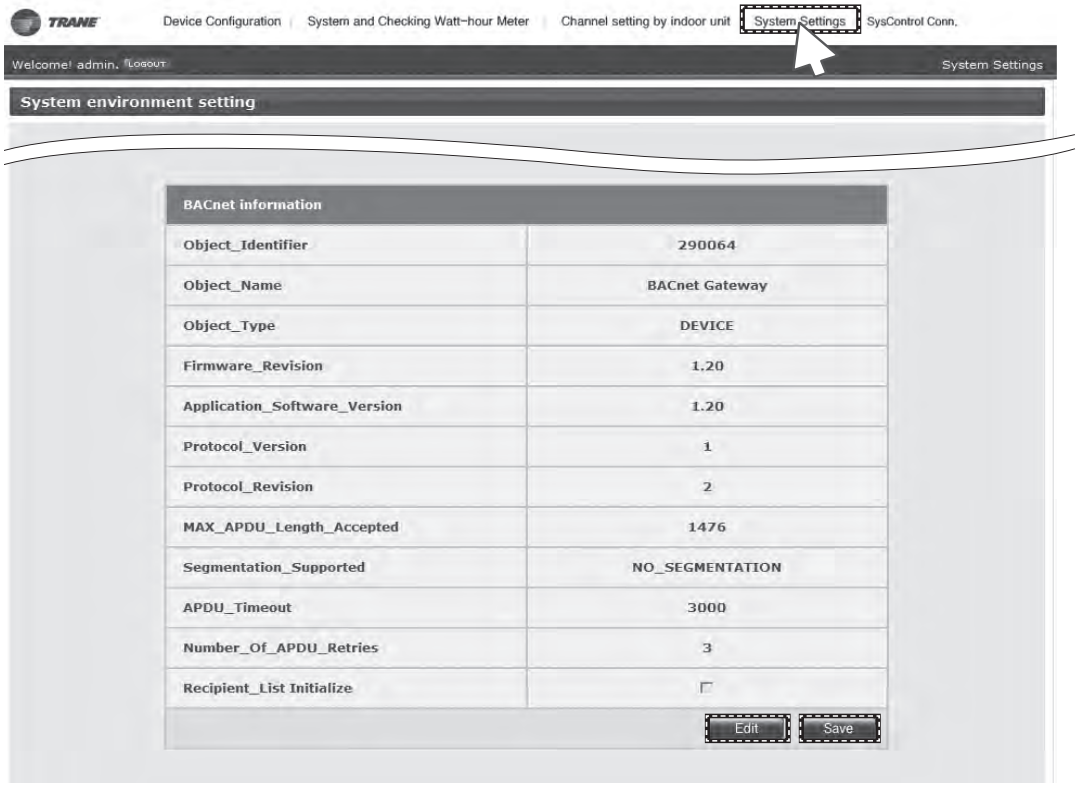
1	IP Config	Network settings
2	In/Outdoor	Checking indoor/outdoor unit information
3	VRF SC Version	Checking system controller version
4	VRF SC	Setting system controller time
5	Data Backup	Setting data backup
6	Peak Level	Checking peak level
7	Error Status	Checking error information
8	Password Reset	Password reset
9	Button Lock	Button lock function(1)
10	Safety Halt	Safe end function

(1) This function prevents button use. The buttons can be locked to avoid problems caused by accidental button presses.

BACnet information

To access BACnet information:

1. With your mouse, hover over the System Settings tab, select BACnet configuration.



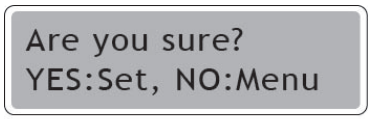
2. From the BACnet configuration page, select System environment setting.
3. Scroll down the System environment setting to BACnet information.
4. To initialize **Recipient_list**, click **Edit**, select the checkbox, and click **Save**.
5. A pop-up window will appear. Click **OK**. The software will restart and the system will initialize **Recipient_list**.

System Setting Initialization

Note: *During initialization, all saved data in the system is deleted. After initialization is complete, the saved data and IP address are the same as the factory setting.*

1. Press **Menu** or **Set** to display the main menu.
2. Press **Menu,** ▼ , ▲ , ▼ , **Menu**, in order.

A confirmation screen will appear:



3. Press **Set** to initialize the VRF SC, or press **Menu** to cancel.

Network Settings

IP Configuration

1. Press **Menu** or **Set** to display the main menu.
2. Select **1. IP Config** by pressing the up/down arrows.

3. Press the **Set** button.

   The network setting screen will appear, as shown in the example:

4. Select the item you want to change by pressing the up/down arrow buttons.

   You can select the IP address, subnet mask address, gateway address, or DNS server.

5. Select the section of the number that you want to change by pressing the **Set** button.

   The section of the number that is editable will blink.

6. To change the value of the blinking number, press the up/down arrow buttons.
7. To move to the next section of the number, press the **Set** button.
8. After setting all sections of the number, press the **Set** button to save the settings. To cancel the setting changes, press the **Menu** button.

Auto Address Setting (DHCP CONFIG)

Note: *DHCP function is not available when using the BACnet function.*

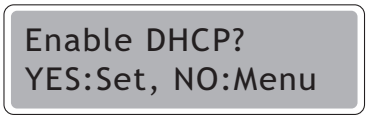
1. Press **Menu** or **Set** to display the main menu.
2. Select **1. IP Config** by pressing the up/down arrow buttons.

3. Then press the **Set** button.

   The network setting screen will appear, as shown in the example:

4. Press the down arrow button to select the auto address-setting function (**DHCP CONFIG)**. The status will appear as either:
   - **Current disabled**: Auto address setting function is disabled.
   - **Current enabled**: Auto address setting function is enabled.

5. To change the status, press the **Set** button. The maintain the current status, press the **Menu** button.



6. To return to the main menu, press the **Menu** or **Set** button.

Checking Indoor/Outdoor Unit Information

1. Press **Menu** or **Set** to display the main menu.
2. Select **2. In/Outdoor** by pressing the up/down arrow buttons.

3. Press the **Set** button.

   The number of indoor units connected to the VRF SC is displayed.

4. Press the down arrow button. The number of outdoor units connected to the VRF SC is displayed.

Note: *To return to the indoor unit information, press the up arrow button.*

5. To return to the main menu, press the **Menu** or **Set** button.

Checking the VRF SC Version

1. Press **Menu** or **Set** to display the main menu.
2. Select **3. Version** by pressing the up/down arrow buttons.

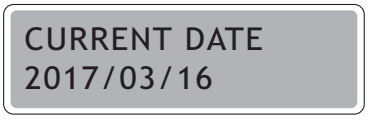
3. Press the **Set** button.
   The current version of the VRF SC is displayed.

4. To return to the main menu, press the **Menu** or **Set** button.

Date Setting

1. Press **Menu** or **Set** to display the main menu.
2. Select **4. Time** by pressing the up/down arrow buttons.

3. Press the **Set** button.
   The current date set in the VRF SC is displayed.



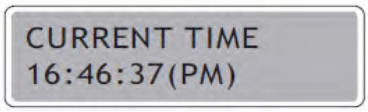
4. To change the date, press the **Set** button.
   The year will blink.
5. Change the hour by pressing the up/down arrow buttons.
   Note: *Press and hold the up/down arrow buttons to run through the numbers quickly.*
6. Press the **Set** button to move to the month. Set the month and day in the same way.
7. Press the **Set** button to save the changes. To cancel the changes, press the **Menu** button.

Time Setting

1. Press **Menu** or **Set** to display the main menu.
2. Select **4. Time** by pressing the up/down arrow buttons.

   Press the **Set** button

3. The current time set in the VRF SC is displayed.



4. To save the current time, press the **Set** button.

   The hour will blink.

5. Change the hour by pressing the up/down arrow buttons.

   Note: *Press and hold the up/down arrow buttons to run through the numbers quickly.*

6. Press the **Set** button to move to minutes. The minutes will blink.
7. Change the minutes by pressing the up/down arrow buttons.
8. Press the **Set** button to move to seconds. The seconds will blink.
9. Change the seconds by pressing the up/down arrow buttons.
10. Press the **Set** button to save changes. To cancel the settings, press the **Menu** button.

Data Backup

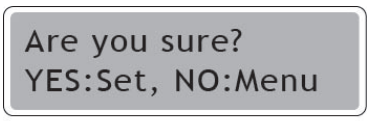
Note: *Before executing data backup, ensure that the SD card is inserted. If necessary, unlock SD card write protection.*

1. Press **Menu** or **Set** to display the main menu.
2. Select **5. Data Backup** by pressing the up/down arrow buttons.

