



D-checker User Manual

Ver. 3.7.0.4

DAIKIN INDUSTRIES, LTD.

Global Service Department

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Caution

This software is designed to be used by Daikin authorized service engineers. Use by any other party is prohibited.

- D-checker is a software application used to record and monitor operation data from an air conditioner to which it has been connected with a cable. Be sure to read the User Manual before use.
- The software can monitor the status of sensors (temperature and pressure) and actuators (compressors, solenoid valves, etc.) on air conditioners.
- The data supported by the software vary by model.
- D-checker collects air conditioner operation data via control PCB connectors on outdoor units. Monitoring and recording of data from multiple outdoor unit circuits is not supported. The following table compares D-checker with the Type4 Checker:

	D-checker	Type4 Checker
Connection method	PCB connection	D3-NET connection
Maximum number of connections per record	1 circuit (cable connection)	D3-NET: All devices on same D3-NET
Recorded data	Sensor data, actuator status, other	
Extra sensors	Not supported	Not supported
Centralized control	Not supported	Setpoints can be changed, and indoor units can be turned on and off.

Supported products	D-checker	Type4 Checker
SkyAir	Models manufactured in 2003 and later*	Models manufactured in 1998 and later
Split	Models manufactured in 2002 and later*	Some models manufactured from 1992 to 1995
Chiller	Not supported	Some models manufactured in 2000 and later
VRV**	Models manufactured in 2003 and later*	Models manufactured in 1990 and later
Altherma LT:BB,CA	Indoor unit models (2010 and later)	Not supported
Altherma HT	Not supported	AB models (2010 and later)
Altherma Flex	Not supported	All models

* Exceptions may apply (even though applicable to this condition, some models do not support D-checker protocol). VRVII M series or older models are not supported.

** Maximum supported number of VRV indoor unit data is 59.

You will need the following equipment:

1. A computer that satisfies the following requirements:

Operating system	WindowsXP, Vista, 7, 8, 8.1* ¹ , 10* ²	
RS-232C	D-sub 9-pin interface (faster than 9,600 bps)	
Other	.NET framework 4 or later* ³	
	Windows 8, 8.1, 10	Already installed
	Windows 7 Windows Vista	.NET Framework 4.5.1 is recommended.
	Windows XP	Only .NET Framework 4 can be installed.

*1 The software has only been confirmed to work with 32-bit version.

*2 The software has only been confirmed to work with 64-bit version.

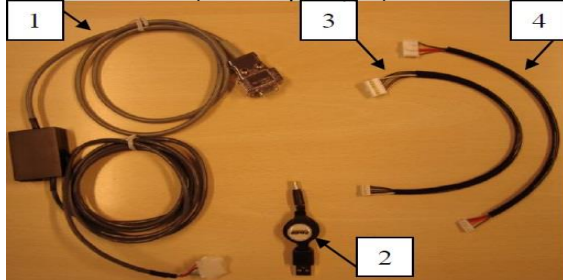
*3 If you do not have installation privileges, install from a user account with Administrator privileges.

Checking the .NET Framework version

Check the Microsoft .NET Framework version from the list of installed programs under Control Panel → (Programs →) Programs and Functions (on Windows XP, under Control Panel → Add or Remove Programs).

2. Connection devices

D-checker cable (D-sub9 pin type)



<Equipment>

- 1: Cable
- 2: USB power supply for cable
- 3: Connection harness 1 (for split)
- 4: Connection harness 2 (for SkyAir)

*Additional connecting harness is required for Altherma LT (BB type) indoor units (CA type or later models do not need for this).



D-checker cable (USB type)



STE-01 (TCP/IP connection)



With STE-01 (service tool expander by Raspberry-Pi platform, you can connect D-checker by TCP/IP connection (Wi-Fi or internet) → please refer to manual for more details

Caution

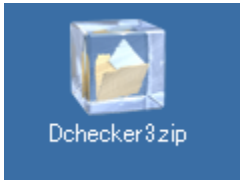
Only use the cable shown above. Use of other cables may cause electric shock or damage to the AC power supply or computer.

1. Installing D-checker

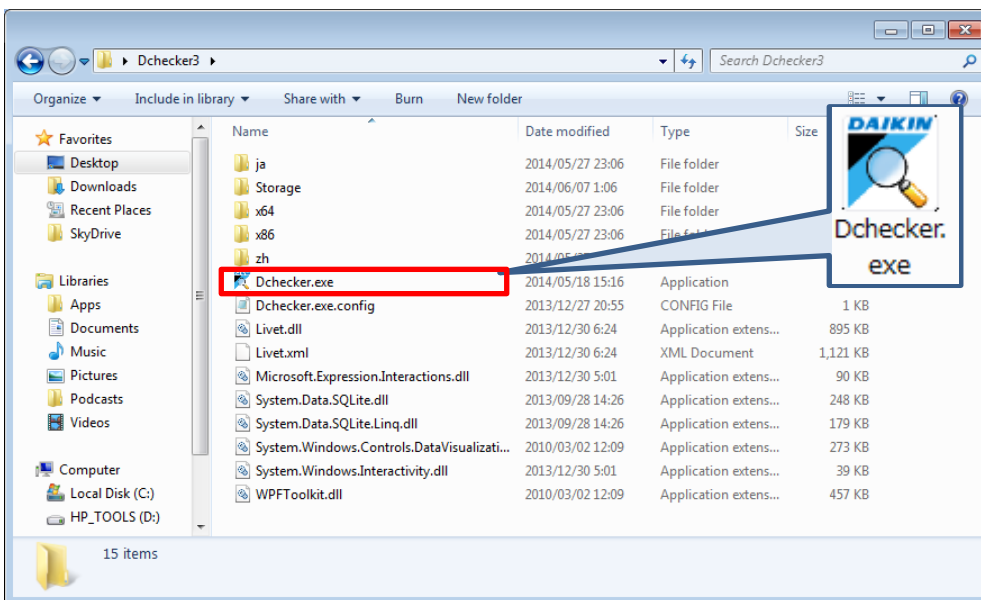
This chapter describes how to install and launch D-checker.

1-1. Installing D-checker

- Unzip the D-checker package into a folder of your choice (for example, on the desktop).

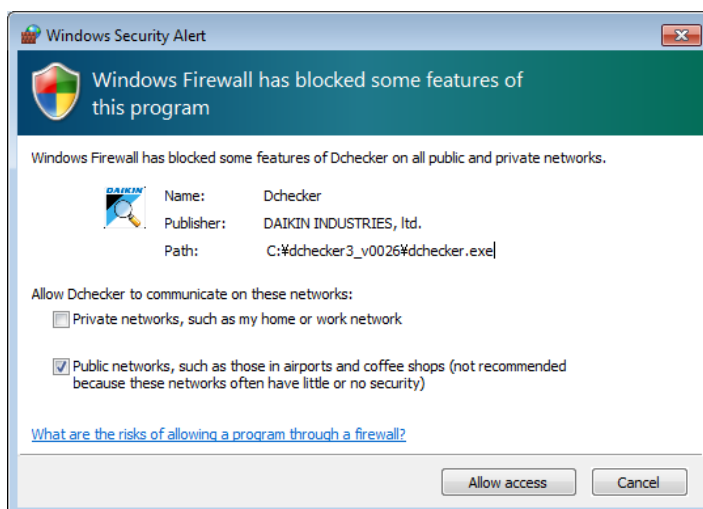


- Double-click D-checker.exe, which can be found in the unzipped folder, to launch D-checker.



- When you launch D-checker for the first time, a firewall settings dialog box will be displayed. You can choose either “Allow access” or “Cancel.”

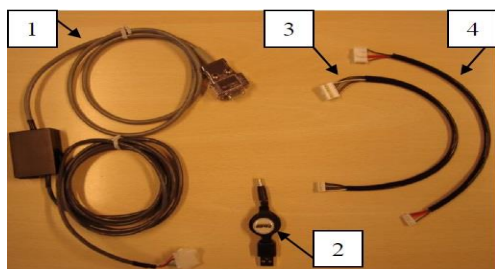
*This dialog box may not be displayed on some computers.



2. Connecting D-checker to the air conditioner

Caution

Split air conditioners have two types of control PCB (isolated and non-isolated). All components on non-isolated PCBs are charged with a high voltage. Be sure to turn the air conditioner off before connecting the cable to the PCB.



<Equipment>

- 1: Cable
- 2: USB power supply for cable
- 3: Connection harness 1 (for split)
- 4: Connection harness 2 (for SkyAir)

*Additional connecting harness is required for Altherma LT (BB type) indoor units (CA type or later models do not need for this).



D-checker cable (USB type)



STE-01 (TCP/IP connection)



With STE-01 (service tool expander by Raspberry-Pi platform, you can connect D-checker by TCP/IP connection (Wi-Fi or internet) → please refer to manual for more details

<Connecting the cable>

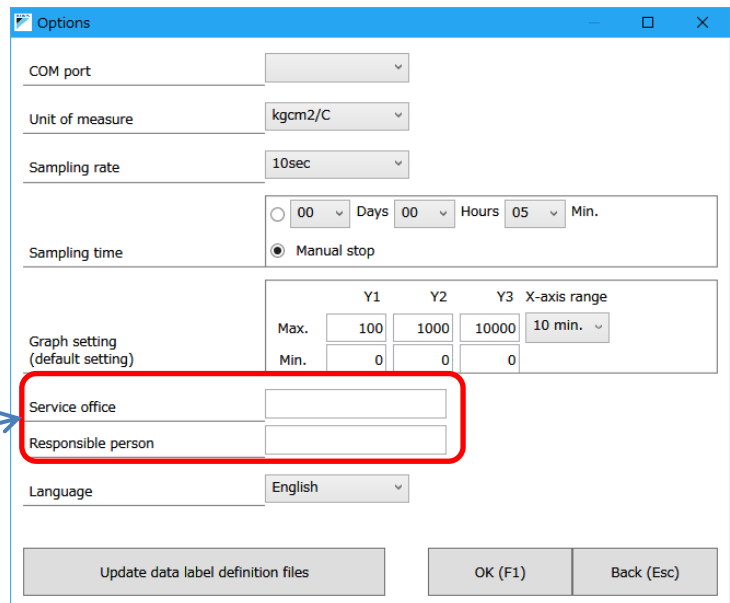
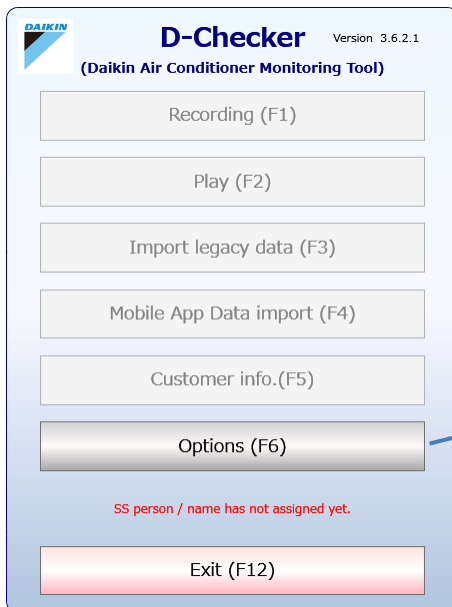
1. Attach the connection harness (3 or 4) to the cable (1) as appropriate for the AC unit's connection type. → In case of USB type, skip to step2
 - SkyAir
Since the cable can be connected to the blue 5-pin connector (CN-IF) on the outdoor unit's control PCB, choose the appropriate connector adapter.
 - Split
The connector varies with the control PCB type (isolated or non-isolated).
 - Altherma LT indoor units (BB type only)
A dedicated cable is required for this type of equipment (see note above).
2. Connect the cable to the computer's serial port.
(If the computer does not have a serial port, use the USB converter.)
→ In case of USB type, connect USB cable (6) between USB type cable (5) and PC and skip to step4
3. Connect the DC connector on the USB power supply (2).
4. Connect the connection harness to the PCB connector.

3. Launching and Exiting D-checker

This chapter describes how to launch and exit D-checker, how to use the menu window, and how to configure options.

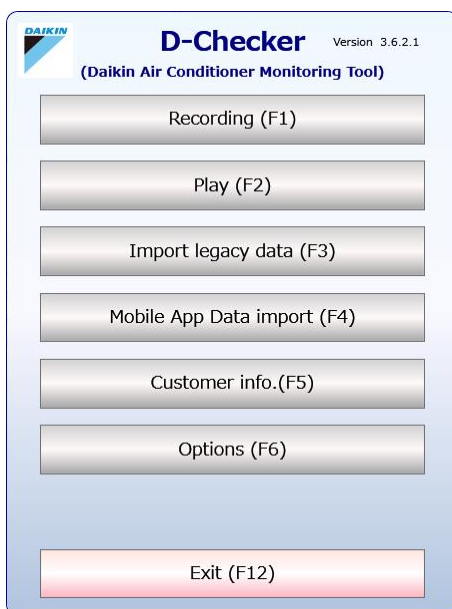
3-1. Launching D-checker for the first time

Available functionality is limited when you launch D-checker for the first time until you enter certain information. Register the service office name and person on the “Options” window. Once you have set this information, you will be able to use the “Recording (F1),” “Play (F2),” “Import legacy data (F3),” “Mobile App Data Import (F4),” and “Customer info. (F5)” functions.



3.2 Menu

This section describes the menu window.



[Recording (F1)]

Records operation data.

(For more information, see “5. Recording operation data.”)

[Play (F2)]

Plays recorded operation data.

(For more information, see “6. Playing operation data.”)

[Import legacy data (F3)]

Imports data gathered with D-checker Ver. 2.18 or earlier.

(For more information, see “8. Importing legacy data.”)

[Mobile App Data Import (F4)]

Imports data gathered with D-checker app for Android or iOS. (For more information, see “9. Importing mobile app data”)

[Customer info. (F5)]

Provides customer-specific operations.

(For more information, see “4. Setting customer information.”)

[Options (F6)]

Configures COM port, units, and other settings.

(For more information, see “3-3. Options.”)

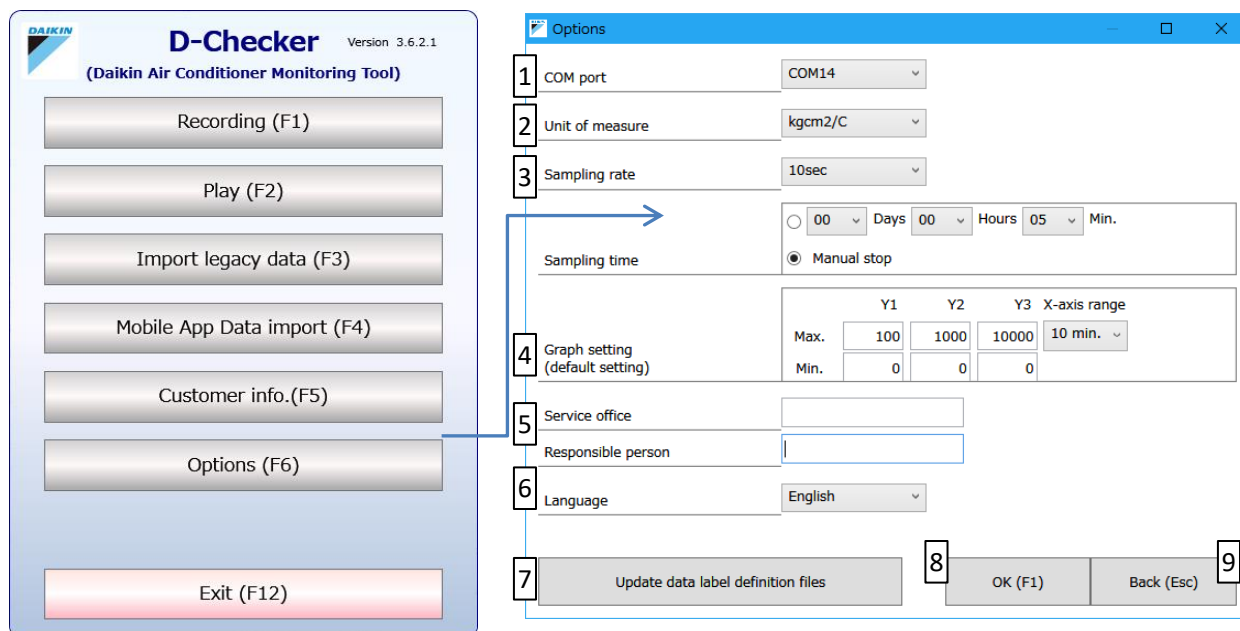
[Exit (F12)]

Exits D-checker.

3. Launching and Exiting D-checker

3-3. Options

Click the “Options (F6)” button to display the “Options” window, which allows you to configure settings needed in order to record operation data and set visual information used when playing data.



1. Set the COM port to use.
(You can choose any currently recognized port.)

NC_RPi	192.168.237.1	NextCheckerRPi
TCP/IP	127.0.0.1	AndroidAP

If connected to STE-011 Wi-Fi access point, select “NC_RPi”. IP address information is automatically obtained from the tool.

If connected to other Wi-Fi (internet), enter IP address of USB modem connected to Raspberry-Pi tool

2. Choose the unit of measure (kgcm/C, MPa/C, bar/C, or psi/F).
3. Choose the sampling rate (5, 10, 20, 30, 60, 120, or 300 sec.).

If you need to automatically stop recording after a certain amount of time has elapsed, set the sampling time.

***If you do not need to automatically stop recording, choose “Manual stop.”**

4. Set the length (in the form of minimum and maximum values) of the Y-axis (which displays analog data values) used on the “Graph view” tab.

Set the range for the X-axis (which displays the time axis range) used on the “Graph view” tab.

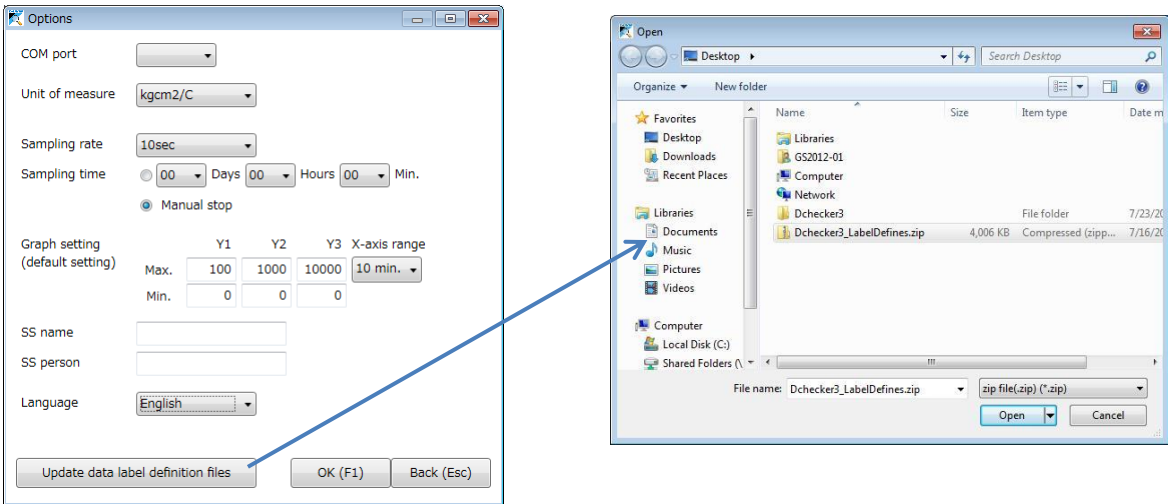
5. Enter the service office name and responsible person.
6. Choose preferred language as the display language.
7. Label definition files are used when importing data. (More details in next page)
8. Click “OK (F1)” to save changes.
9. Click “Back (Esc)” to discard changes.

3. Launching and Exiting D-checker

Update data label definition files

In Options screen, when [Update data label definition files] button is pressed, data label file (zip file) selection window will appear. By locating correct data label file and pressing [Open] button, data label definition files in zip file will be imported.

- Existing data label definition files with same name as imported files will be overwritten by new files.
- Existing data label definition files with different names from imported files will be retained.

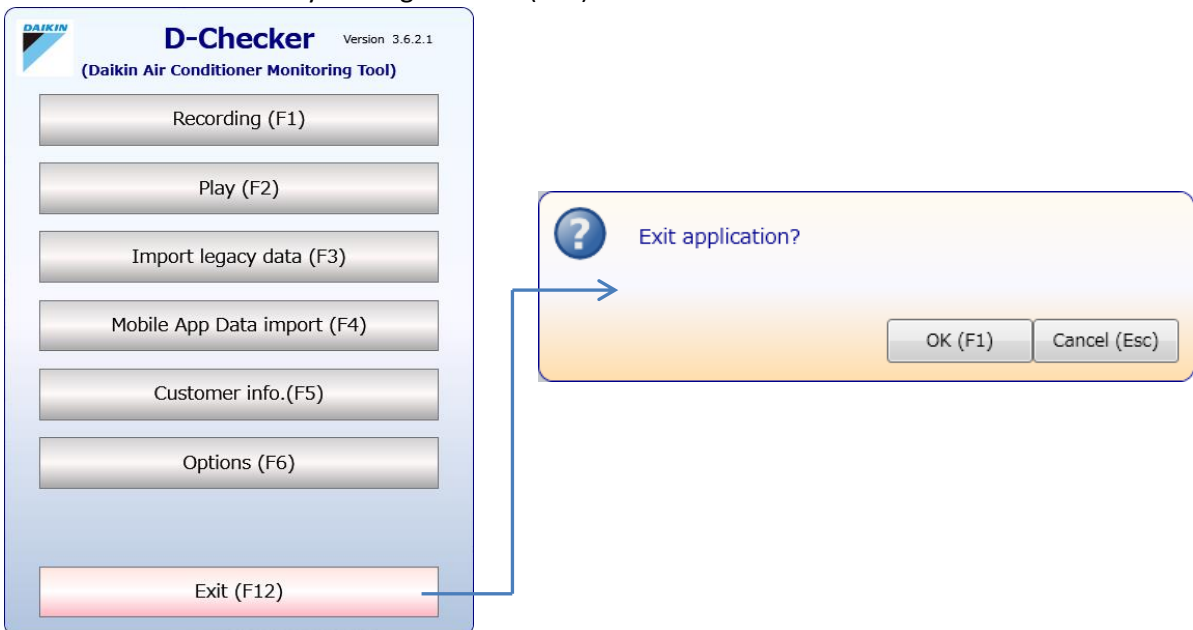


◆ What is data label definition file?

They are external files which lists names (meanings) of data transmit from products. If incorrect data label definition file was selected, incorrect data name could be listed in D-checker screen.

3-4. Exiting D-checker

You can exit D-checker by clicking the “Exit (F12)” button.



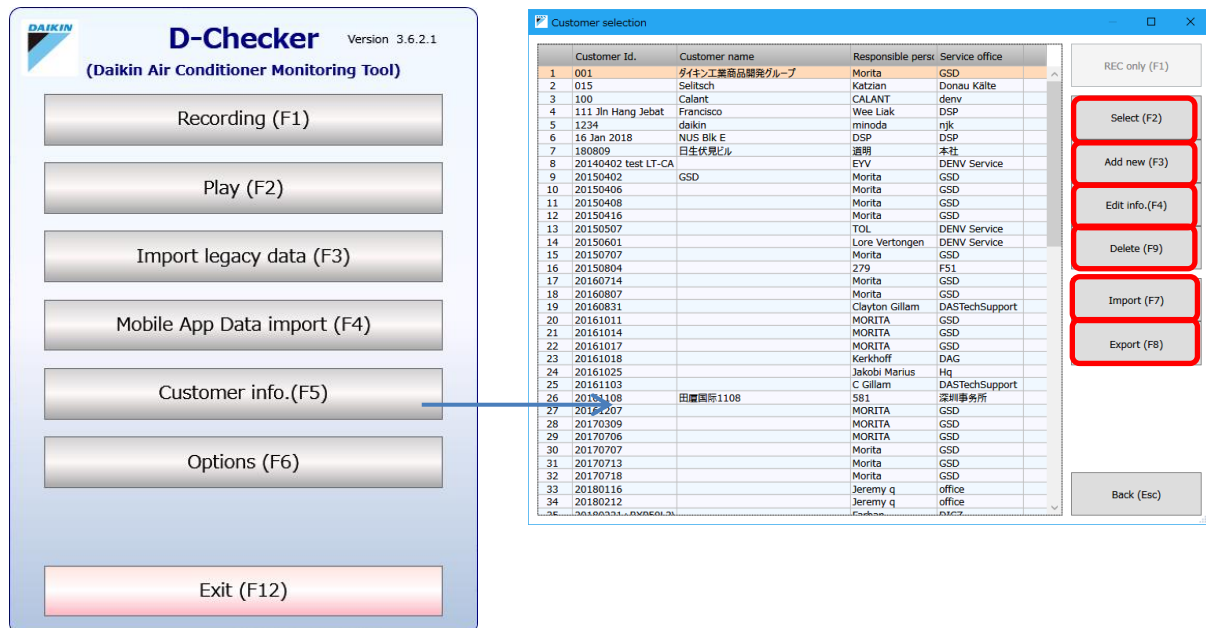
When you exit the application, a confirmation dialog box will be displayed. Click “OK (F1).”

4. Setting customer information

This chapter describes how to set customer information.

4-1. Registering, choosing, editing, deleting, importing, and exporting customer information

Click the “Customer info. (F5)” button to display the “Customer selection” window. This section describes the buttons used to handle customer information.



[Select (F2)]

Uses the customer information that has been selected in the list.

[Add new (F3)]

Registers new customer information.

[Edit info. (F4)]

Allows you to edit the customer information that has been selected in the list.

[Delete (F9)]

Deletes the customer information that has been selected in the list.

***Exercise caution since when customer information is deleted, the network map and recorded data associated with the selected customer will also be deleted.**

[Import (F7)]

Imports operation data recorded by another D-checker and the associated customer information.

***Import function only supports zip files exported by “Export(F8)” button (see 4-6 for details).**

[Export (F8)]

Outputs the recorded operation data and the associated customer information as a ZIP file.

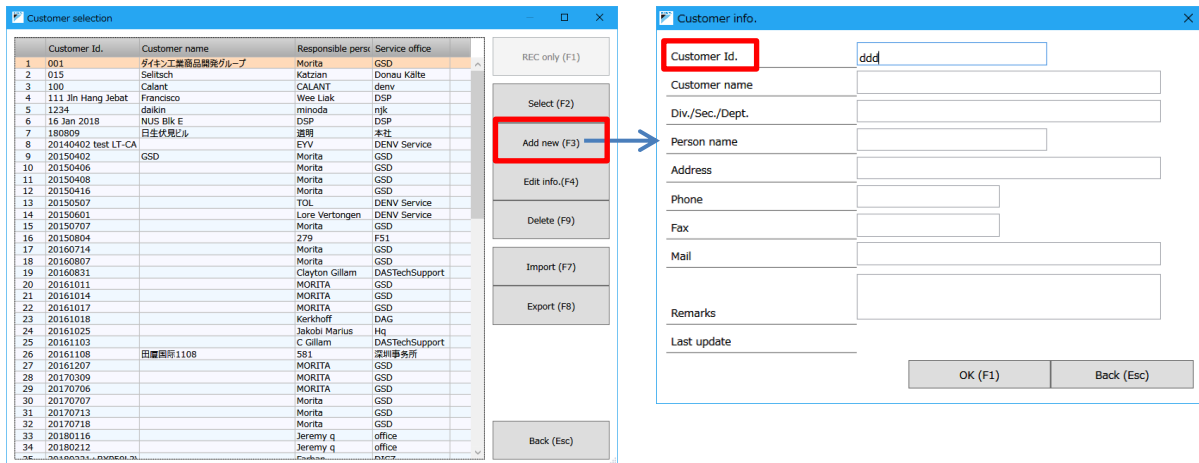
Recommended practice

It is recommended to create a new customer information file for each customer and equipment location. This approach will allow you to manage information appropriately for each customer and to maintain and check model data in an appropriate manner.

4. Setting customer information

4-2. Registering new customer information

Click the “Add new” button on the “Customer selection” window to start the customer information registration process. New customer information can be registered on this window.

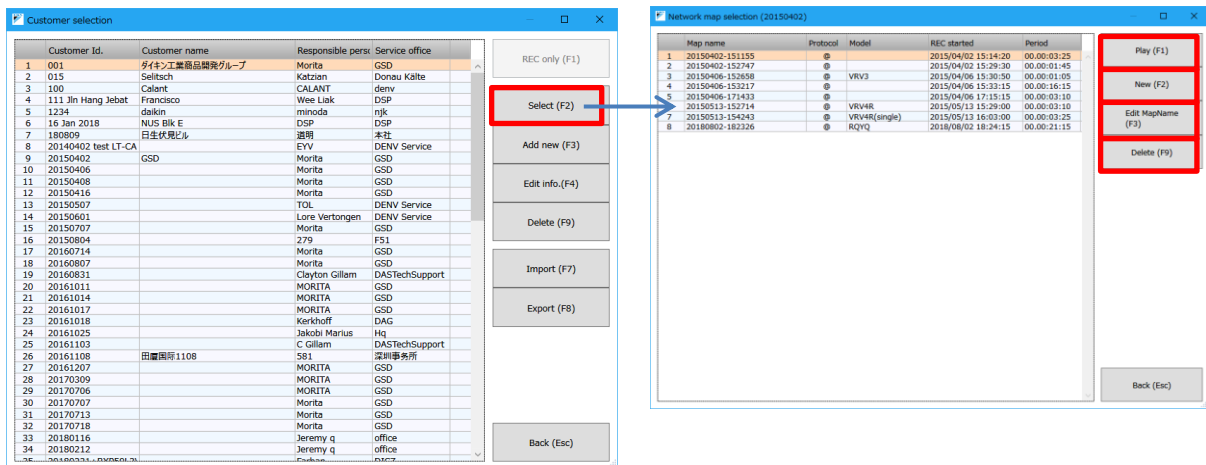


- The customer ID is used to identify customers.
*You must enter a customer ID.
- The customer ID and customer name are shown on the “Customer selection” window.
- Other information is for informational purposes.
- Click “OK (F1)” to register the customer.
- Click “Back (Esc)” to cancel the registration.

