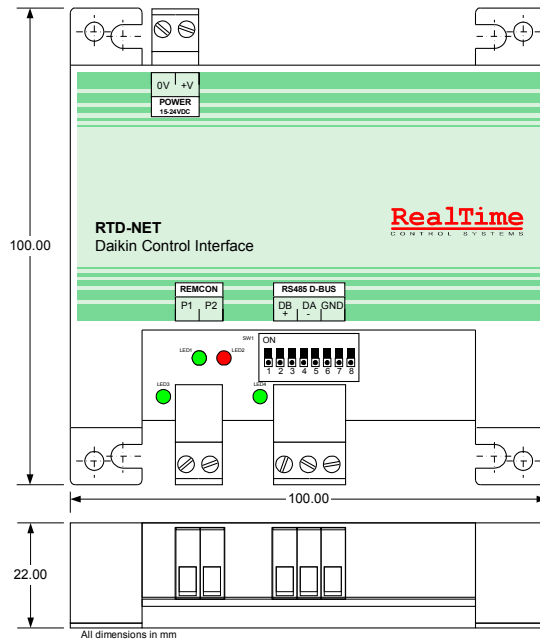


RTD-Net Interface v1.04

Installation and Operating Instructions



RTD-Net Description

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

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

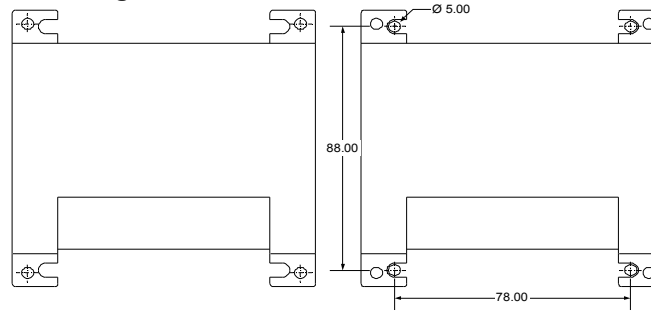
CUSTOM CONTROL. RTD interfaces can be supplied in custom configurations to suit specific applications.

Warnings and Cautions



Observe precautions for handling Electrostatic Sensitive Devices

Mounting



MOUNTING PILLARS

The RTD-Net is supplied with 4 mounting pillars that can be used to mount the interface within units with compatible mounting holes

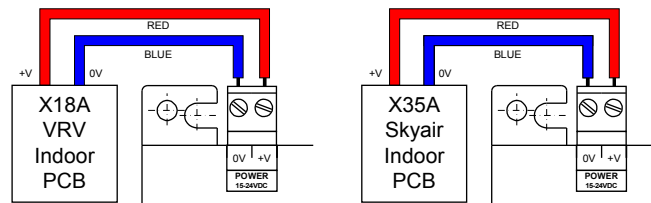
SCREW MOUNTING

The RTD-Net can be mounted using screws of up to 5mm diameter.

The RTD-Net can be mounted horizontally or vertically.

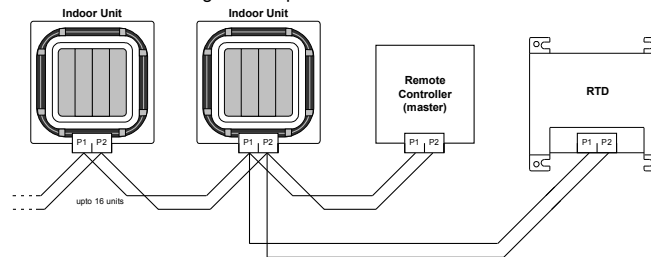
Power Supply

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



P1,P2 Network

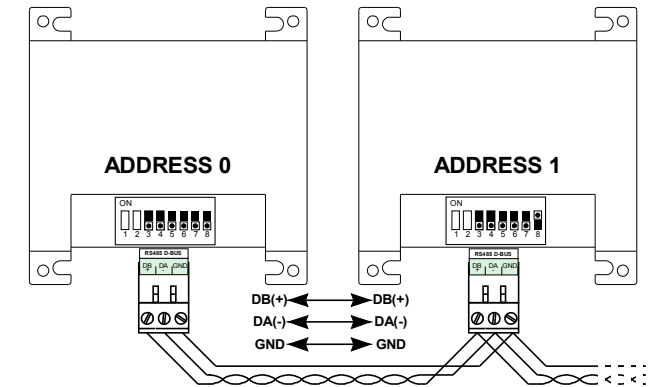
Terminals P1, P2 connect to the Daikin P1, P2 network. P1,P2 installation should follow Daikin installation specifications. The RTD-Net can operate in Master or Slave mode with any Daikin remote controller. Operation is also possible without a remote controller being connected. Note that infra-red receivers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



Networking

NETWORK INSTALLATION

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.



SPECIFICATION

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.

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. Network termination should not be necessary for networks of this length. The network can be extended further using RS485 repeaters.