3. Press the **Set** button.

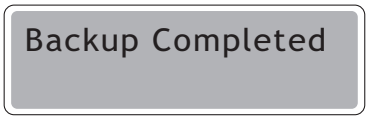
   The backup menu with **data backup** will appear.

4. Press the **Set** button. A confirmation screen will appear.



5. Press the **Set** button to start the backup process, or the **Menu** button to cancel it.

When the data backup is completed successfully, the following screen will appear.



Data Restore

Note: *Before executing data restoration, ensure that the SD card is inserted. If necessary, unlock SD card write protection.*

1. Press **Menu** or **Set** to display the main menu.
2. Select **5. Data Backup** by pressing the up/down arrow buttons.

3. Press the **Set** button.

   The backup menu with **data restore** will appear.

4. Press the **Set** button.
5. Select the file that you want to restore by pressing the up/down arrow buttons.

6. Press the **Set** button to start the restoration process, or the **Menu** button to cancel it.

Error Information Check

1. Press **Menu** or **Set** to display the main menu.
2. Select **7. Error Status** by pressing the up/down arrow buttons.

3. Press the **Set** button.

   Unsolved error information is displayed.

To check the next item in the sequence, press the up arrow button. To check the previous error in sequence, press the down arrow button.

Password Reset

1. Press **Menu** or **Set** to display the main menu.
1. Select **8. Password Reset** by pressing the up/down arrow buttons.

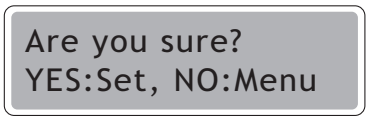
2. Then press the **Set** button.

   The following screen is displayed.

3. Press the **Menu** and **Set** buttons at the same time.

   The button lock function is released and a confirmation message for password initialization appears.

   Note: *If there is no button input for around 3 seconds, the password reset will fail and the main menu will appear.*



4. Press the **Set** button to confirm password reset.
   - The password is reset as a factory setting (ac0530).
   - To cancel the password reset, press the **Menu** button.

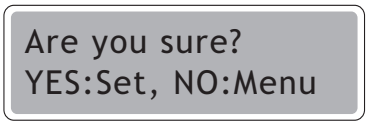
   Note: *If you reset the password while you have the system controller Web page open, you must close the browser and log in again to use the password reset function.*

Button Lock

1. Press **Menu** or **Set** to display the main menu.
2. Select **9. Button Lock** by pressing the up/down arrow buttons.

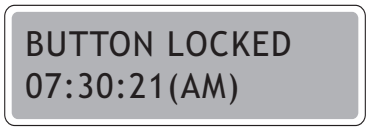
3. Press the **Set** button.

   A confirmation screen will appear.



4. Press the **Set** button.

The LCD operating button is now locked.



Notes:

- *To cancel button lock, press the **Menu** button.*
- *To release the button lock function, press the **Menu** and **Set** buttons at the same time for 5 seconds.*

Safety Halt

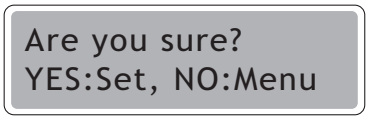
The safety halt function is an operation that saves system controller data and then stops operation safely. Use this function when relocation and system restart are needed.

This function will not transfer system controller power to OFF status. Therefore, when the screen above appears, press the RESET button on the bottom of system controller or remove the power cable. If you do not press the RESET button or remove power after 10 minutes passes, the system controller will automatically restart.

1. Press **Menu** or **Set** to display the main menu.
2. Select **10. Safety Halt** by pressing the up/down arrow buttons.

3. Press the **Set** button.

   A confirmation message will appear.



4. Press the **Set** button.

   All functions of the system controller stop and a message appears to confirm that the system controller is not operational.

The VRF SC will restart.

Appendix: Open Source Announcement

The software included in this product contains copyrighted software that is licensed under the GPL/LGPL. You may obtain the complete Corresponding Source code from us for a period of three years after our last shipment of this product by sending email to:

http://www.trane.com/commercial/AboutTrane/ContactUs/Feedback.aspx?i=1528

If you want to obtain the complete Corresponding Source code in the physical medium such as CD-ROM, the cost of physically performing source distribution may be charged. This offer is valid to anyone in receipt of this information.

GPL Software : darsa, dbus, e2fsprogs, libcap, systemd-210, termcap, util-linux, ncures, busybox, Linux kernel, uboot

LGPL Software : attr, Smack, MiniXML, glibc, libstdc++,rxtx

—GNU GENERAL PUBLIC LICENSE

The GNU General Public License (GPL)

Version 2, June 1991

Copyright ©1989, 1991 Free Software Foundation, Inc.

59 Temple Place, Suite 330, Boston, MA 02111-1307 USA

Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

Preamble

The licenses for most software are designed to take away your freedom to share and change it. By contrast, the GNU General Public License is intended to guarantee your freedom to share and change free software--to make sure the software is free for all its users. This General Public License applies to most of the Free Software Foundation's software and to any other program whose authors commit to using it. (Some other Free Software Foundation software is covered by the GNU Library General Public License instead.) You can apply it to your programs, too.

When we speak of free software, we are referring to freedom, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for this service if you wish), that you receive source code or can get it if you want it, that you can change the software or use pieces of it in new free programs; and that you know you can do these things.

To protect your rights, we need to make restrictions that forbid anyone to deny you these rights or to ask you to surrender the rights. These restrictions translate to certain responsibilities for you if you distribute copies of the software, or if you modify it.

For example, if you distribute copies of such a program, whether gratis or for a fee, you must give the recipients all the rights that you have. You must make sure that they, too, receive or can get the source code. And you must show them these terms so they know their rights.

We protect your rights with two steps: (1) copyright the software, and (2) offer you this license which gives you legal permission to copy, distribute and/or modify the software.

Also, for each author's protection and ours, we want to make certain that everyone understands that there is no warranty for this free software. If the software is modified by someone else and passed on, we want its recipients to know that what they have is not the original, so that any problems introduced by others will not reflect on the original authors' reputations.

Finally, any free program is threatened constantly by software patents. We wish to avoid the danger that redistributors of a free program will individually obtain patent licenses, in effect making the program proprietary. To prevent this, we have made it clear that any patent must be licensed for everyone's free use or not licensed at all.

The precise terms and conditions for copying, distribution and modification follow.

TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION

0. This License applies to any program or other work which contains a notice placed by the copyright holder saying it may be distributed under the terms of this General Public License. The "Program," below, refers to any such program or work, and a "work based on the Program" means either the Program or any derivative work under copyright law: that is to say, a work containing the Program or a portion of it, either verbatim or with modifications and/or translated into another language. (Hereinafter, translation is included without limitation in the term "modification.") Each licensee is addressed as "you."

Activities other than copying, distribution and modification are not covered by this License; they are outside its scope. The act of running the Program is not restricted, and the output from the Program is covered only if its contents constitute a work based on the Program (independent of having been made by running the Program). Whether that is true depends on what the Program does.

1. You may copy and distribute verbatim copies of the Program's source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice and disclaimer of warranty; keep intact all the notices that refer to this License and to the absence of any warranty; and give any other recipients of the Program a copy of this License along with the Program.

You may charge a fee for the physical act of transferring a copy, and you may at your option offer warranty protection in exchange for a fee.

2. You may modify your copy or copies of the Program or any portion of it, thus forming a work based on the Program, and copy and distribute such modifications or work under the terms of Section 1 above, provided that you also meet all of these conditions:

a) You must cause the modified files to carry prominent notices stating that you changed the files and the date of any change.

b) You must cause any work that you distribute or publish, that in whole or in part contains or is derived from the Program or any part thereof, to be licensed as a whole at no charge to all third parties under the terms of this License.

c) If the modified program normally reads commands interactively when run, you must cause it, when started running for such interactive use in the most ordinary way, to print or display an announcement including an appropriate copyright notice and a notice that there is no warranty (or else, saying that you provide a warranty) and that users may redistribute the program under these conditions, and telling the user how to view a copy of this License. (Exception: if the Program itself is interactive but does not normally print such an announcement, your work based on the Program is not required to print an announcement.)