4. Setting customer information

4-3. Recording and playing operation data

Click the “Select” button on the “Customer selection” window to open the “Network map selection” window, which allows you to perform the operations described below.



[Play (F1)]

Plays the operation data that has been selected in the list.

[New (F2)]

Registers new equipment information and records data.

[Edit MapName (F3)]

Allows you to edit the equipment information for the operation data that has been selected in the list.

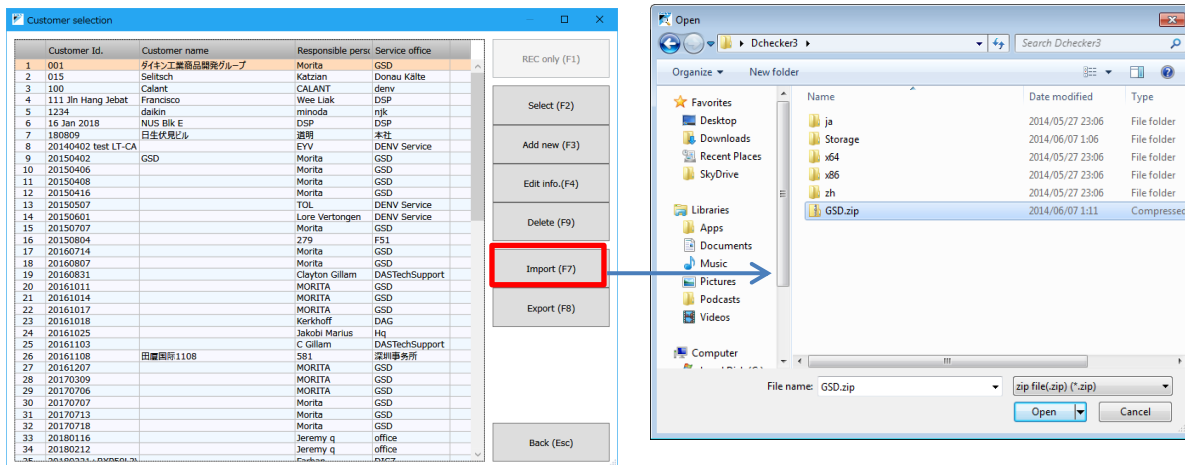
[Delete (F9)]

Deletes the operation data that has been selected in the list.

4. Setting customer information

4-4. Importing customer information

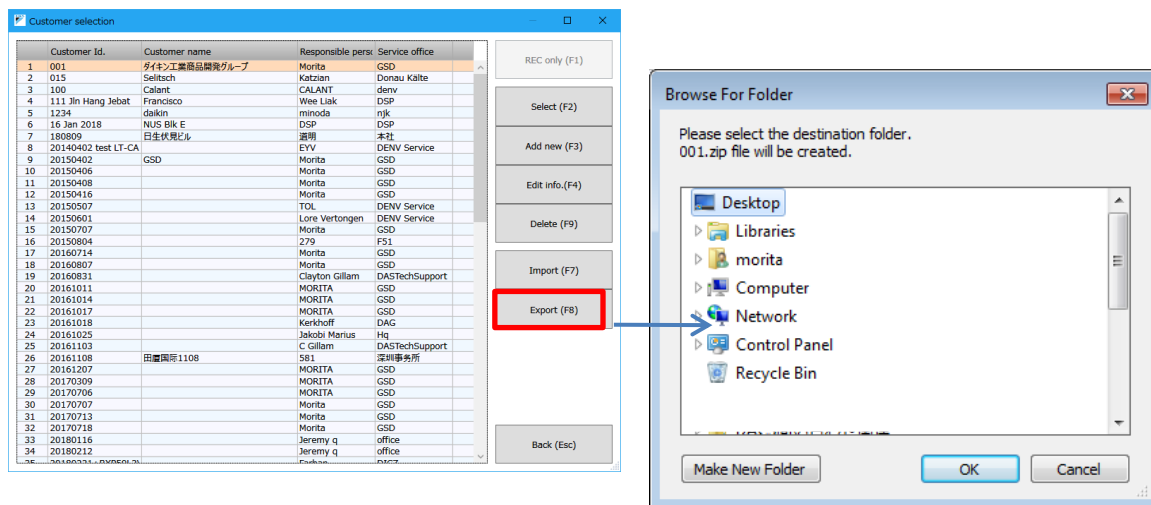
Click the “Import” button on the “Customer selection” window to display the dialog box shown below, which is used to import previously recorded operation data and associated customer information.



- Select a customer information file that has been saved as a ZIP file and click the “Open” button.
- If the information is successfully imported, a list of the customer information will be shown.

4-5. Exporting customer information

Click the “Export” button on the “Customer selection” window to display the dialog box shown below, which is used to output recorded operation data and associated customer information as a ZIP file.

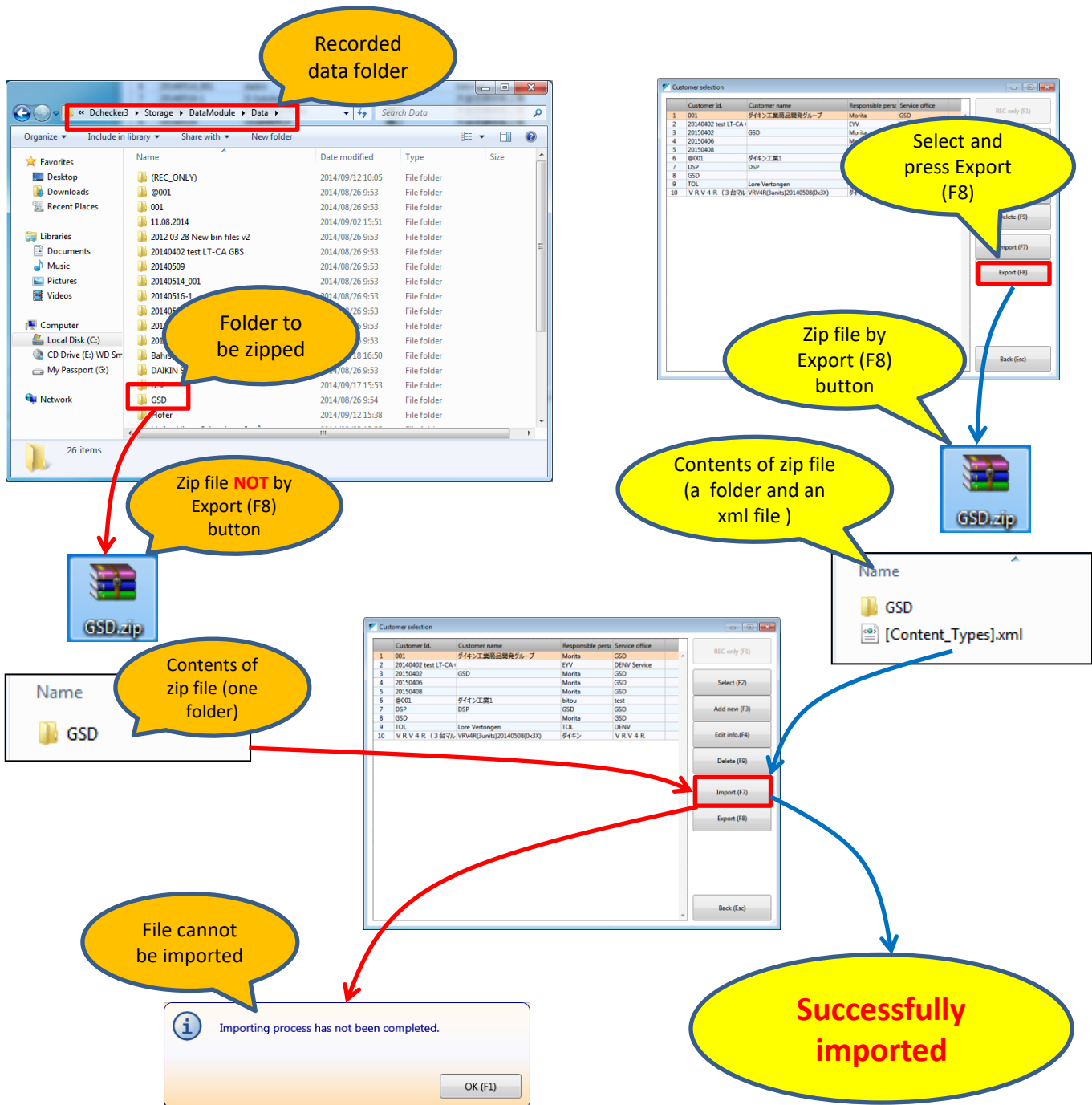


- Select the customer information you wish to output from the list and click the “Export” button.
- When the dialog box is displayed, select the destination folder and click “OK.” (The customer ID will be used as the filename.)

4. Setting customer information

4-6. Caution regarding importing recorded files

Import (F7) button function in "Customer selection" screen only works if you locate compressed (zipped) files **which was made by Export (F8) button function**. If you made zip file directly from saved recordings folder by general file compression software such as Winzip, etc, those zip files cannot be imported by Import (F7) button operation.

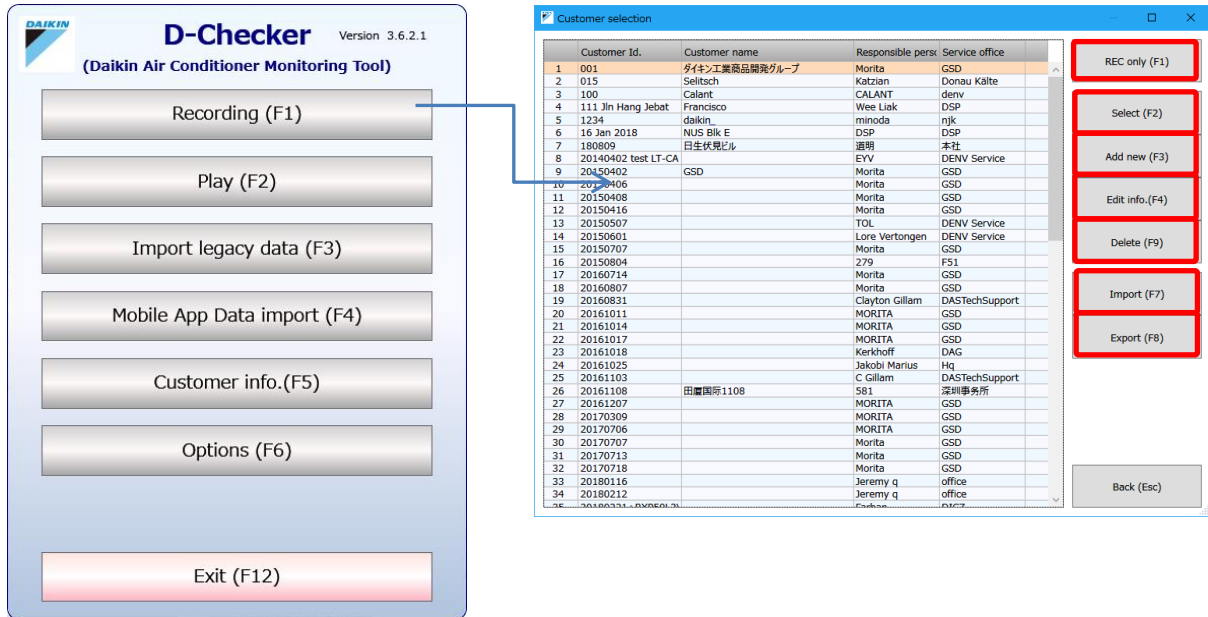


5. Recording operation data

This chapter describes how to record operation data.

5-1. Registering, selecting, editing, deleting, importing, and exporting customer information

Click the “Recording (F1)” button to display the “Customer selection” window. This section describes the functionality provided by each button for recording operation data.



[REC only (F1)]

Records data without using customer information.

[Select (F2)]

Uses the customer information that has been selected in the list.

[Add new (F3)]

Opens the “Customer info.” window.

[Edit info. (F4)]

Allows you to edit the customer information that has been selected in the list of registered customer information.

[Delete (F9)]

Deletes the customer information that has been selected in the list of registered customer information.

***Exercise caution since when customer information is deleted, the network map and recorded data associated with the selected customer will also be deleted.**

[Import (F7)]

Imports operation data recorded by another D-checker and the associated customer information.

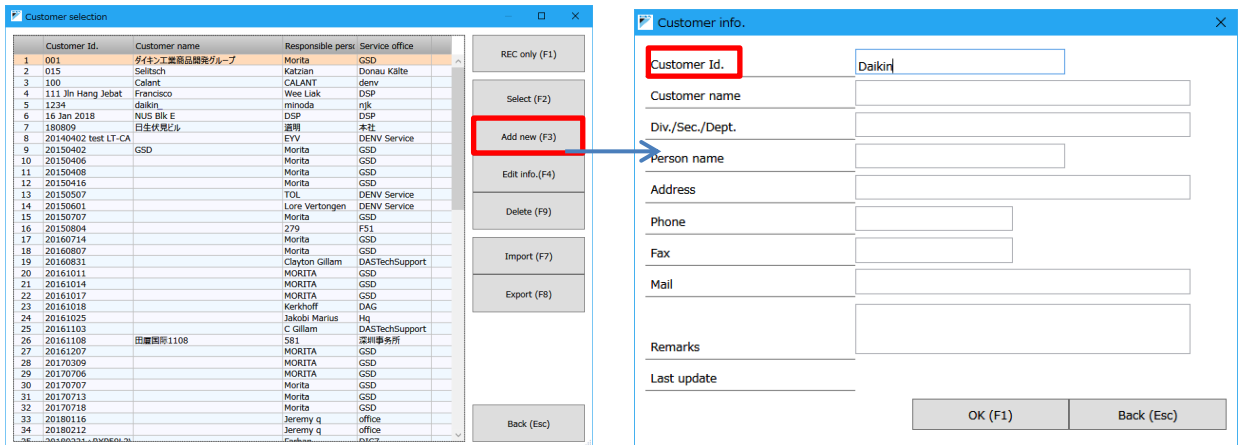
***Import function only supports zip files exported by “Export(F8)” button (see 4-6 for details).**

[Export (F8)]

Outputs the recorded operation data and the associated customer information as a ZIP file.

5-2. Registering new customer information

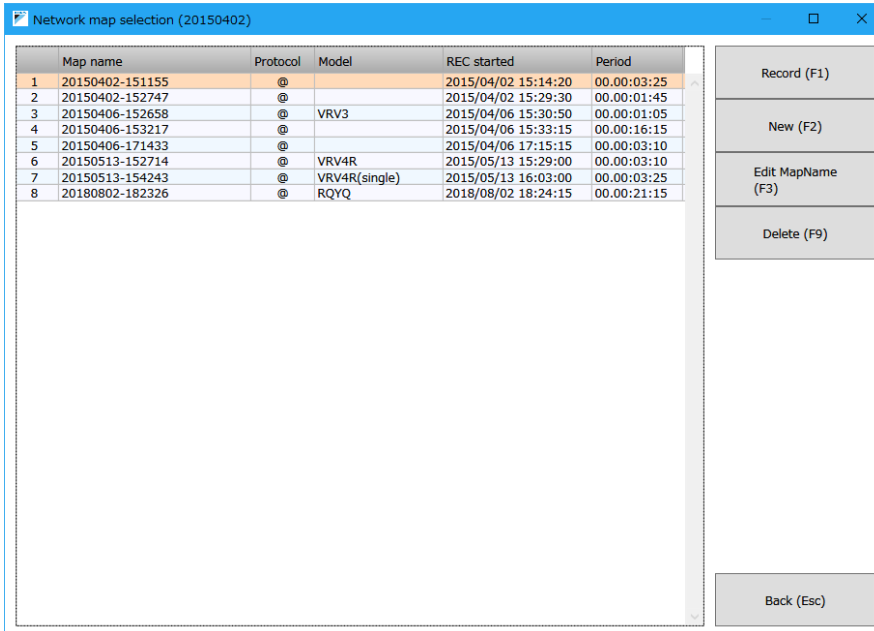
Click the “Add new” button on the “Customer selection” window to start the customer information registration process. New customer information can be registered on this window.



- The customer ID is used to identify customers.
***You must enter a customer ID.**
- The customer ID and customer name are shown on the “Customer selection” window.
- Other information is for informational purposes.
- Click “OK (F1)” to register the customer.
- Click “Back (Esc)” to cancel the registration.

5-3. Configuring equipment information

Select a customer on the “Customer selection” window to display the “Network map selection” window, which allows you to register new equipment information and edit or delete existing equipment information.



The screenshot shows a window titled "Network map selection (20150402)". It contains a table with the following data:

	Map name	Protocol	Model	REC started	Period
1	20150402-151155	@		2015/04/02 15:14:20	00.00:03:25
2	20150402-152747	@		2015/04/02 15:29:30	00.00:01:45
3	20150406-152658	@	VRV3	2015/04/06 15:30:50	00.00:01:05
4	20150406-153217	@		2015/04/06 15:33:15	00.00:16:15
5	20150406-171433	@		2015/04/06 17:15:15	00.00:03:10
6	20150513-152714	@	VRV4R	2015/05/13 15:29:00	00.00:03:10
7	20150513-154243	@	VRV4R(single)	2015/05/13 16:03:00	00.00:03:25
8	20180802-182326	@	RQYQ	2018/08/02 18:24:15	00.00:21:15

On the right side of the window, there are four buttons: "Record (F1)", "New (F2)", "Edit MapName (F3)", and "Delete (F9)". At the bottom right, there is a "Back (Esc)" button.

[Record (F1)]

Records data using the equipment information that has been selected in the list.

[New (F2)]

Registers new equipment information and records data.

[Edit MapName (F3)]

Allows you to edit the equipment information that has been selected in the list.

[Delete (F9)]

Deletes the equipment information that has been selected in the list.

5-4. Entering equipment information

Click the “New” button on the “Network map selection” window to open the “Protocol detection” window, which allows you to register and configure information about the connected equipment.

1. Before detection

Protocol detection

Map name: 20200413-141255

System name: []

Model: []

Data label file: []

Revert to the original text file used for recording.

Protocol

Indoor units: 0

COM port: COM14

With BTSC/Wi-Fi

Auto select (F2)

SkyAir, VRV, Refrigeration (F3)

Split (F4)

Chiller (F5)

Altherma (F6)

OK (F1) Back (Esc)

- To detect the connected equipment, choose “Auto select,” “SkyAir, VRV, Refrigeration,” “Split,” “Chiller,” or “Altherma.”
- Once the connection to the equipment is detected, the map name, system name, protocol, and indoor units will be displayed.
- The default value for the map name and system name is “yyyymmdd-hhmmss.” Edit the map name as necessary.
 - To make it easier to manage recorded operation data later, change the map name to a more descriptive phrase. Choose “Indoor” when registering outdoor models.
- If you use STE-01 (Wi-Fi connection) or BTSC (Bluetooth COM port), “With BTSC/Wi-Fi” check box must be ticked.

Caution

If a “Protocol detection failure” message is displayed, verify that the cable is securely connected and check the system settings to verify that the proper COM port has been selected. Then click “Auto select.” In case of “standby electricity saving function” activated for Split products, it is necessary to cancel this mode by switch on indoor unit by remote controller (fan mode, etc.).

2. After detection

Protocol detection

Map name: 20200413-141255

System name: 20200413-141255

Model:

Data label file:

Revert to the original text file used for recording.

Protocol: @

Indoor units: 1

COM port: COM14

With BTSC/Wi-Fi

Auto select (F2)

SkyAir, VRV, Refrigeration (F3)

Split (F4)

Chiller (F5)

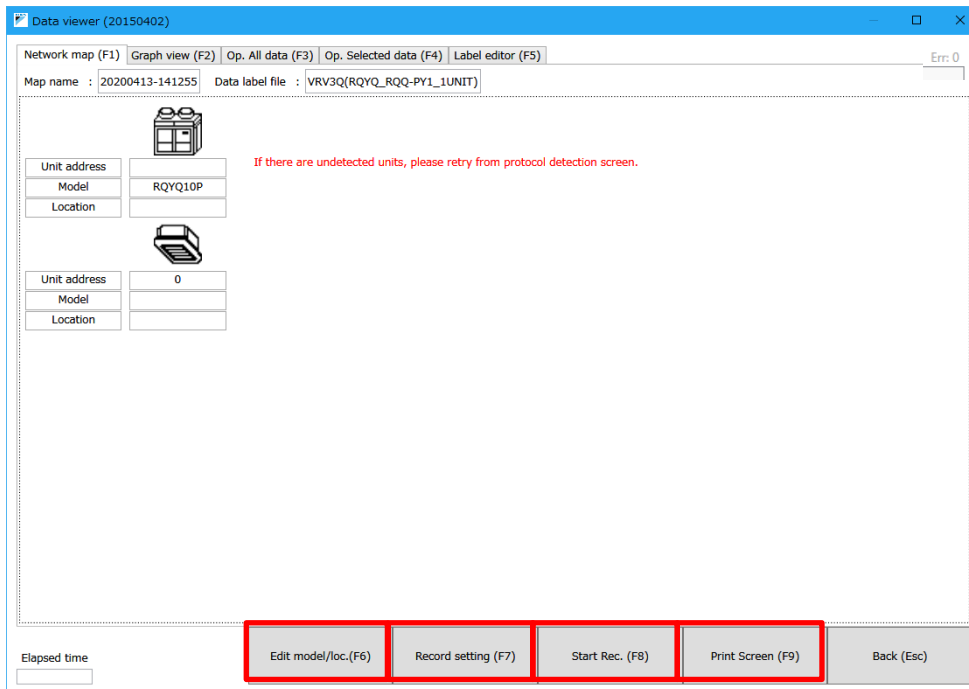
Altherma (F6)

OK (F1) Back (Esc)

- If you know the model name for the connected equipment, select it from the “Data label file” drop-down menu. If not, choose “Default.”
 - * If you choose the wrong data label file, the data may not be displayed properly.
- If the target equipment is a Split AC, choose “MULTI_SPLIT” or “SINGLE_SPLIT.”
- Click the "OK (F1)" button to proceed to the "Network map display" window.
- If D-checker is connected to an Altherma LT indoor unit, do not click any button other than “Altherma.” Doing so may prevent the data from being displayed properly. If the outdoor unit is compatible, outdoor unit data will be displayed properly.

5-5. Displaying the network map

Once the equipment information has been entered, the “Network map” tab for the connected equipment will be displayed. This tab displays connection information for indoor and outdoor units.



[Edit model/loc. (F6)]

Allows you to enter and edit the model name and location.

[Record setting (F7)]

Opens the “Options” window.

[Start Rec. (F8)]

Starts recording.

[Print Screen (F9)]

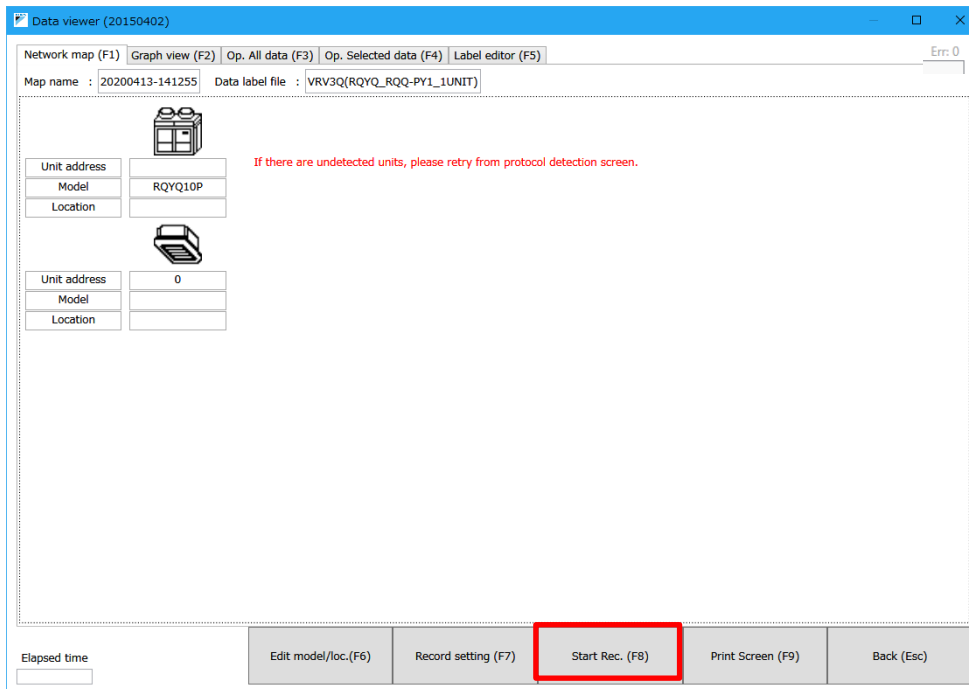
Saves a screenshot of the currently displayed window as a JPEG image file.

Caution

Do not change the computer’s time setting after the network map has been displayed. If the time is changed to a time that is later than the current time, the order of recorded data will be lost, and data will not play properly. If there are units which are not listed in the network map, please go back to protocol detection screen and execute unit scan again (if number of units are different from existing network map due to addition of indoor units, carry out same process).

5-6. Starting and stopping recording of operation data

This section describes how to record operation data for the connected equipment.



- Click the “Start Rec. (F8)” button to start recording operation data.
- The label of the “Start Rec. (F8)” button will change to “Stop Rec. (F8)” while recording is in progress. Click “Stop Rec. (F8)” to stop recording of operation data.

*Recording of operation data cannot be stopped with the “X” button at the top right corner of the window.

Troubleshooting

If D-checker freezes while recording data, you can click the “X” button at the top right corner of the window while pressing Shift+Ctrl on the keyboard.

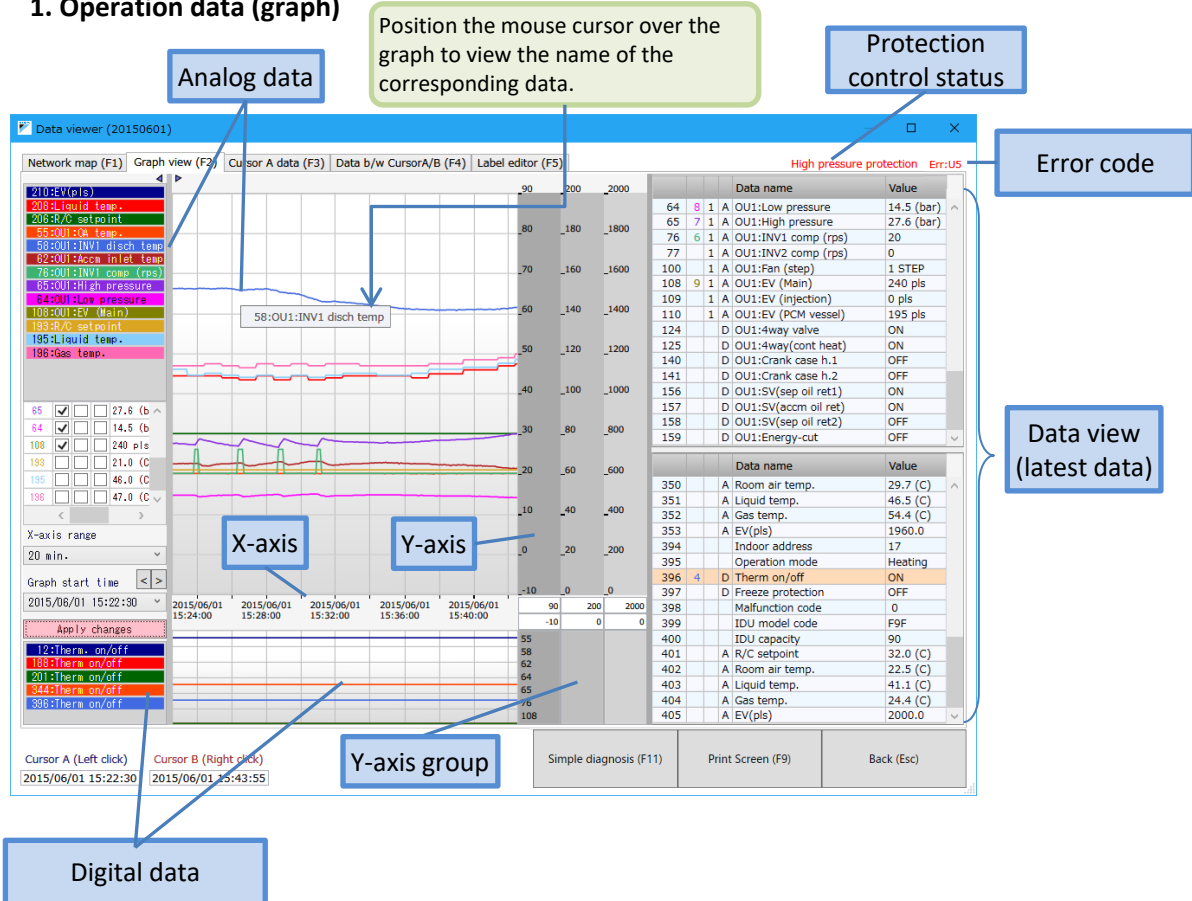
Caution

Do not disconnect cable between equipment and PC **BEFORE** completion of recording process (until “Back” button will be active again). By this action, data saving process could hang and recorded data will be lost.

