Procon
MelcoRETAIL MINI

FOR INSTALLERS

INSTALLATION MANUAL
Manual version 1.0.6

Firmware version 1.0.3

For safe and correct use, please read this installation manual thoroughly before installing the PROCON MelcoRETAIL MINI.

Preface

Safety warnings

⚠ **Caution:**

Do not expose to rain or moisture.

⚠ **Operating Temperature:**

The product has been designed to operate between -20° C and +60° C

⚠ **Shielded Signal Cables:**

Use only shielded cables for connecting peripherals to any Procon MelcoRETAIL MINI device to reduce the possibility of interference with radio communications services. Using shielded cables ensures that you maintain the appropriate EMC classification for the intended environment.

⚠ **CE Notice:**

This product has been determined to be in compliance with 2014/30/EU (EMC Directive), 2014/35/EU (Low Voltage Directive) and 2011/65/EU (RoHS Directive).

UL 61010-1 Electrically Safety Tested.

⚠ **European Union, Class A:**

Class A products are intended for use in non-residential/non-domestic environments. Class A products may also be utilized in residential/domestic environments but may cause interference and require the user to take adequate corrective measures.

This is a Class A product. In a domestic environment this product may cause radio frequency interference in which case the user may be required to take adequate measures.

A “Declaration of Conformity” in accordance with the preceding directives and standards has been made and is available on request.

If this equipment does cause interference with radio communications services, which can be determined by turning the equipment off and on, you are encouraged to try to correct the interference by one or more of the following measures:

Reorient the receiving antenna.
Relocate the Procon MelcoRETAIL MINI with respect to the receiver.
Move the Procon MelcoRETAIL MINI away from the receiver.

If necessary, consult a Procon MelcoRETAIL MINI technical support representative or an experienced radio/television or EMC technician for additional suggestions.

Disclaimer

⚠ **Warranty:**

All products manufactured on behalf of Mitsubishi Electric UK are warranted against defective materials for a period of three years from the date of delivery to the original purchaser.

⚠ **Warning:**

Mitsubishi Electric UK assumes no liability for damages consequent to the user of this product. We reserve the right to change this manual at any time without notice. The information furnished by us is believed to be accurate and reliable. However, no responsibility is assumed by us for its use, nor for any infringements of patents or other rights of third parties resulting from its use.

If the equipment is used in a manor not specified by the manufacturer, the protection provided by the equipment may be impaired.

Document Amendment Register

Document Version	Latest Firmware Version	Date	Author	Notes
1.0.0	1.0.0	12/07/17	GD	Initial version.
1.0.1	1.0.0	31/07/17	GD	Added information to Connections section regarding connections to twin/triple/quad and MXZ systems. Correction made to section 2, the name MAC-399IF replaced with MAC-333IF.
1.0.2	1.0.1	11/08/17	GD	Voltage/resistance bands changed for setpoint, mode and fan speed control.
1.0.3	1.0.1	29/09/17	GD	Added certification logos
1.0.4	1.0.2	27/11/17	GD	Updates for V1.0.2 firmware. Sections 7.9, 7.10 and 7.11 updated. Addition of new Modbus holding registers (see section 12.1). Firmware revision history table added.
1.0.5	1.0.3	17/01/18	GD	Added section *8. Failsafe AUTO Mode*. Updated sections *7.2 Mode control* and *7.3 Fan Speed control*. Firmware revision history table updated.
1.0.6	1.0.3	08/02/18	GD	Corrected text in section *9.Deadband mode* to state deadband mode is enabled by setting DIP switch 2-1 to the ON position.

Any additional notes since printing will be appended to the rear of this document on separate sheets of paper.

Firmware Revision History

Firmware Version	Date	Notes
1.0.0	21/07/17	Release for testing purposes.
1.0.1	25/08/17	Voltage/resistance bands changed for setpoint, mode and fan speed control.
1.0.2	28/11/17	Operation of HEATING relay changed so it only energises when in Heat or Auto mode when the return air temperature is less than the setpoint. Operation of COOLING relay changed so it only energises when in Cool or Auto mode when the return air temperature is greater than the setpoint. A configurable relay switching delay has been added to prevent rapid switching.
1.0.3	17/01/18	Added Failsafe AUTO mode feature (see section *8. Failsafe AUTO Mode*)

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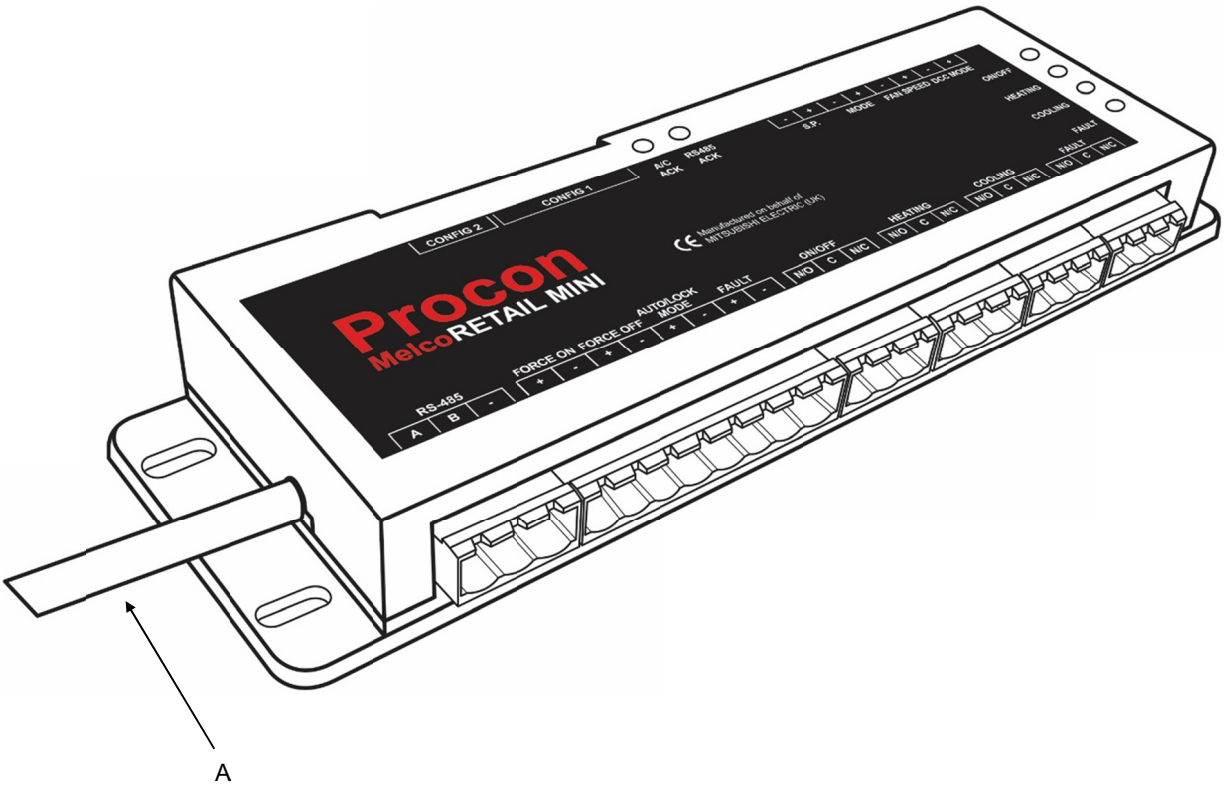
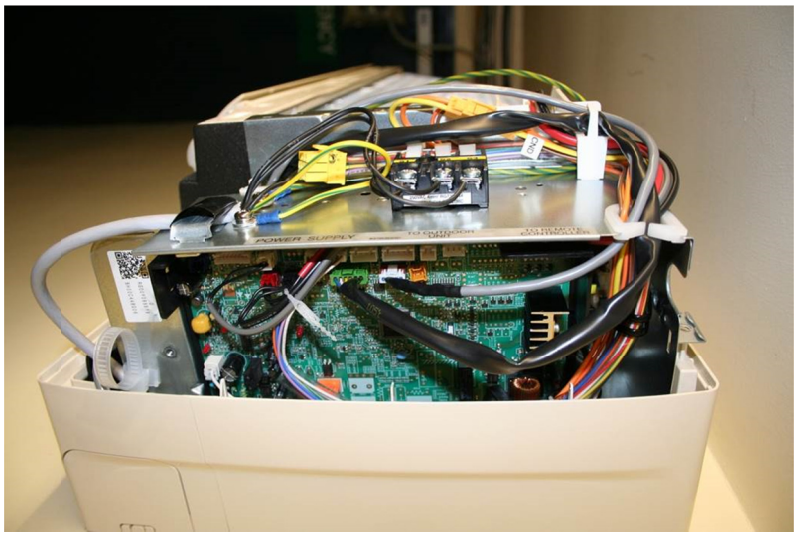
[Fig. 1]



A CN105/CN92 connection lead

2

[Fig. 2]



Air to air unit

Contents

1. Safety precautions

- **Before installing the unit, make sure you read all the "Safety precautions"**
- **The "Safety precautions" provide very important points regarding safety. Make sure you follow them**

Symbols used in the text

⚠ Warning:

Describes precautions that should be observed to prevent danger of injury or death to the user.

⚠ Caution:

Describes precautions that should be observed to prevent damage to the unit.