These requirements apply to the modified work as a whole. If identifiable sections of that work are not derived from the Program, and can be reasonably considered independent and separate works in themselves, then this License, and its terms, do not apply to those sections when you distribute them as separate works. But when you distribute the same sections as part of a whole which is a work based on the Program, the distribution of the whole must be on the terms of this License, whose permissions for other licensees extend to the entire whole, and thus to each and every part regardless of who wrote it.

Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Program.

In addition, mere aggregation of another work not based on the Program with the Program (or with a work based on the Program) on a volume of a storage or distribution medium does not bring the other work under the scope of this License.

3. You may copy and distribute the Program (or a work based on it, under Section 2) in object code or executable form under the terms of Sections 1 and 2 above provided that you also do one of the following:

a) Accompany it with the complete corresponding machine-readable source code, which must be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange; or,

b) Accompany it with a written offer, valid for at least three years, to give any third party, for a charge no more than your cost of physically performing source distribution, a complete machine-readable copy of the corresponding source code, to be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange; or,

c) Accompany it with the information you received as to the offer to distribute corresponding source code. (This alternative is allowed only for noncommercial distribution and only if you received the program in object code or executable form with such an offer, in accord with Subsection b above.)

The source code for a work means the preferred form of the work for making modifications to it. For an executable work, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the executable. However, as a special exception, the source code distributed need not include anything that is normally distributed (in either source or binary form) with the major components (compiler, kernel, and so on) of the operating system on which the executable runs, unless that component itself accompanies the executable.

If distribution of executable or object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place counts as distribution of the source code, even though third parties are not compelled to copy the source along with the object code.

4. You may not copy, modify, sublicense, or distribute the Program except as expressly provided under this License. Any attempt otherwise to copy, modify, sublicense or distribute the Program is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.

5. You are not required to accept this License, since you have not signed it. However, nothing else grants you permission to modify or distribute the Program or its derivative works. These actions are prohibited by law if you do not accept this License. Therefore, by modifying or distributing the Program (or any work based on the Program), you indicate your acceptance of this License to do so, and all its terms and conditions for copying, distributing or modifying the Program or works based on it.

6. Each time you redistribute the Program (or any work based on the Program), the recipient automatically receives a license from the original licensor to copy, distribute or modify the Program subject to these terms and conditions. You may not impose any further restrictions on the recipients' exercise of the rights granted herein. You are not responsible for enforcing compliance by third parties to this License.

7. If, as a consequence of a court judgment or allegation of patent infringement or for any other reason (not limited to patent issues), conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot distribute so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not distribute the Program at all. For example, if a patent license would not permit royalty-free redistribution of the Program by all those who receive copies directly or indirectly through you, then the only way you could satisfy both it and this License would be to refrain entirely from distribution of the Program.

If any portion of this section is held invalid or unenforceable under any particular circumstance, the balance of the section is intended to apply and the section as a whole is intended to apply in other circumstances.

It is not the purpose of this section to induce you to infringe any patents or other property right claims or to contest validity of any such claims; this section has the sole purpose of protecting the

integrity of the free software distribution system, which is implemented by public license practices. Many people have made generous contributions to the wide range of software distributed through that system in reliance on consistent application of that system; it is up to the author/donor to decide if he or she is willing to distribute software through any other system and a licensee cannot impose that choice.

This section is intended to make thoroughly clear what is believed to be a consequence of the rest of this License.

8. If the distribution and/or use of the Program is restricted in certain countries either by patents or by copyrighted interfaces, the original copyright holder who places the Program under this License may add an explicit geographical distribution limitation excluding those countries, so that distribution is permitted only in or among countries not thus excluded. In such case, this License incorporates the limitation as if written in the body of this License.

9. The Free Software Foundation may publish revised and/or new versions of the General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Program specifies a version number of this License which applies to it and "any later version", you have the option of following the terms and conditions either of that version or of any later version published by the Free Software Foundation. If the Program does not specify a version number of this License, you may choose any version ever published by the Free Software Foundation.

10. If you wish to incorporate parts of the Program into other free programs whose distribution conditions are different, write to the author to ask for permission. For software which is copyrighted by the Free Software Foundation, write to the Free Software Foundation; we sometimes make exceptions for this. Our decision will be guided by the two goals of preserving the free status of all derivatives of our free software and of promoting the sharing and reuse of software generally.

NO WARRANTY

11. BECAUSE THE PROGRAM IS LICENSED FREE OF CHARGE, THERE IS NO WARRANTY FOR THE PROGRAM, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE PROGRAM "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE PROGRAM IS WITH YOU. SHOULD THE PROGRAM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.

12. IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MAY MODIFY AND/OR REDISTRIBUTE THE PROGRAM AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PROGRAM (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE PROGRAM TO OPERATE WITH ANY OTHER PROGRAMS), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

END OF TERMS AND CONDITIONS

How to Apply These Terms to Your New Programs

If you develop a new program, and you want it to be of the greatest possible use to the public, the best way to achieve this is to make it free software which everyone can redistribute and change under these terms.

To do so, attach the following notices to the program. It is safest to attach them to the start of each source file to most effectively convey the exclusion of warranty; and each file should have at least the “copyright” line and a pointer to where the full notice is found.
one line to give the program's name and a brief idea of what it does.

Copyright

This program is free software; you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation; either version 2 of the License, or (at your option) any later version.

This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details.

You should have received a copy of the GNU General Public License along with this program; if not, write to the Free Software Foundation, Inc., 59 Temple Place, Suite 330, Boston, MA 02111-1307 USA

Also add information on how to contact you by electronic and paper mail.
If the program is interactive, make it output a short notice like this when it starts in an interactive mode:

Gnomovision version 69, Copyright year name of author Gnomovision comes with ABSOLUTELY NO WARRANTY; for details type `show w'. This is free software, and you are welcome to redistribute it under certain conditions; type `show c' for details.

The hypothetical commands `show w' and `show c' should show the appropriate parts of the General Public License. Of course, the commands you use may be called something other than `show w' and `show c'; they could even be mouse-clicks or menu items--whatever suits your program.
You should also get your employer (if you work as a programmer) or your school, if any, to sign a "copyright disclaimer" for the program, if necessary. Here is a sample; alter the names:

Yoyodyne, Inc., hereby disclaims all copyright interest
in the program `Gnomovision' (which makes passes at compilers)
written by James Hacker.

signature of Ty Coon, 1 April 1989

Ty Coon, President of Vice

This General Public License does not permit incorporating your program into proprietary programs. If your program is a subroutine library, you may consider it more useful to permit linking proprietary applications with the library. If this is what you want to do, use the GNU Library General Public License instead of this License.

—GNU LESSER GENERAL PUBLIC LICENSE

GNU Lesser General Public License

Version 2.1, February 1999

Copyright © 1991, 1999 Free Software Foundation, Inc.

59 Temple Place, Suite 330, Boston, MA 02111-1307 USA

Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

[This is the first released version of the Lesser GPL. It also counts as the successor of the GNU Library Public License, version 2, hence the version number 2.1.]

Preamble

The licenses for most software are designed to take away your freedom to share and change it. By contrast, the GNU General Public Licenses are intended to guarantee your freedom to share and change free software--to make sure the software is free for all its users.

This license, the Lesser General Public License, applies to some specially designated software packages--typically libraries--of the Free Software Foundation and other authors who decide to use it. You can use it too, but we suggest you first think carefully about whether this license or the ordinary General Public License is the better strategy to use in any particular case, based on the explanations below.

When we speak of free software, we are referring to freedom of use, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for this service if you wish); that you receive source code or can get it if you want it; that you can change the software and use pieces of it in new free programs; and that you are informed that you can do these things.

To protect your rights, we need to make restrictions that forbid distributors to deny you these rights or to ask you to surrender these rights. These restrictions translate to certain responsibilities for you if you distribute copies of the library or if you modify it.

For example, if you distribute copies of the library, whether gratis or for a fee, you must give the recipients all the rights that we gave you. You must make sure that they, too, receive or can get the source code. If you link other code with the library, you must provide complete object files to the recipients, so that they can relink them with the library after making changes to the library and recompiling it. And you must show them these terms so they know their rights.

We protect your rights with a two-step method: (1) we copyright the library, and (2) we offer you this license, which gives you legal permission to copy, distribute and/or modify the library.

To protect each distributor, we want to make it very clear that there is no warranty for the free library. Also, if the library is modified by someone else and passed on, the recipients should know that what they have is not the original version, so that the original author's reputation will not be affected by problems that might be introduced by others.

