RTD-NET
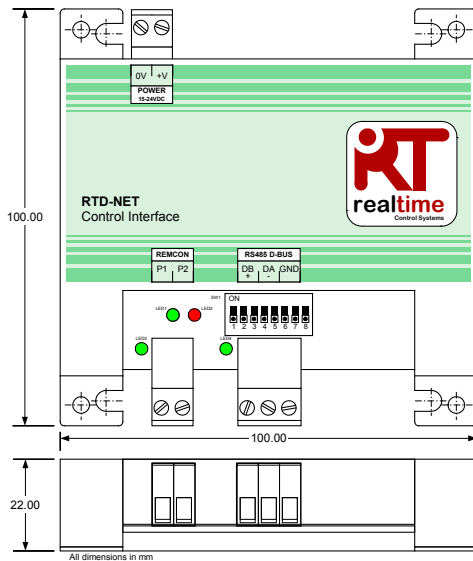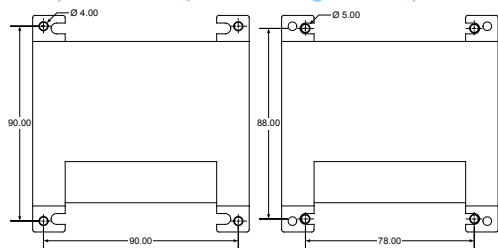
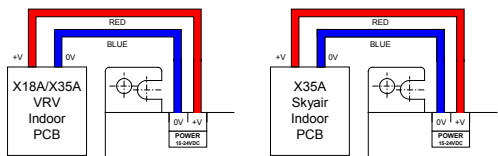## Installation Instructions

English   RTD-NET Installation Instructions

All dimensions in mm

RT
real**time**
Control Systems

1

2

3

4

ADDRESS 0

ADDRESS 1

DB(+) ◄───► DB(+)
DA(-) ◄───► DA(-)
GND ◄───► GND

ADDRESS 0	ADDRESS 1	ADDRESS 2	ADDRESS 3	ADDRESS 4	ADDRESS 5	ADDRESS 6	ADDRESS 7
ADDRESS 8	ADDRESS 9	ADDRESS 10	ADDRESS 11	ADDRESS 12	ADDRESS 13	ADDRESS 14	ADDRESS 15
ADDRESS 16	ADDRESS 17	ADDRESS 18	ADDRESS 19	ADDRESS 20	ADDRESS 21	ADDRESS 22	ADDRESS 23
ADDRESS 24	ADDRESS 25	ADDRESS 26	ADDRESS 27	ADDRESS 28	ADDRESS 29	ADDRESS 30	ADDRESS 31
ADDRESS 32	ADDRESS 33	ADDRESS 34	ADDRESS 35	ADDRESS 36	ADDRESS 37	ADDRESS 38	ADDRESS 39
ADDRESS 40	ADDRESS 41	ADDRESS 42	ADDRESS 43	ADDRESS 44	ADDRESS 45	ADDRESS 46	ADDRESS 47
ADDRESS 48	ADDRESS 49	ADDRESS 50	ADDRESS 51	ADDRESS 52	ADDRESS 53	ADDRESS 54	ADDRESS 55
ADDRESS 56	ADDRESS 57	ADDRESS 58	ADDRESS 59	ADDRESS 60	ADDRESS 61	ADDRESS 62	ADDRESS 63

5

6a LED2 / LED1

6b LED2 / LED1

6c LED2 / LED1

7a LED2 / LED1

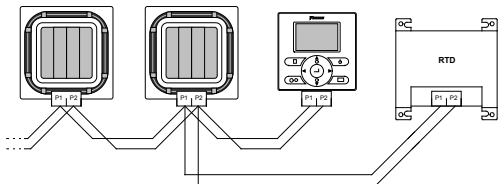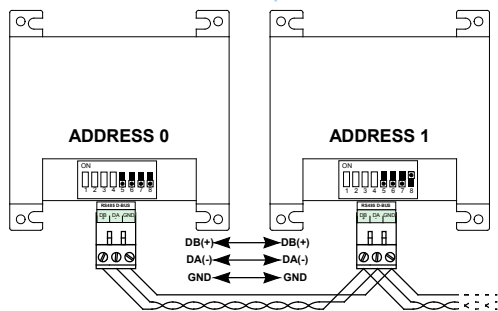7b LED2 / LED1