5-7. Displaying operation data

Operation data can be viewed using three methods: "Graph view (F2)," "Op. All data (F3)," and "Op. Selected data (F4)."

1. Operation data (graph)

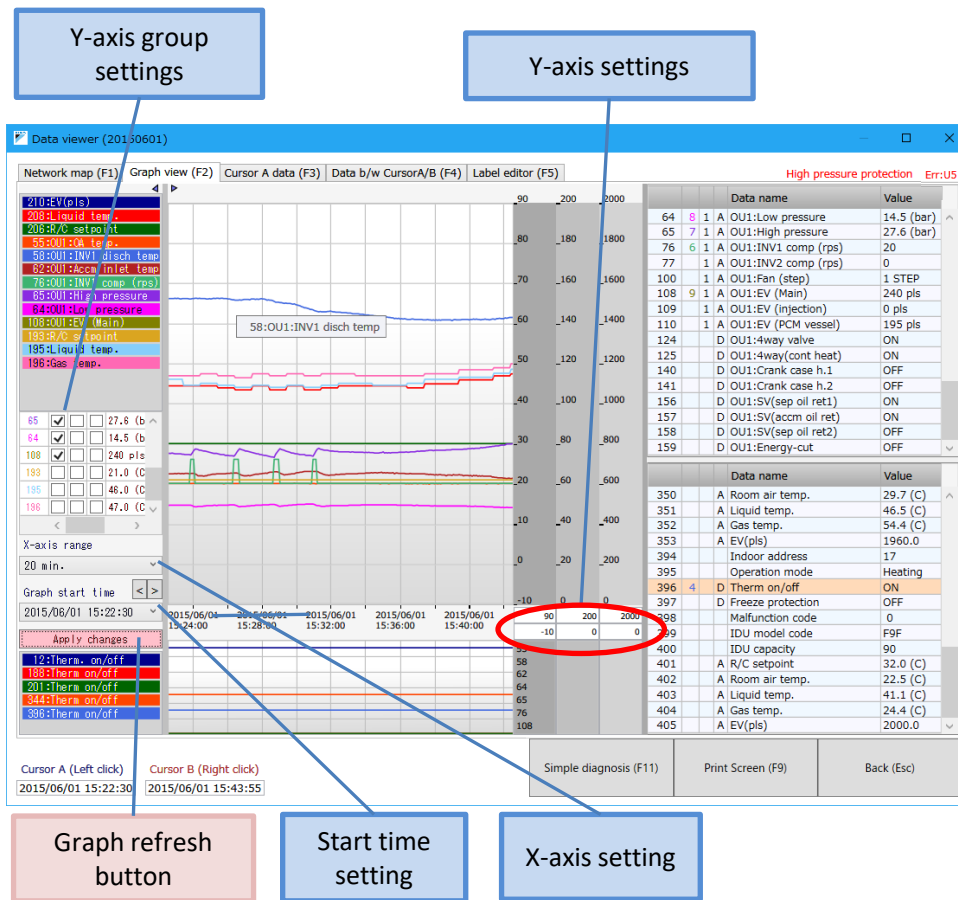


- Position the mouse cursor over the graph to display the name of the corresponding data.

For your reference

EV pulse data for indoor units connected to BP unit is displayed in VRV indoor unit value range (0-2000pls), it is necessary to convert reading value to split indoor EV value range (0-480pls).

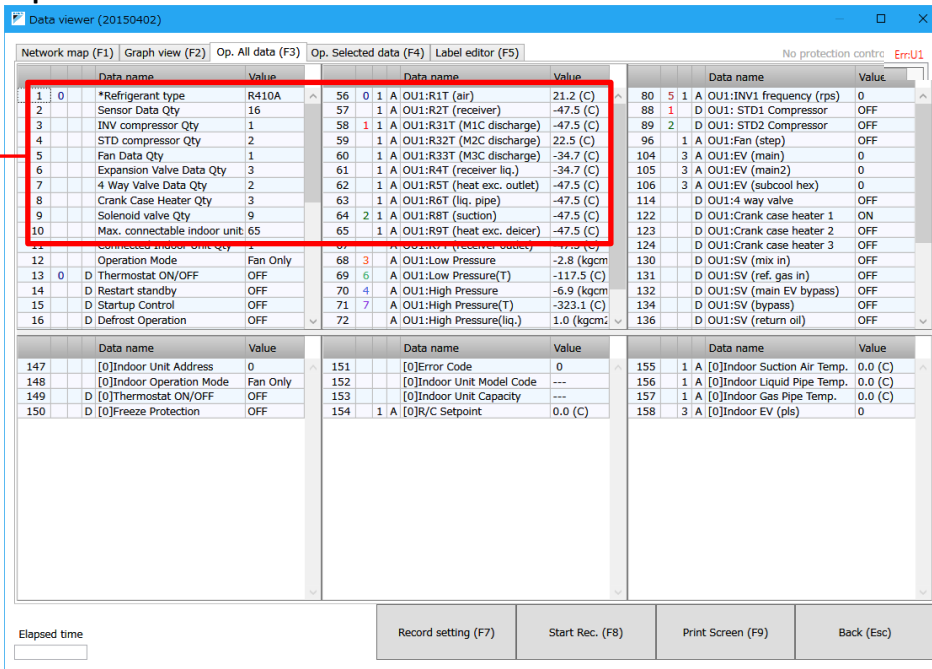
5. Recording operation data



- X-axis setting (time display interval)
Set the X-axis (time axis) display interval with the drop-down menu. (Choose from 10 min., 20 min., 30 min., and 60 min.)
- Y-axis settings
Set the upper and lower limits for the Y-axis (analog data value). You can set three Y-axis values (Y1, Y2, and Y3, from the top).
- Y-axis group settings
Set the Y-axis used to display graph data from 1 to 3.
- Once any setting has been changed, the color of the "Apply changes" button will change. Click the "Apply changes" button to apply the settings to the graph.

5. Recording operation data

2. Op. All data



			Data name	Value
63	0	1	A OU1:Low Pressure (kg/cm2)	14.2 (kgcm
64	1	1	A OU1:High Pressure (kg/cm2)	14.2 (kgcm
87	6	1	A OU1:INV1 Frequency (rps)	0
88	1	1	A OU1:INV2 Frequency (rps)	0
111	1	1	A OU1:Fan Frequency (step)	OFF STEP
119	2	1	A OU1:EV (Main)	0 pls
120	3	1	A OU1:EV (Injection)	0 pls
135	0	1	D OU1:4 Way Valve	OFF
136	1	1	D OU1:4 Way Valve (Continuou	OFF

- Right-click with the mouse to display data on the graph.
* You can choose either "Analog data" or "Digital data."
- Right-click with the mouse to choose the Y-axis used to display graph data. (This can also be set on the "Graph view" tab.)
* You can only choose "Analog data."

			Data name	Value
63	0	1	A OU1:Low Pressure (kg/cm2)	14.2 (kgcm
64	1	1	A OU1:High Pressure (kg/cm2)	14.2 (kgcm
87	6	1	A OU1:INV1 Frequency (rps)	0
88	1	1	A OU1:INV2 Frequency (rps)	0
111	1	1	A OU1:Fan Frequency (step)	OFF STEP
119	2	1	A OU1:EV (Main)	0 pls
120	3	1	A OU1:EV (Injection)	0 pls

A: Analog data (Up to 16 can be displayed.)
D: Digital data (Up to 6 can be displayed.)

5. Recording operation data

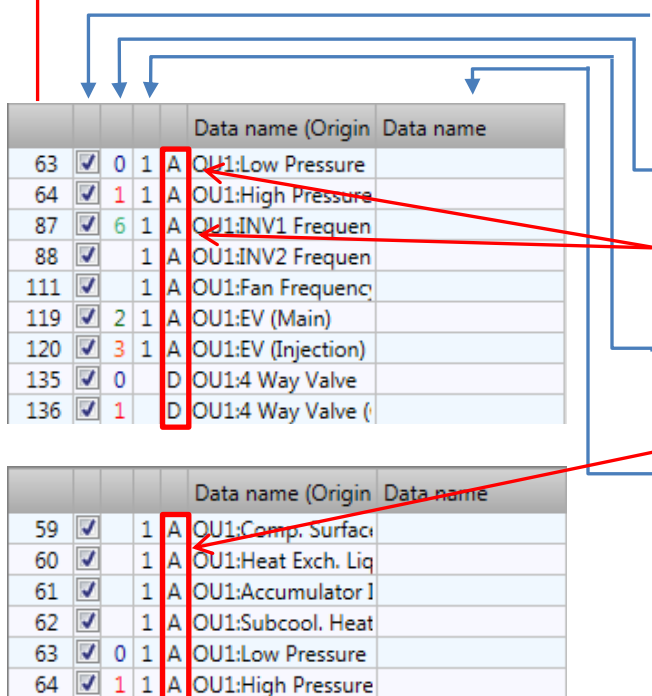
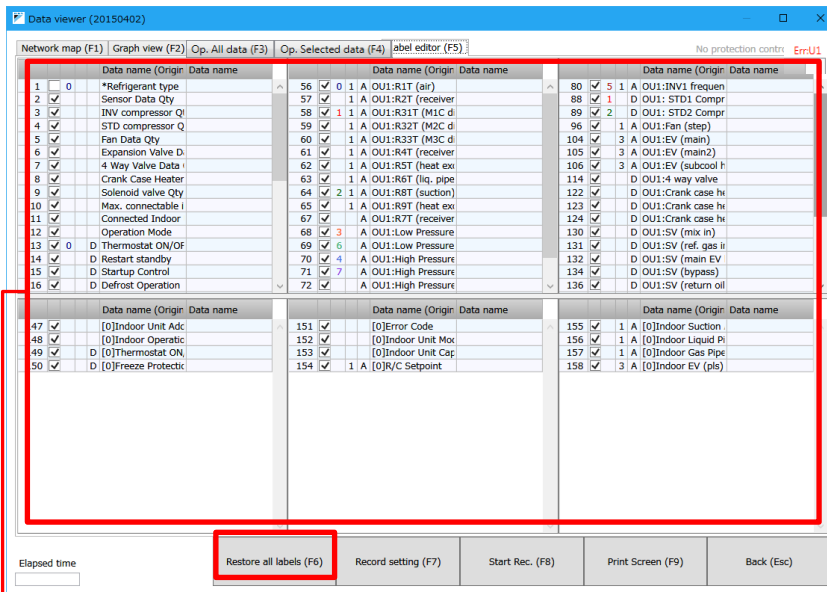
3. Op. Selected data

Data name	Value	Data name	Value	Data name	Value											
2	Sensor Data Qty	16	56	0	1	A	OU1:R1T (air)	21.3 (C)	80	5	1	A	OU1:INV1 frequency (rps)	0		
3	INV compressor Qty	1	57	1	1	A	OU1:R2T (receiver)	-47.5 (C)	88	1	D	OU1: STD1 Compressor	OFF			
4	STD compressor Qty	2	58	1	1	A	OU1:R31T (M1C discharge)	-47.5 (C)	89	2	D	OU1: STD2 Compressor	OFF			
5	Fan Data Qty	1	59	1	1	A	OU1:R32T (M2C discharge)	22.7 (C)	96	1	A	OU1:Fan (step)	OFF			
6	Expansion Valve Data Qty	3	60	1	1	A	OU1:R33T (M3C discharge)	-34.7 (C)	104	3	A	OU1:EV (main)	0			
7	4 Way Valve Data Qty	2	61	1	1	A	OU1:R4T (receiver liq.)	-34.7 (C)	105	3	A	OU1:EV (main2)	0			
8	Crank Case Heater Qty	3	62	1	1	A	OU1:RST (heat exc. outlet)	-47.5 (C)	106	3	A	OU1:EV (subcool hex)	0			
9	Solenoid valve Qty	9	63	1	1	A	OU1:R6T (liq. pipe)	-47.5 (C)	114	D	OU1:4 way valve	OFF				
10	Max. connectable indoor unit	65	64	2	1	A	OU1:R8T (suction)	-47.5 (C)	122	D	OU1:Crank case heater 1	ON				
11	Connected Indoor Unit Qty	1	65	1	1	A	OU1:R9T (heat exc. deicer)	-47.5 (C)	123	D	OU1:Crank case heater 2	OFF				
12	Operation Mode	Fan Only	67	1	1	A	OU1:R7T (receiver outlet)	-47.5 (C)	124	D	OU1:Crank case heater 3	OFF				
13	0	D	Thermostat ON/OFF	OFF	68	3	A	OU1:Low Pressure	-2.8 (kgcm	130	D	OU1:SV (mix in)	OFF			
14	D	Restart standby	OFF	69	6	A	OU1:Low Pressure(T)	-117.5 (C)	131	D	OU1:SV (ref. gas in)	OFF				
15	D	Startup Control	OFF	70	4	A	OU1:High Pressure	-6.9 (kgcm	132	D	OU1:SV (main EV bypass)	OFF				
16	D	Defrost Operation	OFF	71	7	A	OU1:High Pressure(T)	-323.1 (C)	134	D	OU1:SV (bypass)	OFF				
17	D	Oil Return Operation	OFF	72	1	A	OU1:High Pressure(liq.)	1.0 (kgcm:	136	D	OU1:SV (return oil)	OFF				
147	[0]	Indoor Unit Address	0	151		[0]	Error Code	0	155	1	A	[0]	Indoor Suction Air Temp.	0.0 (C)		
148	[0]	Indoor Operation Mode	Fan Only	152		[0]	Indoor Unit Model Code	---	156	1	A	[0]	Indoor Liquid Pipe Temp.	0.0 (C)		
149	D	[0]	Thermostat ON/OFF	OFF	153		[0]	Indoor Unit Capacity	---	157	1	A	[0]	Indoor Gas Pipe Temp.	0.0 (C)	
150	D	[0]	Freeze Protection	OFF	154	1	A	[0]	R/C Setpoint	0.0 (C)	158	3	A	[0]	Indoor EV (pls)	0

- The necessary data is extracted from all operation data and displayed.
- This tab is useful when you only need to display a subset of the data.
- You can choose which data to display on the “Label editor” tab.

5. Recording operation data

<“Label editor” tab>



- Right-click with the mouse to toggle the state of the checkboxes. Data whose checkbox is not selected will not be shown on the “Op. Selected data” tab.
- Right-click with the mouse to display the data on the graph.
 - * You can choose either “Analog data” or “Digital data.”
- Right-click with the mouse to choose the Y-axis used to display graph data. (This can also be set on the “Graph view” tab.)
 - * You can only choose “Analog data.”
- Right-click with the mouse to copy the data name (original). To edit manually, left-click with the mouse and enter the data name. The data name edited here will be applied to other windows.

A: Analog data (Up to 16 can be displayed.)
D: Digital data (Up to 6 can be displayed.)

- Click “Restore all labels (F6)” to delete all currently set data names.
- * This action cannot be undone.

5-8. Editing equipment information

You can change the map name, system name, and label definition file for registered equipment information. If you registered the information with the wrong label definition file, you can choose the correct label definition file to enable operation data to be recorded correctly.

Protocol detection

Map name: 20150406-152658

System name: VRV 64IDU

Model: VRV3

Data label file: +VRV4(1UNIT)

Revert to the original text file used for recording.

Protocol: @

Indoor units: 64

COM port: COM14

With BTSC/Wi-Fi

OK (F1) Back (Esc)

- Change the label definition file.
(For example, if you discover that the model name of equipment registered as “DEFAULT” is actually “LRDYP10C,” changing the label definition file to “LRDYP10C” will allow operation data to be recorded correctly.)
- Select the “Revert to the original text file used for recording” checkbox will revert to the label definition file used to record data. You can change data label language by this option if you received data in other language which is different from the language option of your D-checker software.

* The “IMPORTED_DATALABEL” label definition file is the default setting for legacy data.

Caution

- Selecting the “Revert to the original text file used for recording” checkbox with the label definition file set to “IMPORTED_DATALABEL” and then clicking “OK” will cause “IMPORTED_DATALABEL” to be deleted.
- Once you have deleted “IMPORTED_DATALABEL,” the operation cannot be undone.
- If “IMPORTED_DATALABEL” is deleted, no label definition file will be selected. Click “Edit MapName” again and choose a label definition file.

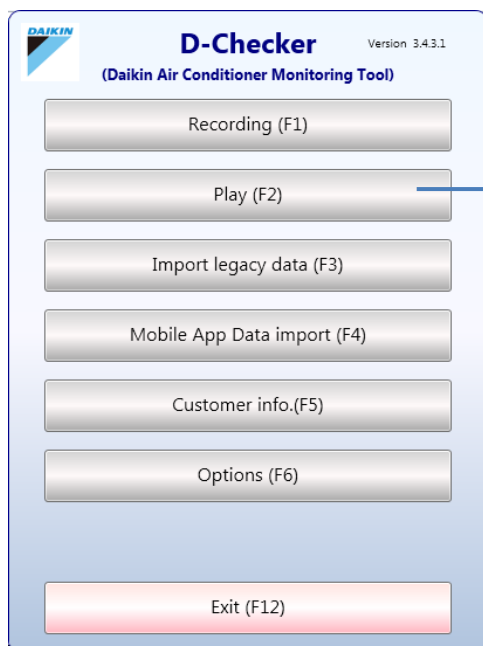
6. Playing operation data

This chapter describes how to play previously recorded operation data.

6-1. Playing operation data

Click the “Play (F2)” button to display the “Recorded data selection” window.

Following are descriptions of each button related to playback of recorded operation data.



Customer Id	Customer name	Map name	System name	REC started	Period	Responsible pe
1	001	20140422115156	20140422115156	2014/04/22 11:53:40	00:00:02:50	Monta
2	20140402 test LT-CA	20140402115614	20140402115614	2014/04/02 15:26:40	00:00:06:30	EYV
3	20150402	GSD	20150402-151155	2015/04/02 15:14:20	00:00:03:25	Monta
4	20150402	GSD	20150402-152747	2015/04/02 15:29:30	00:00:01:45	Monta
5	20150402	GSD	20150406-152658	2015/04/06 15:30:50	00:00:01:05	Monta
6	20150402	GSD	20150406-153217	2015/04/06 15:33:15	00:00:16:15	Monta
7	20150402	GSD	20150406-171433	2015/04/06 17:15:15	00:00:03:10	Monta
8	20150406		20150406165039	2015/04/06 16:51:15	00:00:01:55	Monta
9	20150406		20150406165945	2015/04/06 17:06:00	00:00:08:35	Monta
10	20150406		20150406171921	2015/04/06 17:19:40	00:00:06:50	Monta
11	20150408		20150408123018	2015/04/08 12:31:05	00:00:14:45	Monta
12	20150408		20150408125945	2015/04/08 13:00:25	00:00:01:10	Monta
13	20150408		20150408130222	2015/04/08 13:02:40	00:00:00:10	Monta
14	20150408		20150408130725	2015/04/08 13:07:45	00:00:18:40	Monta
15	20150408		20150408133951	2015/04/08 13:40:40	00:00:03:20	Monta
16	20150408		20150408134612	2015/04/08 13:48:15	00:00:00:00	Monta
17	0001	ダイキン工業1	20140506-101832	2014/05/06 10:19:40	00:00:10:00	ibrou
18	DSP	DSP	20140915-122948	2014/09/15 12:31:05	00:00:15:00	GSD
19	DSP	DSP	20140915-125205	2014/09/15 13:00:40	00:00:29:30	GSD
20	GSD		20140422-172251	2014/04/22 17:23:45	00:00:01:40	Monta
21	GSD		20140422-172812	2014/04/22 17:29:10	00:00:01:00	Monta
22	GSD		20140423-143533	2014/04/23 14:36:35	00:00:06:35	Monta
23	GSD		20140430-094708	2014/04/30 09:47:35	00:00:05:15	Monta
24	GSD		20140430-095300	2014/04/30 09:53:25	00:00:04:15	Monta
25	GSD		20140430-100738	2014/04/30 10:08:15	00:00:05:55	Monta
26	GSD		20140430-101419	2014/04/30 10:14:50	00:00:06:35	Monta

You can sort data display order by clicking header name area, by first click data will be sorted in ascending order, by second click data will be in descending order. Sort function works in “Customer selection” window as well.

[Op. Data disp. (F1)]

Plays the operation data that has been selected in the list.

[CSV output (F2)]

Outputs the data that has been selected in the list as a CSV file.

[Edit MapName (F3)]

Allows you to edit the equipment information for the operation data that has been selected in the list.

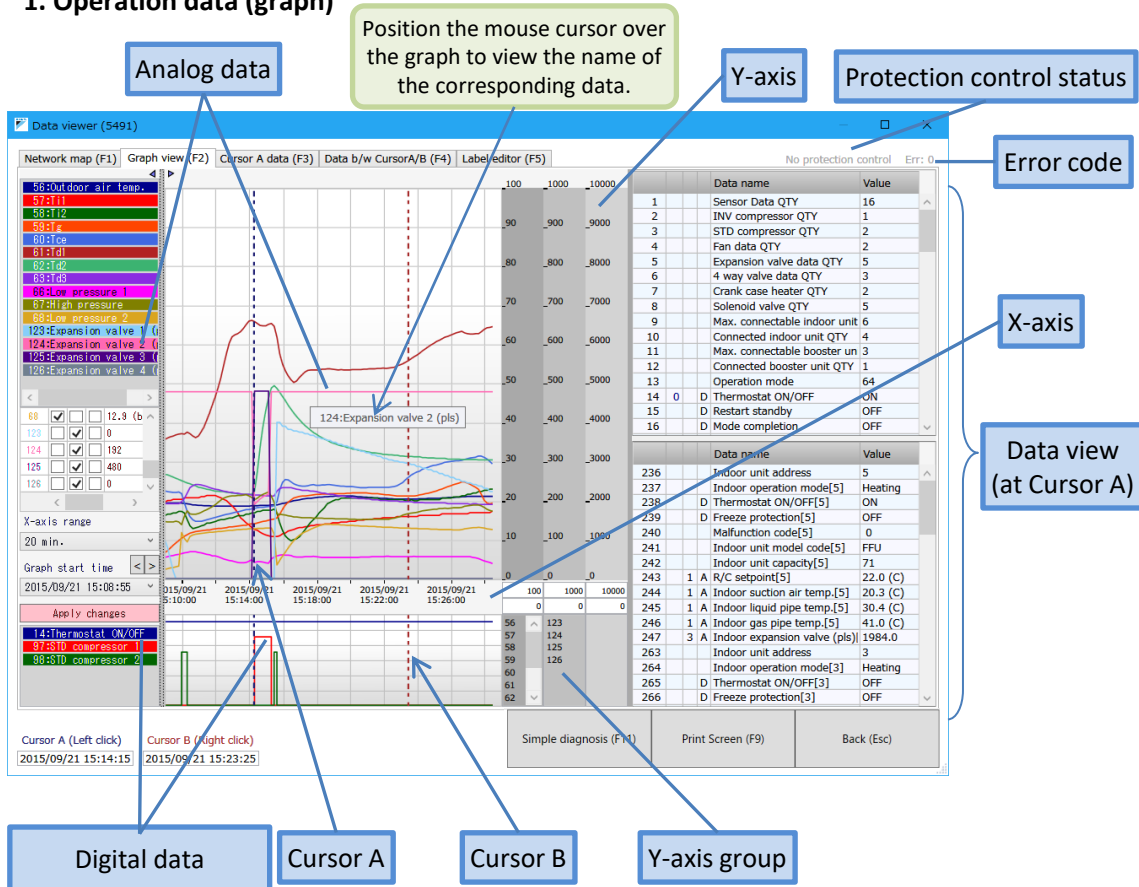
[Delete (F9)]

Deletes the operation data that has been selected in the list.

6-2. Displaying operation data

Operation data can be viewed using three methods: "Graph view (F2)," "Cursor A data (F3)," and "Data b/w CursorA/B (F4)."

1. Operation data (graph)



- Left-click with the mouse inside the graph to set the position of cursor A.
- Right-click with the mouse inside the graph to set the position of cursor B.
- Position the mouse cursor A over the graph to display the name of the corresponding data.

The screenshot shows the 'Data viewer' software interface. On the left, there is a 'Network map' list with various sensors and actuators. The main area is a graph with multiple data series plotted against time. The Y-axis has numerical values ranging from -1000 to 1000. The X-axis shows dates from 2015/09/21. On the right, there are two tables: one for 'Sensor Data QTY' and another for 'Data name' and 'Value'. At the bottom, there are buttons for 'Simple diagnosis (F11)', 'Print Screen (F9)', and 'Back (Esc)'. Callouts from external boxes point to specific UI elements: 'Y-axis group settings' points to the sensor list; 'Y-axis settings' points to the Y-axis scale; 'Graph refresh button' points to the 'Apply changes' button; 'Start time setting' points to the 'Graph start time' dropdown; and 'X-axis setting' points to the 'X-axis range' dropdown.

- X-axis setting (time display interval)
Set the X-axis (time axis) display interval with the drop-down menu. (Choose from 10 min., 20 min., 30 min., and 60 min.)
- Y-axis settings
Set the upper and lower limits for the Y-axis (analog data value). You can set three Y-axis values (Y1, Y2, and Y3, from the top).
- Y-axis group settings
Set the Y-axis used to display graph data from 1 to 3.
- Start time setting
Set the start time using the “<” and “>” buttons and the drop-down menu. (The drop-down menu provides a series of settings that are 5 minutes apart, and the “<” and “>” buttons move the time axis range by the set time.) For example, if the time-axis range were set to 30 minutes, the buttons would move the time backwards and forwards in 30-minute increments.
- Once any setting has been changed, the color of the “Apply changes” button will change. Click the “Apply changes” button to apply the settings to the graph.

2. Operation data (cursor A)

Cursor A (Left click) Cursor B (Right click)
2014/06/06 22:26:55 2014/06/06 22:36:55

- The data at the position of cursor A will be shown.
- All recorded data will be shown.

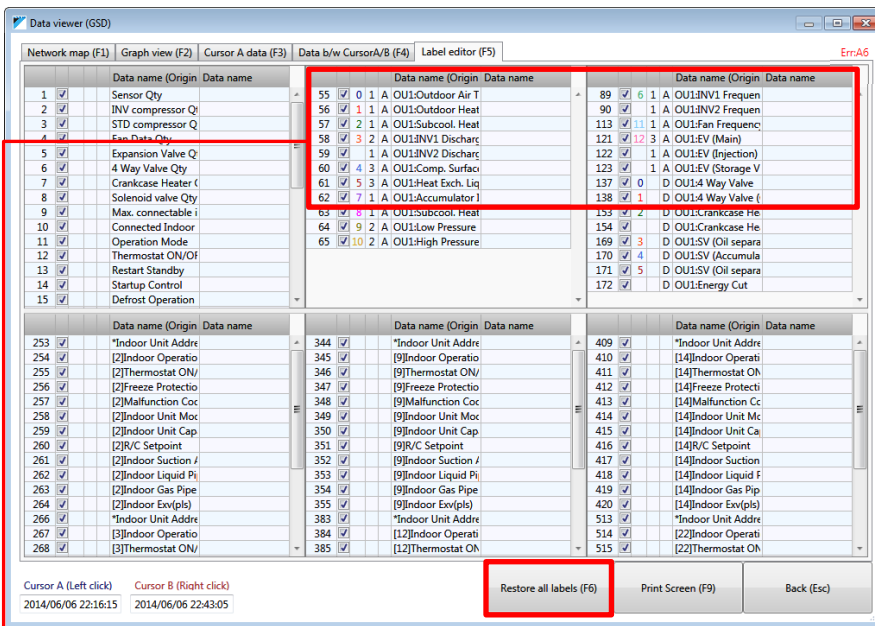
3. Operation data (between cursor A and cursor B)

Cursor A (Left click) Cursor B (Right click)
2014/06/06 22:26:55 2014/06/06 22:36:55

- Operation data between cursor A and cursor B as set in the graph view will be shown on a time axis.
- Chose which data items to display on the “Label editor” tab.

6. Playing operation data

<“Label editor” tab>



				Data name (Origin)	Data name
63	<input checked="" type="checkbox"/>	0	1	A	OU1:Low Pressure
64	<input checked="" type="checkbox"/>	1	1	A	OU1:High Pressure
87	<input checked="" type="checkbox"/>	6	1	A	OU1:INV1 Frequen
88	<input checked="" type="checkbox"/>	1	1	A	OU1:INV2 Frequen
111	<input checked="" type="checkbox"/>	1	1	A	OU1:Fan Frequenc
119	<input checked="" type="checkbox"/>	2	1	A	OU1:EV (Main)
120	<input checked="" type="checkbox"/>	3	1	A	OU1:EV (Injection)
135	<input checked="" type="checkbox"/>	0	1	D	OU1:4 Way Valve
136	<input checked="" type="checkbox"/>	1	1	D	OU1:4 Way Valve (

				Data name (Origin)	Data name
59	<input checked="" type="checkbox"/>	1	1	A	OU1:Comp. Surfac
60	<input checked="" type="checkbox"/>	1	1	A	OU1:Heat Exch. Liq
61	<input checked="" type="checkbox"/>	1	1	A	OU1:Accumulator 1
62	<input checked="" type="checkbox"/>	1	1	A	OU1:Subcool. Heat
63	<input checked="" type="checkbox"/>	0	1	A	OU1:Low Pressure
64	<input checked="" type="checkbox"/>	1	1	A	OU1:High Pressure

- Right-click with the mouse to toggle the state of the checkboxes. Data whose checkbox is not selected will not be shown on the “Data b/w CursorA/B” tab.
- Right-click with the mouse to display the data on the graph.
 - * You can choose either “Analog data” or “Digital data.”
- Right-click with the mouse to choose the Y-axis used to display graph data. (This can also be set on the “Graph view” tab.)
 - * You can only choose “Analog data.”
- Right-click with the mouse to copy the data name (original). To edit manually, left-click with the mouse and enter the data name. The data name edited here will be applied to other windows.