Finally, software patents pose a constant threat to the existence of any free program. We wish to make sure that a company cannot effectively restrict the users of a free program by obtaining a restrictive license from a patent holder. Therefore, we insist that any patent license obtained for a version of the library must be consistent with the full freedom of use specified in this license.

Most GNU software, including some libraries, is covered by the ordinary GNU General Public License. This license, the GNU Lesser General Public License, applies to certain designated libraries, and is quite different from the ordinary General Public License. We use this license for certain libraries in order to permit linking those libraries into non-free programs.

When a program is linked with a library, whether statically or using a shared library, the combination of the two is legally speaking a combined work, a derivative of the original library. The ordinary General Public License therefore permits such linking only if the entire combination fits its criteria of freedom. The Lesser General Public License permits more lax criteria for linking other code with the library.

We call this license the "Lesser" General Public License because it does Less to protect the user's freedom than the ordinary General Public License. It also provides other free software developers Less of an advantage over competing non-free programs. These disadvantages are the reason we use the ordinary General Public License for many libraries. However, the Lesser license provides advantages in certain special circumstances.

For example, on rare occasions, there may be a special need to encourage the widest possible use of a certain library, so that it becomes a de-facto standard. To achieve this, non-free programs must be allowed to use the library. A more frequent case is that a free library does the same job as widely

used non-free libraries. In this case, there is little to gain by limiting the free library to free software only, so we use the Lesser General Public License.

In other cases, permission to use a particular library in non-free programs enables a greater number of people to use a large body of free software. For example, permission to use the GNU C Library in non-free programs enables many more people to use the whole GNU operating system, as well as its variant, the GNU/Linux operating system.

Although the Lesser General Public License is Less protective of the users' freedom, it does ensure that the user of a program that is linked with the Library has the freedom and the wherewithal to run that program using a modified version of the Library.

The precise terms and conditions for copying, distribution and modification follow. Pay close attention to the difference between a "work based on the library" and a "work that uses the library". The former contains code derived from the library, whereas the latter must be combined with the library in order to run.

TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION

0.This License Agreement applies to any software library or other program which contains a notice placed by the copyright holder or other authorized party saying it may be distributed under the terms of this Lesser General Public License (also called "this License"). Each licensee is addressed as "you".

A "library" means a collection of software functions and/or data prepared so as to be conveniently linked with application programs (which use some of those functions and data) to form executables.

The "Library," below, refers to any such software library or work which has been distributed under these terms. A "work based on the Library" means either the Library or any derivative work under copyright law: that is to say, a work containing the Library or a portion of it, either verbatim or with modifications and/or translated straightforwardly into another language. (Hereinafter, translation is included without limitation in the term "modification".)

"Source code" for a work means the preferred form of the work for making modifications to it. For a library, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the library.

Activities other than copying, distribution and modification are not covered by this License; they are outside its scope. The act of running a program using the Library is not restricted, and output from such a program is covered only if its contents constitute a work based on the Library (independent of the use of the Library in a tool for writing it). Whether that is true depends on what the Library does and what the program that uses the Library does.

1. You may copy and distribute verbatim copies of the Library's complete source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice and disclaimer of warranty; keep intact all the notices that refer to this License and to the absence of any warranty; and distribute a copy of this License along with the Library.

You may charge a fee for the physical act of transferring a copy, and you may at your option offer warranty protection in exchange for a fee.

2.You may modify your copy or copies of the Library or any portion of it, thus forming a work based on the Library, and copy and distribute such modifications or work under the terms of Section 1 above, provided that you also meet all of these conditions:

a) The modified work must itself be a software library.

b) You must cause the files modified to carry prominent notices stating that you changed the files and the date of any change.

c) You must cause the whole of the work to be licensed at no charge to all third parties under the terms of this License.

d) If a facility in the modified Library refers to a function or a table of data to be supplied by an application program that uses the facility, other than as an argument passed when the facility is invoked, then you must make a good faith effort to ensure that, in the event an application does not supply such function or table, the facility still operates, and performs whatever part of its purpose remains meaningful.

(For example, a function in a library to compute square roots has a purpose that is entirely well-defined independent of the application. Therefore, Subsection 2d requires that any application-supplied function or table used by this function must be optional: if the application does not supply it, the square root function must still compute square roots.)

These requirements apply to the modified work as a whole. If identifiable sections of that work are not derived from the Library, and can be reasonably considered independent and separate works in themselves, then this License, and its terms, do not apply to those sections when you distribute them as separate works. But when you distribute the same sections as part of a whole which is a work based on the Library, the distribution of the whole must be on the terms of this License, whose permissions for other licensees extend to the entire whole, and thus to each and every part regardless of who wrote it.

Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Library.

In addition, mere aggregation of another work not based on the Library with the Library (or with a work based on the Library) on a volume of a storage or distribution medium does not bring the other work under the scope of this License.

3. You may opt to apply the terms of the ordinary GNU General Public License instead of this License to a given copy of the Library. To do this, you must alter all the notices that refer to this License, so that they refer to the ordinary GNU General Public License, version 2, instead of to this License. (If a newer version than version 2 of the ordinary GNU General Public License has appeared, then you can specify that version instead if you wish.) Do not make any other change in these notices.

Once this change is made in a given copy, it is irreversible for that copy, so the ordinary GNU General Public License applies to all subsequent copies and derivative works made from that copy.

This option is useful when you wish to copy part of the code of the Library into a program that is not a library.

4. You may copy and distribute the Library (or a portion or derivative of it, under Section 2) in object code or executable form under the terms of Sections 1 and 2 above provided that you accompany it with the complete corresponding machine-readable source code, which must be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange.

If distribution of object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place satisfies the requirement to distribute the source code, even though third parties are not compelled to copy the source along with the object code.

5. A program that contains no derivative of any portion of the Library, but is designed to work with the Library by being compiled or linked with it, is called a "work that uses the Library". Such a work, in isolation, is not a derivative work of the Library, and therefore falls outside the scope of this License.

However, linking a "work that uses the Library" with the Library creates an executable that is a derivative of the Library (because it contains portions of the Library), rather than a "work that uses the library". The executable is therefore covered by this License. Section 6 states terms for distribution of such executables.

When a "work that uses the Library" uses material from a header file that is part of the Library, the object code for the work may be a derivative work of the Library even though the source code is

not. Whether this is true is especially significant if the work can be linked without the Library, or if the work is itself a library. The threshold for this to be true is not precisely defined by law.

If such an object file uses only numerical parameters, data structure layouts and accessors, and small macros and small inline functions (ten lines or less in length), then the use of the object file is unrestricted, regardless of whether it is legally a derivative work. (Executables containing this object code plus portions of the Library will still fall under Section 6.)

Otherwise, if the work is a derivative of the Library, you may distribute the object code for the work under the terms of Section 6. Any executables containing that work also fall under Section 6, whether or not they are linked directly with the Library itself.

6. As an exception to the Sections above, you may also combine or link a "work that uses the Library" with the Library to produce a work containing portions of the Library, and distribute that work under terms of your choice, provided that the terms permit modification of the work for the customer's own use and reverse engineering for debugging such modifications.

You must give prominent notice with each copy of the work that the Library is used in it and that the Library and its use are covered by this License. You must supply a copy of this License. If the work during execution displays copyright notices, you must include the copyright notice for the Library among them, as well as a reference directing the user to the copy of this License. Also, you must do one of these things:

a) Accompany the work with the complete corresponding machine-readable source code for the Library including whatever changes were used in the work (which must be distributed under Sections 1 and 2 above); and, if the work is an executable linked with the Library, with the complete machine-readable "work that uses the Library", as object code and/or source code, so that the user can modify the Library and then relink to produce a modified executable containing the modified Library. (It is understood that the user who changes the contents of definitions files in the Library will not necessarily be able to recompile the application to use the modified definitions.)

b) Use a suitable shared library mechanism for linking with the Library. A suitable mechanism is one that (1) uses at run time a copy of the library already present on the user's computer system, rather than copying library functions into the executable, and (2) will operate properly with a modified version of the library, if the user installs one, as long as the modified version is interface-compatible with the version that the work was made with.

c) Accompany the work with a written offer, valid for at least three years, to give the same user the materials specified in Subsection 6a, above, for a charge no more than the cost of performing this distribution.

d) If distribution of the work is made by offering access to copy from a designated place, offer equivalent access to copy the above specified materials from the same place.

e) Verify that the user has already received a copy of these materials or that you have already sent this user a copy.