⚠ Warning:

- **Ask the dealer or an authorised technician to install the unit**
  - Improper installation by the user may result in electric shock, or fire
- **Use the specified cables for wiring. Make the connections securely so that any outside forces acting on the cables are not applied to the terminals**
  - Inadequate connection and fastening may generate heat and cause a fire
- **Never repair the unit. If the controller must be repaired, consult the dealer**
  - If the unit is repaired improperly, electric shock, or fire may result
- **Have all electric work done by a licensed electrician according to "Electric Facility Engineering Standard", "Interior Wire Regulations" and the instructions given in this manual and always use a special circuit**
  - If the power source capacity is inadequate or electric work is performed improperly, electric shock and fire may result
- **Keep the electric parts away from any water - washing water etc…**
  - Contact may result in electric shock, fire or smoke
- **To dispose of this product, consult your dealer**

⚠ Caution:

- **Safely dispose of the packing materials**
  - Packing materials, such as nails and other metal or wooden parts, may cause stabs or other injuries
  - Tear apart and throw away plastic packaging bags so that children will not play with them - If children play with a plastic bag which has not been torn apart, they face the risk of suffocation

2. Overview

The Procon MelcoRETAIL MINI Protocol Converter is used for remote monitoring and control of Air-to-Air products (M-, S- and P-series split air conditioning systems).It acts as a gateway between the system and external third party equipment. It has digital outputs for status information such as current Heat/Cool mode and Fault. It has analogue inputs so that settings such as temperature set point can be set via a 0-10V or resistive output from a 3rd party system. It also has digital inputs to force certain modes of operation and for indication of a 3rd party system fault.

The MelcoRETAIL MINI continuously reads data from the system and changes configuration when necessary. Because the reading is continuous the MelcoRETAIL MINI always stores up-to-date data. This data is then available to external devices through the RS-485 port using the Modbus RTU software protocol. Values can be read and changed via this connection. Please refer to the Modbus section for further information.

The MelcoRETAIL MINI is powered via the CN105/CN92 connector on the indoor unit, hence no external power supply is needed.

Compatible Air-To-Air model numbers can be found in Appendix A of this document.

⚠ **Caution:**

MAC-397IF and MAC-333IF units cannot be connected when the MelcoRETAIL MINI is connected, as the same CN105/CN92 connector is used.

Figure 1 shows the MelcoRETAIL MINI.

Figure 2 shows the CN105/CN92 connector on the indoor unit PCB that the MelcoRETAIL MINI connects to on Air-to-Air units.

3. Installation

3.1. Physical connection

The MelcoRETAIL MINI has a 1 metre flying lead to connect directly into the CN105/CN92 connector on the controller PCB.

3.2. Power supply

The MelcoRETAIL MINI is powered from the CN105/CN92 air conditioner host connector at 12V DC and therefore does not require an external power supply.

3.3. RS-485 connection

The MelcoRETAIL MINI has a 3-way screw terminal to provide Modbus RTU communication via RS-485. See chapter 5.3 for more details.

4. DIP switch settings

The MelcoRETAIL MINI has a total of 12 DIP switches which are used for configuration of the unit.
There is a bank of 8 DIP switches labelled *CONFIG 1* and a bank of 4 DIP switches labelled *CONFIG 2*.
The following sections detail how the switches are used to configure the MelcoRETAIL MINI.

Note: The MelcoRETAIL MINI must be power cycled for any changes to the DIP switch changes to take effect.

4.1. Modbus Slave ID

Any Modbus Slave ID in the range 1 – 30 can be chosen using switches *CONFIG 1-1* to *1-5*. The address is set in binary, where the switch positions have the following values:

Switch number	Address value when switch is set ON
1-1	1
1-2	2
1-3	4
1-4	8
1-5	16

To get the Slave ID, add together the value for each switch set ON. For example, to set Slave ID 13 set switches 1-1, 1-3 and 1-4 ON (1 + 4 + 8 = 13).

When switches *CONFIG 1-1* to *1-5* are all set to the ON position the Slave ID is set in software by writing to a Modbus Holding register (see chapter 12.1 for more details).

Note: Setting switches *CONFIG 1-1* to *1-5* all to the OFF position is an invalid combination and should not be used.

Note: Each Modbus device connected on the same RS-485 network must have a unique Slave ID.

4.2. RS-485 communication settings

The RS-485 communication settings are set using switch *CONFIG 1-6*.
When the switch is in the OFF position the Baud Rate and Parity settings are set in software by writing to Modbus registers (see chapter 12.1).

1-6	RS-485 communication settings
OFF	Baud Rate and Parity set in software
ON	9600 baud, no parity

The number of data bits is fixed at 8 and the number of stop bits is fixed at 1.

4.3. Protocol selection

The RS485 protocol is set using DIP switch *CONFIG 1-7*, currently only Modbus RTU is supported.

When the switch is in the ON position the Modbus RTU protocol is selected.

1-7	Protocol selection
OFF	(Reserved for future use)
ON	Modbus RTU

4.4. Auto Mode / Lock Mode selection

The function of the *LOCK/AUTO MODE* digital input is determined by switch *CONFIG 1-8*.

When the switch is in the OFF position input *LOCK/AUTO MODE* is used to enable/disable Auto Mode.
When the switch is in the ON position input *LOCK/AUTO MODE* is used to enable/disable Lock Mode.

1-8	*LOCK/AUTO MODE* input function
OFF	Enable/disable Auto Mode
ON	Enable/disable Lock Mode

4.5. Deadband Mode

The Deadband Mode feature can be enabled using switch *CONFIG 2-1*.

When the switch is in the OFF position Deadband Mode is disabled.
When the switch is in the ON position Deadband Mode is enabled.

2-1	Deadband Mode
OFF	Disabled
ON	Enabled

Note: Deadband settings can be changed by writing to Modbus registers (see chapter 12.1 for more details).

4.6. Setpoint Limiting

The Setpoint Limiting feature can be enabled using switch CONFIG 2-2.

When the switch is in the OFF position Setpoint Limiting is disabled.
When the switch is in the ON position Setpoint Limiting is enabled.

2-2	Setpoint Limiting
OFF	Disabled
ON	Enabled

Note: Setpoint Limiting settings can be changed by writing to Modbus registers (see chapter 12.1 for more details).

4.7. Timeout

The Timeout feature can be enabled using switch *CONFIG 2-3*.

When the switch is in the OFF position the Timeout feature is disabled.
When the switch is in the ON position the Timeout feature is enabled.

2-3	Timeout Feature
OFF	Disabled
ON	Enabled

Note: The timeout value can be changed by writing to a Modbus register (see chapter 12.1 for more details).

4.8. Input type selection

The input type for the four analogue inputs (*S.P, MODE, FAN SPEED, OCC MODE*) can be configured using switch *CONFIG 2-4*.

When the switch is in the OFF position inputs these inputs are set to voltage (0-10VDC) type.
When the switch is in the ON position inputs these inputs are set to resistive (Ω) type.

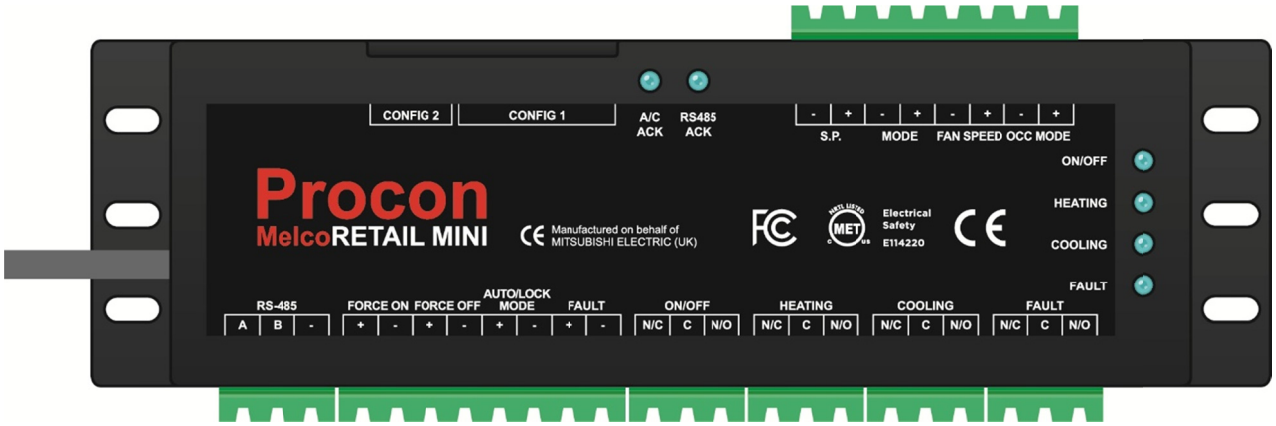
2-4	Analogue input type
OFF	Voltage (0-10VDC)
ON	Resistive (Ω)

4.9. Summary

Switch	Description	Notes
1-1	Modbus Slave ID	Node ID 1 – 30 (see chapter 4.1). All OFF = Invalid combination. All ON = Software selectable Slave ID.
1-2		
1-3		
1-4		
1-5		
1-6	Comms Settings	OFF = Baud rate and parity software selectable ON = 9600 baud, no parity
1-7	Protocol Selection	OFF = (Reserved for future use) ON = Modbus RTU
1-8	Auto Mode / Lock Mode	OFF = AUTO/LOCK MODE input used to enable Auto Mode ON = AUTO/LOCK MODE input used to enable Lock Mode
2-1	Deadband Mode	OFF = Deadband Mode disabled ON = Deadband Mode enabled
2-2	Setpoint Limiting	OFF = Setpoint Limiting disabled ON = Setpoint Limiting enabled
2-3	Timeout	OFF = Timeout feature disabled ON = Timeout feature enabled
2-4	Input Type Selection	OFF = Analogue inputs are voltage (0-10VDC) type ON = Analogue inputs are resistive (Ω) type

5. Connections

5.1. Overview



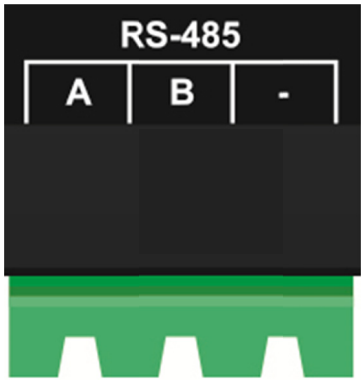
5.2. CN92/CN105

The MelcoRETAIL MINI flying lead connects to either the CN92 or CN105 connector on the indoor unit PCB. The MelcoRETAIL MINI does not require an external power supply.