8a LED2 / LED1

8b LED2 / LED1

8c LED2 / LED1

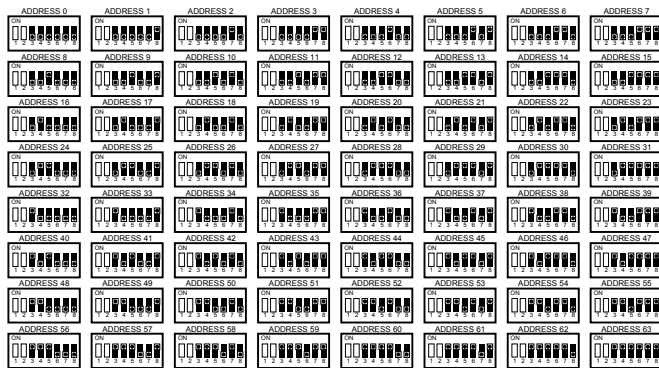## ⚠ Warnings and Cautions

All cable connections to the device must be adequately secured by suitable strain relief fasteners

The RTD must either be mounted in a suitable metal enclosure or plastic enclosure with a flammability rating of at least IEC60695-11-10 V-1. Do not install it inside the air-conditioning unit. In all cases access by non-qualified persons must be prevented (the enclosure may not accessible without a tool). The unit can be mounted horizontally or vertically

When the RTD is powered from the indoor unit power supply or other non-SELV supply, all external wiring and electrically attached devices must be suitably insulated to prevent access by non-qualified persons. Where this is not possible, the RTD must be powered from an SELV supply.

RS485 Cables must use stranded 24awg shielded or unshielded twisted pair to Cat3, Cat4 or Cat5 specification. Use a twisted pair for connections DB,DA and an extra core for connection GND. Install RS485 cable as shown in Figure 4.

The P1,P2 Network should be connected as shown in Figure 3. Up to 16 units and one remote controller can be connected to the RTD.

Specifications

Electrical

Supply	15V-24V DC, 120mA Regulated
Power	<2.5VA
Connectors	Rising clamp to 0.75mm^2 cable

Network

P1P2	<500m
RS485	<500m

Environmental

Temperature	
Storage	-10oC to 50oC
Operation	0oC to 50oC
Humidity	0-90% RH non-condensing

Your product is marked with the symbol shown to the left. This symbol on the product indicates that this product must not be disposed of with your other household waste. Inappropriate disposal may be harmful. Instead, it is your responsibility to dispose of your waste equipment by handing it over to a designated collection point for the recycling of waste electrical and electronic equipment. Units must be treated at a specialized treatment facility for re-use, recycling and recovery. By ensuring this product is disposed of correctly, you will help to prevent potential negative consequences for the environment and human health. Please contact the installer or local authority for more information.

Observe precautions for handling Electrostatic Sensitive Devices

Additional information, including Fault Codes are available from
www.realtime-controls.co.uk/rtd

RTD-NET Installation Instructions

The RTD-Net is a Modbus interface for monitoring and control of Daikin VRV and Skyair ranges of air-conditioners; and VAM and VKM ventilation units. The interface is compatible with all units that have a P1,P2 remote controller network connection and allows control of up to 16 units in a single group. Control functions include:

GROUP CONTROL. Group control of unit settings such as Setpoint, Fanspeed, Run Mode, Louvre and On/Off State

KEYPAD CONTROL. Control of lock/unlock state of individual buttons on wired remote controller and the ability to limit ranges of user adjustment.

UNIT MONITORING. Group and individual readback of unit data including Fault Codes, Unit Temperatures.

VAM CONTROL. Control of VAM and VKM unit fanspeed and damper position

Installation

MOUNTING (FIGURE 1)

MOUNTING PILLARS	SCREW MOUNTING
The RTD-NET is supplied with 4 mounting pillars that can be used to mount the interface within units with compatible mounting holes	The RTD-NET can be mounted using screws of up to 5mm diameter.

POWER SUPPLY (FIGURE 2)

The RTD requires a 15V to 24VDC power connection. Power can be supplied from VRV indoor unit PCB X18A or X35A connection, a Skyair indoor unit PCB X35A connection or VAM PCB X11A connection. A 1m cable and connector is supplied with the RTD.

P1,P2 NETWORK (FIGURE 3)

Terminals P1, P2 connect to the Daikin P1, P2 network. P1,P2 installation should follow Daikin installation specifications. The RTD-NET can operate in Master or Slave mode with any Daikin remote controller. Operation is also possible without a remote controller being connected. Note that BRC infra-red receivers must be configured to operate in SUB (S) mode (RTD in MAIN (M) mode).