A: Analog data (Up to 16 can be displayed.)

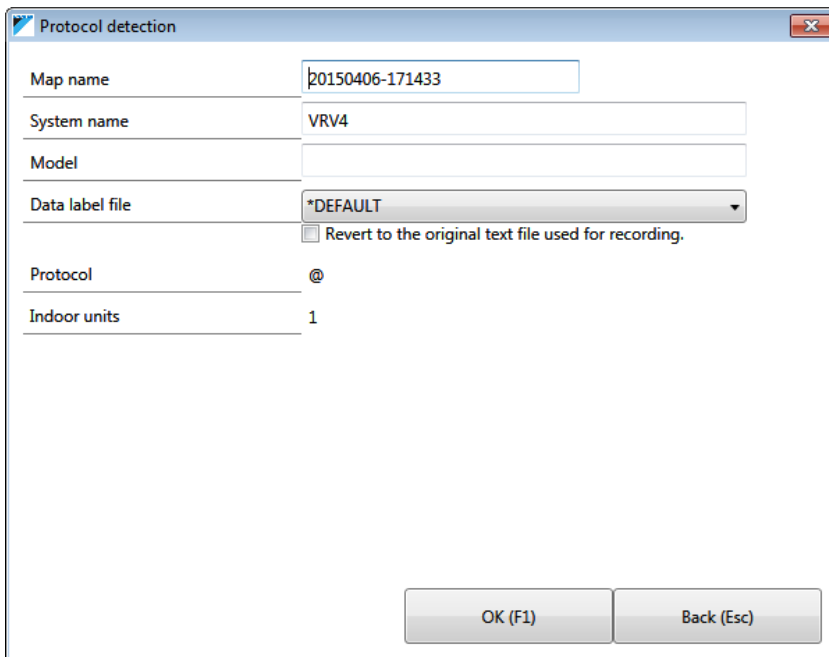
D: Digital data (Up to 6 can be displayed.)

- Click “Restore all labels (F6)” to delete all currently set data names.

* This action cannot be undone.

6-3. Editing equipment information

You can change the map name, system name, and label definition file for registered equipment information. If you registered the information with the wrong label definition file, you can choose the correct label definition file to enable operation data to be recorded correctly.



Map name	20150406-171433
System name	VRV4
Model	
Data label file	*DEFAULT
<input type="checkbox"/> Revert to the original text file used for recording.	
Protocol	@
Indoor units	1

- Change the label definition file.
(For example, if you discover that the model name of equipment registered as “DEFAULT” is actually “LRDYP10C,” changing the label definition file to “LRDYP10C” will allow operation data to be recorded correctly.)
- Select the “Revert to the original text file used for recording” checkbox will revert to the label definition file used to record data. You can change data label language by this option if you received data in other language which is different from the language option of your D-checker software.

* The “IMPORTED_DATALABEL” label definition file is the default setting for legacy data.

Caution

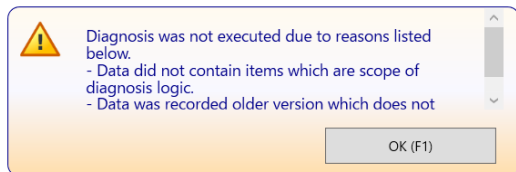
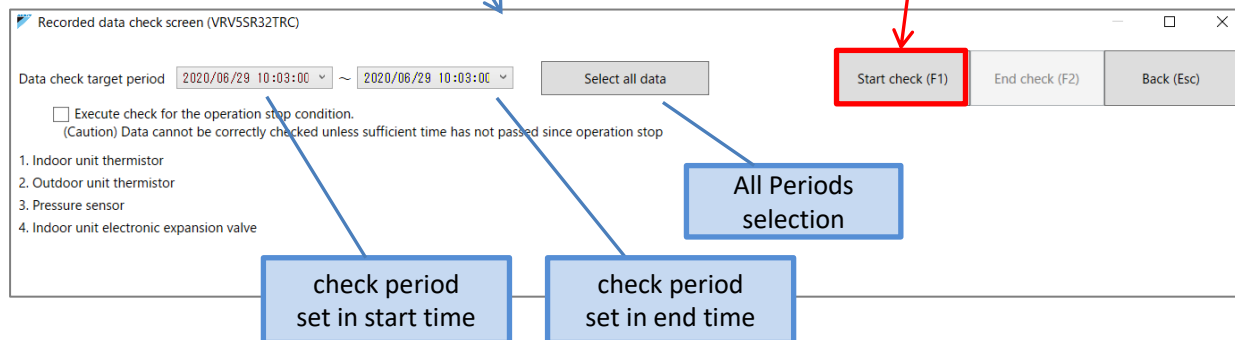
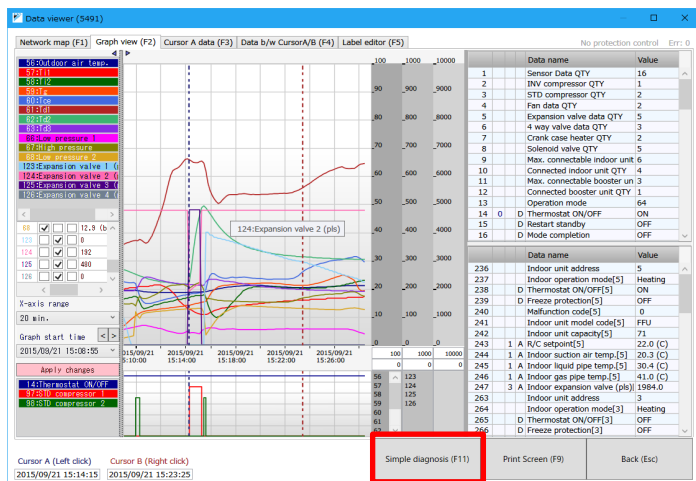
- Selecting the “Revert to the original text file used for recording” checkbox with the label definition file set to “IMPORTED_DATALABEL” and then clicking “OK” will cause “IMPORTED_DATALABEL” to be deleted.
- Once you have deleted “IMPORTED_DATALABEL,” the operation cannot be undone.
- If “IMPORTED_DATALABEL” is deleted, no label definition file will be selected. Click “Edit MapName” again and choose a label definition file.

This chapter describes how to use Simple diagnosis feature.

outline

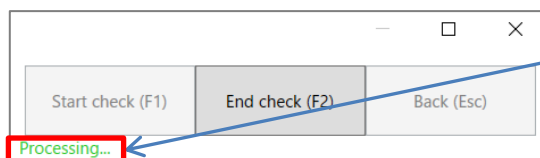
Supports the user to determine operation data. Analyzes D-Checker data with simple logic and displays the results.

Press [Simple diagnosis (F11)] button on graphic chart marking screen of operation data to display record data check screen in marking. Set the check period and press the [Start check(F1)] button to start the simple diagnosis of the target data.



Diagnosis was not executed due to reasons listed below.

- Data did not contain items which are scope of diagnosis logic.
- Data was recorded older version which does not support diagnosis function (V3.7 or later is supported)



During the simple diagnosis, the lower part of start check button "Processing..." is marking. When the check is completed,

1. Indoor unit thermistor
2. Outdoor unit thermistor
3. Pressure sensor
4. Indoor unit electronic expansion valve

Displays each item.
For the list of logic, see < Reference 1 > page.

7. Simple diagnosis

Recorded data check screen (石川眼科)

Data check target period: 2016/07/15 13:54:35 ~ 2016/07/19 12:55:00

Start check (F1) End check (F2) Back (Esc)

Execute check for the operation stop condition.
(Caution) Data cannot be correctly checked unless sufficient time has not passed since operation stop.

1. Indoor unit thermistor
Condition: Regardless of running, stop, thermo-ON/OFF

Item	Detected time	Value	Result	Value range of normal operation condition	Diagnosis logic	Hit	View
1: In Gas Pipe Temp(0)			OK	-20°C - 90°C	Indoor unit gas pipe temp >90 OR <-20		
2: In Liquid Pipe Temp(0)			OK	-20°C - 60°C	Indoor unit liquid pipe temp >60 OR <-2		
3: In Suction Air Temp(0)			OK	-20°C - 60°C	Indoor unit suction air temp >60 OR <-2		

Condition: Indoor unit thermo-ON

Item	Detected time	Value	Result	Value range of normal operation condition	Diagnosis logic	Hit	View
7: In Gas Pipe Temp(0)	2016/07/17 21:56:50	24.9 (C)	Not OK	Indoor unit gas pipe temp ≥ Indoor unit	Indoor unit gas pipe temp < Indoor unit	10	View

2. Outdoor unit thermistor
Condition: Regardless of running, stop, thermo-ON/OFF

Item	Detected time	Value	Result	Value range of normal operation condition	Diagnosis logic	Hit	View
10: Suction Pipe Temp			OK	Evaporating temp +2°C<Suction temp<E	Outdoor unit suction pipe temp>80 OR <E		
11: Discharge Pipe Temp 1			OK	Condensing Temp +20°C<Discharge Temp	Outdoor unit discharge pipe temp 1 >16f		
12: Outdoor heat exchanger temp.			OK	-20°C - 30°C	Outdoor unit liquid pipe temp (other than		
12: Outdoor heat exchanger mid temp.			OK	-20°C - 30°C	Outdoor unit liquid pipe temp (other than		
12: Outdoor heat exchanger liquid temp.			OK	-20°C - 30°C	Outdoor unit liquid pipe temp (other than		
12: INV fin temp.			OK	-20°C - 30°C	Outdoor unit liquid pipe temp (other than		
12: Fan1 Fin temp.			OK	-20°C - 30°C	Outdoor unit liquid pipe temp (other than		
12: Fan2 Fin temp.			OK	-20°C - 30°C	Outdoor unit liquid pipe temp (other than		
13: Out air temp			OK	-20°C - 50°C	Outdoor unit air temp>60 OR <-30		

Condition: Compressor running (INV>0)

Item	Detected time	Value	Result	Value range of normal operation condition	Diagnosis logic	Hit	View
14: Suction Pipe Temp	2016/07/18 04:39:00	35.1 (C)	Not OK	Evaporating temp +2°C<Suction temp<E	Outdoor unit suction pipe temp>TC+10	8	View
15: Suction Pipe Temp			OK	Evaporating temp +2°C<Suction temp<E	Outdoor unit suction pipe temp<TE-10		
16: Discharge Pipe Temp 1			OK	Condensing temp +20°C<Discharge temp	Outdoor unit discharge pipe temp 1 >16f		
17: Discharge Pipe Temp 1	2016/07/19 12:06:40	47.4 (C)	Not OK	Condensing temp +20°C<Discharge temp	Outdoor unit discharge pipe temp 1 <TC	137	View

3. Pressure sensor
Condition: Regardless of running, stop, thermo-ON/OFF

1. Detected time

Displays the date and time of the first fault detection within the check period.

2. Value

Displays the value when fault is detected.

3. Result

The display will be green during normal operation and red during faulty operation.

4. Diagnosis logic

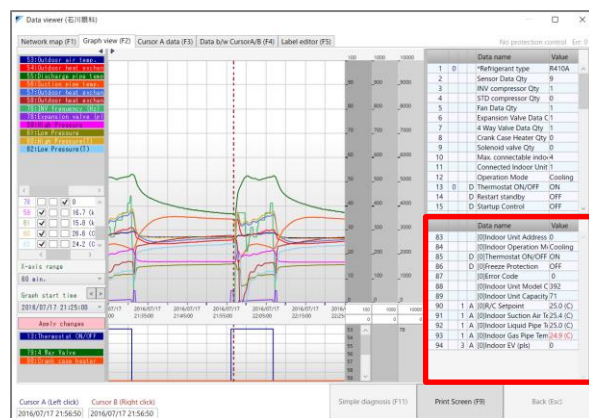
Displays the logic when it determines that it is Not OK.

5. Hit

Number of times Not OK was detected within the check period.

6. View

Press the [View] button to display graph with the cursor positioned at the date and time when a Not OK was detected. The corresponding [Value] changes to red.



	Data name	Value
83	[Indoor Unit Address 0	
84	[Indoor Operation Mode Cooling	
85	D [Thermostat ON/OFF ON	
86	D [Freeze Protection OFF	
87	[Error Code 0	
88	[Indoor Unit Model C392	
89	[Indoor Unit Capacity 71	
90	1 A [R/C Setpoint 25.0 (C)	
91	1 A [Indoor Suction Air Temp 25.4 (C)	
92	1 A [Indoor Liquid Pipe Temp 25.0 (C)	
93	1 A [Indoor Gas Pipe Temp 24.9 (C)	
94	3 A [Indoor EV (pis) 0	

8. Outputting operation data as a CSV file

This chapter describes how to output operation data as a CSV file.

8-1. Outputting data as a CSV file

Click the “Play (F2)” button to display the “Recorded data selection” screen. Recorded operation data can be output as a CSV file.



Customer id.	Customer name	Map name	System name	REC started	Period	Responsible per
1 (REC_ONLY)		20191127-155408	20191127-155408	2019/11/27 15:57:45	00:00:00:30	GSD
2 (REC_ONLY)		20200127-150809	20200127-150809	2020/01/27 15:09:00	00:00:00:30	GSD
3 (REC_ONLY)		20200127-151028	20200127-151028	2020/01/27 15:11:05	00:00:00:35	GSD
4 (REC_ONLY)		20200127-151612	20200127-151612	2020/01/27 15:18:40	00:00:00:35	GSD
5 (REC_ONLY)		20200127-151743	20200127-151743	2020/01/27 15:18:15	00:00:01:15	GSD
6 001	ダイキン工業長官邸検校グループ	20140422115156	20140422115156	2014/04/22 11:53:40	00:00:02:50	Morita
7 015	Seltech	20180705-115144	20180705-114825	2018/07/05 11:51:50	00:00:44:05	Kataoan
8 015	Seltech	20180718-142500	20180718-142500	2018/07/18 14:28:55	00:00:10:40	Kataoan
9 100	Calant	20200203-173556	20200203-173556	2020/02/03 18:17:55	00:14:10:40	CALANT
10 100	Calant	20200204-082854	20200203-173556	2020/02/04 08:29:05	00:00:56:35	CALANT
11 100	Calant	20200204-092557	20200204-092557	2020/02/04 10:06:15	00:01:38:25	CALANT
12 100	Calant	20200204-175612	20200204-175612	2020/02/04 17:57:20	00:19:25:45	CALANT
13 114	Hang Jebat, Francisco	20190305-100728	20190305-100728	2019/03/05 10:08:20	00:00:00:40	Yue Lark
14 10000	daikin	20200124-084700	20200124-084700	2020/01/24 08:47:30	00:00:00:20	mimoda
15 1100009	日生牧場ビル	20180809-11458	20180809	2018/08/09 11:25:05	18:21:18:00	齋藤
16 20140402 test LT-CA		20140402152614	20140402152614	2014/04/02 15:26:46	00:00:06:30	DTV
17 20150402	GSD	20150402-151155	20150402-151155	2015/04/02 15:14:20	00:00:03:25	Morita
18 20150402	GSD	20150402-152747	20150402-152747	2015/04/02 15:29:30	00:00:01:45	Morita
19 20150402	GSD	20150406-152658	VRV 64DU	2015/04/06 15:30:50	00:00:01:05	Morita
20 20150402	GSD	20150406-153217	20150406-153217	2015/04/06 15:33:15	00:00:16:15	Morita
21 20150402	GSD	20150406-174433	Shy Air	2015/04/06 17:15:15	00:00:03:10	Morita
22 20150402	GSD	20150513-152714	VRV4R	2015/05/13 15:29:00	00:00:03:10	Morita
23 20150402	GSD	20150513-154243	VRV4R(jmglo)	2015/05/13 16:03:00	00:00:03:25	Morita
24 20150402	GSD	20180802-182326	20180802-182326	2018/08/02 18:24:15	00:00:21:15	Morita
25 20150406		20150406165039	20150406165039	2015/04/06 16:51:15	00:00:01:55	Morita
26 20150406		20150406165945	20150406165945	2015/04/06 17:06:00	00:00:08:35	Morita
27 20150406		20150406171921	20150406171921	2015/04/06 17:19:40	00:00:06:50	Morita
28 20150408		20150408123018	20150408123018	2015/04/08 12:31:05	00:00:14:45	Morita
29 20150408		20150408125945	20150408125945	2015/04/08 12:50:25	00:00:01:10	Morita

Op. Data disp. (F1) **CSV output (F2)** Edit MapName (F3) Delete (F9) Back (Esc)

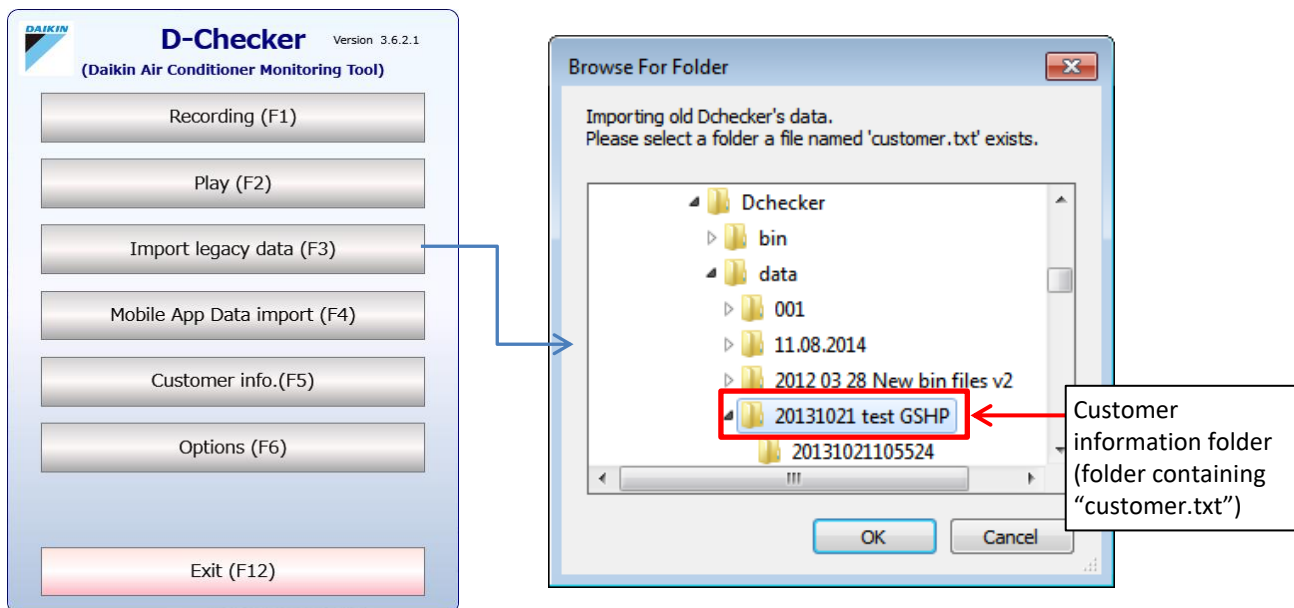
- Select the operation data you wish to output in the list and click the “CSV output (F2)” button.
- When the dialog box is displayed, select the save destination and click “OK.”

9. Importing legacy data

This chapter describes how to import legacy data.

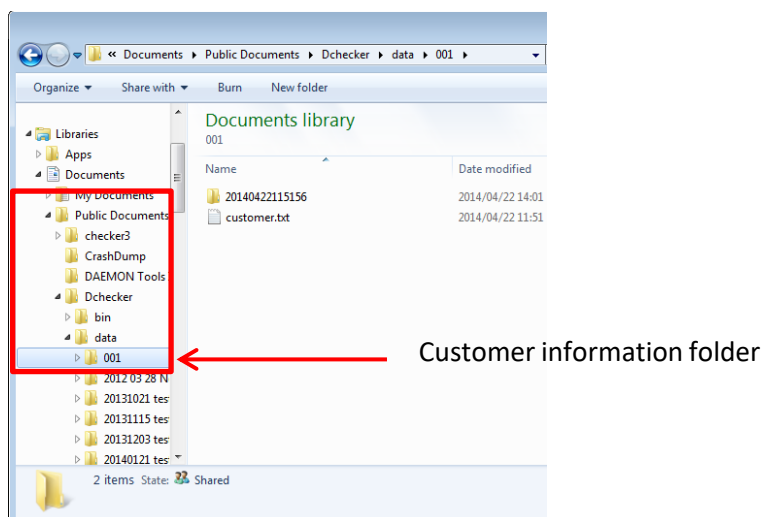
9-1. Procedure for importing legacy data

Click the “Import legacy data (F3)” button to import data recorded with Version 2.18 or earlier of the software.



- Select the folder containing the legacy data and click the “OK” button.
* Verify that the file “customer.txt” exists in the folder.
- If the import operation is successful, the imported data will appear in the “Customer info.” and “Data viewer” windows.
- The default installation folder for older versions of D-checker is “C:\Users\Public\Documents\D-checker.”
- The “customer.txt” file can be found in the customer information folder.

<Default installation folder for older versions of D-checker>

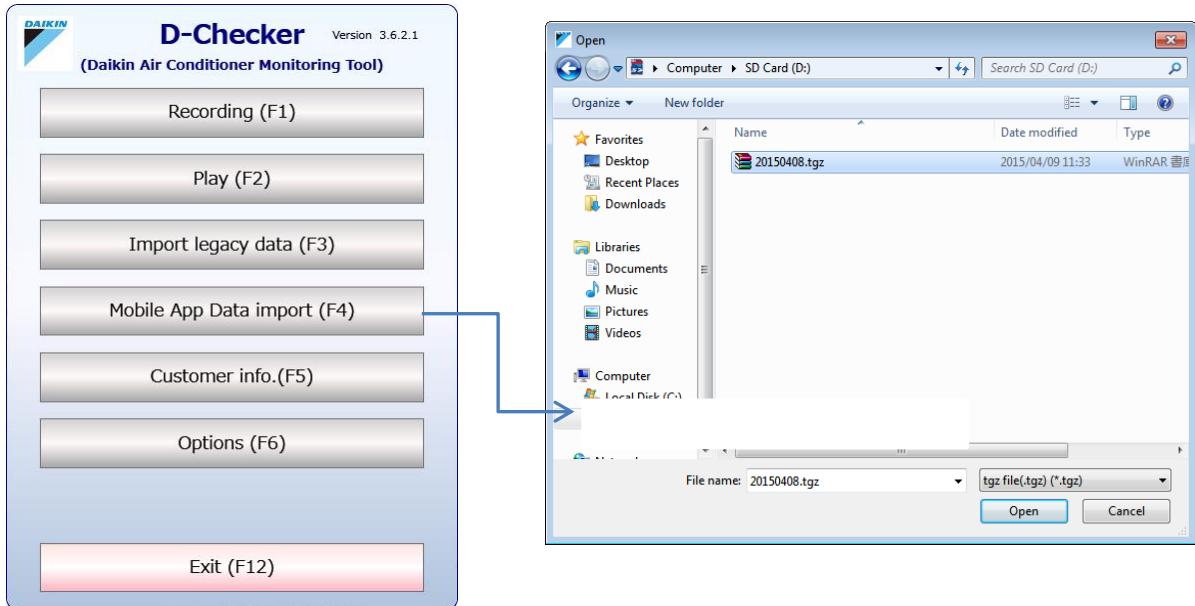


10. Importing mobile app data

This chapter describes how to import recorded data by mobile apps (Android, iOS).

10-1. Procedure for importing mobile app data

Click the “Mobile App Data Import (F4)” button to import data recorded by mobile app version of D-checker software (Android/iOS).

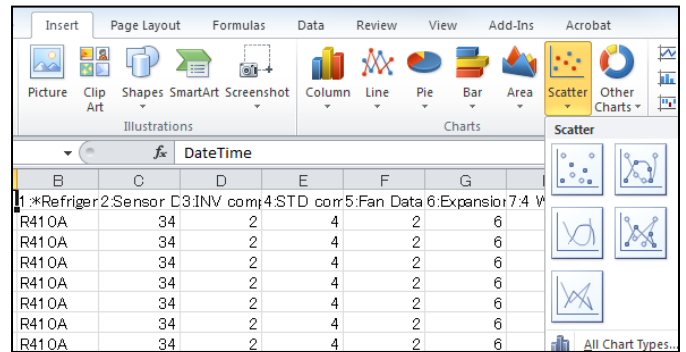
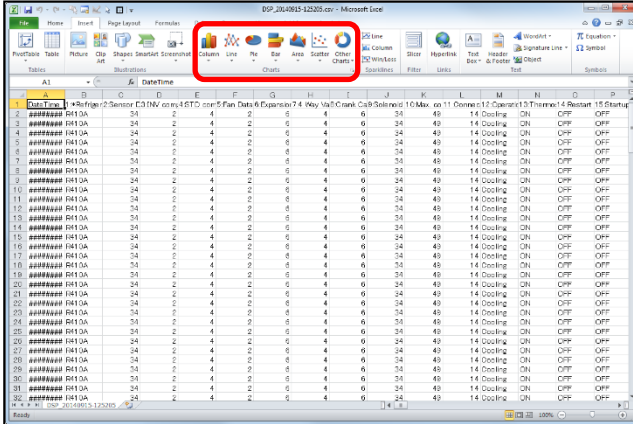


- Select the recorded file by mobile app and click the “Open” button.
- If the import operation is successful, the imported data will appear in the “Customer info.” and “Data viewer” windows.
- The default file name of mobile app data is “YYYYMMDD.tgz”

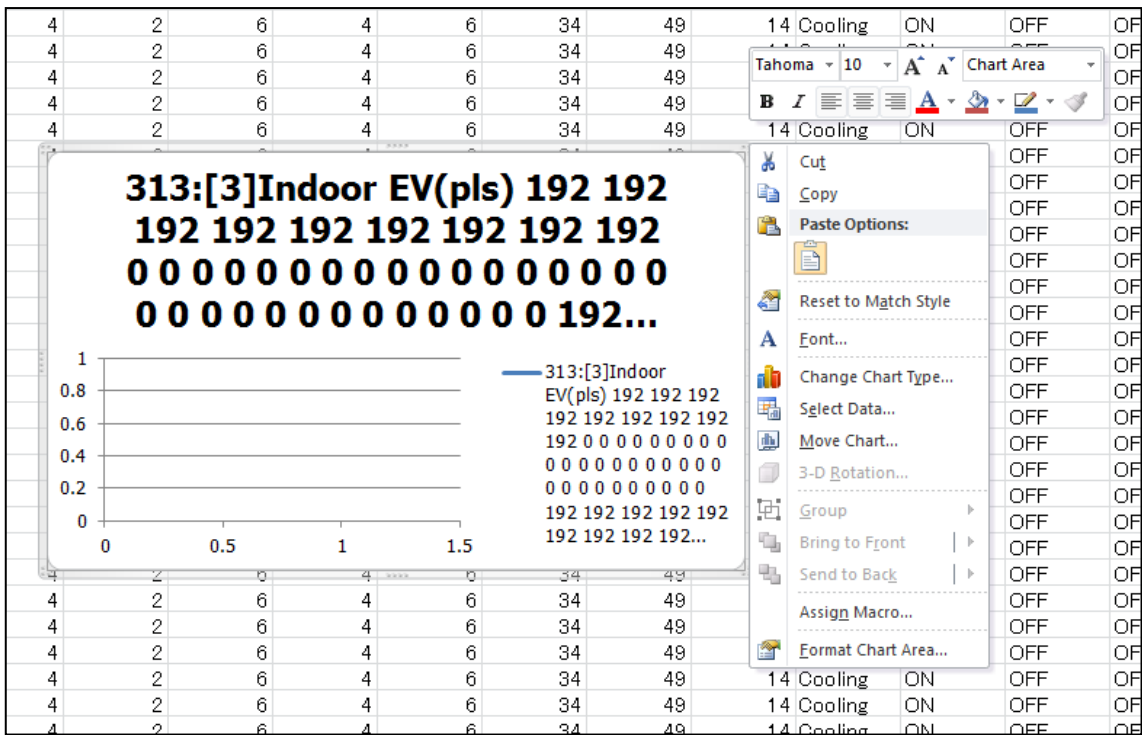
11. CSV data exporting process

For Excel data graphing

- From Excel menu, select "Insert">"Scatter"

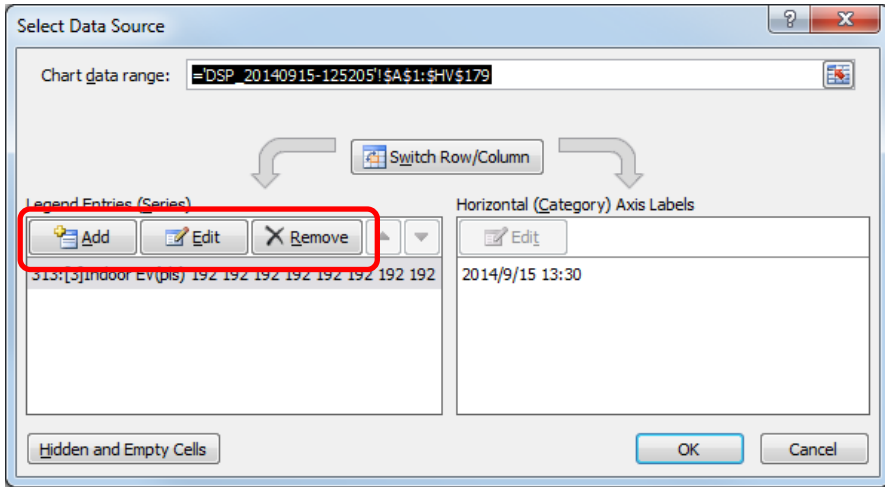


- Right click on the chart, then choose "Select Data"