5.3. RS-485

The RS-485 connector has A, B and ground (-) connections.

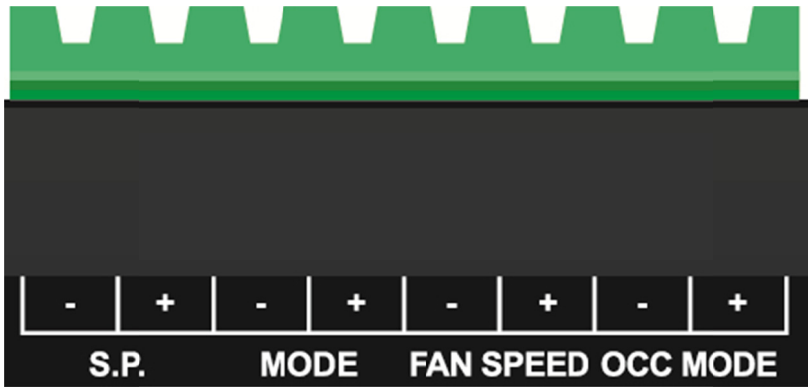
⚠ To ensure reliable Modbus communications the ground **must** be connected to the Modbus Master device.



5.3.1. RS-485 termination resistor

On the MelcoRETAIL MINI PCB there's a 2-pin jumper header located next to the RS-485 connector. Fitting a jumper to this header will enable the 120Ω termination resistor to the RS-485 bus.

5.4. Analogue Inputs



5.4.1. Input type selection

DIP switch 2-4 determines the input type for all four inputs, see section 4.8. It is not possible to set the input type for each input individually; all four will be set to the same type.

When set to the voltage range (DIP switch 2-4 OFF) a voltage between 0 and 10VDC can be applied to the input.

When set to the resistance range (DIP switch 2-4 ON) any value of resistance can be applied to the input.

5.4.2. S.P.

The input labelled *S.P.* can be used to control the unit Setpoint, see chapter 7.1 for more details.

5.4.3. MODE

The input labelled *MODE* can be used to control the unit Mode, see section 7.2 for more details.

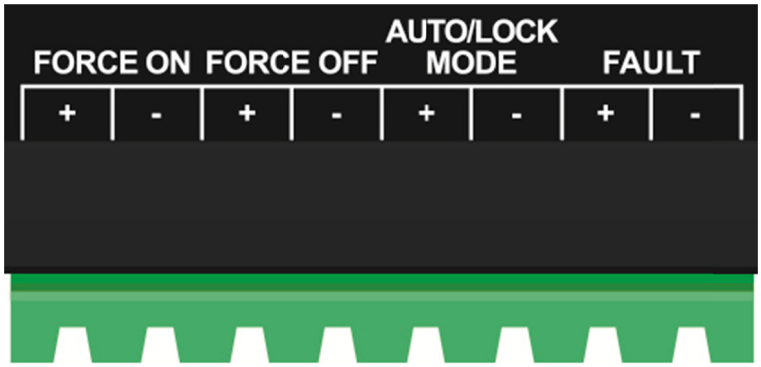
5.4.4. FAN SPEED

The input labelled *FAN SPEED* can be used to control the unit Fan Speed, see section 7.3 for more details.

5.4.5. OCC MODE

The input labelled *OCC* can be used to set the current occupancy state, see section 7.4 for more details.

5.5. Digital Inputs



The four digital inputs are of the volt-free type, so just require an open or closed circuit connection (i.e. the output side of a relay).

5.5.1. FORCE ON

The input labelled *FORCE ON* is used to force the unit to switch on, see section 7.5 for more details.

5.5.2. FORCE OFF

The input labelled *FORCE OFF* is used to force the unit to switch off, see section 7.6 for more details.

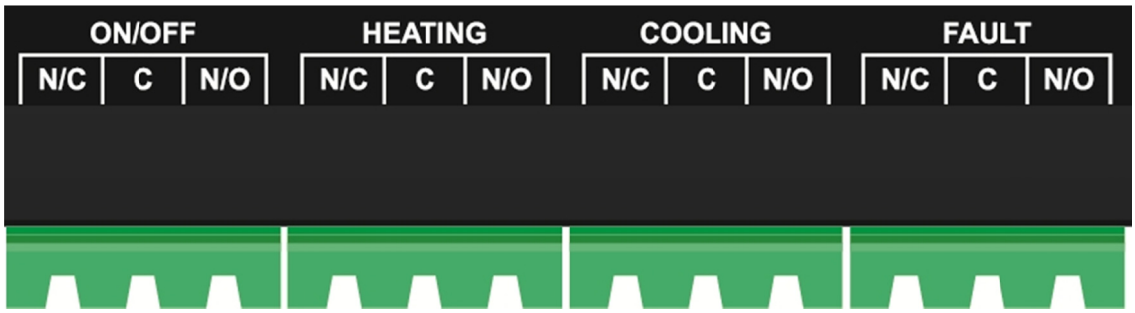
5.5.3. AUTO/LOCK MODE

The input labelled *AUTO/LOCK MODE* is used for either the Auto or Lock function, depending on the state is DIP switch 1-8. See section 7.7 for more details.

5.5.4. FAULT

The input labelled *FAULT* is used to indicate the presence of a fault with 3rd party equipment, see section 7.8 for more details.

5.6. Relay Outputs



The relay outputs are used for status information.

5.6.1. ON/OFF

The *ON/OFF* output indicates whether the unit is running or not, see section 7.9 for more details.

5.6.2. HEATING

The *HEATING* output indicates the unit is in Heat or Auto mode and the return air temperature is less than the temperature setpoint. See section 7.10 for more details.

5.6.3. COOLING

The *COOLING* output indicates the unit is in Cool or Auto mode and the return air temperature is greater than the return air setpoint. See section 7.11 for more details.

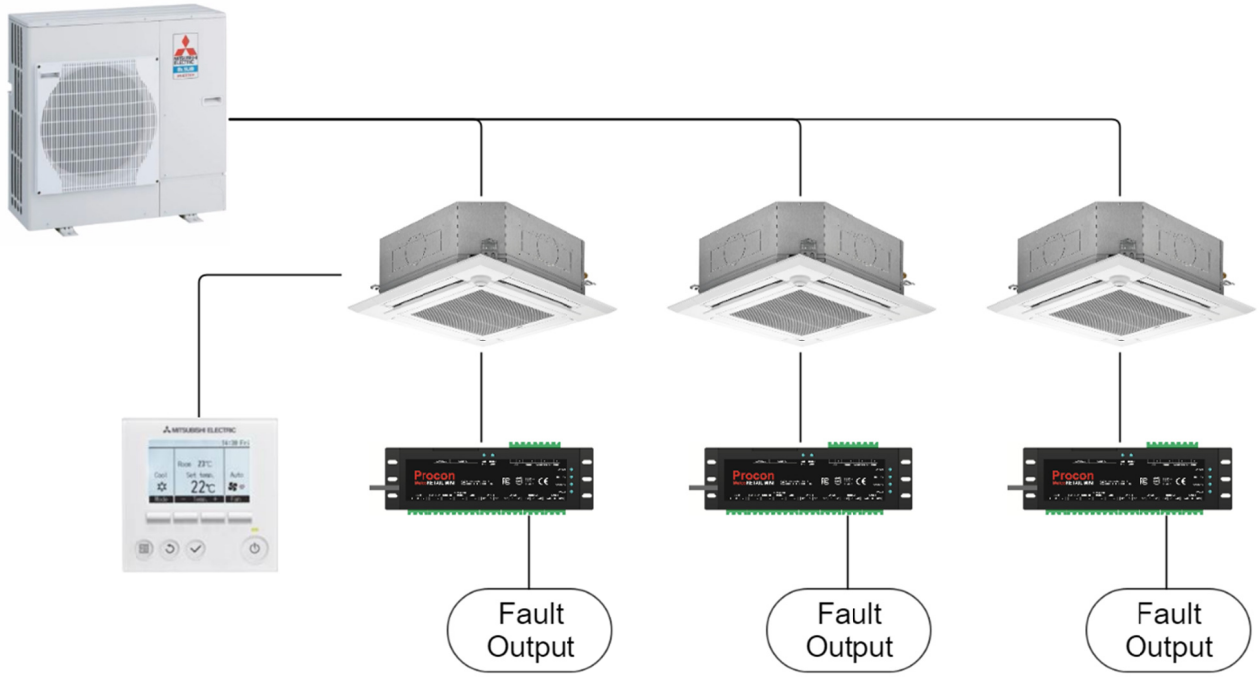
5.6.4. FAULT

The *FAULT* output indicates if there is a fault with the unit, see section 7.12 for more details.