For an executable, the required form of the "work that uses the Library" must include any data and utility programs needed for reproducing the executable from it. However, as a special exception, the materials to be distributed need not include anything that is normally distributed (in either source or binary form) with the major components (compiler, kernel, and so on) of the operating system on which the executable runs, unless that component itself accompanies the executable.

It may happen that this requirement contradicts the license restrictions of other proprietary libraries that do not normally accompany the operating system. Such a contradiction means you cannot use both them and the Library together in an executable that you distribute.

7. You may place library facilities that are a work based on the Library side-by-side in a single library together with other library facilities not covered by this License, and distribute such a combined library, provided that the separate distribution of the work based on the Library and of the other library facilities is otherwise permitted, and provided that you do these two things:

a) Accompany the combined library with a copy of the same work based on the Library, uncombined with any other library facilities. This must be distributed under the terms of the Sections above.

b) Give prominent notice with the combined library of the fact that part of it is a work based on the Library, and explaining where to find the accompanying uncombined form of the same work.

8. You may not copy, modify, sublicense, link with, or distribute the Library except as expressly provided under this License. Any attempt otherwise to copy, modify, sublicense, link with, or distribute the Library is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.

9. You are not required to accept this License, since you have not signed it. However, nothing else grants you permission to modify or distribute the Library or its derivative works. These actions are prohibited by law if you do not accept this License. Therefore, by modifying or distributing the Library (or any work based on the Library), you indicate your acceptance of this License to do so, and all its terms and conditions for copying, distributing or modifying the Library or works based on it.

10. Each time you redistribute the Library (or any work based on the Library), the recipient automatically receives a license from the original licensor to copy, distribute, link with or modify the Library subject to these terms and conditions. You may not impose any further restrictions on the recipients' exercise of the rights granted herein. You are not responsible for enforcing compliance by third parties with this License.

11. If, as a consequence of a court judgment or allegation of patent infringement or for any other reason (not limited to patent issues), conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot distribute so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not distribute the Library at all. For example, if a patent license would not permit royalty-free redistribution of the Library by all those who receive copies directly or indirectly through you, then the only way you could satisfy both it and this License would be to refrain entirely from distribution of the Library.

If any portion of this section is held invalid or unenforceable under any particular circumstance, the balance of the section is intended to apply, and the section as a whole is intended to apply in other circumstances.

It is not the purpose of this section to induce you to infringe any patents or other property right claims or to contest validity of any such claims; this section has the sole purpose of protecting the integrity of the free software distribution system which is implemented by public license practices. Many people have made generous contributions to the wide range of software distributed through that system in reliance on consistent application of that system; it is up to the author/donor to decide if he or she is willing to distribute software through any other system and a licensee cannot impose that choice.

This section is intended to make thoroughly clear what is believed to be a consequence of the rest of this License.

12. If the distribution and/or use of the Library is restricted in certain countries either by patents or by copyrighted interfaces, the original copyright holder who places the Library under this License may add an explicit geographical distribution limitation excluding those countries, so that distribution is permitted only in or among countries not thus excluded. In such case, this License incorporates the limitation as if written in the body of this License.

13. The Free Software Foundation may publish revised and/or new versions of the Lesser General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Library specifies a version number of this License which applies to it and "any later version", you have the option of following the terms

and conditions either of that version or of any later version published by the Free Software Foundation. If the Library does not specify a license version number, you may choose any version ever published by the Free Software Foundation.

14. If you wish to incorporate parts of the Library into other free programs whose distribution conditions are incompatible with these, write to the author to ask for permission. For software which is copyrighted by the Free Software Foundation, write to the Free Software Foundation; we sometimes make exceptions for this. Our decision will be guided by the two goals of preserving the free status of all derivatives of our free software and of promoting the sharing and reuse of software generally.

NO WARRANTY

15. BECAUSE THE LIBRARY IS LICENSED FREE OF CHARGE, THERE IS NO WARRANTY FOR THE LIBRARY, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE LIBRARY "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE LIBRARY IS WITH YOU. SHOULD THE LIBRARY PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.

16. IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MAY MODIFY AND/OR REDISTRIBUTE THE LIBRARY AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE LIBRARY (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE LIBRARY TO OPERATE WITH ANY OTHER SOFTWARE), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

END OF TERMS AND CONDITIONS

How to Apply These Terms to Your New Libraries

If you develop a new library, and you want it to be of the greatest possible use to the public, we recommend making it free software that everyone can redistribute and change. You can do so by permitting redistribution under these terms (or, alternatively, under the terms of the ordinary General Public License).

To apply these terms, attach the following notices to the library. It is safest to attach them to the start of each source file to most effectively convey the exclusion of warranty; and each file should have at least the "copyright" line and a pointer to where the full notice is found.

one line to give the library's name and an idea of what it does.

Copyright year name of author

This library is free software; you can redistribute it and/or

modify it under the terms of the GNU Lesser General Public License as published by the Free Software Foundation; either version 2.1 of the License, or (at your option) any later version.

This library is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU Lesser General Public License for more details.

You should have received a copy of the GNU Lesser General Public License along with this library; if not, write to the Free Software Foundation, Inc., 59 Temple Place, Suite 330, Boston, MA 02111-1307 USA

Also add information on how to contact you by electronic and paper mail.

You should also get your employer (if you work as a programmer) or your school, if any, to sign a "copyright disclaimer" for the library, if necessary. Here is a sample; alter the names:

Yoyodyne, Inc., hereby disclaims all copyright interest in the library `Frob' (a library for tweaking knobs) written by James Random Hacker.

signature of Ty Coon, 1 April 1990

Ty Coon, President of Vice

That's all there is to it!

- OpenSSL

This product includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit. (http://www.openssl.org/)
This product includes cryptographic software written by Eric Young (eay@cryptsoft.com)

LICENSE ISSUES

The OpenSSL toolkit stays under a dual license, i.e. both the conditions of the OpenSSL License and the original SSLeay license apply to the toolkit. See below for the actual license texts. Actually both licenses are BSD-style Open Source licenses. In case of any license issues related to OpenSSL please contact openssl-core@openssl.org.

- OpenSSL License

Copyright © 1998-2008 The OpenSSL Project. All rights reserved.
Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:
Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
All advertising materials mentioning features or use of this software must display the following acknowledgment:
"This product includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit. (http://www.openssl.org/)"
The names "OpenSSL Toolkit" and "OpenSSL Project" must not be used to endorse or promote products derived from this software without prior written permission. For written permission, please contact openssl-core@openssl.org.
Products derived from this software may not be called "OpenSSL" nor may "OpenSSL" appear in their names without prior written permission of the OpenSSL Project.
Redistributions of any form whatsoever must retain the following acknowledgment:
"This product includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit (http://www.openssl.org/)"
THIS SOFTWARE IS PROVIDED BY THE OpenSSL PROJECT "AS IS" AND ANY EXPRESSED OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE OpenSSL PROJECT OR ITS CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED

OF THE POSSIBILITY OF SUCH DAMAGE.

This product includes cryptographic software written by Eric Young (eay@cryptsoft.com). This product includes software written by Tim Hudson (tjh@cryptsoft.com).

- BSD Software:

flex, shadow, dom4j

- BSD LICENSE

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:
Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
Neither the name of the nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

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

- Apache License
Version 2.0, January 2004

http://www.apache.org/licenses/

TERMS AND CONDITIONS FOR USE, REPRODUCTION, AND DISTRIBUTION

1. Definitions.

"License" shall mean the terms and conditions for use, reproduction, and distribution as defined by Sections 1 through 9 of this document.

"Licensor" shall mean the copyright owner or entity authorized by the copyright owner that is granting the License.

"Legal Entity" shall mean the union of the acting entity and all other entities that control, are controlled by, or are under common control with that entity. For the purposes of this definition, "control" means (i) the power, direct or indirect, to cause the direction or management of such entity, whether by contract or otherwise, or (ii) ownership of fifty percent (50%) or more of the outstanding shares, or (iii) beneficial ownership of such entity.

"You" (or "Your") shall mean an individual or Legal Entity exercising permissions granted by this License.

"Source" form shall mean the preferred form for making modifications, including but not limited to software source code, documentation source, and configuration files.

"Object" form shall mean any form resulting from mechanical transformation or translation of a Source form, including but not limited to compiled object code, generated documentation, and conversions to other media types.