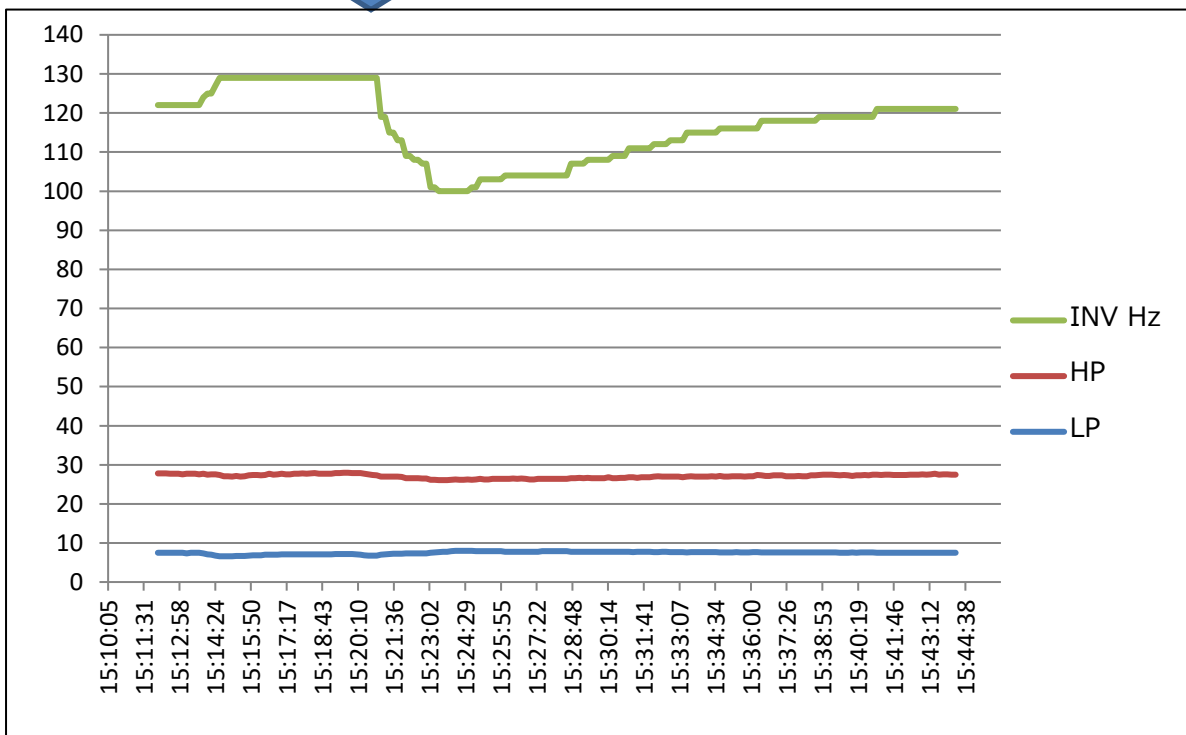
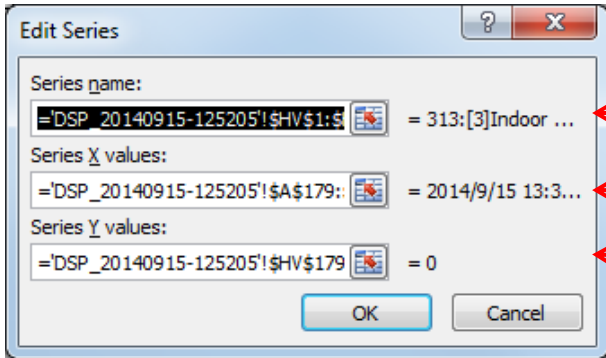


11. CSV data exporting process

- Click "Add", "Edit", "Delete" to process data

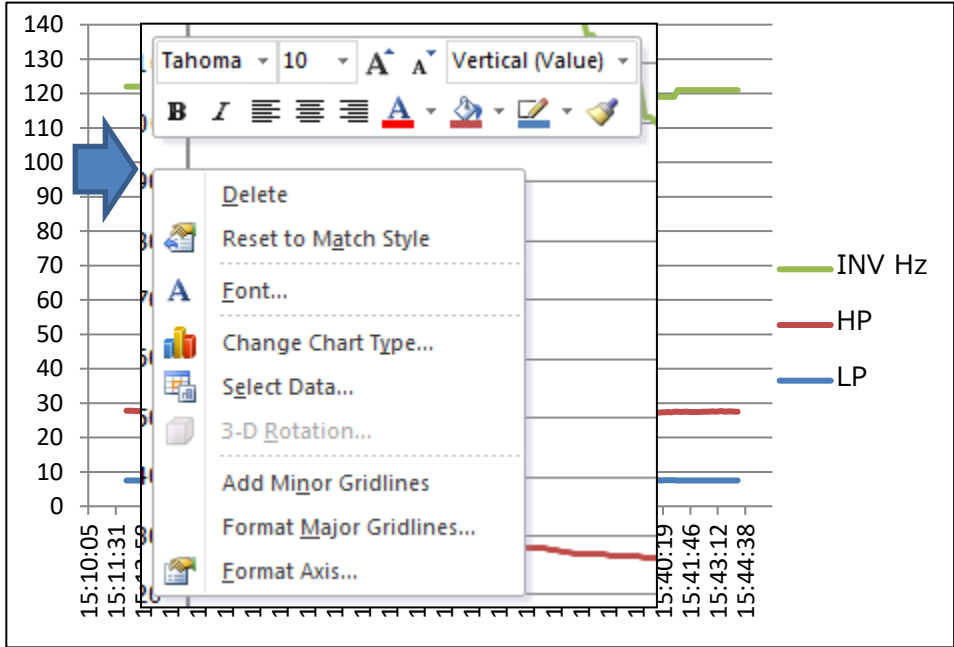


- Select the appropriate data

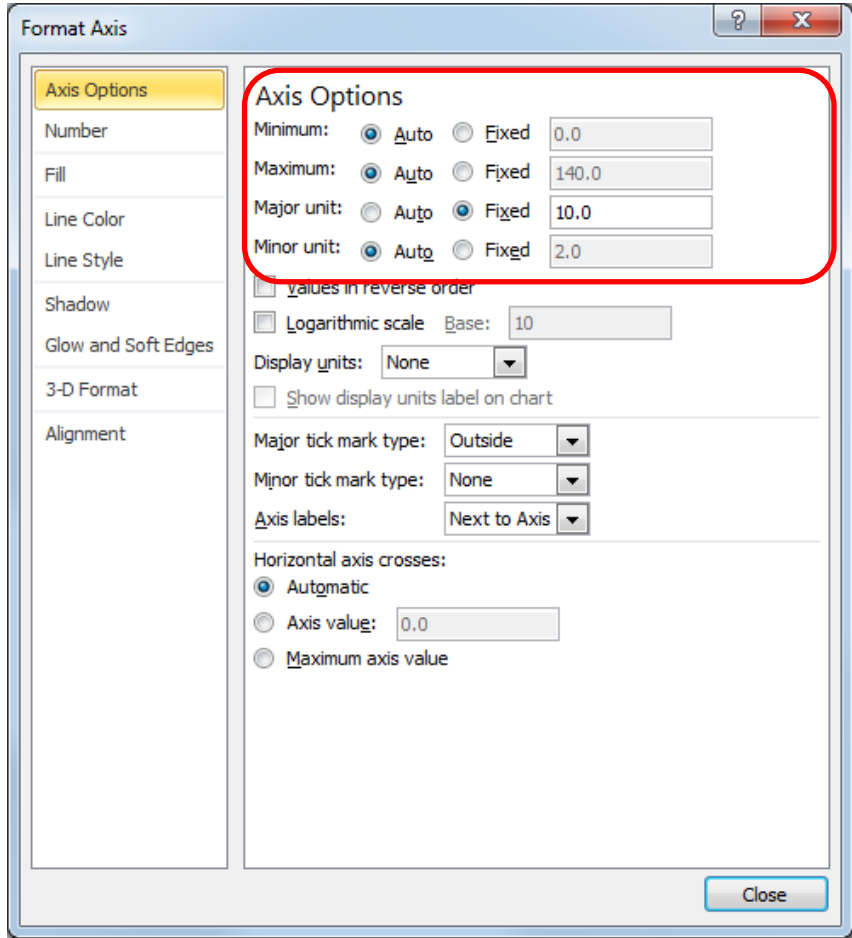


11. CSV data exporting process

- Right click on the Y axis scale value numbers to show the menu and select "Format Axis" to set axis options

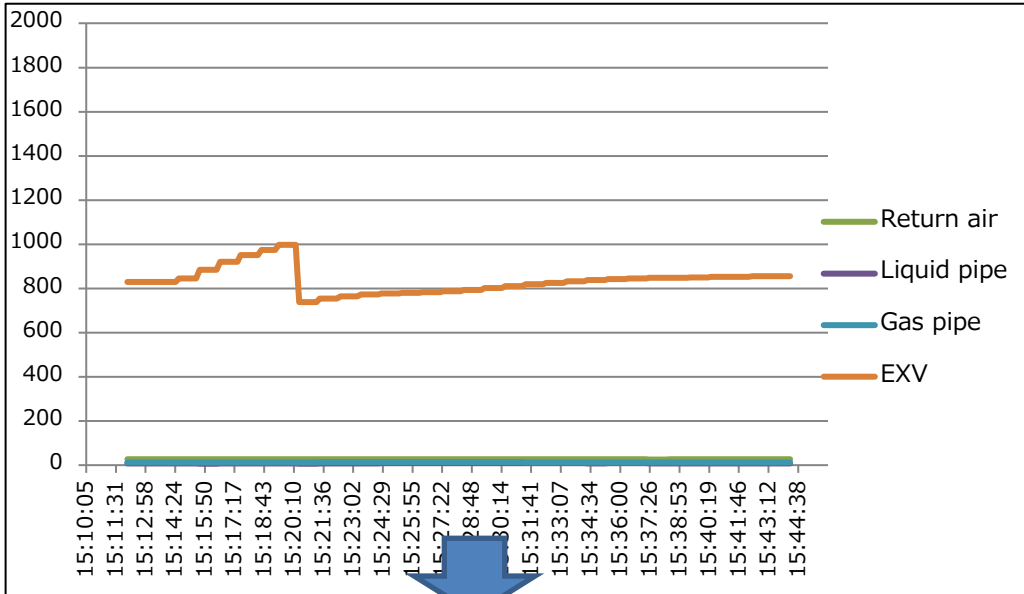


- Select "Axis options" to scale units, adjust max/min values

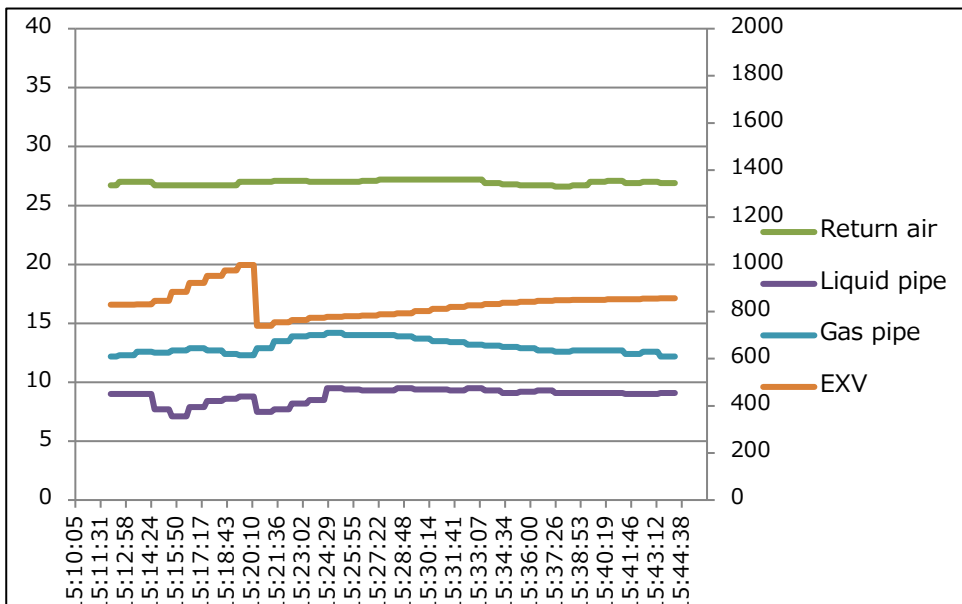


11. CSV data exporting process

- If value scale of data does not match in the same graph, they can belong to 2nd axis. By double clicking the line, "Set data series format" will appear, then select 2nd axis.



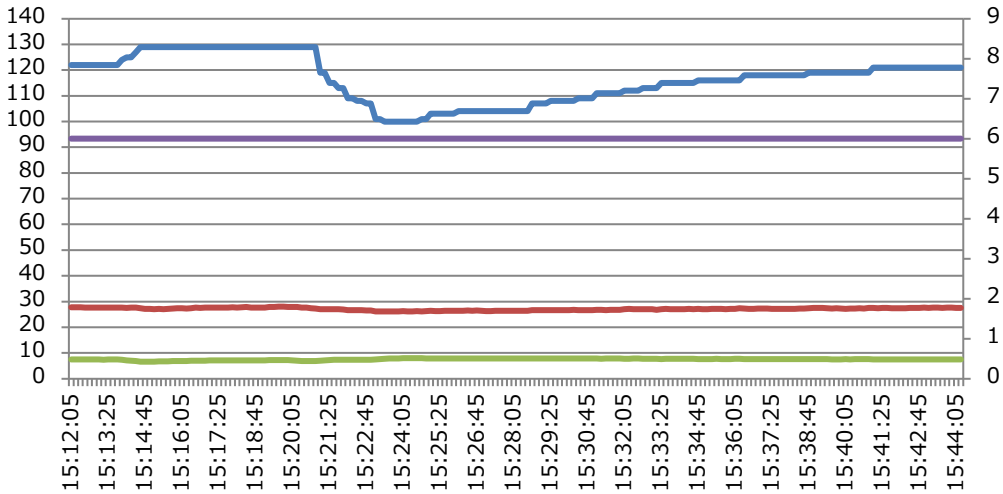
The 'Format Data Series' dialog box is shown with the 'Series Options' tab selected. Under 'Plot Series On', the 'Secondary Axis' radio button is selected, indicating that the data series will be plotted against the right-hand Y-axis.



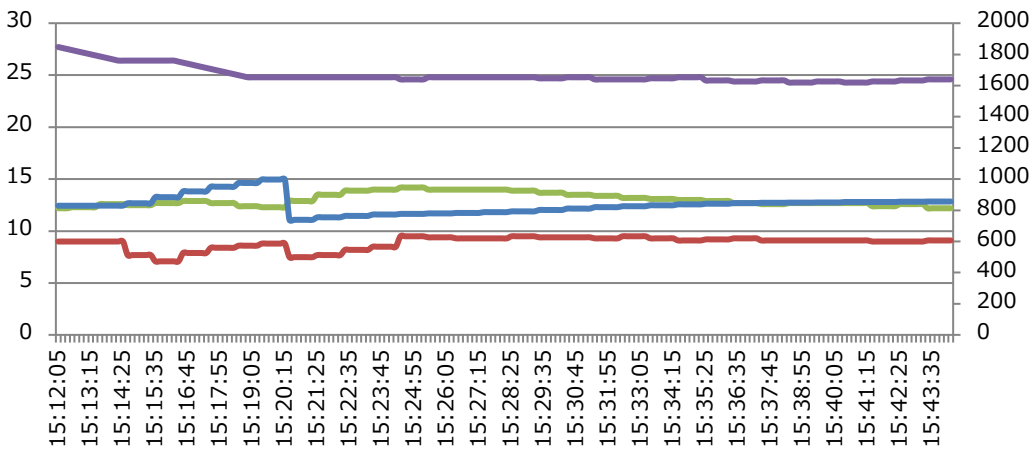
Sample 1

12-1. Normal data (VRV4 heat pump 12HP data as a sample)

ODU: INV(rps) HP(kg/cm²) LP(kg/cm²) Fan speed (step)



IDU: Liq. pipe Gas pipe Return air Indoor Exv



- Operating conditions: In/out distance=10m, level difference=3m, 3 IDU connected, connection ratio=100% , outdoor temp.=30deg, indoor temp.=30deg (when unit stops)

Normal data:

ODU	Comp (rps)	129
	Fan step	6
	HP	27.7kg
	LP	8.2kg
IDU	Return temp.	24.3
	Liquid pipe	9.1
	Gas pipe	12.2
	Exv pulse	850



Sample 2

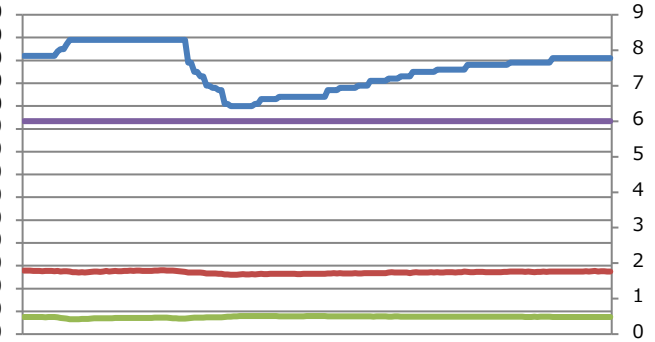
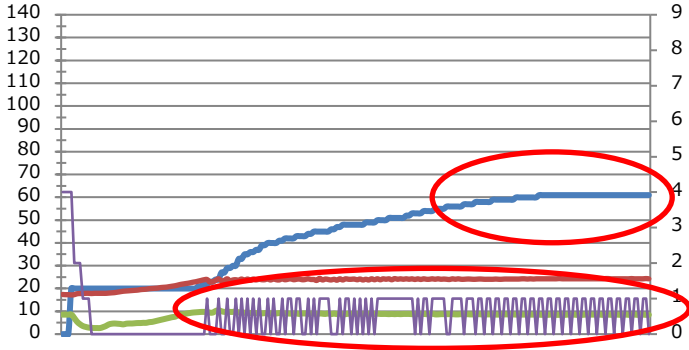
Sample data is for reference only due to the special conditions for test purpose.

12-2. Anomaly data

12-2.1: Refrigerant shortage

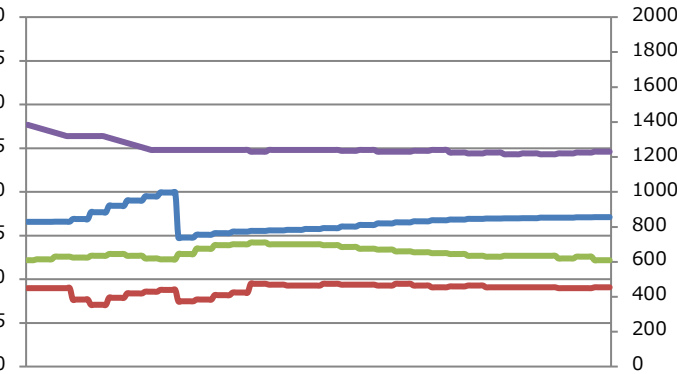
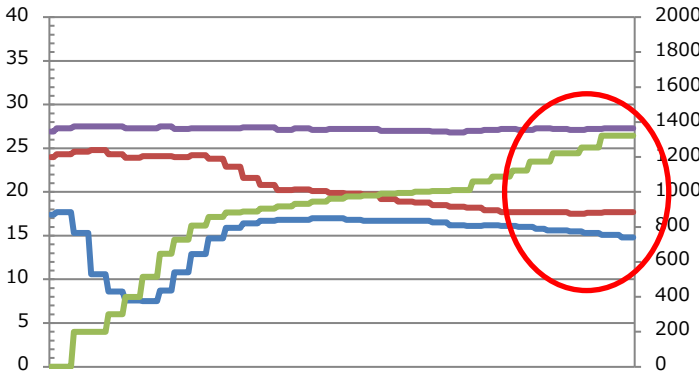
ODU:

— INV(rps) — HP(kg/cm²)
— LP(kg/cm²) — Fan speed (step)



IDU: **Not normal**

Normal



Not normal

Normal

— Liq. Pipe
— Gas pipe
— Return air
— Indoor Exv

• Data analysis:

ODU	Comp(rps)	61↓	129
	Fan step	1	6
	HP	24.2kg↓	27.7kg
	LP	8.4kg	8.2kg
	Disch.	58.3	73.4
IDU	Return	27.1↑	24.3
	Liquid pipe	15.1↑	9.1
	Gas pipe	17.7↑	12.2
	Exv pulse	1330↑	850

• Anomalies:

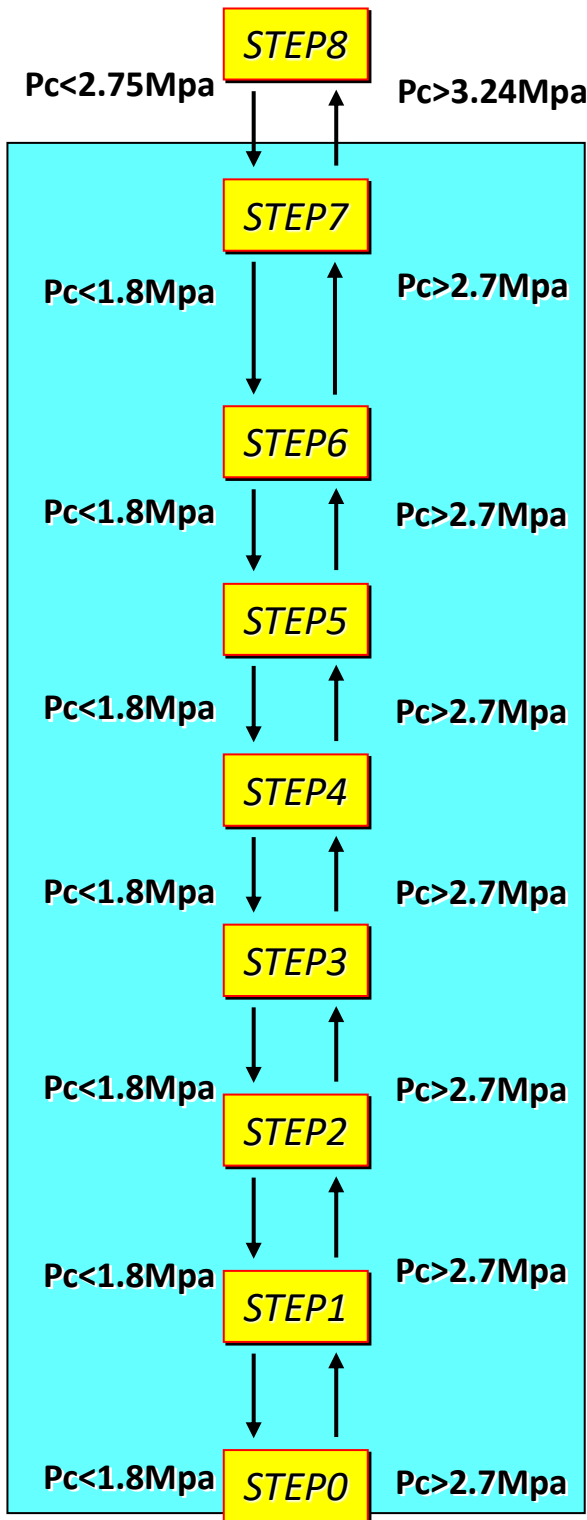
1. When fan speed is low, HP is still low
2. Compressor speed is limited at 50% of normal
3. IDU EXV keeps wide open, but return air temp is still high, superheat is high.



Sample 3

• Probable cause: refrigerant shortage

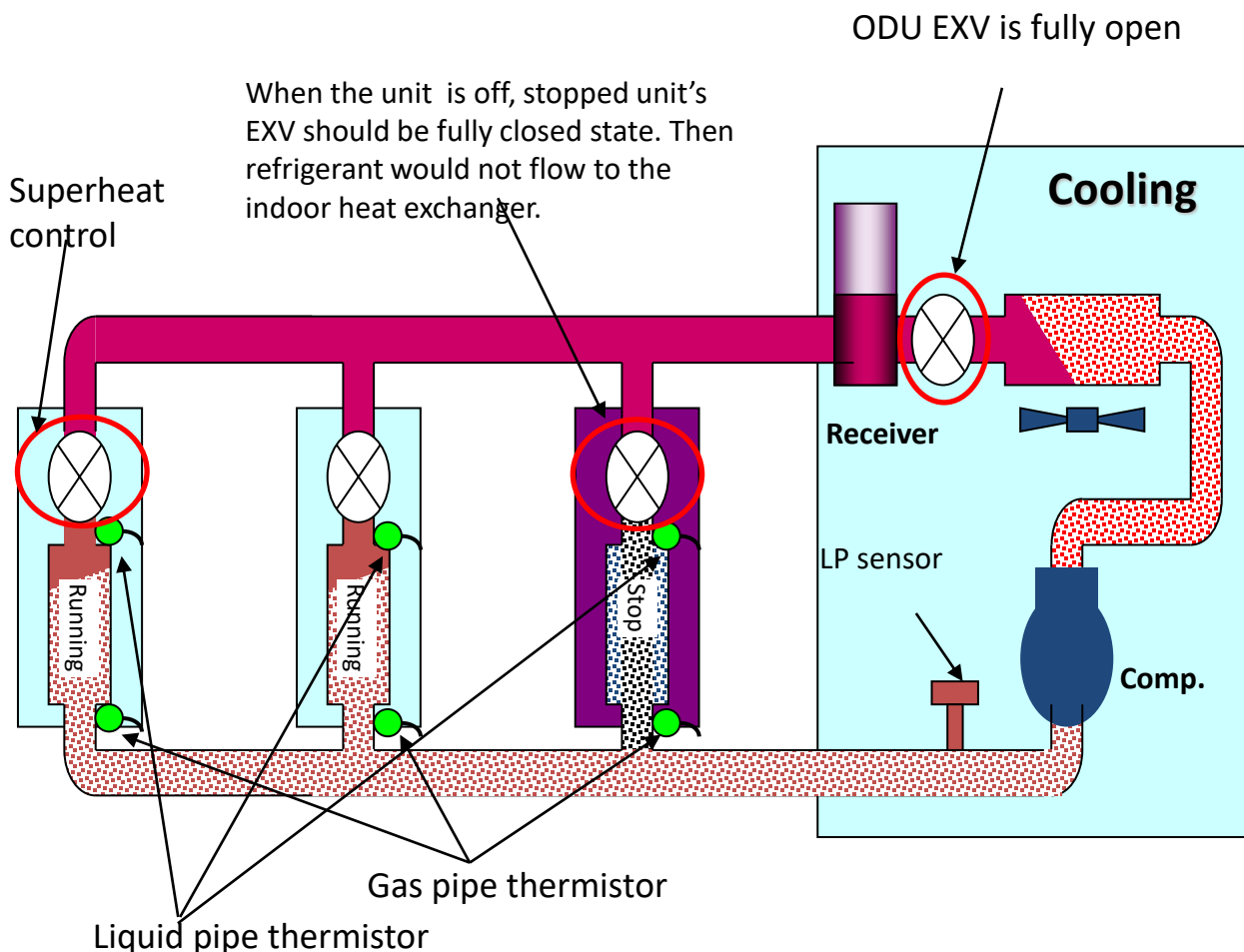
Fan speed control



Pc: pressure sensor feedback value

Each step is kept for 20sec after the check, then condition matches fan speed increases or decreases by 1 step and remains.

VRV system refrigerant control points (cooling mode)



■ Compressor capacity control

In response to the evaporator capacity, load changes in order to satisfy overall cooling capacity of the system according to the outdoor unit. Detected pressure value of LP sensor controls the capacity of the compressor to make the system's equivalent saturation refrigerant temperature of low pressure (evaporation temperature= T_e) close to the target value.

■ Indoor EXV superheat control

To keep superheat of the evaporator and to distribute the appropriate refrigerant flow with respect to the different loads of each indoor unit, indoor unit expansion valve is controlled to keep superheat value close to the target based on the detected indoor unit liquid/gas pipe thermistor readings.

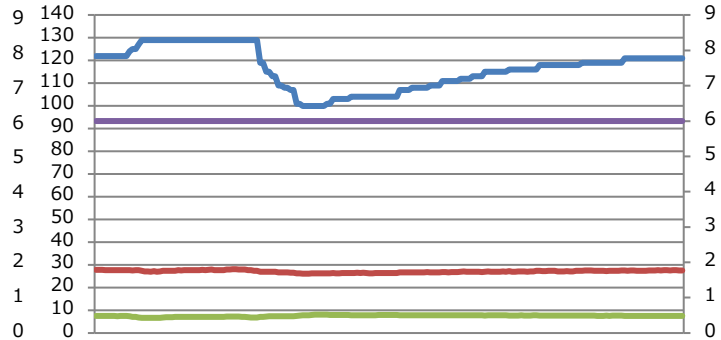
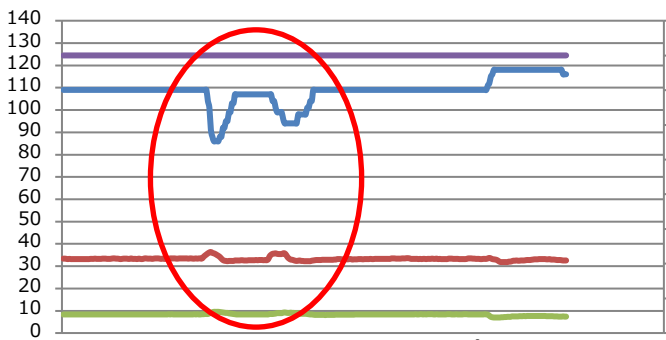
● Superheat (SH) = indoor gas pipe temp. – indoor liquid pipe temp.