RS485 NETWORK INSTALLATION (FIGURE 4)

The RS485 D-Bus network requires a twisted pair cable connecting terminals DB(+) and DA(-) on each RTD as shown below. Terminal DB must be connected to all other DB terminals. Terminal DA must be connected to all other DA terminals. In addition the common terminal GND on all devices must be connected together. If a shielded cable is used then the shield can be used for this purpose. It is recommended that the GND connection is connected to local Earth at one point only. The network must be installed as a daisy-chained point-to-point Bus configuration, Star and Ring connections must NOT be used.

RS485 NETWORK LENGTH

Standard installation for total network distances of up to 500m can be achieved following the basic daisy-chaining method showed in the above diagram. The network can be extended further using RS485 repeaters.

LED FUNCTIONALITY (Figures 6 to 8)

When the RTD-NET is powered up, or if it looses communication with the Remote Controller the RTD-NET enters P1,P2 search mode. If

P1,P2 communications are not re-established after 1 minute the RTD-NET will raise an alarm which will be indicated on the fault relay output. Led behaviour is shown in the following figures

Power-Up sequence: Factory Configuration	Figure 6a
Power-Up sequence: Custom Configuration	Figure 6b
P1,P2 Search. After power-up and during unit configuration	Figure 6c
No Fault State	Figure 7a
Unit Fault	Figure 7b
Device configuration error	Figure 8a
AC Unit Missing (U5 Fault)	Figure 8b
RS485 Communications timeout	Figure 8c

LED Key:

O	OFF	☀	ON	☀	Flashing

UNIT SEARCH

When the RTD-NET is powered up, or if it looses communication with the Remote Controller the RTD-NET enters P1,P2 search mode. If P1,P2 communications are not re-established after 1 minute the RTD-NET will raise an alarm which will be indicated on the fault relay output.

RTD-10 COMPATIBILITY

The RTD-10 has the same Modbus register layout as the RTD-NET, therefore the Modbus functionality in this datasheet also applies to RTD-10 Modbus operation for RTD-10 devices with the same firmware version.

Modbus Protocol

MODBUS CONFIGURATION

Network	3 wire RS485
Mode	Modbus RTU Slave
Baud	9600*
Parity	None*
Stop bits	1
Register Base	0

RTD interfaces can be configured with different baud rate and parity settings if required

Modbus address range 0 to 63 set using SW1 (Figure 5).

*Details of the Modbus Protocol can be found in the **Modicon Modbus Protocol Reference Guide** available on the internet.*

MODBUS REGISTERS

The RTD-Net supports two types of register, analogue *Holding Registers* and analogue *Input Registers*. Register Addresses are '0' based in the range 0..65535.

Register Type	Access	Function
Holding Register	Read/Write	Control and Command Registers
Input Register	Read Only	Readback and Monitoring Registers

All analogue and digital values are accessed through these registers. All register values are 2 byte (16 bit) values.

Different data types are returned using specific conventions

Data Type	Range	Convention
Digital	0..1	0=FALSE, 1=TRUE
Integer	0..65535	No scaling required
Temperature	0..65535	Temperatures values are generally returned *multiplied by 100* to allow greater precision. To allow for negative temperature the value is returned as a *signed integer,* this means that any value greater than 32767 must be converted into a negative value by subtracting 65536.

Examples:

A readback value of 2150 is a positive temperature so:

$$2150 / 100 = 21.50°C$$

A readback value of 65036 is a negative temperature so:
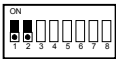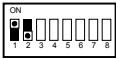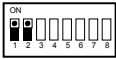
$$65036 - 65536 = -500$$
$$-500 / 100 = -5.00°C$$ |

Registers are accessed using standard Modbus functions. The following four functions are supported by the RTD interface.

Function Code (hex code)	Function Name	Register Count
03 (03h)	Read Holding Registers	1..10
04 (04h)	Read Input Registers	1..10
06 (06h)	Preset Single Holding Register	1
16 (10h)	Preset Multiple Holding Register	1..10

In this document, Holding registers are written as **H0010** where '**H**' indicates *Holding* register and '**0010**' indicates the register address 0010. Similarly Input registers are referred to as **I0010** where '**I**' indicates an *Input* register

MODBUS MASTER TIMEOUT

The RTD-NET can be configured to operate with an optional Modbus Master timeout. In this configuration if no Holding Register writes occur for a period of 120 seconds then a timeout event will occur and all A/C units will be switched on with their current settings. In a timeout condition the RTD Leds will indicate an *RS485 Communications Timeout* as illustrated in the *LED Functionality* section of this datasheet. SW1 DIP Switch settings to enable or disable Modbus Master Timeout are shown in the following table.