"Work" shall mean the work of authorship, whether in Source or Object form, made available under the License, as indicated by a copyright notice that is included in or attached to the work (an example is provided in the Appendix below).

"Derivative Works" shall mean any work, whether in Source or Object form, that is based on (or derived from) the Work and for which the editorial revisions, annotations, elaborations, or other modifications represent, as a whole, an original work of authorship. For the purposes of this License, Derivative Works shall not include works that remain separable from, or merely link (or bind by name) to the interfaces of, the Work and Derivative Works thereof.

"Contribution" shall mean any work of authorship, including the original version of the Work and any modifications or additions to that Work or Derivative Works thereof, that is intentionally submitted to Licensor for inclusion in the Work by the copyright owner or by an individual or Legal Entity authorized to submit on behalf of the copyright owner. For the purposes of this definition, "submitted" means any form of electronic, verbal, or written communication sent to the Licensor or its representatives, including but not limited to communication on electronic mailing lists, source code control systems, and issue tracking systems that are managed by, or on behalf of, the Licensor for the purpose of discussing and improving the Work, but excluding communication that is conspicuously marked or otherwise designated in writing by the copyright owner as "Not a Contribution."

"Contributor" shall mean Licensor and any individual or Legal Entity on behalf of whom a Contribution has been received by Licensor and subsequently incorporated within the Work.

2. Grant of Copyright License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable copyright license to reproduce, prepare Derivative Works of, publicly display, publicly perform, sublicense, and distribute the Work and such Derivative Works in Source or Object form.

3. Grant of Patent License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable (except as stated in this section) patent license to make, have made, use, offer to sell, sell, import, and otherwise transfer the Work, where such license applies only to those patent claims licensable by such Contributor that are necessarily infringed by their Contribution(s) alone or by combination of their Contribution(s) with the Work to which such Contribution(s) was submitted. If You institute patent litigation against any entity (including a cross-claim or counterclaim in a lawsuit) alleging that the Work or a Contribution incorporated within the Work constitutes direct or contributory patent infringement, then any patent licenses granted to You under this License for that Work shall terminate as of the date such litigation is filed.

4. Redistribution. You may reproduce and distribute copies of the Work or Derivative Works thereof in any medium, with or without modifications, and in Source or Object form, provided that You meet the following conditions:

You must give any other recipients of the Work or Derivative Works a copy of this License; and

You must cause any modified files to carry prominent notices stating that You changed the files; and

You must retain, in the Source form of any Derivative Works that You distribute, all copyright, patent, trademark, and attribution notices from the Source form of the Work, excluding those notices that do not pertain to any part of the Derivative Works; and

If the Work includes a "NOTICE" text file as part of its distribution, then any Derivative Works that You distribute must include a readable copy of the attribution notices contained within such NOTICE file, excluding those notices that do not pertain to any part of the Derivative Works, in at least one of the following places: within a NOTICE text file distributed as part of the Derivative Works; within the Source form or documentation, if provided along with the Derivative Works; or, within a display generated by the Derivative Works, if and wherever such third-party notices normally appear. The contents of the NOTICE file are for informational purposes only and do not modify the License. You may add Your own attribution notices within Derivative Works that You distribute, alongside or as an addendum to the NOTICE text from the Work, provided that such

additional attribution notices cannot be construed as modifying the License.
You may add Your own copyright statement to Your modifications and may provide additional or different license terms and conditions for use, reproduction, or distribution of Your modifications, or for any such Derivative Works as a whole, provided Your use, reproduction, and distribution of the Work otherwise complies with the conditions stated in this License.

5. Submission of Contributions. Unless You explicitly state otherwise, any Contribution intentionally submitted for inclusion in the Work by You to the Licensor shall be under the terms and conditions of this License, without any additional terms or conditions. Notwithstanding the above, nothing herein shall supersede or modify the terms of any separate license agreement you may have executed with Licensor regarding such Contributions.

6. Trademarks. This License does not grant permission to use the trade names, trademarks, service marks, or product names of the Licensor, except as required for reasonable and customary use in describing the origin of the Work and reproducing the content of the NOTICE file.

7. Disclaimer of Warranty. Unless required by applicable law or agreed to in writing, Licensor provides the Work (and each Contributor provides its Contributions) on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied, including, without limitation, any warranties or conditions of TITLE, NON-INFRINGEMENT, MERCHANTABILITY, or FITNESS FOR A PARTICULAR PURPOSE. You are solely responsible for determining the appropriateness of using or redistributing the Work and assume any risks associated with Your exercise of permissions under this License.

8. Limitation of Liability. In no event and under no legal theory, whether in tort (including negligence), contract, or otherwise, unless required by applicable law (such as deliberate and grossly negligent acts) or agreed to in writing, shall any Contributor be liable to You for damages, including any direct, indirect, special, incidental, or consequential damages of any character arising as a result of this License or out of the use or inability to use the Work (including but not limited to damages for loss of goodwill, work stoppage, computer failure or malfunction, or any and all other commercial damages or losses), even if such Contributor has been advised of the possibility of such damages.

9. Accepting Warranty or Additional Liability. While redistributing the Work or Derivative Works thereof, You may choose to offer, and charge a fee for, acceptance of support, warranty, indemnity, or other liability obligations and/or rights consistent with this License. However, in accepting such obligations, You may act only on Your own behalf and on Your sole responsibility, not on behalf of any other Contributor, and only if You agree to indemnify, defend, and hold each Contributor harmless for any liability incurred by, or claims asserted against, such Contributor by reason of your accepting any such warranty or additional liability.

END OF TERMS AND CONDITIONS

>
APPENDIX: How to apply the Apache License to your work
To apply the Apache License to your work, attach the following boilerplate notice, with the fields enclosed by brackets "[]" replaced with your own identifying information. (Don't include the brackets!) The text should be enclosed in the appropriate comment syntax for the file format. We also recommend that a file or class name and description of purpose be included on the same "printed page" as the copyright notice for easier identification within third-party archives.

Copyright [yyyy] [name of copyright owner] Licensed under the Apache License, Version 2.0 (the "License"); you may not use this file except in compliance with the License. You may obtain a copy of the License at http://www.apache.org/licenses/LICENSE-2.0 Unless required by applicable law or agreed to in writing, software distributed under the License is distributed on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied. See the License for the specific language governing permissions and limitations under the License.

- Microsoft Public License (Ms-PL)

Microsoft Public License (Ms-PL)

This license governs use of the accompanying software. If you use the software, you accept this license. If you do not accept the license, do not use the software.

1. Definitions

The terms "reproduce," "reproduction," "derivative works," and "distribution" have the same meaning here as under U.S. copyright law.

A "contribution" is the original software, or any additions or changes to the software.

A "contributor" is any person that distributes its contribution under this license.

"Licensed patents" are a contributor's patent claims that read directly on its contribution.

2. Grant of Rights

A. Copyright Grant- Subject to the terms of this license, including the license conditions and limitations in section 3, each contributor grants you a non-exclusive, worldwide, royalty-free copyright license to reproduce its contribution, prepare derivative works of its contribution, and distribute its contribution or any derivative works that you create.

B. Patent Grant- Subject to the terms of this license, including the license conditions and limitations in section 3, each contributor grants you a non-exclusive, worldwide, royalty-free license under its licensed patents to make, have made, use, sell, offer for sale, import, and/or otherwise dispose of its contribution in the software or derivative works of the contribution in the software.

3. Conditions and Limitations

A. No Trademark License- This license does not grant you rights to use any contributors' name, logo, or trademarks.

B. If you bring a patent claim against any contributor over patents that you claim are infringed by the software, your patent license from such contributor to the software ends automatically.

C. If you distribute any portion of the software, you must retain all copyright, patent, trademark, and attribution notices that are present in the software.

D. If you distribute any portion of the software in source code form, you may do so only under this license by including a complete copy of this license with your distribution. If you distribute any portion of the software in compiled or object code form, you may only do so under a license that complies with this license.

E. The software is licensed "as-is." You bear the risk of using it. The contributors give no express warranties, guarantees or conditions. You may have additional consumer rights under your local laws which this license cannot change. To the extent permitted under your local laws, the contributors exclude the implied warranties of merchantability, fitness for a particular purpose and non-infringement.

-jaxen-license

Copyright 2003 ©The Werken Company. All Rights Reserved.

Redistribution and use of this software and associated documentation ("Software"), with or without modification, are permitted provided that the following conditions are met:

1. Redistributions of source code must retain copyright statements and notices. Redistributions must also contain a copy of this document.