12-2. Anomaly data

12-2.2: Excessive high pressure

ODU:

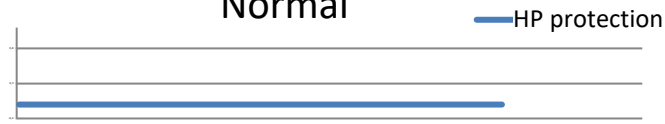
— INV(rps)
— HP(kg/cm²)
— LP(kg/cm²)
— Fan speed (step)



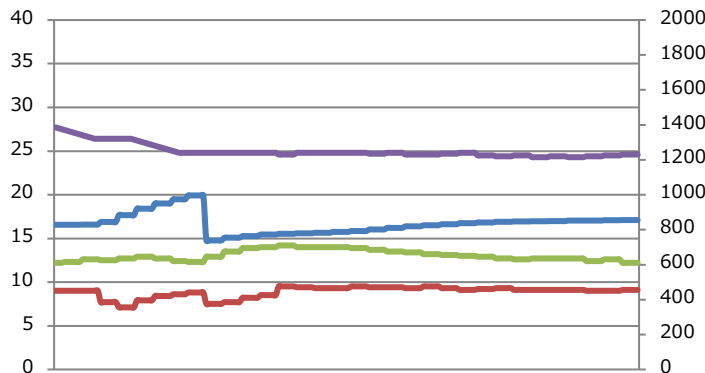
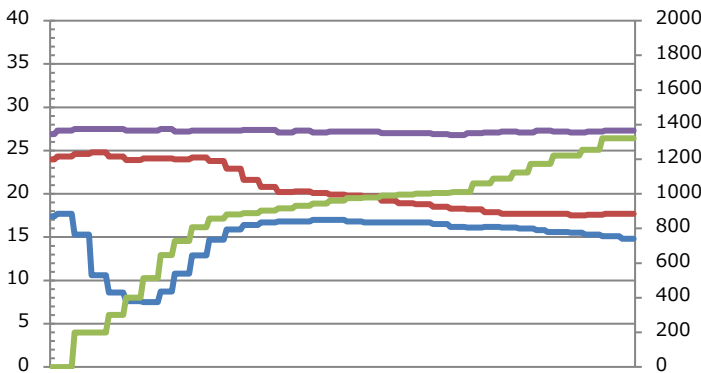
Not normal

Normal

High pressure protection control:



IDU:



Not normal

Normal

— Liq. Pipe
— Gas pipe
— Return air
— Indoor Exv

• Data analysis:

ODU	Comp. (rps)	99 ↓	129
	Fan step	8	6
	HP	38.2kg ↑	27.7kg
	LP	8.6kg	8.2kg
IDU	Return air	27.5 ↑	24.3
	Liquid pipe	14.8 ↑	9.1
	Gas pipe	20.2 ↑	12.2
	Exv pulse	1330 ↑	850

• Anomalies:

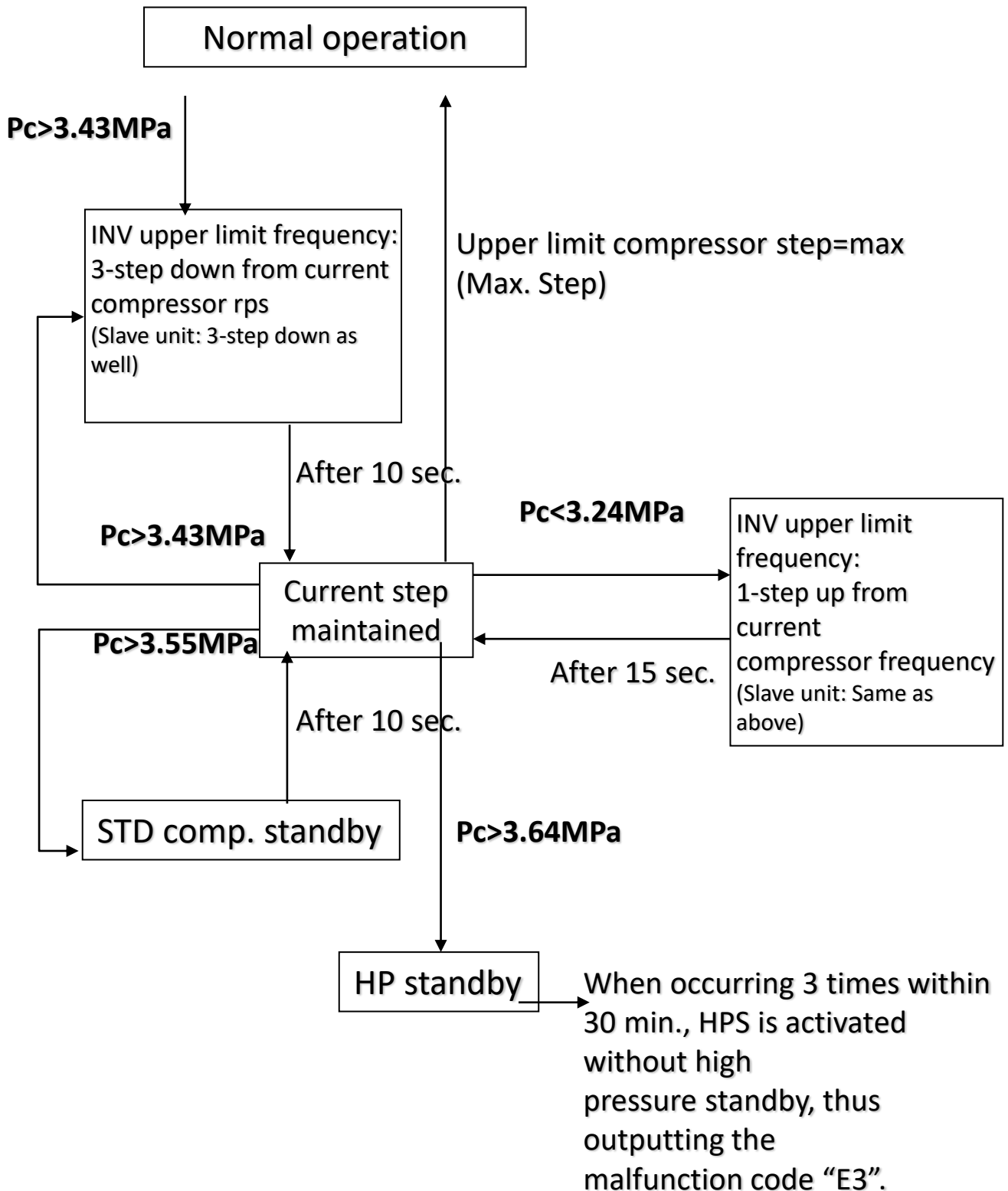
1. Fan step stayed at maximum but HP was still high, highest HP was 38.2kg
2. Indoor unit EXV was fully open, return air temp did not decline and liquid/gas pipe temp was high



Sample 4

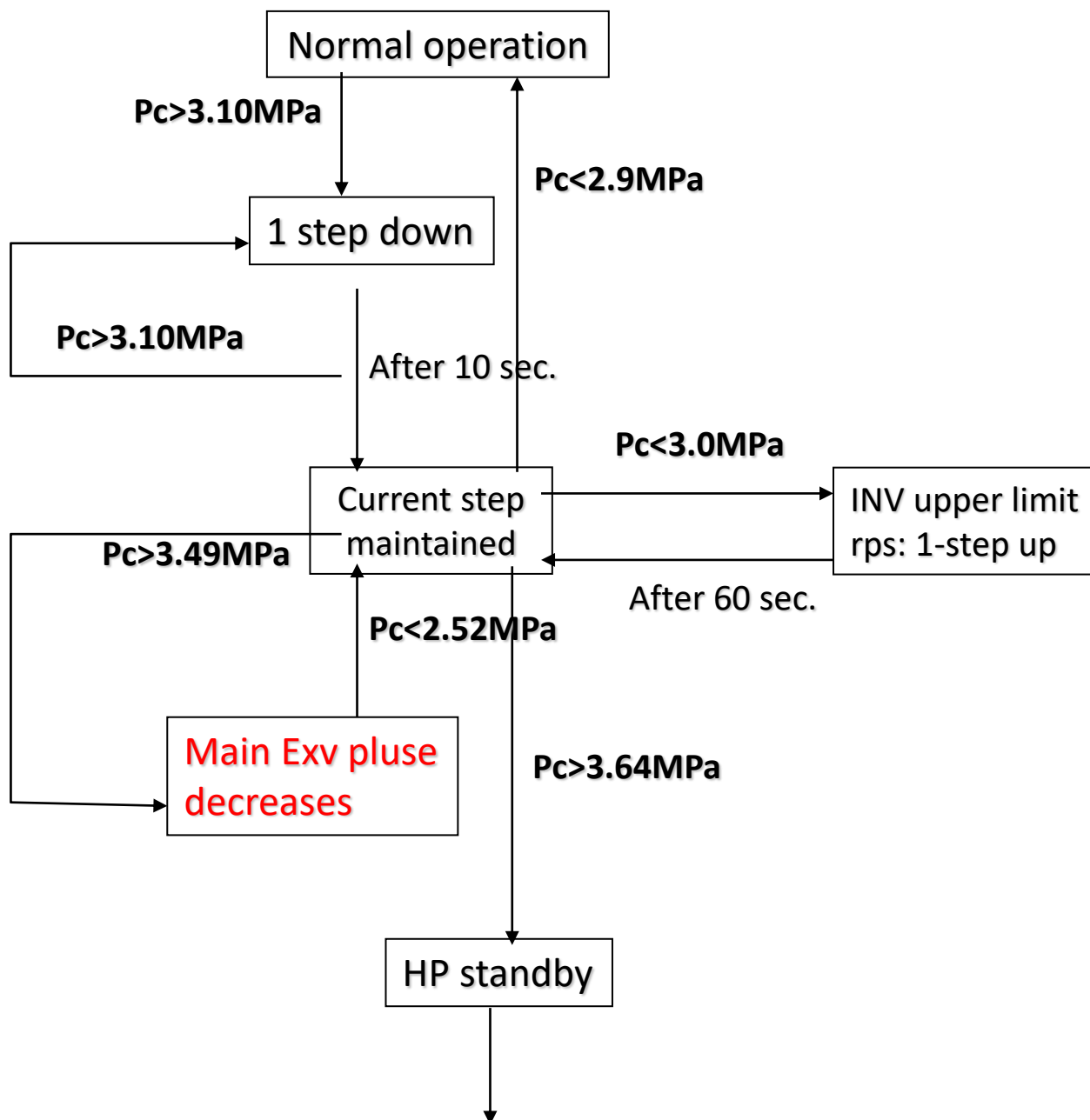
- Probable cause: faulty outdoor unit heat exchange, dirtiness of outdoor unit heat exchanger, outdoor unit fan motor failure

High pressure protection control (cooling)



From VRV3 HP service manual

High pressure protection control (heating)



When occurring 3 times within 30 min., HPS is activated without high pressure standby, thus outputting the malfunction code "E3" .

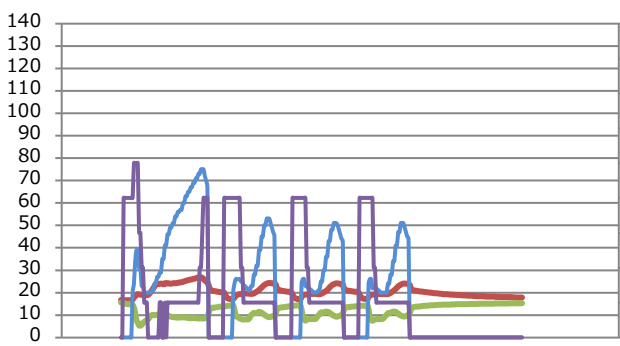
From VRV3 HP service manual

12-2. Anomaly data

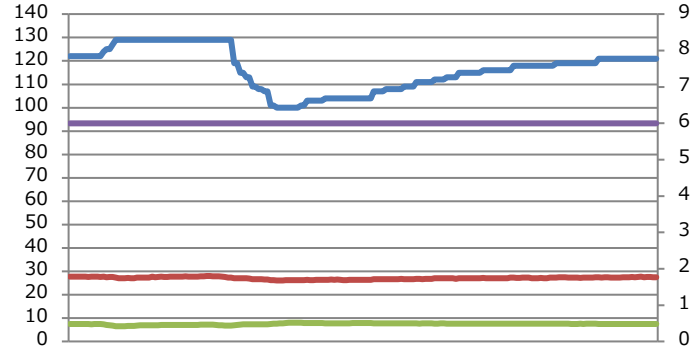
12-2.3: Inverter retry

ODU:

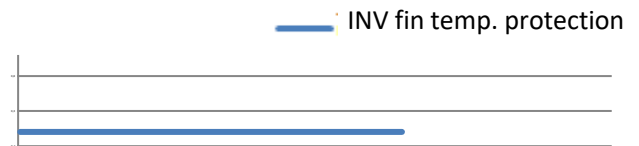
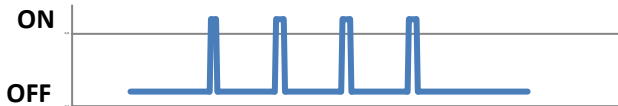
— INV(rps) — HP(kg/cm²)
— LP(kg/cm²) — Fan speed (step)



Not normal



Normal



• Data analysis:

ODU	Comp (rps)	47↓	129
	Fan step	4	6
	HP	28kg	27.7kg
	LP	8.6kg	8.2kg

Anomalies:

1. Compressor starts/stops frequently
2. INV temp. protection control activated

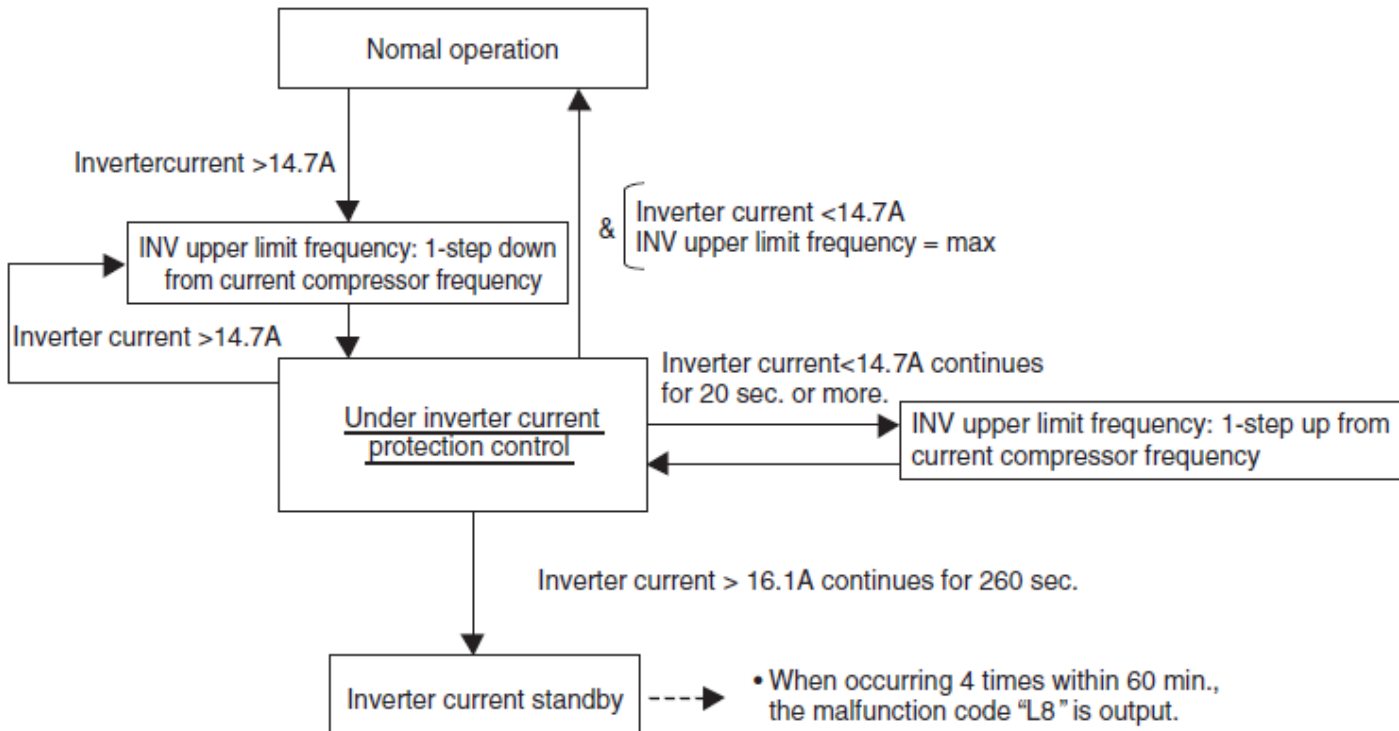
- Probable cause: Faulty heat exchange of INV fin, INV fin failure



Sample 5

Inverter protection control

[Inverter overcurrent protection control]



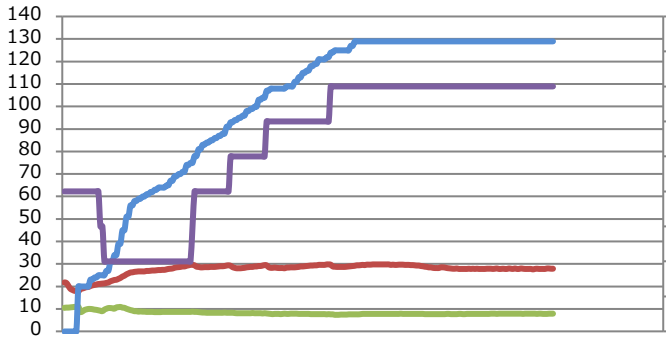
From VRV3 HP service manual

12-2. Anomaly data

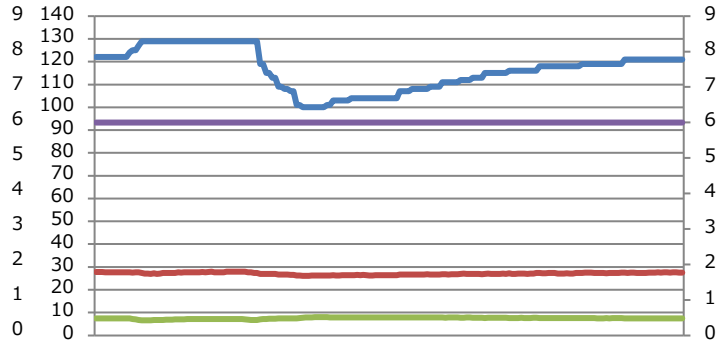
12-2.4: Refrigerant overcharge

ODU:

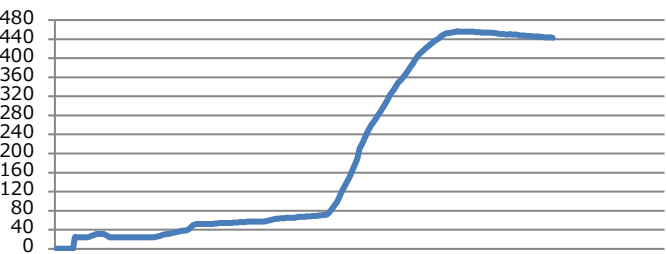
— INV(rps) — HP(kg/cm²)
 — LP(kg/cm²) — Fan speed (step)



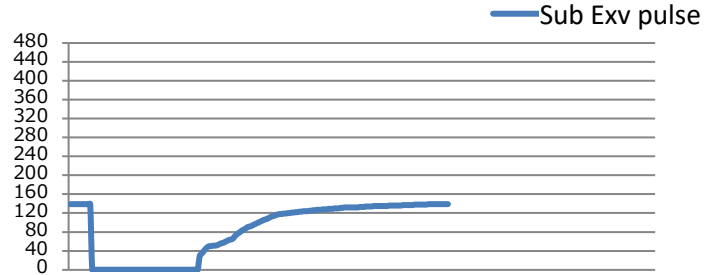
Not normal



Normal



Not normal



Normal

- Data analysis:

ODU	Comp (rps)	129	129
	Fan step	7	6
	HP	28.7kg↑	27.7kg
	LP	8.6kg	8.2kg
	Sub Exv pulse	430↑	139

Anomalies:

- Fan step is high, HP is high
- ODU sub-Exv is wide open close to full



Sample 6

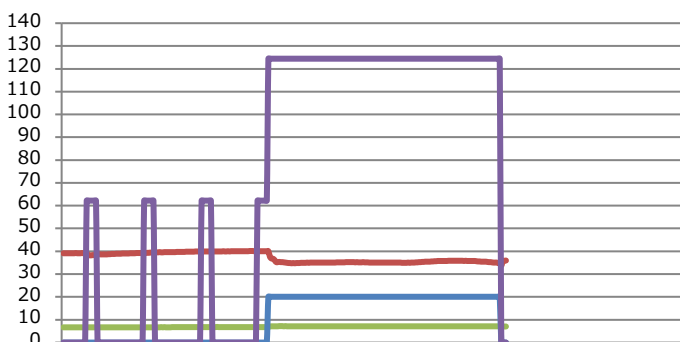
- Probable cause: Refrigerant overcharge

12-2. Anomaly data

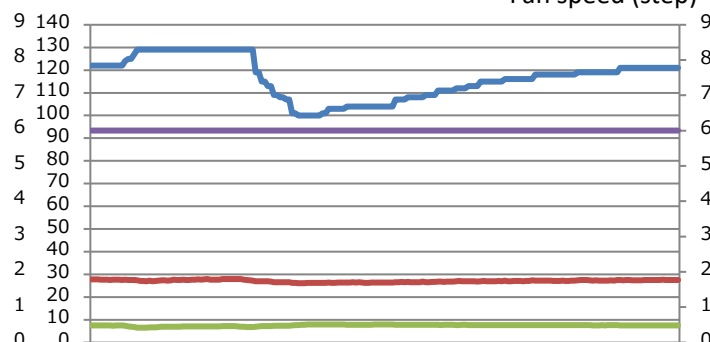
12-2.5: Pressure sensor error

ODU:

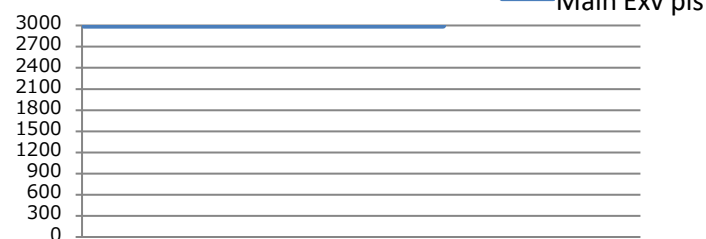
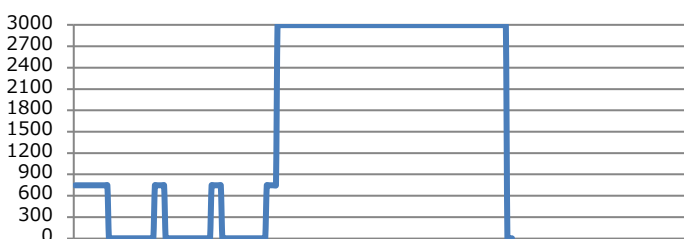
— INV(rps)
— HP(kg/cm²)
— LP(kg/cm²)
— Fan speed (step)



Not normal



Normal



• Data analysis:

ODU	Comp (rps)	129	129
	Fan step	8	6
	HP	38.7kg ↑	27.7kg
	LP	7.1kg ↓	8.2kg
	Main Exv pls	3000	3000

Anomalies:

1. Pressure differential is high when the unit stops
2. Fan step is maximum at main Exv is fully open, but the unit cannot level the pressure.

- Probable cause: pressure sensor failure, control PCB failure

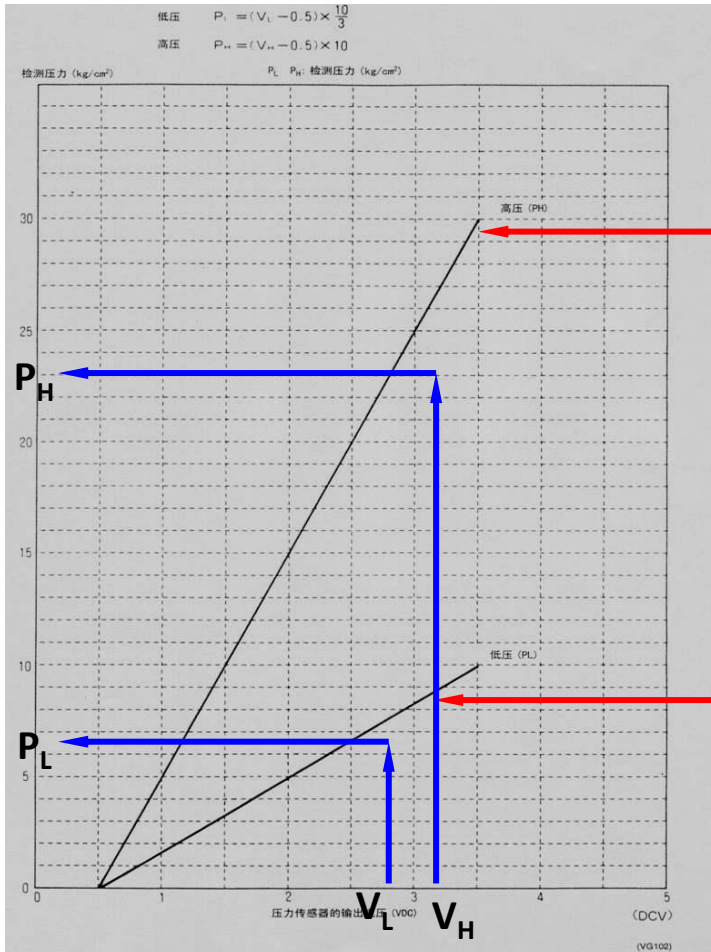
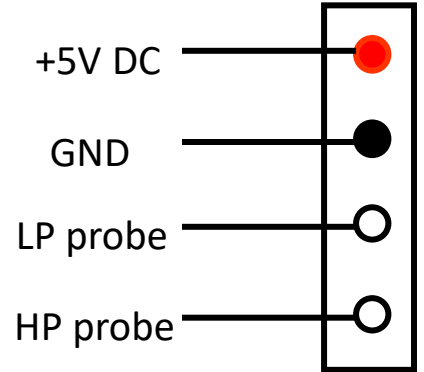


Sample 7

Pressure sensor check

Check points:

1. Measure voltage from pressure sensor red/black line not normal → PCB failure
2. Compare pressure value/voltage chart value during the machine stops and there is pressure differential → sensor failure



For R22 models

$$P_H = (V_H - 0.5) \times 10 \text{ [kg/cm}^2\text{]}$$

For R410A models

$$P_H = 1.38V_H - 0.69 \text{ [Mpa]} \text{ (R410A)}$$

For R22 models

$$P_L = (V_L - 0.5) \times \frac{10}{3} \text{ [kg/cm}^2\text{]} \text{ (R22)}$$

For R410A models

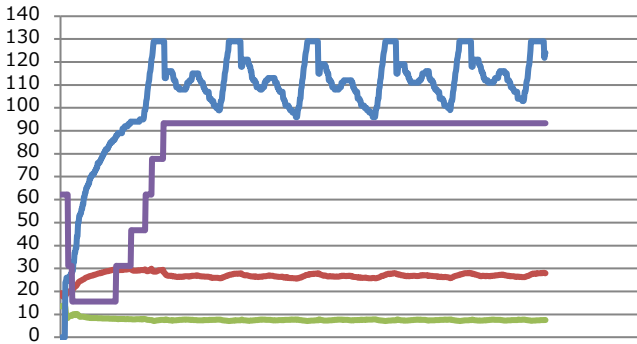
$$P_L = 0.57V_L - 0.28 \text{ [MPa]} \text{ (R410A)}$$

12-2. Anomaly data

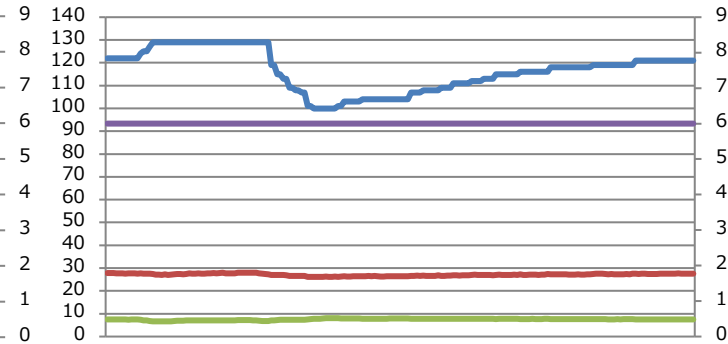
12-2.6: Discharge pipe sensor error

ODU:

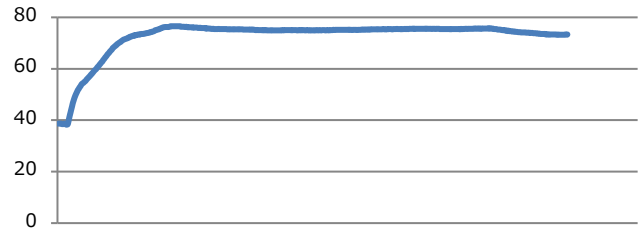
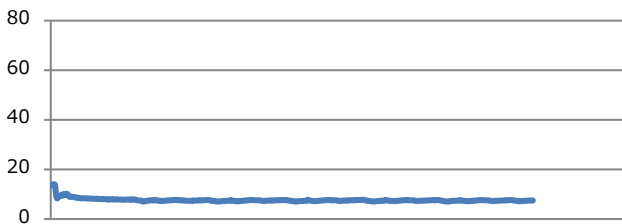
— INV(rps) — HP(kg/cm²)
— LP(kg/cm²) — Fan speed (step)



Not normal



Normal



— Disch. pipe temp.