NETWORK DEVICE COUNT

Each RTD has half a standard RS485 network load. An RS485 network can have a maximum of 32 standard network loads. Assuming the Modbus master is a standard network load then a maximum of 62 RTD devices can be placed on a single physical network.

ADDRESSING

Each RTD-Net must have a unique Modbus network address in the range 0 to 63 using DIP switches SW1.2 to SW1.8. A table of switch setting is given on the last page of this datasheet.

Modbus Protocol

MODBUS CONFIGURATION

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

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

Modbus message response time is approximately 20ms, no throttling is required.

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: $2150 / 100 = 21.50^{\circ}\text{C}$ A readback value of 65036 is a negative temperature so: $65036 - 65536 = -500$ $-500 / 100 = -5.00^{\circ}\text{C}$

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 #0010 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.

Control Functions

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
#0001	Setpoint	16..32
#0002	Fanspeed	1..3 (1:Low, 2:High1, 3: High2*)
#0003	Mode	0..4 (0:Auto, 1:Heat, 2:Fan, 3:Cool, 4:Dry)
#0004	Louvre	1..7 (1:Swing, 2: 0 Degrees, 3: 20 Degrees, 4:45 Degrees, 5:70 Degrees, 6:90 Degrees)
#0005	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 #0010 can be used to set all update registers with one command, or the individual registers can be written to.

Holding Register	Name	Lock Mode*
#0010	Global Update	0:LastTouch, 1:Central,2:Local,3:OnChange
#0011	Setpoint Update	0:LastTouch, 1:Central,2:Local,3:OnChange
#0012	Fanspeed Update	0:LastTouch, 1:Central,2:Local,3:OnChange
#0013	Mode Update	0:LastTouch, 1:Central,2:Local,3:OnChange
#0014	Louvre Update	0:LastTouch, 1:Central,2:Local,3:OnChange
#0015	OnOff Update	0:LastTouch, 1:Central,2:Local,3:OnChange

*Last Touch updates are written to the A/C on every register write. On Change updates are only sent if the value written changes. Central locks the corresponding RC button. Local unlocks the RC button and prevents any updates from the RTD.

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
#0020	Setpoint Min	16..32, 0 = No Limit
#0021	Setpoint Max	16..32, 0 = No Limit
#0022	Fanspeed Inhibit	0 = No Inhibit, else Inhibit Value
#0023	Mode Inhibit	0 = No Inhibit, else Inhibit Value
#0024	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:

$$\begin{aligned}
 \text{Mode Inhibit Value} &= \text{AUTO} + \text{FAN} + \text{DRY} \\
 &= (1 + 4 + 16) \\
 &= 21
 \end{aligned}$$

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

$$\begin{aligned}
 \text{Louvre Inhibit Value} &= \text{Swing} + 70 \text{ Degrees} + 90 \text{ Degrees} \\
 &= (2 + 32 + 64) \\
 &= 98
 \end{aligned}$$

VAM CONTROL

VAM and VKM units can be switched on and off using the On/off register #0005. Control of VAM and VKM unit fanspeed and damper position are possible using the VAM control registers #0030 for damper position control and #0031 for VAM fanspeed.

Holding Register	Name	Range
#0030	Damper Control	0: Auto, 1: Cross Flow / Heat Recovery, 2: Bypass
#0031	VAM Fanspeed	1,2 (1:Low, 2:High)

The VAM buttons on a remote controller will be locked by setting the Global Update register #0010 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.

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 60 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. RTD DIP Switch settings to enable or disable Modbus Master Timeout are shown in the following table.

Switch Setting	Function
	No Timeout
	Timeout if no Holding Register WRITE command for 60 seconds. All units switched ON with current settings. Remote control LOCK state unchanged.
	Timeout if no Holding Register WRITE command for 60 seconds. All units switched ON with current settings. Remote controllers UNLOCKED.

RTD-10 COMPATIBILITY

The RTD-NET 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.

Readback Data

All readback data is available in analogue Input Registers.

GROUP READBACK

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

Input Register	Name	Range	Notes
#0020	Unit Count	0..16	Number of units found on network
#0021	Is Fault	0..1	0:No Fault, 1: At least one unit in fault
#0022	Fault Code	0..65535	255: No Fault, else fault code from first unit in fault
#0023	Return Air Average	Degrees C x 100	Average of all unit return air temperatures
#0024	Filter Alarm	0..1	0: No Alarm, 1: At least one unit with filter alarm
#0025	Return Air Min	Degrees C x 100	Minimum of all unit return air temperatures
#0026	Return Air Max	Degrees C x 100	Maximum of all unit return air temperatures
#0030	Thermo On	0..3	Summary of unit operation 0:Idle/Fan, 1:Heating, 2:Cooling, 3:Heat and Cool
#0035	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

REMOTE CONTROLLER READBACK

In a standard installation the Remote Controller temperature sensor value #0050 is available **only if there is only one indoor unit on the P1,P2 network.**

The RC Operation Mode #0051 returns the current operating mode of the group.