2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the

following disclaimer in the documentation and/or other materials provided with the distribution.

3. The name "jaxen" must not be used to endorse or promote products derived from this Software without prior written permission of The Werken Company. For written permission, please contact bob@werken.com.

4. Products derived from this Software may not be called "jaxen" nor may "jaxen" appear in their names without prior written permission of The Werken Company. "jaxen" is a registered trademark of The Werken Company.

5. Due credit should be given to The Werken Company. (http://jaxen.werken.com/).

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

-com.oreilly.servlet_license

Copyright © 2001-2009 by Jason Hunter, jhunter_AT_servlets.com.
All rights reserved.
The source code, object code, and documentation in the com.oreilly.servlet package is copyright and owned by Jason Hunter.

ON-SITE USE RIGHTS

Permission is granted to use the com.oreilly.servlet.* packages in the development of any non-commercial project. For this use you are granted a non-exclusive, non-transferable limited license at no cost.

For a commercial project, permission is granted to use the com.oreilly.servlet.* packages provided that every person on the development team for that project owns a copy of the book Java Servlet Programming (O'Reilly) in its most recent edition. The most recent edition is currently the 2nd Edition, available in association with Amazon.com at http://www.amazon.com/exec/obidos/ASIN/0596000405/jasonhunter.

Other (sometimes cheaper) license terms are available upon request; please write to jhunter_AT_servlets.com for more information.

REDISTRIBUTION RIGHTS

Commercial redistribution rights of the com.oreilly.servlet.* packages are available by writing jhunter_AT_servlets.com.

Non-commercial redistribution is permitted provided that:

1. You redistribute the package in object code form only (as Java .class files or a .jar file containing the .class files) and only as part of a product that uses the classes as part of its primary functionality.

2. The product containing the package is non-commercial in nature.

3. The public interface to the classes in the package, and the public interface to any classes with similar functionality, is hidden from end users when engaged in normal use of the product.

4. The distribution is not part of a software development kit, operating system, other library, or a development tool without written permission from the copyright holder.

5. The distribution includes copyright notice as follows: "The source code, object code, and documentation in the com.oreilly.servlet package is copyright and owned by Jason Hunter." in the documentation and/or other materials provided with the distribution.

6. You reproduce the above copyright notice, this list of conditions, and the following disclaimer in the documentation and/or other materials provided with the distribution.

7. Licensor retains title to and ownership of the Software and all enhancements, modifications, and updates to the Software.

Note that the com.oreilly.servlet package is provided "as is" and the author will not be liable for any damages suffered as a result of your use. Furthermore, you understand the package comes without any technical support.

You can always find the latest version of the com.oreilly.servlet package at http://www.servlets.com.

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

Thanks,
Jason Hunter
jhunter_AT_servlets.com

License- Common Development and Distribution License (CDDL-1.0)

Further resources on CDDL-1.0

COMMON DEVELOPMENT AND DISTRIBUTION LICENSE Version 1.0 (CDDL-1.0) (text)

1. Definitions.

1.1. Contributor means each individual or entity that creates or contributes to the creation of Modifications.

1.2. Contributor Version means the combination of the Original Software, prior Modifications used by a Contributor (if any), and the Modifications made by that particular Contributor.

1.3. Covered Software means (a) the Original Software, or (b) Modifications, or (c) the combination of files containing Original Software with files containing Modifications, in each case including portions thereof.

1.4. Executable means the Covered Software in any form other than Source Code.

1.5. Initial Developer means the individual or entity that first makes Original Software available under this License.

1.6. Larger Work means a work which combines Covered Software or portions thereof with code not governed by the terms of this License.

1.7. License means this document.

1.8. Licensable means having the right to grant, to the maximum extent possible, whether at the time of the initial grant or subsequently acquired, any and all of the rights conveyed herein.

1.9. Modifications means the Source Code and Executable form of any of the following:

A. Any file that results from an addition to, deletion from or modification of the contents of a file containing Original Software or previous Modifications;

B. Any new file that contains any part of the Original Software or previous Modification; or

C. Any new file that is contributed or otherwise made available under the terms of this License.

1.10. Original Software means the Source Code and Executable form of computer software code that is originally released under this License.

1.11. Patent Claims means any patent claim(s), now owned or hereafter acquired, including without limitation, method, process, and apparatus claims, in any patent Licensable by grantor.

1.12. Source Code means (a) the common form of computer software code in which modifications are made and (b) associated documentation included in or with such code.

1.13. You (or Your) means an individual or a legal entity exercising rights under, and complying with all of the terms of, this License. For legal entities, You includes any entity which controls, is controlled by, or is under common control with You. For purposes of this definition, control means (a) the power, direct or indirect, to cause the direction or management of such entity, whether by contract or otherwise, or (b) ownership of more than fifty percent (50%) of the outstanding shares or beneficial ownership of such entity.

2. License Grants.

2.1. The Initial Developer Grant.

Conditioned upon Your compliance with Section 3.1 below and subject to third party intellectual property claims, the Initial Developer hereby grants You a world-wide, royalty-free, non-exclusive license:

(a) under intellectual property rights (other than patent or trademark) Licensable by Initial Developer, to use, reproduce, modify, display, perform, sublicense and distribute the Original Software (or portions thereof), with or without Modifications, and/or as part of a Larger Work; and

(b) under Patent Claims infringed by the making, using or selling of Original Software, to make, have made, use, practice, sell, and offer for sale, and/or otherwise dispose of the Original Software (or portions thereof).

(c) The licenses granted in Sections 2.1(a) and (b) are effective on the date Initial Developer first distributes or otherwise makes the Original Software available to a third party under the terms of this License.

(d) Notwithstanding Section 2.1(b) above, no patent license is granted: (1) for code that You delete from the Original Software, or (2) for infringements caused by: (i) the modification of the Original Software, or (ii) the combination of the Original Software with other software or devices.

2.2. Contributor Grant.

Conditioned upon Your compliance with Section 3.1 below and subject to third party intellectual property claims, each Contributor hereby grants You a world-wide, royalty-free, non-exclusive license:

(a) under intellectual property rights (other than patent or trademark) Licensable by Contributor to use, reproduce, modify, display, perform, sublicense and distribute the Modifications created by such Contributor (or portions thereof), either on an unmodified basis, with other Modifications, as Covered Software and/or as part of a Larger Work; and

(b) under Patent Claims infringed by the making, using, or selling of Modifications made by that Contributor either alone and/or in combination with its Contributor Version (or portions of such combination), to make, use, sell, offer for sale, have made, and/or otherwise dispose of: (1) Modifications made by that Contributor (or portions thereof); and (2) the combination

of Modifications made by that Contributor with its Contributor Version (or portions of such combination).

(c) The licenses granted in Sections 2.2(a) and 2.2(b) are effective on the date Contributor first distributes or otherwise makes the Modifications available to a third party.

(d) Notwithstanding Section 2.2(b) above, no patent license is granted: (1) for any code that Contributor has deleted from the Contributor Version; (2) for infringements caused by: (i) third party modifications of Contributor Version, or (ii) the combination of Modifications made by that Contributor with other software (except as part of the Contributor Version) or other devices; or (3) under Patent Claims infringed by Covered Software in the absence of Modifications made by that Contributor.

3. Distribution Obligations.

3.1. Availability of Source Code.

Any Covered Software that You distribute or otherwise make available in Executable form must also be made available in Source Code form and that Source Code form must be distributed only under the terms of this License. You must include a copy of this License with every copy of the Source Code form of the Covered Software You distribute or otherwise make available. You must inform recipients of any such Covered Software in Executable form as to how they can obtain such Covered Software in Source Code form in a reasonable manner on or through a medium customarily used for software exchange.

3.2. Modifications.

The Modifications that You create or to which You contribute are governed by the terms of this License. You represent that You believe Your Modifications are Your original creation(s) and/or You have sufficient rights to grant the rights conveyed by this License.

3.3. Required Notices.

You must include a notice in each of Your Modifications that identifies You as the Contributor of the Modification. You may not remove or alter any copyright, patent or trademark notices contained within the Covered Software, or any notices of licensing or any descriptive text giving attribution to any Contributor or the Initial Developer.