- Data analysis:

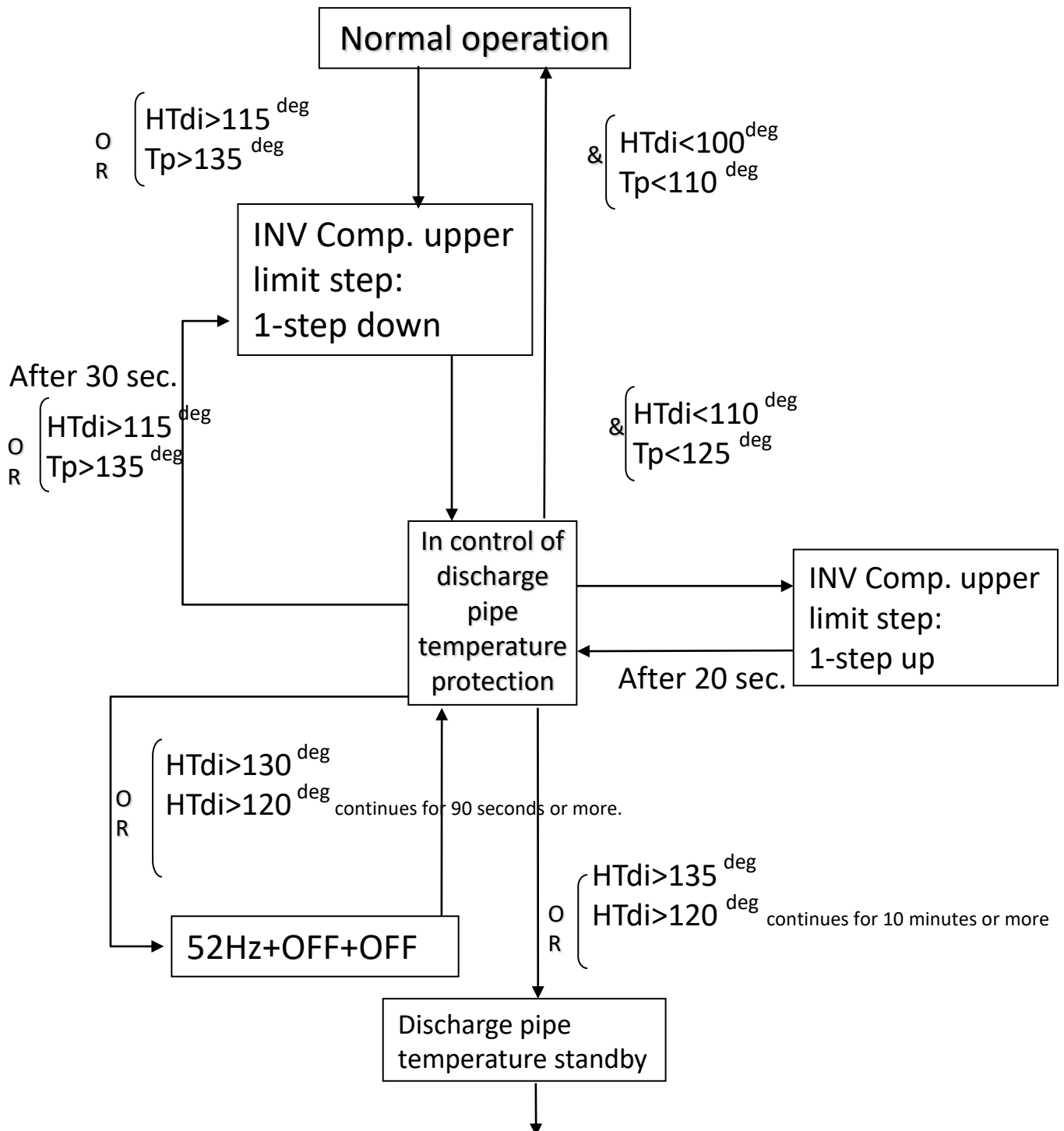
ODU	Comp (rps)	119	129
	Fan step	6	6
	HP	27.7kg	27.7kg
	LP	7.6kg	8.2kg
	Discharge temp.	7.3	75.2

Anomalies:

- Compressor rps repeatedly up/down
- Discharge pipe temp. is strangely low

- Probable cause: discharge pipe sensor failure

Discharge Pipe Protection Control



When occurring 3 times within 100 min., the malfunction code "F3" is output.

From VRV3 HP service manual

Thermistor Resistance / Temperature Characteristics

Outdoor unit thermistors for discharge pipe

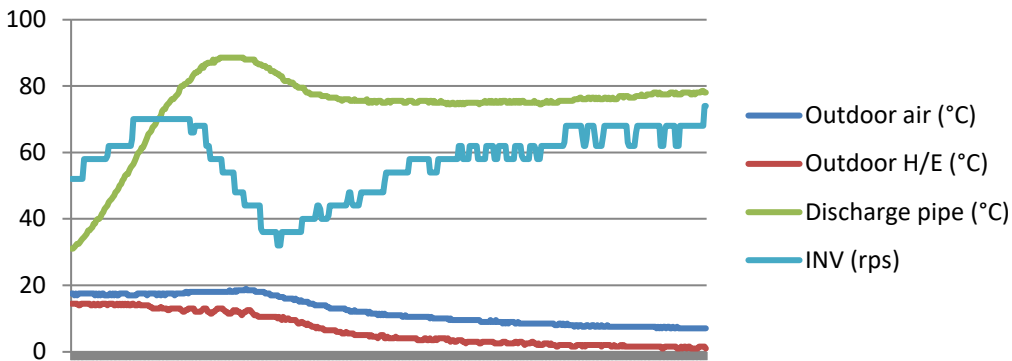
T °C	kΩ
-30	3257.371
-25	2429.222
-20	1827.883
-15	1387.099
-10	1061.098
-5	817.9329
0	635.0831
5	496.5712
10	391.0070
15	309.9511
20	247.2696
25	198.4674
30	160.2244
35	130.0697
40	106.1517
45	87.0725
50	71.7703
55	59.4735
60	49.5180
65	41.4168
70	34.7923
75	29.3499
80	24.8586
85	21.1360
90	18.0377
95	15.4487
100	13.2768
105	11.4395
110	9.8902
115	8.5788
120	7.4650
125	6.5156
130	5.7038
135	5.0073
140	4.4080
145	3.8907
150	3.4429

Air, heat exchanger

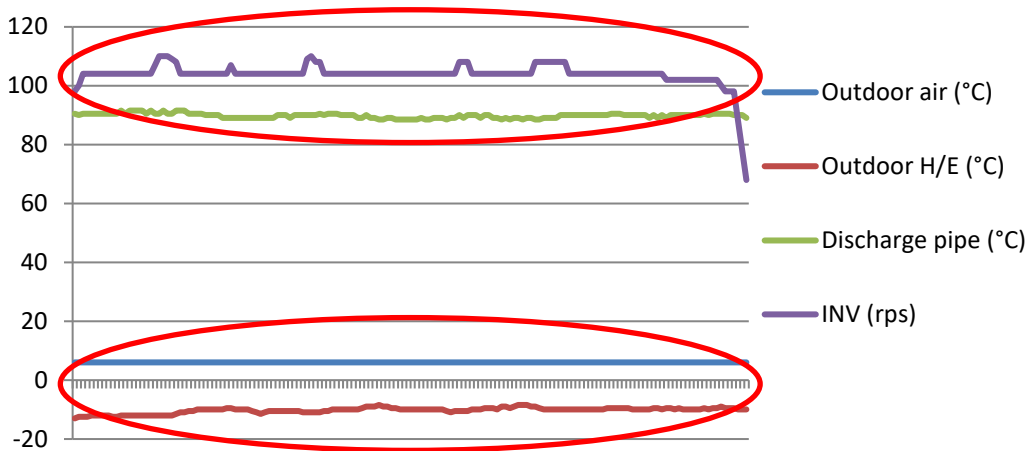
T °C	kΩ
-30	361.7719
-25	265.4704
-20	196.9198
-15	147.5687
-10	111.6578
-5	85.2610
0	65.6705
5	50.9947
10	39.9149
15	31.4796
20	25.0060
25	20.0000
30	16.1008
35	13.0426
40	10.6281
45	8.7097
50	7.1764
55	5.9407
60	4.9439
65	4.1352
70	3.4757
75	2.9349
80	2.4894
85	2.1205
90	1.8138
95	1.5575
100	1.3425
105	1.1614

12-2. Anomaly data

12-2.7: Clogged ODU heat exchanger



Normal



Not normal

• Data analysis:

ODU		Normal operation	Not normal operation
	Outdoor air	7	5
	Outdoor H/E	2	-12 ↓
	Discharge pipe	75	90 ↑
	Inverter	70	105 ↑

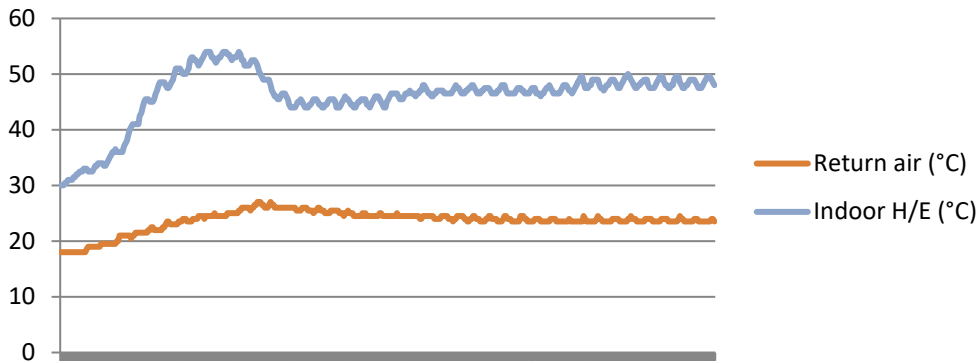
Anomalies:

1. Compressor frequency at maximum and high compressor discharge
2. Large temperature difference between outdoor ambient and H/E temperature

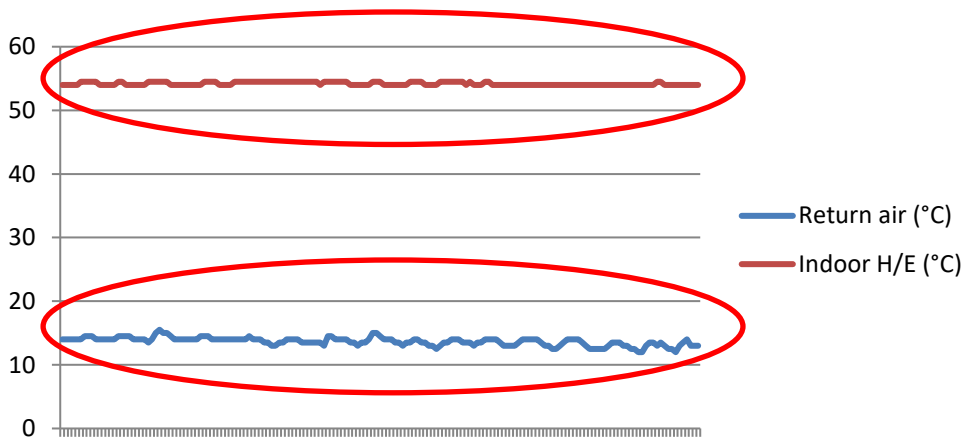
- Probable cause: Clogged or blocked outdoor heat exchanger

12-2. Anomaly data

12-2.8: Clogged IDU heat exchanger



Normal



Not normal

- Data analysis:

IDU		Normal operation	Not normal operation
	Return air temp.	24	14 ↓
	Indoor heat exchanger	48	54 ↑

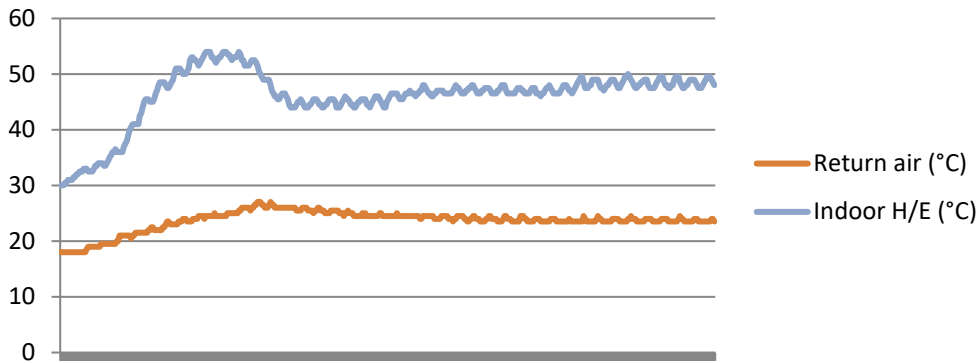
Anomalies:

1. Indoor heat exchanger temperature remains very high
2. Return air temperature remains low and thermo off is not reached

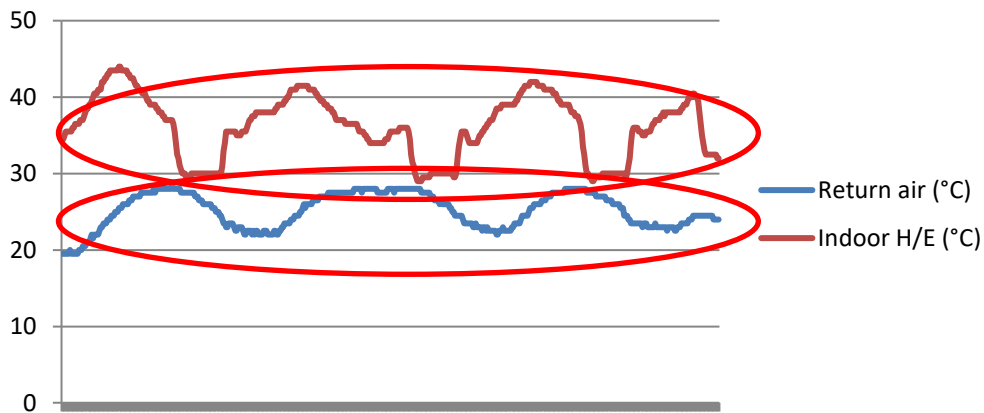
- Probable cause: Clogged or blocked indoor heat exchanger

12-2. Anomaly data

12-2.9: IDU discharged air short circuit



Normal



Not normal

- Data analysis:

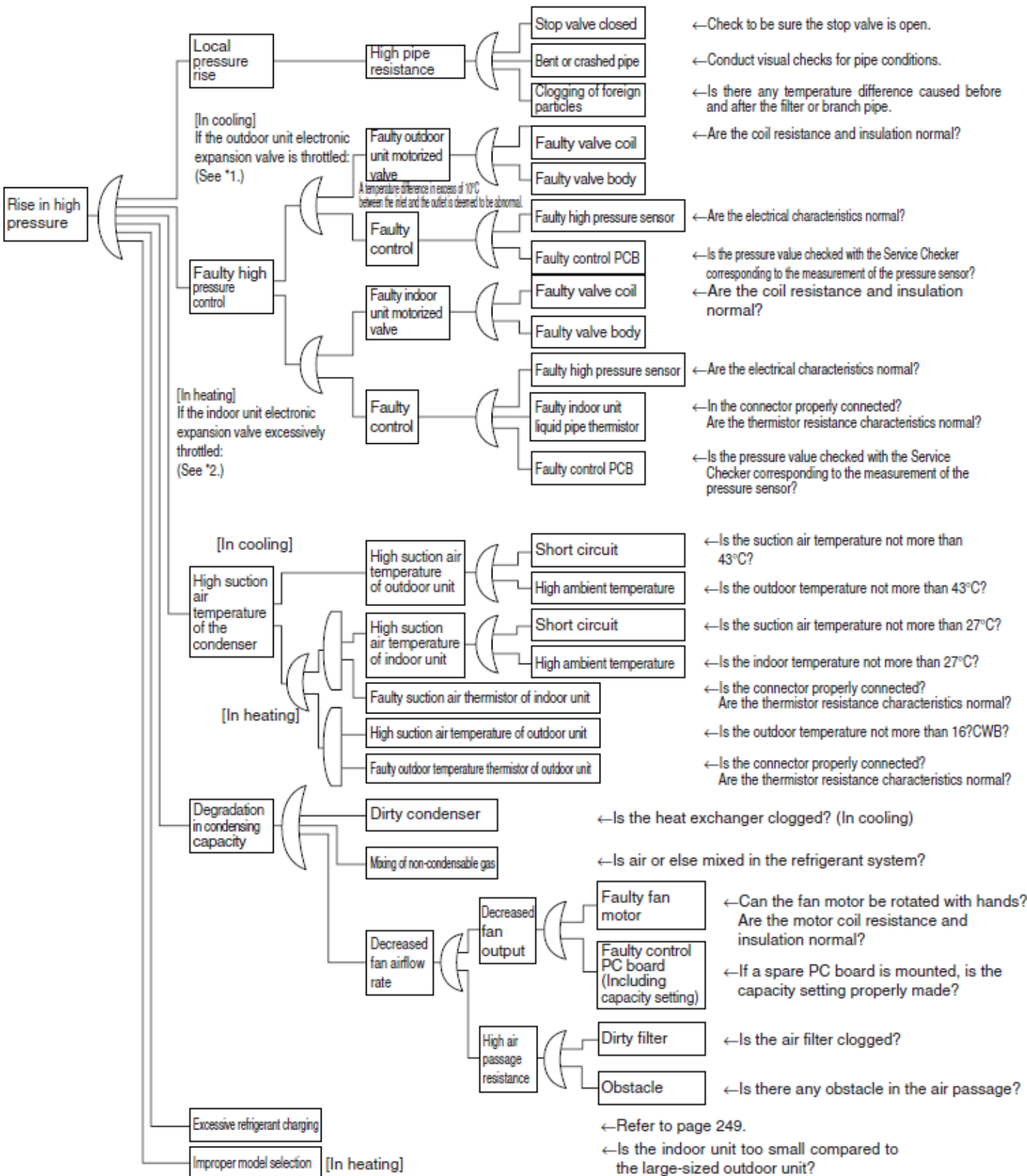
IDU		Normal operation	Not normal operation
	Return air temp.	24	Strongly fluctuating
	Indoor heat exchanger	48	Strongly fluctuating

Anomalies:

- Average indoor heat exchanger temperature is low and strongly fluctuating
- Return air temperature is high and also strongly fluctuating.

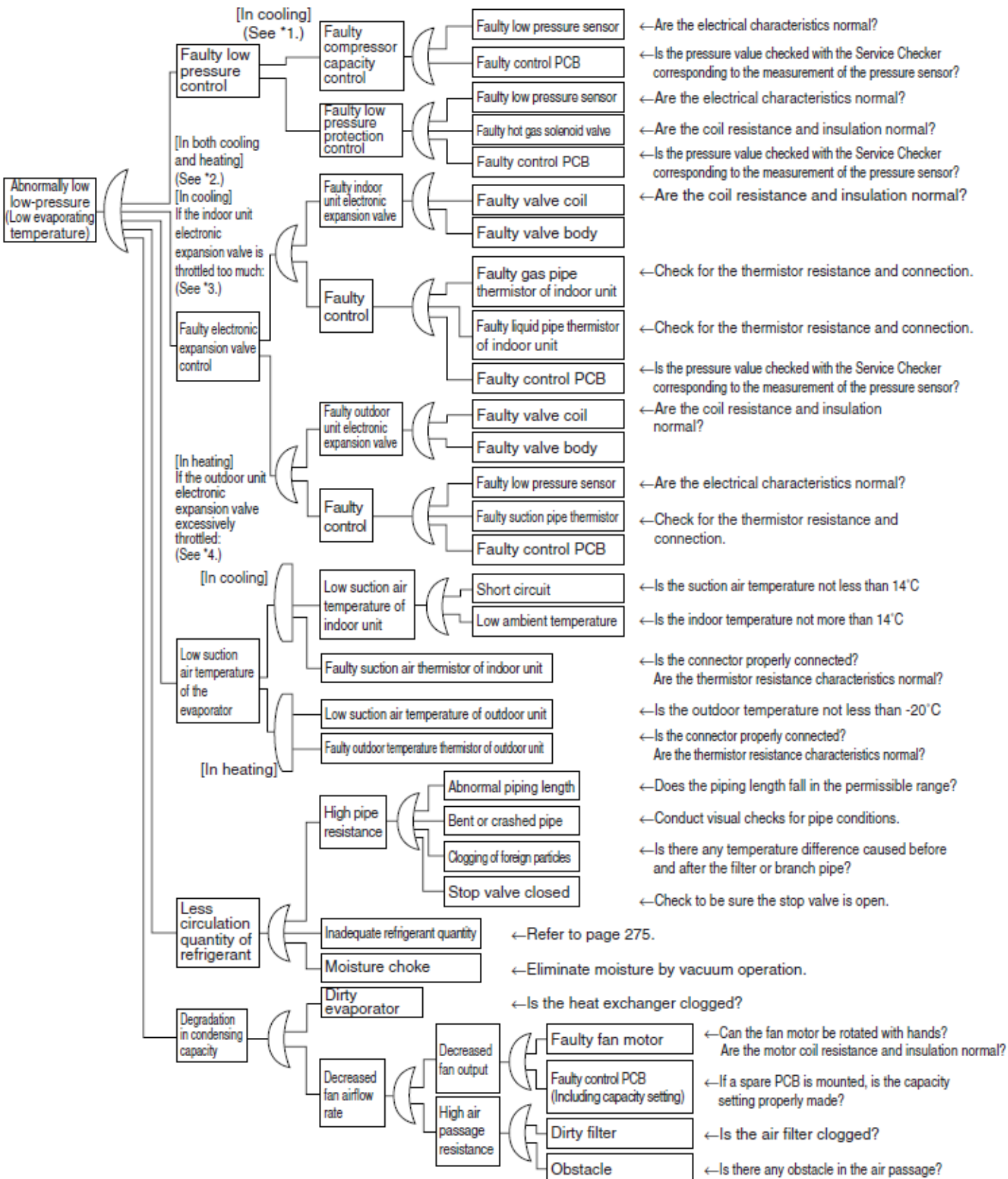
- Probable cause: Short circuit of indoor air

Check for causes of rise in high pressure



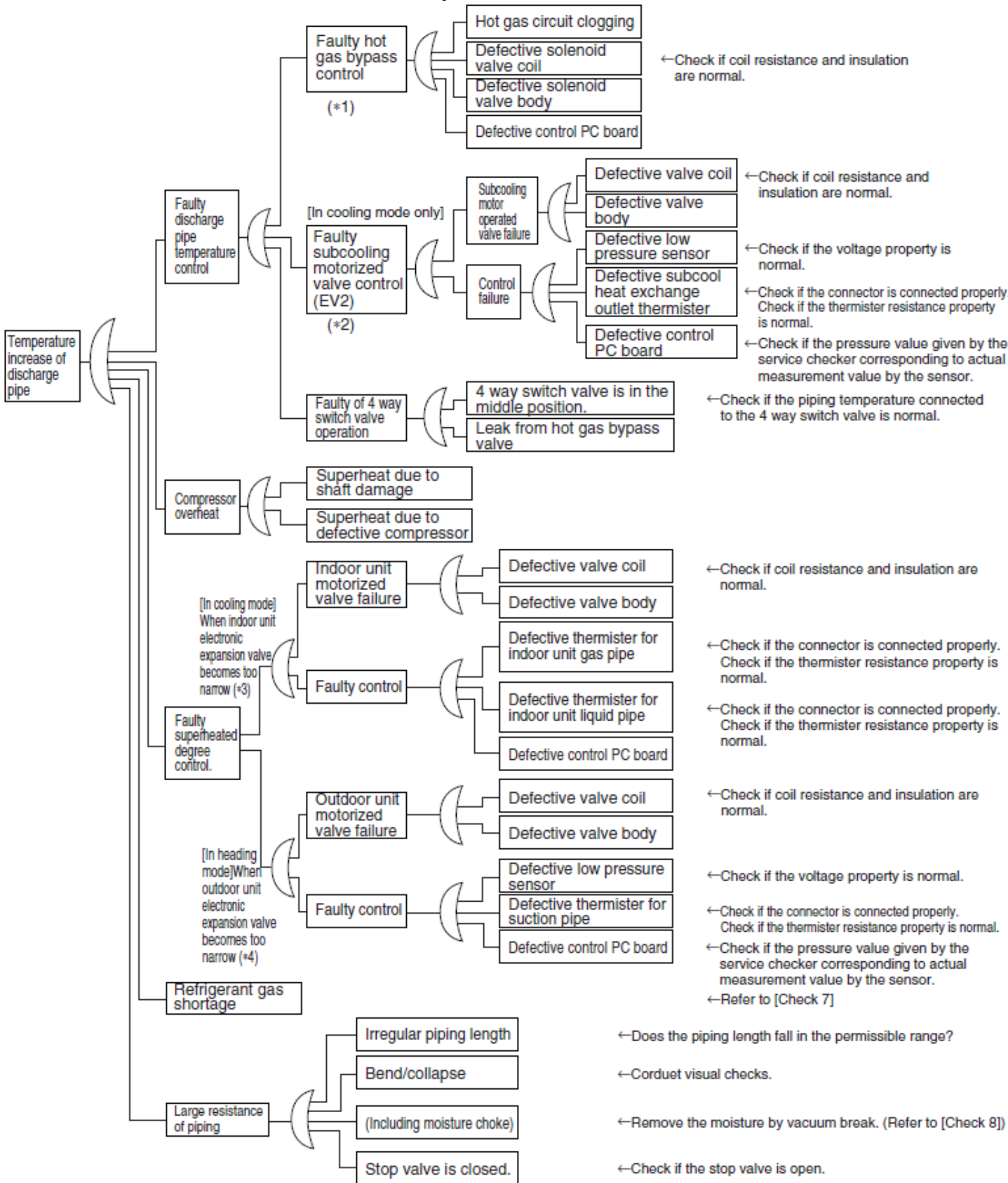
13. Fault tree analysis (FTA)

Check for causes of drop in low pressure



13. Fault tree analysis (FTA)

Check the Factors of Overheat Operation

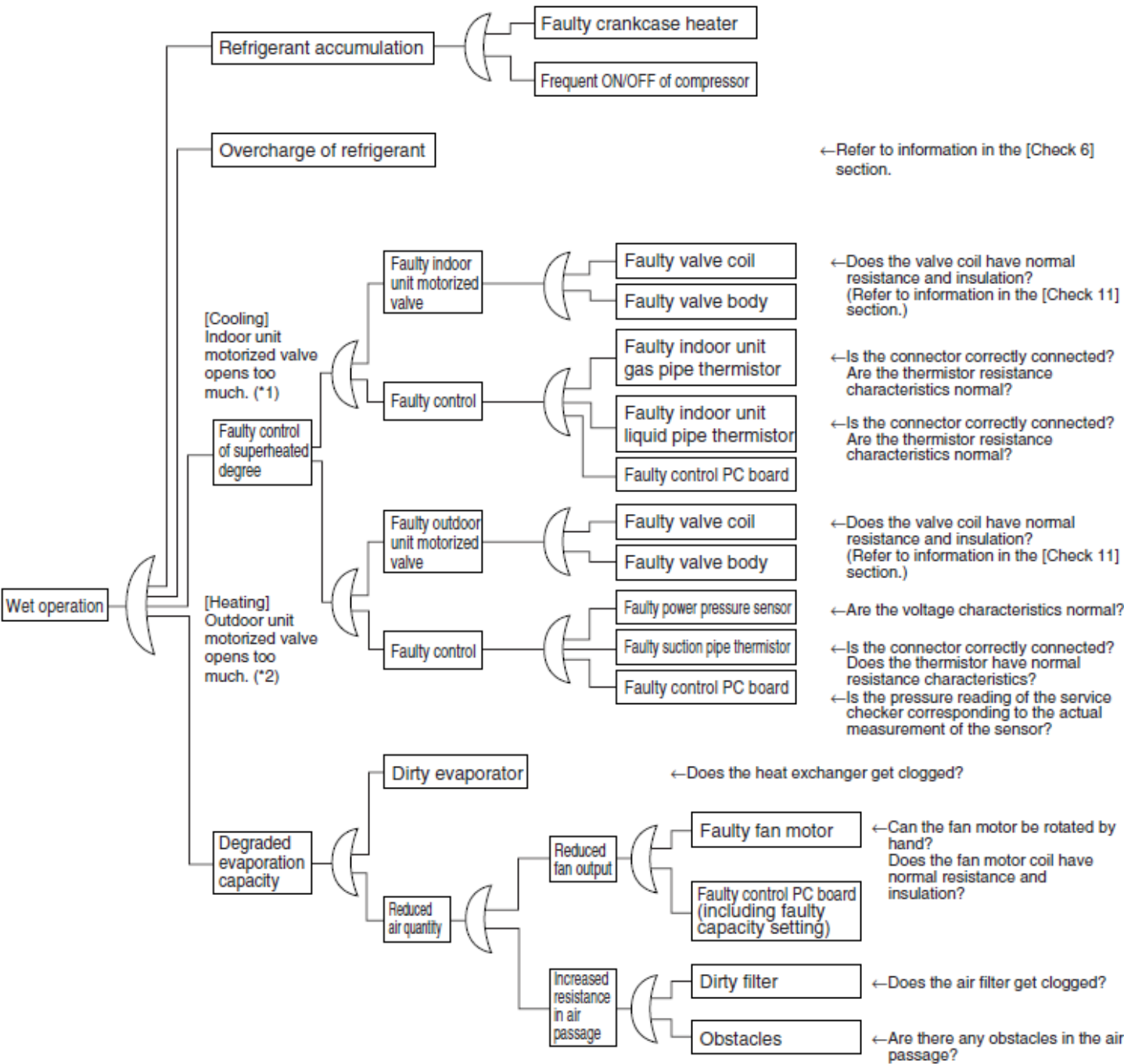


Note 1: Refrigeration is controlled by the indoor electronic expansion valve

Note 2: "Superheat control of outdoor unit heat exchanger" by outdoor unit electronic expansion valve during heating,