Switch Setting	Function
ON 1 2 3 4 5 6 7 8	No Timeout
ON 1 2 3 4 5 6 7 8	Timeout if no Holding Register WRITE command for 120 seconds. All units switched ON with current settings. Remote controllers UNLOCKED.
ON 1 2 3 4 5 6 7 8	Timeout if no Holding Register WRITE command for 120 seconds. All units switched ON with current settings. Remote control LOCK state unchanged.

Control Functions

UNIT CONTROL

The RTD-Net can be used to control all of the operating functions of the air-conditioning system that are available from a standard remote controller. All control registers are analogue Holding Registers**.**

Holding Register	Name	Range
H0001	Setpoint	16..32
H0002	Fanspeed	1..3 (1:Low, 2:High1, 3: High2*)
H0003	Mode	0..4 (0:Auto, 1:Heat, 2:Fan, 3:Cool, 4:Dry)
H0004	Louvre	1..7 (1:Swing, 2: 0 Degrees, 3: 20 Degrees, 4:45 Degrees, 5:70 Degrees, 6:90 Degrees)
H0005	OnOff	0..1 (0:Off, 1:On)

Where HighHigh fanspeed is enabled, High1 = High, High2= HighHigh. Otherwise both modes select High

CONTROL UPDATE MODE

Each control field has a corresponding Update Register which determines how the control commands update the unit and if the corresponding remote controller button(s) are locked or unlocked. Four update modes are available:

Update Mode	Keypad Button(s)	Functionality
0:LastTouch	Unlocked	Unit setting is updated when a holding register WRITE occurs even if the value is unchanged.
1:Central	Locked	The corresponding keypad buttons are locked. The value in the holding register is repeatedly written to the unit.
2:Local	Unlocked	Updates to holding registers are not sent to the unit.
3:OnChange	Unlocked	Unit setting is updated when a holding register WRITE occurs only if the value CHANGES.

The *Last Touched* update mode allows updates from the Keypad or Modbus registers. This requires that WRITES to the Modbus holding register only occur when a change is made. If the Modbus master repeatedly writes the value then this will overwrite the user setting. The *On Change* update mode can be used if repeated writes occur, in which case updates are only sent to the AC unit if the written value changes.

The *Global Update* register **H0010** can be used to set all update registers with one command, or the individual registers can be written to.

Holding Register	Name	Lock Mode*
H0010	Global Update	**0:LastTouch**,1:Central,2:Local,3:OnChange
H0011	Setpoint Update	**0:LastTouch**,1:Central,2:Local,3:OnChange
H0012	Fanspeed Update	**0:LastTouch**,1:Central,2:Local,3:OnChange
H0013	Mode Update	**0:LastTouch**,1:Central,2:Local,3:OnChange
H0014	Louvre Update	**0:LastTouch**,1:Central,2:Local,3:OnChange
H0015	OnOff Update	**0:LastTouch**,1:Central,2:Local,3:OnChange

The default settings on power up are all fields in Last Touch mode.

CONTROL LIMITING

The Control Limit registers allow adjustment from the remote controller or central controller to be limited to specified ranges. The setpoint can be optionally limited to minimum and maximum specified values. Fanspeed, Mode and Louvre settings can also be limited to specific settings using an inhibit value. If the limit values are set to 0 then no limit is applied.

Holding Register	Name	Range
H0020	Setpoint Min	16..32, **0 = No Limit**
H0021	Setpoint Max	16..32, **0 = No Limit**
H0022	Fanspeed Inhibit	**0 = No Inhibit,** else Inhibit Value
H0023	Mode Inhibit	**0 = No Inhibit,** else Inhibit Value
H0024	Louvre Inhibit	**0 = No Inhibit,** else Inhibit Value

Fanspeed, Mode and Louvre inhibit values are calculated by adding the inhibit values for each setting to be inhibited. The values are as follows

Fan Inhibit

Fanspeed	Inhibit Value
Low	**2**
High	**13**

Mode Inhibit

Run Mode	Inhibit Value
AUTO	**1**
HEAT	**2**
FAN	**4**
COOL	**8**
DRY	**16**

Louvre Inhibit

Louvre Position	Inhibit Value
Swing	**2**
0 Degrees	**4**
20 Degrees	**8**
45 Degrees	**16**
70 Degrees	**32**
90 Degrees	**64**

Examples:

To limit the Mode setting to Heat, Cool and Fan:

Mode Inhibit Value = AUTO + FAN + DRY
= (1 + 4 + 16)
= 21

To limit the Louvre setting 0 Degree, 20 Degrees, 45 Degrees:

Louvre Inhibit Value = Swing + 70 Degrees + 90 Degrees
= (2 + 32 + 64)
= 98

VAM CONTROL

VAM and VKM units can be switched on and off using the On/off register H0005. Control of VAM and VKM unit fanspeed and damper position are possible using the VAM control registers H0030 for damper position control and H0031 for VAM fanspeed.