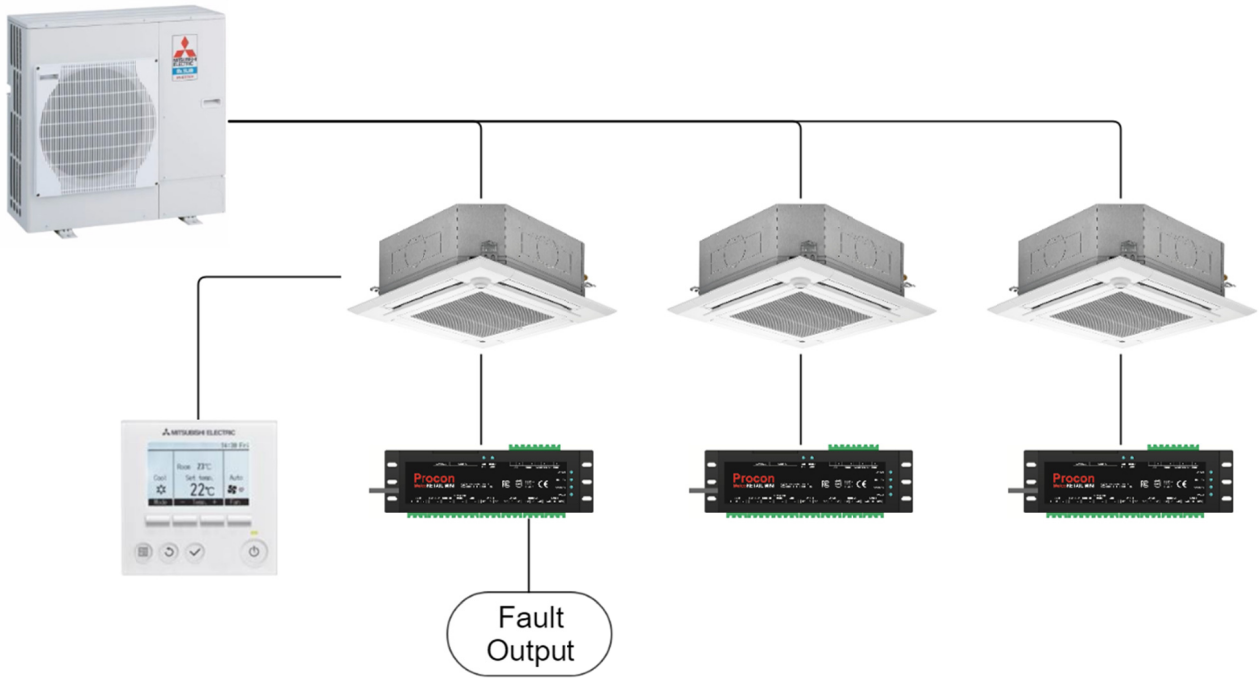
5.7. Using Twin / Triple / Quad systems

It is recommended to use one MelcoRETAIL MINI for each indoor unit, however, if the fault output is not used then one MelcoRETAIL MINI can be used per twin / triple / quad system.

5.7.1. When Fault output is being used



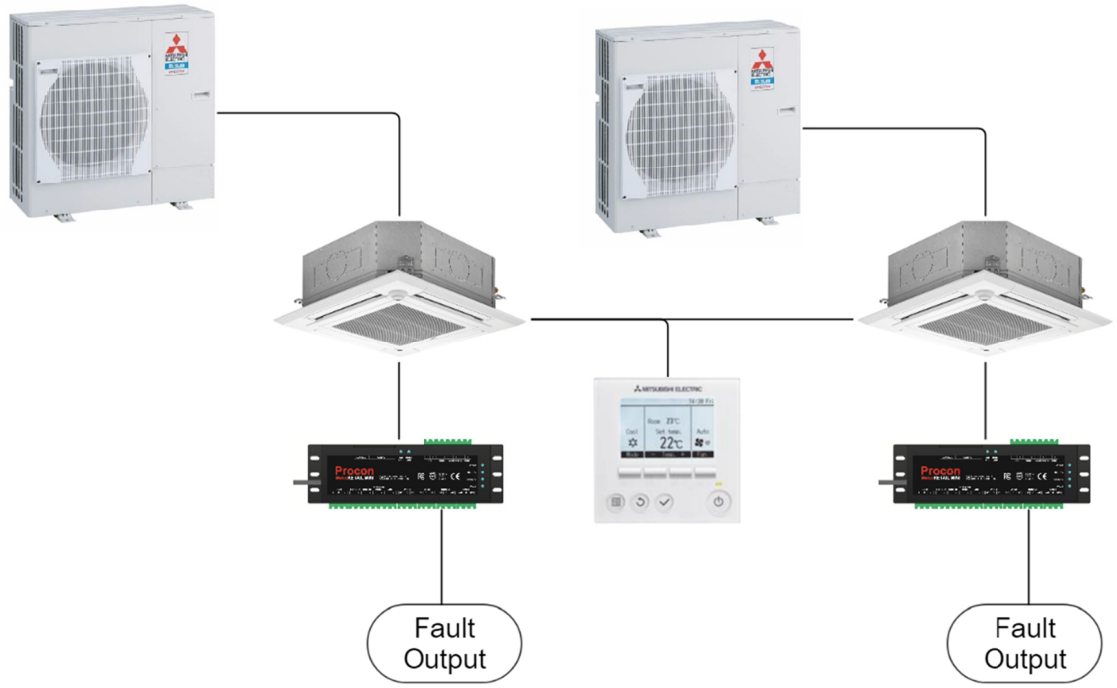
5.7.2. When Fault output is not being used



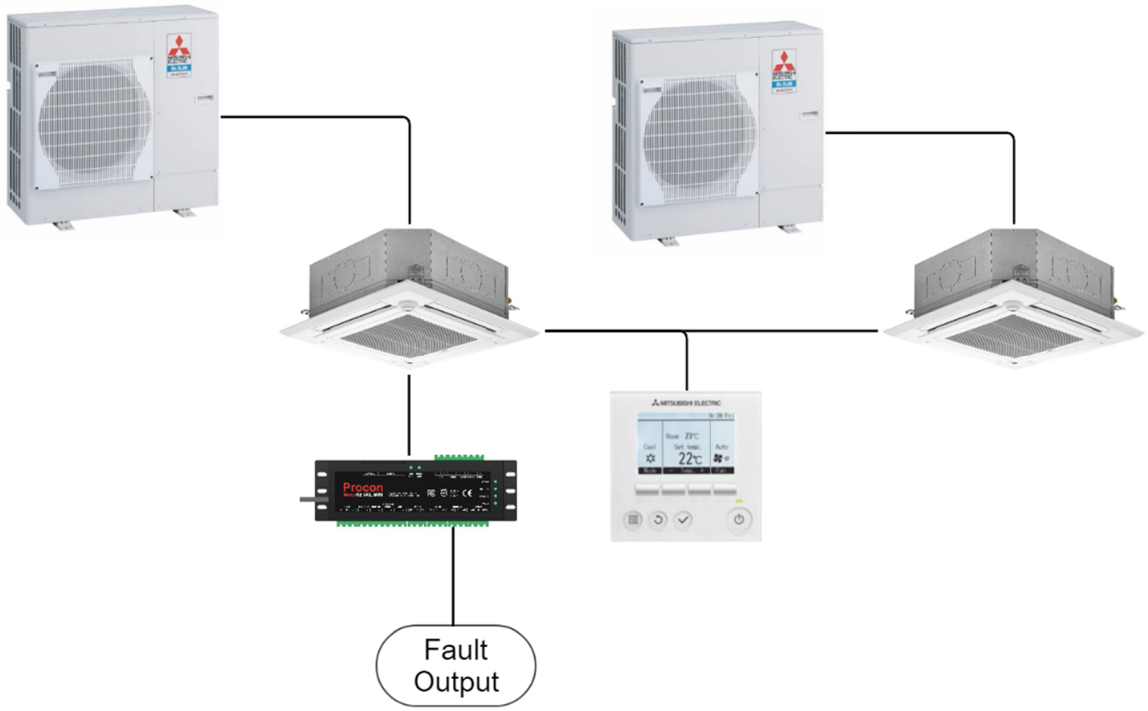
5.8. Using single split units in a group

It is recommended to use one MelcoRETAIL MINI for each indoor unit, however, if the fault output is not used then one MelcoRETAIL MINI can be used per twin / triple / quad system.