3.4. Application of Additional Terms.

You may not offer or impose any terms on any Covered Software in Source Code form that alters or restricts the applicable version of this License or the recipients rights hereunder. You may choose to offer, and to charge a fee for, warranty, support, indemnity or liability obligations to one or more recipients of Covered Software. However, you may do so only on Your own behalf, and not on behalf of the Initial Developer or any Contributor. You must make it absolutely clear that any such warranty, support, indemnity or liability obligation is offered by You alone, and You hereby agree to indemnify the Initial Developer and every Contributor for any liability incurred by the Initial Developer or such Contributor as a result of warranty, support, indemnity or liability terms You offer.

3.5. Distribution of Executable Versions.

You may distribute the Executable form of the Covered Software under the terms of this License or under the terms of a license of Your choice, which may contain terms different from this License, provided that You are in compliance with the terms of this License and that the license for the Executable form does not attempt to limit or alter the recipients rights in the Source Code form from the rights set forth in this License. If You distribute the Covered Software in Executable form under a different license, You must make it absolutely clear that any terms which differ from this License are offered by You alone, not by the Initial Developer or Contributor. You hereby agree to indemnify the Initial Developer and every Contributor for any liability incurred by the Initial Developer or such Contributor as a result of any such terms You offer.

3.6. Larger Works.

You may create a Larger Work by combining Covered Software with other code not governed by the terms of this License and distribute the Larger Work as a single product. In such a case, You must make sure the requirements of this License are fulfilled for the Covered Software.

4. Versions of the License.

4.1. New Versions.

Sun Microsystems, Inc. is the initial license steward and may publish revised and/or new versions of this License from time to time. Each version will be given a distinguishing version number. Except as provided in Section 4.3, no one other than the license steward has the right to modify this License.

4.2. Effect of New Versions.

You may always continue to use, distribute or otherwise make the Covered Software available under the terms of the version of the License under which You originally received the Covered Software. If the Initial Developer includes a notice in the Original Software prohibiting it from being distributed or otherwise made available under any subsequent version of the License, You must distribute and make the Covered Software available under the terms of the version of the License under which You originally received the Covered Software. Otherwise, You may also choose to use, distribute or otherwise make the Covered Software available under the terms of any subsequent version of the License published by the license steward.

4.3. Modified Versions.

When You are an Initial Developer and You want to create a new license for Your Original Software, You may create and use a modified version of this License if You: (a) rename the license and remove any references to the name of the license steward (except to note that the license differs from this License); and (b) otherwise make it clear that the license contains terms which differ from this License.

5. DISCLAIMER OF WARRANTY.

COVERED SOFTWARE IS PROVIDED UNDER THIS LICENSE ON AN AS IS BASIS, WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, WARRANTIES THAT THE COVERED SOFTWARE IS FREE OF DEFECTS, MERCHANTABLE, FIT FOR A PARTICULAR PURPOSE OR NON-INFRINGING. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE COVERED SOFTWARE IS WITH YOU. SHOULD ANY COVERED SOFTWARE PROVE DEFECTIVE IN ANY RESPECT, YOU (NOT THE INITIAL DEVELOPER OR ANY OTHER CONTRIBUTOR) ASSUME THE COST OF ANY NECESSARY SERVICING, REPAIR OR CORRECTION. THIS DISCLAIMER OF WARRANTY CONSTITUTES AN ESSENTIAL PART OF THIS LICENSE. NO USE OF ANY COVERED SOFTWARE IS AUTHORIZED HEREUNDER EXCEPT UNDER THIS DISCLAIMER.

6. TERMINATION.

6.1. This License and the rights granted hereunder will terminate automatically if You fail to comply with terms herein and fail to cure such breach within 30 days of becoming aware of the breach. Provisions which, by their nature, must remain in effect beyond the termination of this License shall survive.

6.2. If You assert a patent infringement claim (excluding declaratory judgment actions) against Initial Developer or a Contributor (the Initial Developer or Contributor against whom You assert such claim is referred to as Participant) alleging that the Participant Software (meaning the Contributor Version where the Participant is a Contributor or the Original Software where the Participant is the Initial Developer) directly or indirectly infringes any patent, then any and all rights granted directly or indirectly to You by such Participant, the Initial Developer (if the Initial Developer is not the Participant) and all Contributors under Sections 2.1 and/or 2.2 of this License shall, upon 60 days notice from Participant terminate prospectively and automatically at the expiration of such 60 day notice period, unless if

within such 60 day period You withdraw Your claim with respect to the Participant Software against such Participant either unilaterally or pursuant to a written agreement with Participant.

6.3. In the event of termination under Sections 6.1 or 6.2 above, all end user licenses that have been validly granted by You or any distributor hereunder prior to termination (excluding licenses granted to You by any distributor) shall survive termination.

7. LIMITATION OF LIABILITY.

UNDER NO CIRCUMSTANCES AND UNDER NO LEGAL THEORY, WHETHER TORT (INCLUDING NEGLIGENCE), CONTRACT, OR OTHERWISE, SHALL YOU, THE INITIAL DEVELOPER, ANY OTHER CONTRIBUTOR, OR ANY DISTRIBUTOR OF COVERED SOFTWARE, OR ANY SUPPLIER OF ANY OF SUCH PARTIES, BE LIABLE TO ANY PERSON FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OF ANY CHARACTER INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOST PROFITS, LOSS OF GOODWILL, WORK STOPPAGE, COMPUTER FAILURE OR MALFUNCTION, OR ANY AND ALL OTHER COMMERCIAL DAMAGES OR LOSSES, EVEN IF SUCH PARTY SHALL HAVE BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. THIS LIMITATION OF LIABILITY SHALL NOT APPLY TO LIABILITY FOR DEATH OR PERSONAL INJURY RESULTING FROM SUCH PARTYS NEGLIGENCE TO THE EXTENT APPLICABLE LAW PROHIBITS SUCH LIMITATION. SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THIS EXCLUSION AND LIMITATION MAY NOT APPLY TO YOU.

8. U.S. GOVERNMENT END USERS.

The Covered Software is a commercial item, as that term is defined in 48 C.F.R. 2.101 (Oct. 1995), consisting of commercial computer software (as that term is defined at 48 C.F.R. 252.227-7014(a)(1)) and commercial computer software documentation as such terms are used in 48 C.F.R. 12.212 (Sept. 1995). Consistent with 48 C.F.R. 12.212 and 48 C.F.R. 227.7202-1 through 227.7202-4 (June 1995), all U.S. Government End Users acquire Covered Software with only those rights set forth herein. This U.S. Government Rights clause is in lieu of, and supersedes, any other FAR, DFAR, or other clause or provision that addresses Government rights in computer software under this License.

9. MISCELLANEOUS.

This License represents the complete agreement concerning subject matter hereof. If any provision of this License is held to be unenforceable, such provision shall be reformed only to the extent necessary to make it enforceable. This License shall be governed by the law of the jurisdiction specified in a notice contained within the Original Software (except to the extent applicable law, if any, provides otherwise), excluding such jurisdictions conflict-of-law provisions. Any litigation relating to this License shall be subject to the jurisdiction of the courts located in the jurisdiction and venue specified in a notice contained within the Original Software, with the losing party responsible for costs, including, without limitation, court costs and reasonable attorneys fees and expenses. The application of the United Nations Convention on Contracts for the International Sale of Goods is expressly excluded. Any law or regulation which provides that the language of a contract shall be construed against the drafter shall not apply to this License. You agree that You alone are responsible for compliance with the United States export administration regulations (and the export control laws and regulation of any other countries) when You use, distribute or otherwise make available any Covered Software.

10. RESPONSIBILITY FOR CLAIMS.

As between Initial Developer and the Contributors, each party is responsible for claims and damages arising, directly or indirectly, out of its utilization of rights under this License and You agree to work with Initial Developer and Contributors to distribute such responsibility on an equitable basis. Nothing herein is intended or shall be deemed to constitute any admission of liability.

- liberal license

libffi - Copyright (c) 1996-2014 Anthony Green, Red Hat, Inc and others.

See source files for details.

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the ``Software''), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED ``AS IS'', WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

Ingersoll Rand (NYSE:IR) advances the quality of life by creating comfortable, sustainable and efficient environments. Our people and our family of brands—including Club Car®, Ingersoll Rand®, Thermo King® and Trane®—work together to enhance the quality and comfort of air in homes and buildings; transport and protect food and perishables; and increase industrial productivity and efficiency. We are a global business committed to a world of sustainable progress and enduring results.

ingersollrand.com

VRF-SVX35B-EN 01 June 2017
Supersedes VRF-SVX35A-EN (01 Mar 2014)