Input Register	Name	Range
#0050	RC Temperature	Degrees C x 100 (only available for 1 indoor unit)
#0051	RC Operation Mode	0:Idle/Fan, 1:Heating, 2:Cooling, 3:Heat and Cool

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 Master Mode.

Fault Codes

FAULT CODES

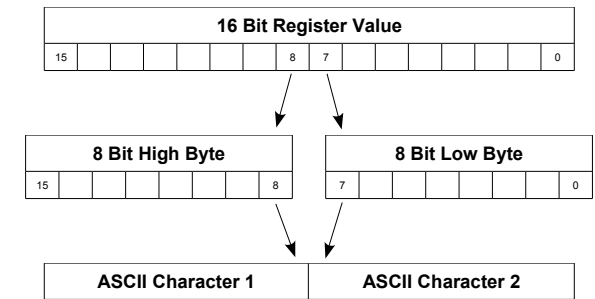
Fault codes are encoded using a standard table to allow standard Daikin fault codes to be generated from the readback value. The **no fault** value is 255.

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.

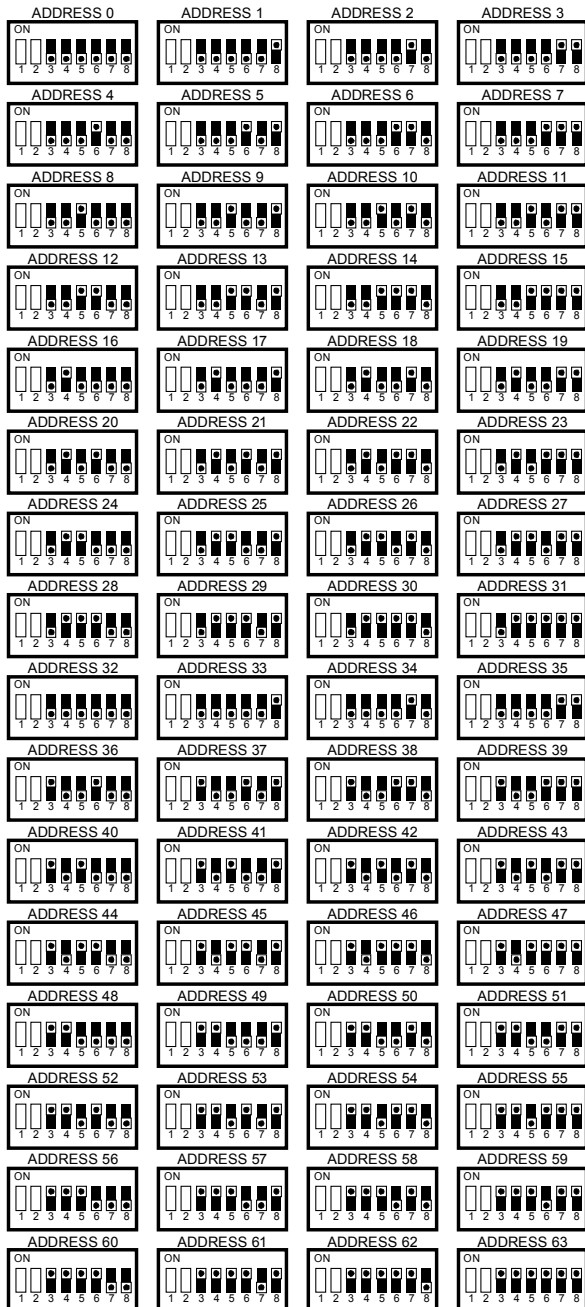
HighByte(16697) = 65 = ASCII Character 'A'

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

Fault Code: 'A9'

Modbus Addressing

The Modbus Address of the RTD is set with the 6 right dip switches on SW1. The address range is 0 to 63.



LED Functionality



Normal Operation

R: ◌ G: ◌	Power-Up sequence Factory Configuration
R: ◌ G: ◌	Power-Up sequence Custom Configuration
R: ◌ G: ◌	P1,P2 Search. After power-up and during unit configuration

R: ◌ G: ◌	No Fault State
R: ◌ G: ◌	Unit Fault

Error Conditions

R: ◌ G: ◌	Device configuration error
R: ◌ G: ◌	AC Unit Missing (U5 Fault)
R: ◌ G: ◌	RS485 Communications Timeout

UNIT SEARCH

When the RTD-10 is powered up, or if it loses communication with the Remote Controller the RTD-10 enters P1,P2 search mode. If P1,P2 communications are not re-established after 1 minute the RTD-NET will generate a Group Fault code.

Functional Specification

Electrical	Environmental
Supply 15V-24V DC, 120mA Regulated	Temperature
Power <2.5VA	Storage Operation -10°C to 50°C 0°C to 50°C
Relay 1A, 24VAC max 1A, 30VDC max	Humidity 0-90% RH non-condensing
Mechanical	Protection IP30
Dimensions H100 x W100 x D22 mm	EMC Emissions EN61000-6-1
Mounting Four screw / pillar mounts	EMC Immunity EN61000-6-3
Casing Zinc coated mild steel	
Weight 120g	
Connectors Rising clamp to 0.75mm ² cable	