5.8.1. When Fault output is being used

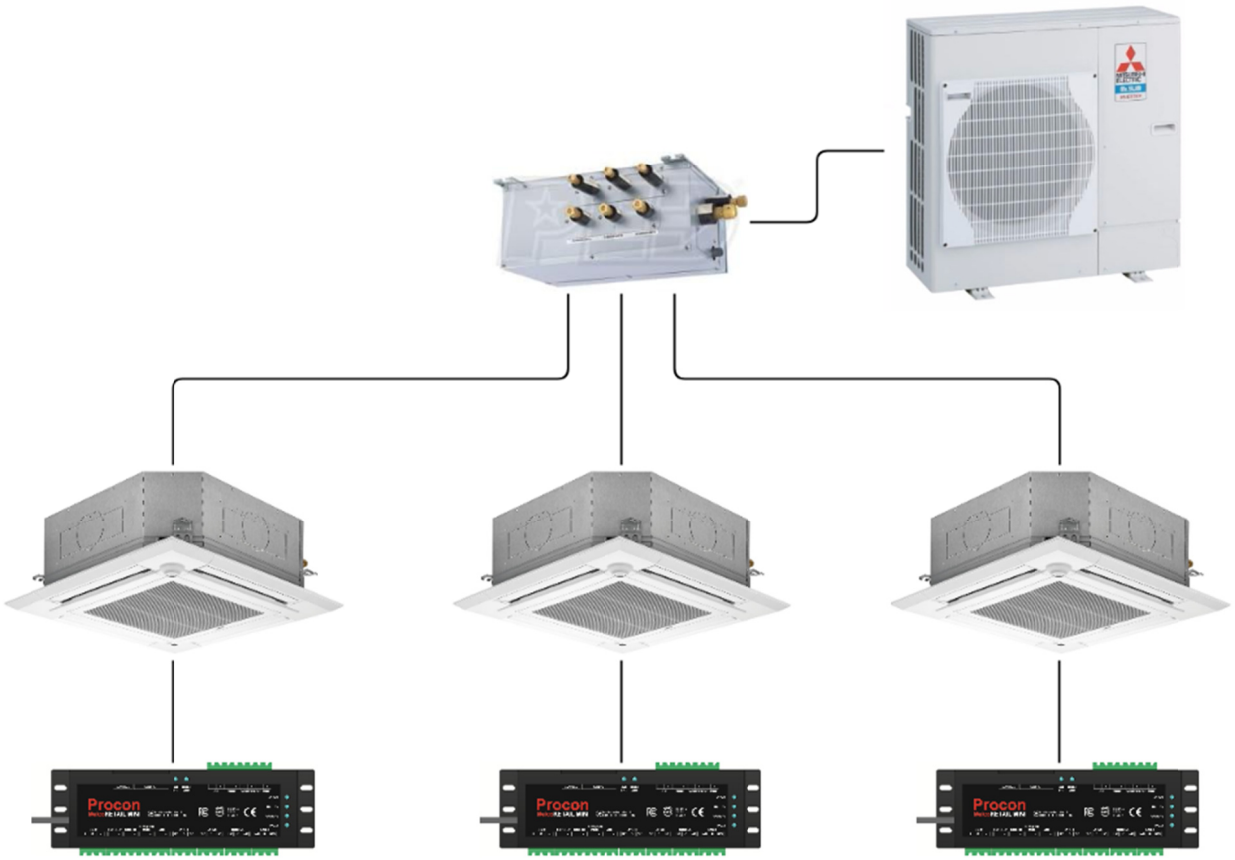


5.8.2. When Fault output is not being used



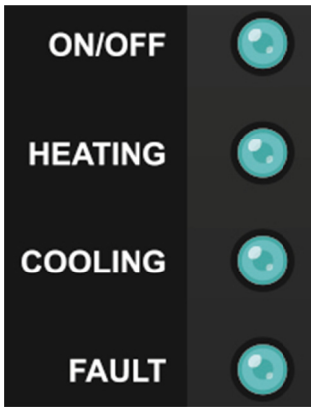
5.9. Using MXZ split units

One MelcoRETAIL MINI must be installed for each indoor unit when using a MXZ system.



6. Status LEDs

6.1. Relay Status



The relay status LEDs indicate the current state of the relay outputs.
The LEDs will switch ON when the corresponding relay energises/switches on.

6.2. Communication Status

When the MelcoRETAIL MINI powers up both LEDs will switch on to indicate it is powered.

The *A/C ACK* LED will flash when there is valid communication with the indoor unit.

The *RS485 ACK* LED will flash when there is valid Modbus RTU communication with a Modbus master device.

7. Control for ATA systems

When the MelcoRETAIL MINI powers up it automatically starts communicating with the indoor unit.

This chapter describes the control for ATA systems.

7.1. Setpoint control

The analogue input labelled *S.P.* controls the unit's Temperature Setpoint.

The DIP switch 2-4 determines whether the input type is voltage (0-10V) or resistance (Ω), see chapter 4.8 for more details.

S.P. Input		Temperature Setpoint (°C)
Voltage (V)	Resistance (KΩ)	
Below 0.75	Below 0.75	Uncontrolled
0.75 – 1.25	0.75 – 1.25	**17**
1.25 – 1.75	1.25 – 1.75	**18**
1.75 – 2.50	1.75 – 2.50	**19**
2.50 – 3.25	2.50 – 3.25	**20**
3.25 – 3.75	3.25 – 3.75	**21**
3.75 – 4.25	3.75 – 4.25	**22**
4.25 – 5.00	4.25 – 5.00	**23**
5.00 – 5.75	5.00 – 5.75	**24**
5.75 – 6.25	5.75 – 6.25	**25**
6.25 – 6.75	6.25 – 6.75	**26**
6.75 – 7.50	6.75 – 7.50	**27**
7.50 – 8.25	7.50 – 8.25	**28**
8.25 – 8.75	8.25 – 8.75	**29**
8.75 – 10.0	8.75 – 10.0	**30**
Above 10	Above 10	Uncontrolled

When the MelcoRETAIL MINI powers up it will read the *S.P.* input and the temperature setpoint will be determined based on data in the table above. A command will then be sent to the indoor unit to set this setpoint value.

If the *S.P.* input changes such that a new temperature setpoint band is entered, a command will be sent to the indoor unit to change the setpoint accordingly. There is 0.1V / 0.1kΩ hysteresis applied to each band change to prevent rapid changes to the setpoint.

When LOCK mode is enabled (see chapter 4.4) the command to set the temperature setpoint will be sent every 5 seconds. This will effectively revert any changes made via a local wall controller.

7.2. Mode control

The input labelled *MODE* controls the unit's Operating Mode.

The DIP switch 2-4 determines whether the input type is voltage (0-10V) or resistance (Ω), see chapter 4.8 for more details.

MODE Input		**Operating Mode**
Voltage (V)	**Resistance (kΩ)**	
0.1 – 2.0	0.0 – 2.0	**Fan**
2.0 – 3.0	2.0 – 3.0	Uncontrolled
3.0 – 4.5	3.0 – 4.5	**Heat**
4.5 – 5.5	4.5 – 5.5	Uncontrolled
5.5 – 7.0	5.5 – 7.0	**Cool**
7.0 – 8.0	7.0 – 8.0	Uncontrolled
8.0 – 10	8.0 – 10	**Auto**
Above 10	Above 10.0	Uncontrolled

When the MelcoRETAIL MINI powers up it will read the *MODE* input and the operating mode will be determined based on data in the table above. A command will then be sent to the indoor unit to set the mode accordingly.

If the *MODE* input changes such that a mode band is entered, a command will be sent to the indoor unit to change the mode accordingly. There is 0.1V / 0.1kΩ hysteresis applied to each band change to prevent rapid changes to the mode.

When LOCK mode is enabled (see chapter 4.4) the command to set the mode will be sent every 5 seconds. This will effectively revert any changes made via a local wall controller.

Note: When the voltage on all four analogue inputs decrease below 0.1V (or if the resistance increases above 100kΩ (i.e. open circuit)) the unit will enter a failsafe state and the Mode will be set to AUTO. See section *8. Failsafe AUTO* Mode **for more details).**

7.3. Fan Speed control

The input labelled *FAN SPEED* controls the unit's Fan Speed.

The DIP switch 2-4 determines whether the input type is voltage (0-10V) or resistance (Ω), see chapter 4.8 for more details.

FAN SPEED Input		Fan Speed
Voltage (V)	Resistance (kΩ)	
0.1 – 2.0	0.0 – 2.0	**Low**
2.0 – 3.0	2.0 – 3.0	Uncontrolled
3.0 – 4.5	3.0 – 4.5	**Mid 1**
4.5 – 5.5	4.5 – 5.5	Uncontrolled
5.5 – 7.0	5.5 – 7.0	**Mid 2**
7.0 – 8.0	7.0 – 8.0	Uncontrolled
8.0 – 10	8.0 – 10	**High**
Above 10	Above 10.0	Uncontrolled

When the MelcoRETAIL MINI powers up it will read the *FAN SPEED* input and the fan speed will be determined based on data in the table above. A command will then be sent to the indoor unit to set the fan speed accordingly.

If the *FAN SPEED* input changes such that a new fan speed band is entered, a command will be sent to the indoor unit to change the fan speed accordingly. There is 0.1V / 0.1kΩ hysteresis applied to each band change to prevent rapid changes to the fan speed.

When LOCK mode is enabled (see chapter 4.4) the command to set the fan speed will be sent every 5 seconds. This will effectively revert any changes made via a local wall controller.

7.4. Occupancy Mode

The input labelled *OCC MODE* determines the temperature deadband settings for the indoor unit.

The DIP switch 2-4 determines whether the input type is voltage (0-10V) or resistance (Ω), see chapter 4.8 for more details.