13. Fault tree analysis (FTA)

Check for causes of wet operation



Note 1: Refrigeration is controlled by the indoor electronic expansion valve

Note 2: "Superheat control of outdoor unit heat exchanger" by outdoor unit electronic expansion valve during heating,

14. Points to check upon symptoms

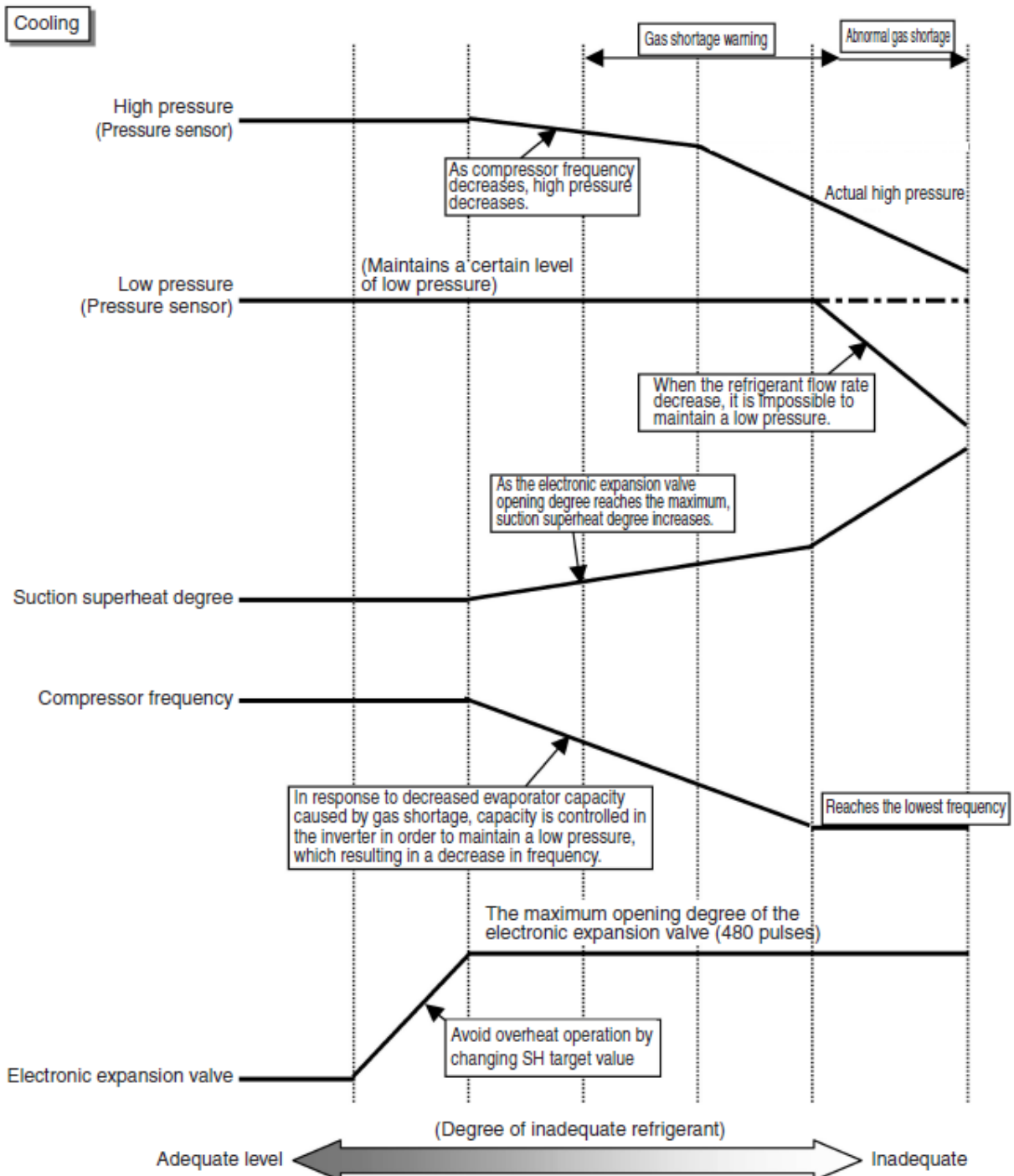
Check for Inadequate Refrigerant

As criteria for judging whether refrigerant is inadequate or not, refer to the following operating conditions.

<Diagnosis of inadequate refrigerant>

In cooling operation

- ① As suction superheat degree increases due to gas shortage, the electronic expansion valve tends to open (opens fully) in order to avoid overheat operation.
- ② In response to decreased evaporator capacity caused by gas shortage, capacity is controlled in the inverter in order to maintain low pressure, which results in a decrease in frequency.
- ③ Because of (1) and (2) above, the compressor frequency decreases despite a large difference (large load) between temperature set by the remote controller and indoor suction temperature, resulting that cooling capacity becomes unavailable.
- ④ If gas shortage worsens, the electronic expansion valve remains fully open and suction superheat degree further increases. In addition, because the compressor frequency drops to the level of the lowest frequency (52 Hz) and the refrigerant flow rate decrease, low pressure cannot be maintained.



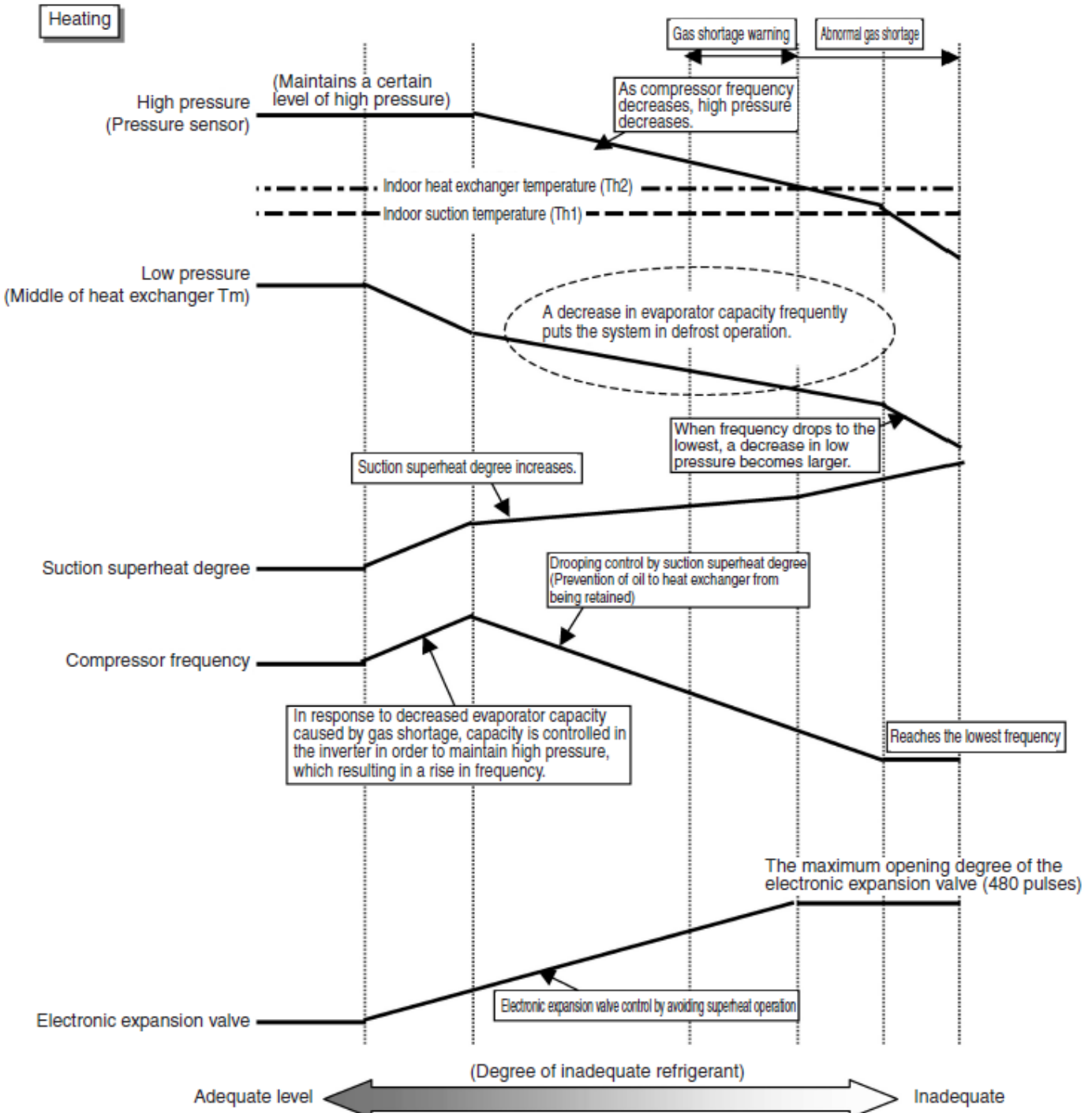
14. Points to check upon symptoms

Check for Inadequate Refrigerant

<Diagnosis of inadequate refrigerant>

In heating operation

- ① As suction superheat degree increases due to gas shortage, the electronic expansion valve tends to open (opens fully) to avoid overheat operation.
- ② As suction superheat degree increases due to gas shortage, compressor frequency decreases because suction superheat degree is controlled in order to prevent oil to the outdoor heat exchanger from being retained.
- ③ Because of (1) and (2) above, evaporator capacity and compressor frequency decrease despite a large difference (large load) between temperature set by the remote controller and indoor suction temperature, resulting that high pressure cannot be maintained and heating capacity becomes unavailable. Also a decrease in evaporator capacity frequently puts the system in defrost operation.
- ④ If gas shortage worsens, high pressure becomes smaller than saturated pressure equivalent to indoor heat exchanger temperature (or indoor suction temperature).



14. Points to check upon symptoms

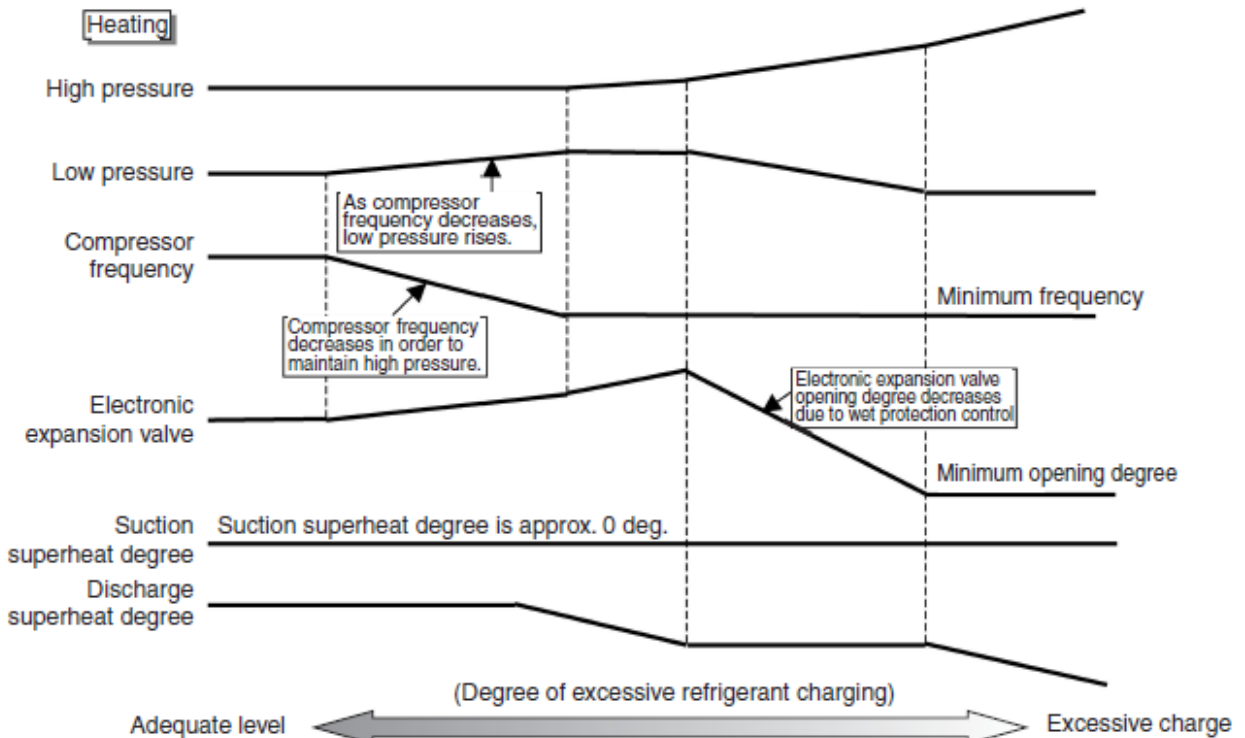
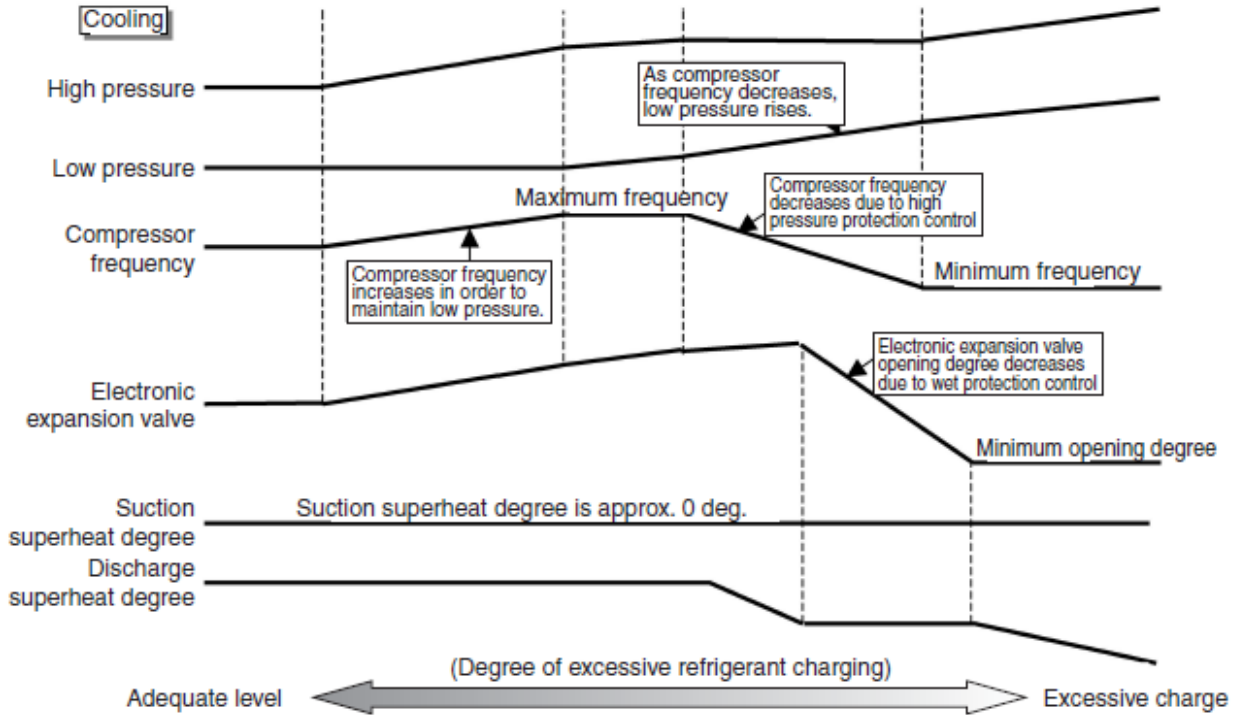
Check for Excessive Refrigerant Charging

As criteria for judging whether refrigerant is excessively charged or not, refer to the following operating conditions.

<Diagnosis of excessive refrigerant charging>

In cooling operation

- ① Because high pressure rises due to excessive charging, overload control is carried out and capacity tends to run short.
- ② Considering pressure load, compressor discharge pipe temperature is low.
- ③ Subcooled degree of condensate liquid becomes large. Therefore, temperature of blown air passing through subcooled part decreases in heating operation.



May 30, 2014	English version	Initial version	D-checker (Ver. 3.0.0.0)
July 22, 2014		1st revision	D-checker (Ver. 3.0.0.1)
September 18, 2014		2nd revision	D-checker (Ver. 3.0.0.1A)
May 12, 2015		3rd revision	D-checker (Ver. 3.2.0.2)
July 17, 2015		4th revision	D-checker (Ver. 3.2.0.4)
August 26, 2015		5th revision	D-checker (Ver. 3.2.0.4)
October 26, 2015		6th revision	D-checker (Ver. 3.2.0.4)
July 14, 2016		7th revision	D-checker (Ver. 3.3.0.3)
September 27, 2016		8th revision	D-checker (Ver. 3.4.0.0)
June 08, 2017		9th revision	D-checker (Ver. 3.4.0.0)
August 10, 2017		10th revision	D-checker (Ver. 3.4.1.0)
January 12, 2018		11th revision	D-checker (Ver. 3.4.2.0)
April 11, 2018		12th revision	D-checker (Ver. 3.4.3.1)
May 14, 2019		13th revision	D-checker (Ver. 3.5.0.1)
September 2, 2019		14th revision	D-checker (Ver. 3.5.1.0)
April 13, 2020		15th revision	D-checker (Ver.3.6.2.1)
February 02, 2021		16th revision	D-checker (Ver.3.6.3.1)
April 4, 2022		17th revision	D-checker (Ver.3.7.0.4)

[Reference 1] Simple diagnosis Logic list

Indoor unit group

Condition		No.	Target	Logic condition
Indoor unit thermistor	Regardless of running, stop, thermo-ON/OFF status	1	Higher read value than actual	Indoor unit gas pipe temp >90 (C)
			Lower read value than actual	Indoor unit gas pipe temp <-20 (C)
		2	Higher read value than actual	Indoor unit liquid pipe temp >60 (C)
			Lower read value than actual	Indoor unit liquid pipe temp <-20 (C)
		3	Higher read value than actual	Indoor unit suction air temp >60 (C)
			Lower read value than actual	Indoor unit suction air temp <-20 (C)
	With user's confirmation of sufficient time elapse after operation stop	4	Higher read value than actual	Other indoor unit gas pipe temp average+5 (C)
			Lower read value than actual	Other indoor unit gas pipe temp average-5 (C)
		5	Higher read value than actual	Other indoor unit liquid pipe temp average+5 (C)
			Lower read value than actual	Other indoor unit liquid pipe temp average-5 (C)
		6	Higher read value than actual	Other indoor unit suction air temp average+5 (C)
			Lower read value than actual	Other indoor unit suction air temp average-5 (C)
Indoor unit thermo-ON status	7	Cross piping	Indoor unit gas pipe temp < Indoor unit liquid temp	
Indoor unit electronic expansion valve	Regardless of running, stop, thermo-ON/OFF status	8	capacity shortage, gas shortage	Indoor unit expansion valve opening (VRV)>1700
		9	capacity shortage, gas shortage	Indoor unit expansion valve opening (RA, SA)>480

Outdoor unit group

Condition		No.	Target	Logic condition	
Outdoor unit thermistor	Regardless of running, stop, thermo-ON/OFF status	10	Higher read value than actual	Outdoor unit suction pipe temp >80 (C)	
			Lower read value than actual	Outdoor unit suction pipe temp <-30 (C)	
		11	Higher or lower value than actual	Outdoor unit discharge pipe temp 1>160 (C) OR <-15 (C)	
			Higher or lower value than actual	Outdoor unit discharge pipe temp 2>160 (C) OR <-15 (C)	
			Higher or lower value than actual	Outdoor unit discharge pipe temp 3>160 (C) OR <-15 (C)	
		12	Higher read value than actual	Outdoor unit liquid pipe temp (other than discharge, suction and outdoor air) >80 (C)	
			Lower read value than actual	Outdoor unit liquid pipe temp (other than discharge, suction and outdoor air) <-30 (C)	
		13	Higher read value than actual	Outdoor unit air temp >60 (C)	
			Lower read value than actual	Outdoor unit air temp <-30 (C)	
		Compressor running (INV>0)	14	Higher read value than actual	Outdoor unit suction pipe temp>TC+10 (C) AND >Outdoor unit air temp+10 (C)
			15	Lower read value than actual	Outdoor unit suction pipe temp<TE-10 (C)
			16	Higher read value than actual	Outdoor unit discharge pipe temp 1>160 (C)
	17		Lower read value than actual	Outdoor unit discharge pipe temp 1<TC-10 (C)	
	Compressor running (STD1=ON)	18	Lower read value than actual	Outdoor unit discharge pipe temp 2<TC-10 (C)	
		19	Higher read value than actual	Outdoor unit discharge pipe temp 2>160 (C)	
	Compressor running (STD2=ON)	20	Lower read value than actual	Outdoor unit discharge pipe temp 2<TC-10 (C)	
		21	Higher read value than actual	Outdoor unit discharge pipe temp 3>160 (C)	
	Pressure sensor	Regardless of running, stop, thermo-ON/OFF status	22	Lower read value than actual	Outdoor unit discharge pipe temp 3<TC-10 (C)
			23	Higher read value than actual	TC<Outdoor unit air temp -5 (C)
			24	Higher read value than actual	TC>Outdoor unit discharge pipe temp1 +5 (C)
			25	Higher read value than actual	TC>Outdoor unit discharge pipe temp2 +5 (C)
			26	Higher read value than actual	TC>Outdoor unit discharge pipe temp3 +5 (C)
Compressor running (INV>0)		27	Higher read value than actual	TE>Outdoor unit air temp +5 (C)	
		28	Lower read value than actual	TC<Outdoor unit air temp -5 (C)	
		29	Higher read value than actual	TC>Outdoor unit discharge pipe temp1	
		30	Higher read value than actual	TC>Outdoor unit discharge pipe temp2	
		31	Higher read value than actual	TE>Outdoor unit suction pipe temp	
Compressor running (STD1=ON)	32	Higher read value than actual	TC>Outdoor unit discharge pipe temp2		
Compressor running (STD2=ON)	33	Higher read value than actual	TC>Outdoor unit discharge pipe temp3		
With user's confirmation of sufficient time elapse after operation stop	34	Lower read value than actual	TC<Outdoor unit air temp -5 (C)		
	35	Higher read value than actual	TC>Outdoor unit air temp +5 (C)		
	36	Lower read value than actual	TE<Outdoor unit air temp -5 (C)		
	37	Higher read value than actual	TE>Outdoor unit air temp +5 (C)		

[Reference 2]

Conversion table for expansion valve pulse value of indoor units being connected to BP unit

Conversion table ("CHK"=LEFT: value listed by checker software, "EV"=RIGHT: converted value)

CHK	EV	CHK	EV	CHK	EV	CHK	EV	CHK	EV	CHK	EV	CHK	EV	CHK	EV	CHK	EV
0	0	200	60	295	120	419	180	586	240	752	300	1016	360	1731	420	2178	480
3	1	202	61	297	121	422	181	588	241	755	301	1029	361	1741	421	2183	481
7	2	203	62	298	122	425	182	591	242	758	302	1042	362	1750	422	2188	482
11	3	205	63	300	123	428	183	594	243	760	303	1056	363	1760	423	2193	483
14	4	207	64	302	124	430	184	597	244	763	304	1069	364	1769	424	2199	484
18	5	208	65	303	125	433	185	600	245	766	305	1082	365	1778	425	2204	485
22	6	210	66	305	126	436	186	602	246	769	306	1095	366	1788	426	2209	486
25	7	211	67	306	127	439	187	605	247	771	307	1108	367	1797	427	2215	487
29	8	213	68	308	128	442	188	608	248	774	308	1122	368	1806	428	2220	488
33	9	214	69	310	129	444	189	611	249	777	309	1135	369	1816	429	2225	489
37	10	216	70	311	130	447	190	613	250	780	310	1148	370	1825	430	2230	490
40	11	218	71	313	131	450	191	616	251	782	311	1161	371	1835	431	2236	491
44	12	219	72	314	132	453	192	619	252	785	312	1174	372	1844	432	2241	492
48	13	221	73	316	133	455	193	622	253	788	313	1188	373	1853	433	2246	493
51	14	222	74	317	134	458	194	624	254	791	314	1201	374	1863	434	2252	494
55	15	224	75	319	135	461	195	627	255	794	315	1214	375	1872	435	2257	495
59	16	226	76	321	136	464	196	630	256	796	316	1227	376	1881	436	2262	496
62	17	227	77	322	137	466	197	633	257	799	317	1240	377	1891	437	2267	497
66	18	229	78	324	138	469	198	636	258	802	318	1254	378	1900	438	2273	498
70	19	230	79	325	139	472	199	638	259	805	319	1267	379	1910	439	2278	499
74	20	232	80	327	140	475	200	641	260	807	320	1280	380	1919	440	2283	500
77	21	234	81	329	141	478	201	644	261	810	321	1293	381	1928	441	2288	501
81	22	235	82	330	142	480	202	647	262	813	322	1306	382	1938	442	2294	502
85	23	237	83	332	143	483	203	649	263	816	323	1320	383	1947	443	2299	503
88	24	238	84	333	144	486	204	652	264	819	324	1333	384	1956	444	2304	504
92	25	240	85	335	145	489	205	655	265	821	325	1346	385	1966	445	2310	505
96	26	241	86	336	146	491	206	658	266	824	326	1359	386	1975	446	2315	506
99	27	243	87	338	147	494	207	661	267	827	327	1372	387	2003	447	2320	507
103	28	245	88	340	148	497	208	663	268	830	328	1386	388	2009	448	2325	508
107	29	246	89	341	149	500	209	666	269	832	329	1399	389	2014	449	2331	509
110	30	248	90	343	150	503	210	669	270	835	330	1412	390	2019	450	2336	510
114	31	249	91	339	151	505	211	672	271	838	331	1425	391	2024	451	2341	511
118	32	251	92	342	152	508	212	674	272	841	332	1438	392	2030	452	2347	512
122	33	253	93	345	153	511	213	677	273	843	333	1452	393	2035	453	2352	513
125	34	254	94	347	154	514	214	680	274	846	334	1465	394	2040	454	2357	514
129	35	256	95	350	155	516	215	683	275	849	335	1478	395	2046	455	2362	515
133	36	257	96	353	156	519	216	685	276	852	336	1491	396	2051	456	2368	516
136	37	259	97	356	157	522	217	688	277	855	337	1504	397	2056	457	2373	517
140	38	260	98	358	158	525	218	691	278	857	338	1518	398	2061	458	2378	518
144	39	262	99	361	159	527	219	694	279	860	339	1531	399	2067	459	2384	519
147	40	264	100	364	160	530	220	697	280	863	340	1544	400	2072	460	2389	520
151	41	265	101	367	161	533	221	699	281	866	341	1553	401	2077	461	2394	521
155	42	267	102	369	162	536	222	702	282	868	342	1563	402	2083	462	2399	522
159	43	268	103	372	163	539	223	705	283	871	343	1572	403	2088	463	2405	523
162	44	270	104	375	164	541	224	708	284	874	344	1581	404	2093	464	2410	524
166	45	272	105	378	165	544	225	710	285	877	345	1591	405	2098	465	2415	525
170	46	273	106	381	166	547	226	713	286	880	346	1600	406	2104	466	2420	526
173	47	275	107	383	167	550	227	716	287	882	347	1610	407	2109	467	2426	527
177	48	276	108	386	168	552	228	719	288	885	348	1619	408	2114	468	2431	528
181	49	278	109	389	169	555	229	722	289	888	349	1628	409	2120	469	2436	529
184	50	279	110	392	170	558	230	724	290	891	350	1638	410	2125	470	2442	530
186	51	281	111	394	171	561	231	727	291	893	351	1647	411	2130	471	2447	531
188	52	283	112	397	172	564	232	730	292	896	352	1656	412	2135	472	2452	532
189	53	284	113	400	173	566	233	733	293	924	353	1666	413	2141	473	2457	533
191	54	286	114	403	174	569	234	735	294	937	354	1675	414	2146	474	2463	534
192	55	287	115	406	175	572	235	738	295	950	355	1685	415	2151	475	2468	535
194	56	289	116	408	176	575	236	741	296	963	356	1694	416	2156	476	2468	536
195	57	291	117	411	177	577	237	744	297	976	357	1703	417	2162	477	2468	537
197	58	292	118	414	178	580	238	746	298	990	358	1713	418	2167	478	2468	538
199	59	294	119	417	179	583	239	749	299	1003	359	1722	419	2172	479	2468	539