Holding Register	Name	Range
H0030	Damper Control	0: Auto, 1: Cross Flow / Heat Recovery, 2: Bypass
H0031	VAM Fanspeed	1..2 (1:Low, 2:High)

The VAM buttons on a remote controller will be locked by setting the Global Update register H0010 to 1:Central. In this update mode, any changes to the settings made on the remote controller will be overwritten by the current values in the above control registers.

Readback Data

All readback data is available in analogue Input Registers.

REMOTE CONTROLLER READBACK

In a standard installation the Remote Controller temperature sensor value I0050 is available **only if there is only one indoor unit on the P1,P2 network and the Remote Controller is configured as MAIN**.

The RC Operation Mode I0051 returns the current operating mode of the group.

Input Register	Name	Range
I0050	RC Temperature	Degrees C x 100 (only available for 1 indoor unit)
I0051	RC Operation Mode	0:Idle/Fan, 1:Heating, 2:Cooling, 3:Heat and Cool

GROUP READBACK

Group data registers provide a summary of the data from all active indoor units on the network.

Input Register	Name	Range	Notes
I0020	Unit Count	0..16	Number of units found on network
I0021	Is Fault	0..1	0:No Fault, 1: At least one unit in fault
I0022	Fault Code	0..65535	255: No Fault, else fault code from first unit in fault
I0023	Return Air Average	Degrees C x 100	Average of all unit return air temperatures
I0024	Filter Alarm	0..1	0: No Alarm, 1: At least one unit with filter alarm
I0025	Return Air Min	Degrees C x 100	Minimum of all unit return air temperatures
I0026	Return Air Max	Degrees C x 100	Maximum of all unit return air temperatures
I0030	Thermo On	0..3	Summary of unit operation 0:Idle/Fan, 1:Heating, 2:Cooling, 3:Heat and Cool
I0035	Defrost	0..1	0: No defrost, 1: At least one unit in defrost Indicates unit in Pressure Equalisation, Hot Start/Pre-heat or outdoor unit Defrost condition

UNIT READBACK

Unit data is available for each of the indoor units on the P1,P2 network. Unit Input registers are numbered using the indoor unit numbering in the range 1 to 16 x 100 added to an offset relating to a specific feature.

Unit 1	Unit 2	...	Unit16	Name	Range	Notes
0120	0220	...	1620	Unit Exists	0..1	0: No Unit Found, 1: Unit Found
0121	0221	...	1621	Is Fault	0..1	0: No Unit Fault, 1: Unit in Fault
0122	0222	...	1622	Fault Code	0..65535	255: No Fault, else fault code
0123	0223	...	1623	Return Air Temperature	Degrees C x 100	Unit Return Air Sensor Value
0124	0224	...	1624	Filter Alarm	0..1	0: No Alarm, 1: Filter Alarm
0130	0230	...	1630	Thermo On*	0..2	0:Idle/Fan, 1:Heating, 2:Cooling
0131	0231	...	1631	Coil In* Temperature	Degrees C x 100	Coil Inlet Temperature
0132	0232	...	1632	Coil Out* Temperature	Degrees C x 100	Coil Outlet Temperature

*Only available when RTD is operating in P1,P2 **MAIN** Mode.*

FAULT CODES

Fault codes are encoded using a standard table to allow standard Daikin fault codes to be generated from the readback value. The **no fault** value is 255.

Special fault codes generated by the RTD are as follows

Code Value	Meaning
0	Waiting for data
255	No Fault
14384	(80) Group Fault, timeout on no units found
14388	(84) Unit Missing, reported if unit data previously observed

All other codes are Daikin fault codes. The full table of fault code values is available from **http://www.realtime-controls.co.uk/rtd**

Fault codes returned from a Modbus Input register are 16 bit values. The fault code is encoded in the 16 bit value by encoding the two 8 bit fault characters in the high and low byte parts of the 16 bit value. Each of the 8 bit values represents an ASCII text character.
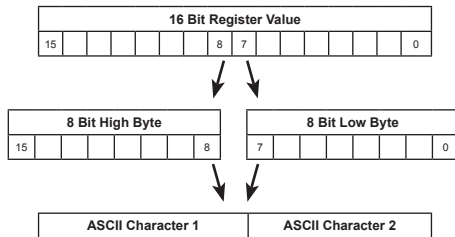
Example:

A fault code value of 16697 is returned.

HighByte(16697) = 65 = ASCII Character 'A'

LowByte(16697) = 57 = ASCII Character '9'

Fault Code: 'A9'