OCC Input		Deadband Settings
Voltage (V)	**Resistance (kΩ)**	
Below 1.5	Below 2.5	Uncontrolled
1.5 – 2.5	2.5 – 4.0	**Unoccupied Heat to 16 ºC, Cool to 26 ºC**
2.5 – 4.5	4.0 – 5.5	Uncontrolled
4.5 – 5.5	5.5 – 7.0	**Staff In Heat to 18 ºC, Cool to 24 ºC**
5.5 – 6.5	7.0 – 8.5	Uncontrolled
6.5 – 7.5	8.5 – 10.0	**Occupied Heat to 21 ºC, Cool to 23ºC**
Above 7.5	Above 10.0	Uncontrolled

When the MelcoRETAIL MINI powers up it will read the *OCC MODE* input and the deadband settings will be updated accordingly based on the data in the table above. Deadband mode will be enabled even if it's not enabled using DIP switch 2-1 (see chapter 4.5). Additionally, deadband control using the *OCC MODE* input will take precedence over the deadband control activated by DIP switch 2-1.

If the *OCC MODE* input changes such that a new deadband settings band is entered, the deadband settings will be updated accordingly. There is 0.1V / 0.1kΩ hysteresis applied to each band change to prevent rapid changing of Deadband settings.

Note: These Deadband settings can be changed by writing to Modbus registers (see chapter 12.1 for more details).

Note: The 4 degree offset AND dual setpoint features must be disabled on the indoor unit for the Occupancy Mode feature to operate correctly.

7.5. Force On

When the *FORCE ON* volt free input is closed a command will be sent to the indoor unit at least once every 10 seconds to switch the drive ON. This will effectively revert any changes made via a local wall controller within 10 seconds.

Attempts to switch the drive OFF using Modbus will be ignored.

The *FORCE ON* input has a higher priority than the *FORCE OFF* input, so if both inputs are in the closed state the indoor unit drive will be forced ON every 10 seconds.

7.6. Force Off

When the *FORCE OFF* volt free input is closed a command will be sent to the indoor unit at least once every 10 seconds to switch the drive OFF. This will effectively revert any changes made via a local wall controller within 10 seconds.

Attempts to switch the drive ON using Modbus will be ignored.

The *FORCE ON* input has a higher priority than the *FORCE OFF* input, so if both inputs are in the closed state the indoor unit drive will be forced ON every 10 seconds.

7.7. Auto Mode / Lock Mode

The operation of the *AUTO/LOCK MODE* input is determined by the state of DIP switch 1-8 (see chapter 4.4 for details). When this DIP switch is OFF the input is used to enable Auto Mode. When the DIP switch is ON the input is used to enable Lock mode.

7.7.1. Auto Mode

When Auto Mode is enabled, when the *AUTO/LOCK MODE* input is momentarily closed a command is sent to the indoor unit to set the operating mode to AUTO.

If the timeout feature is enabled (see chapter 4.7 for details) then a command to set the unit to operate in FAN mode will be sent after a configurable length of time.

7.7.2. Lock Mode

When Lock Mode is enabled commands to set the following settings will be sent every 5 seconds:

- Operating Mode (command only sent if the *MODE* input is controlling the Mode)
- Temperature Setpoint (command only sent if the *S.P.* input is controlling the Setpoint)
- Fan Speed (command only sent if the *FAN SPEED* input is controlling the Fan Speed)

7.8. External Fault

When the FAULT input is closed it is assumed a fault is present with external equipment. Whilst the FAULT input is closed the FAULT relay output will be energised.

7.9. ON/OFF status output

The *ON/OFF* relay output will be energised if the indoor unit drive is currently set to ON, otherwise the output will be de-energised.

Upon a change to the ON/OFF state there is a delay before the relay changes state. The default delay is 30 seconds but this is configurable via a Modbus register (see Modbus section 12.1 - Holding registers).

7.10. Heating status output

The *HEATING* relay output will de-energise when the unit drive is OFF or when the operating mode is not Heat or Auto.

When in Heat or Auto mode the relay will energise when the return air temperature is less than or equal to the temperature setpoint minus 1ºC for a period of at least 30 seconds. It will de-energise if the return air temperature increases so it's greater than or equal to the temperature setpoint.

The 1ºC offset is a configurable value which can be changed via Modbus (see Modbus section 12.1 - Holding registers). The default value is 1ºC.

The 30 second delay is a configurable value which can be changed via Modbus (see Modbus section 12.1 - Holding registers). The default value is 30 seconds.

The following sequence of events show how the HEATING relay will operate (with 1ºC offset and 30 second delay):
Setpoint 21, Inlet Temp 23 – Relay = OFF
Setpoint 21, Inlet Temp 22 – Relay = OFF
Setpoint 21, Inlet Temp 21 – Relay = OFF
Setpoint 21, Inlet Temp 20 – Relay = ON*
Setpoint 21, Inlet Temp 19 – Relay = ON
Setpoint 21, Inlet Temp 20 – Relay = ON
Setpoint 21, Inlet Temp 21 – Relay = OFF*

*after a 30 second delay

7.11. Cooling status output

The *COOLING* relay output will de-energise when the unit drive is OFF or when the operating mode is not Cool or Auto.

When in Cool or Auto mode the relay will energise when the return air temperature is greater than or equal to the temperature setpoint plus 1ºC for a period of at least 30 seconds. It will de-energise if the return air temperature decreases so it is less than or equal to the temperature setpoint.

The 1ºC offset is a configurable value which can be changed via Modbus (see Modbus section 12.1 - Holding registers). The default value is 1ºC.

The 30 second delay is a configurable value which can be changed via Modbus (see Modbus section 12.1 - Holding registers). The default value is 30 seconds.

The following sequence of events show how the COOLING relay will operate (with 1ºC offset and 30 second delay):
Setpoint 21, Inlet Temp 19 – Relay = OFF
Setpoint 21, Inlet Temp 20 – Relay = OFF
Setpoint 21, Inlet Temp 21 – Relay = OFF
Setpoint 21, Inlet Temp 22 – Relay = ON*
Setpoint 21, Inlet Temp 23 – Relay = ON
Setpoint 21, Inlet Temp 22 – Relay = ON
Setpoint 21, Inlet Temp 21 – Relay = OFF*
Setpoint 21, Inlet Temp 20 – Relay = OFF

*after a 30 second delay

7.12. Fault output

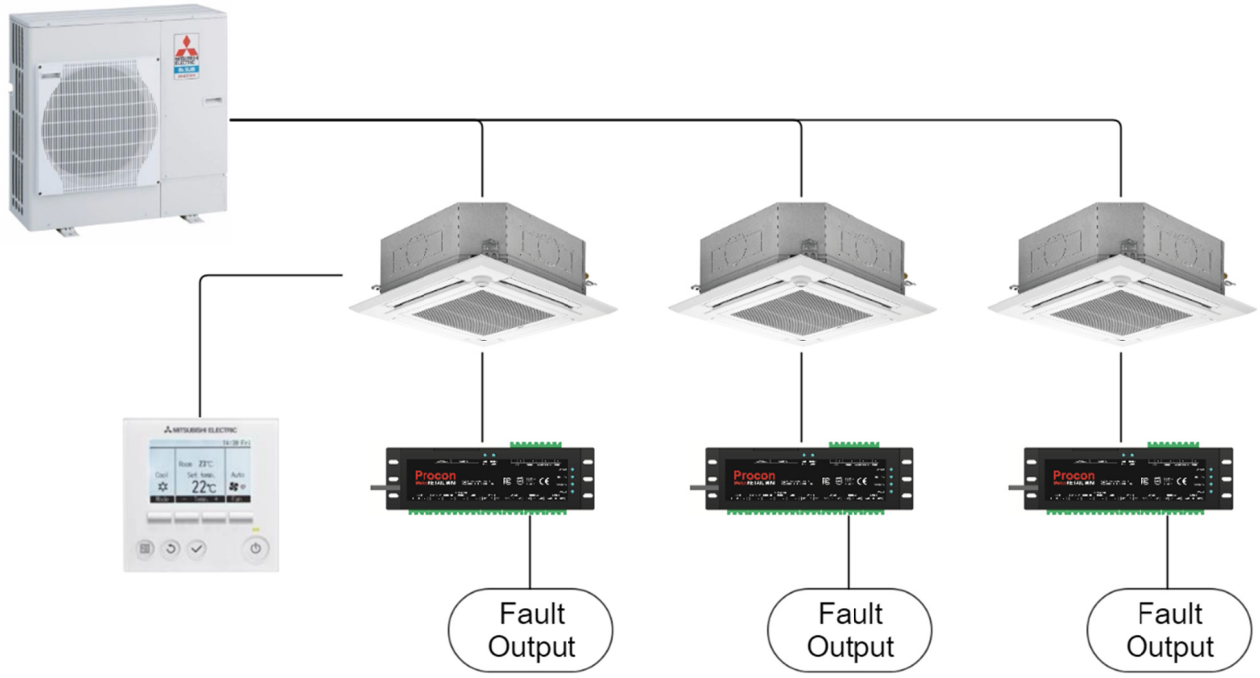
The *FAULT* relay will be energised whenever any of the following are true:

- The 4-digit fault code read from the indoor unit is a value other than 8000.
- There is a communication fault between the MelcoRETAIL MINI and indoor unit.
- The *FAULT* digital input is in the closed position.

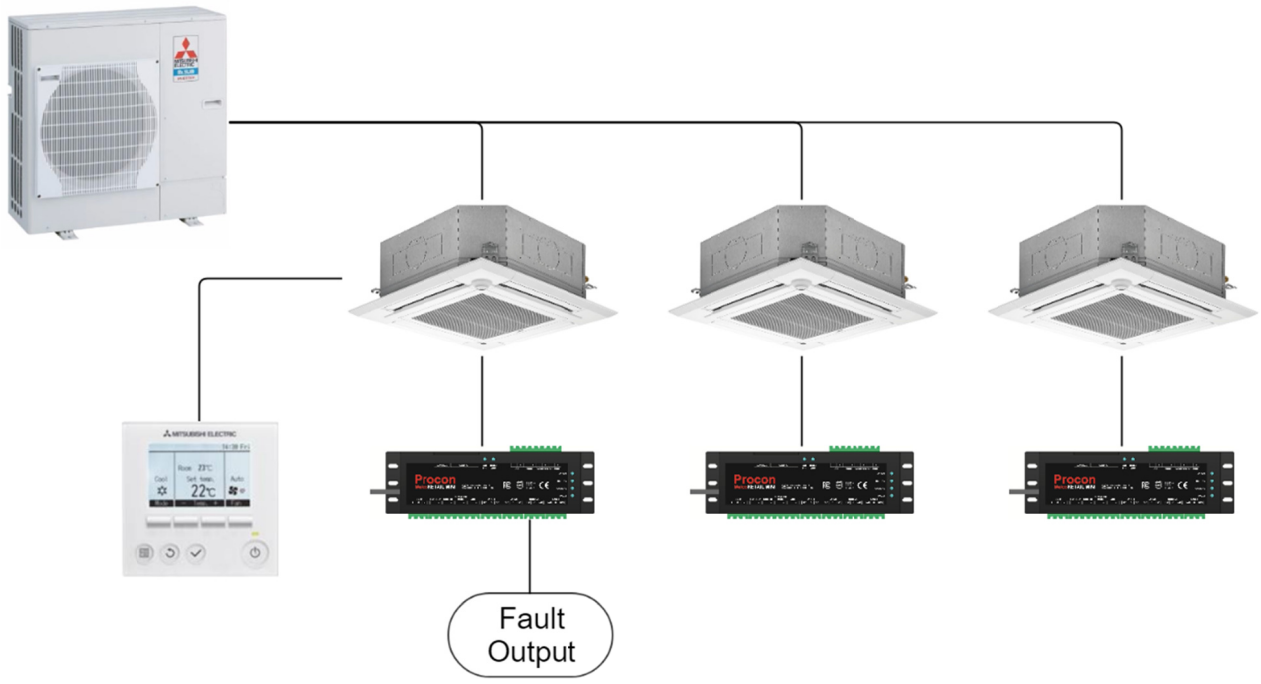
7.12.1. Using Twin / Triple / Quad systems

It is recommended to use one MelcoRETAIL MINI for each indoor unit, however, if the fault output is not used then one MelcoRETAIL MINI can be used per twin / triple / quad system.

When Fault output is being used



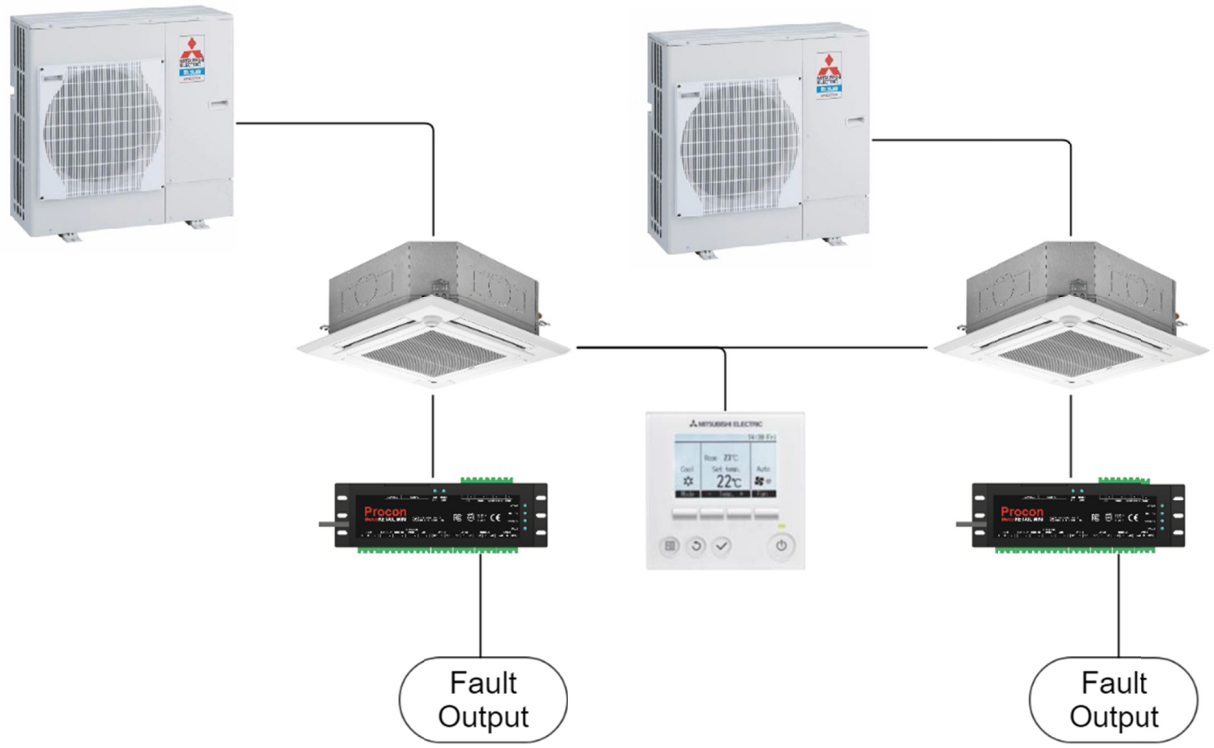
When Fault output is not being used



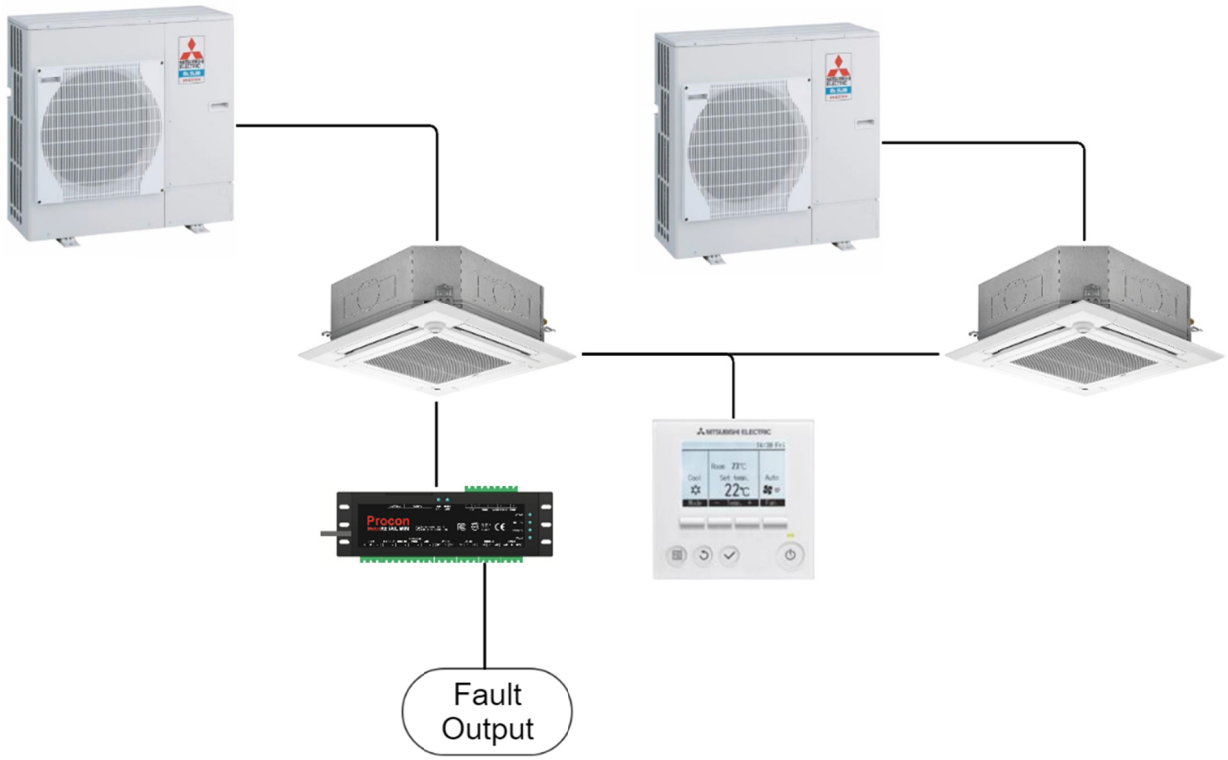
Using single split units in a group

It is recommended to use one MelcoRETAIL MINI for each indoor unit, however, if the fault output is not used then one MelcoRETAIL MINI can be used per twin / triple / quad system.

When Fault output is being used

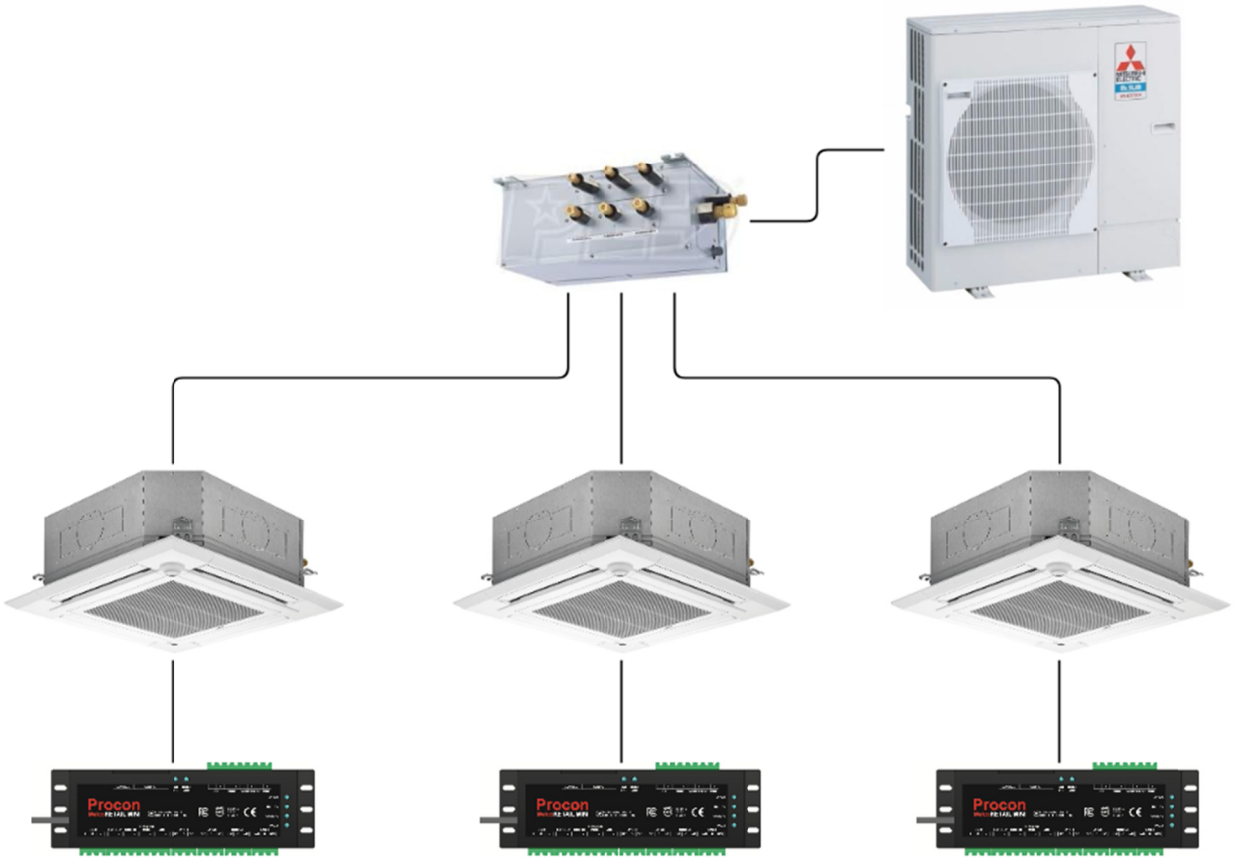


When Fault output is not being used



Using MXZ split units

One MelcoRETAIL MINI must be installed for each indoor unit when using a MXZ system.



8. Failsafe AUTO Mode

The four analogue inputs for control of Setpoint, Mode, Fan Speed and Occupancy would typically be connected to a third party BMS. In the event of the BMS being switched off or becoming disconnected the MelcoRETAIL MINI will set the Mode to AUTO.

8.1. Failsafe trigger thresholds

When configured to use 0-10V inputs, failsafe mode will be triggered when the voltage on each of the inputs decreased below 0.1V.

When configured to use resistance inputs, failsafe mode will be triggered when the resistance on each of the inputs increases above 100kΩ (i.e. open circuit).

8.2. Power up

It is possible to use the MelcoRETAIL MINI without a connection to a BMS hence without using the four analogue inputs. On power up the inputs will be checked to see if they are all below the trigger threshold (or open circuit). If they are the failsafe mode will not be triggered and the MelcoRETAIL MINI will start normal operation.

8.3. Triggering failsafe AUTO mode

If at any time since power up any of the four inputs are below the trigger threshold (or open circuit) the failsafe mode becomes ‘armed’. Then if all four inputs are below the trigger threshold (or open circuit) the failsafe mode will activate.

When failsafe mode activates the Mode will be set to AUTO once. It will not continuously set AUTO mode so can be overridden by a wall controller or through a Modbus command.

9. Deadband mode

The deadband mode is enabled by setting DIP switch 2-1 ON.

Note: The 4 degree offset AND dual setpoint features must be disabled on the indoor unit for the Deadband Mode feature to operate correctly.

9.1. Settings

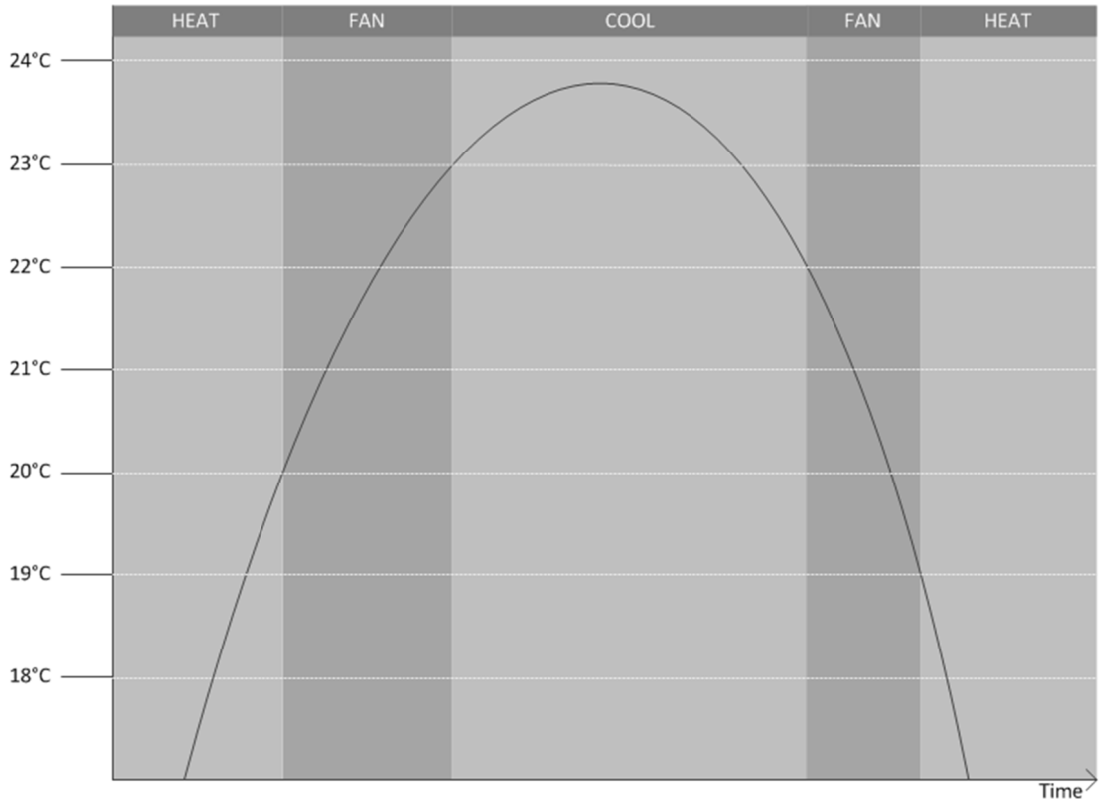
There are two settings, the Heating Setpoint (default 19º) and Cooling Setpoint (default 23ºC). These values can be changed via Modbus, refer to the Modbus register tables for more information.

The Cooling Setpoint must be at least 2ºC greater than the Heating Setpoint, otherwise the default values given above will be assumed.

9.2. Operation

When enabled, the MelcoRETAIL MINI controls the Mode and Temperature Setpoint based on the Room (return air) Temperature.

While the room temperature is less than the *Heating Setpoint* the unit will be set to HEAT mode with a setpoint of 28ºC.
Whilst in HEAT mode, if the room temperature rises above the *Heating Setpoint + 1ºC* the unit will be set to FAN mode.
Whilst in FAN mode, if the temperature rises above the *Cooling Setpoint* the unit will be set to COOL mode with a setpoint of 19ºC.
Whilst in COOL mode, if the room temperature falls below the *Cooling Setpoint – 1ºC* the unit will be set to FAN mode.
Whilst in FAN mode, if the room temperature falls below the *Heating Setpoint* the unit will be set to HEAT mode with a setpoint of 28ºC.
The following image shows this graphically (assuming a Heating Setpoint of 19ºC and a Cooling Setpoint of 23ºC):



9.3. Initialisation

When the MelcoRETAIL MINI powers up it will set the mode, which will be determined by the room temperature.

If less than the Heating Setpoint the unit will be set to HEAT mode with a setpoint of 28ºC.
If greater than or equal to the Cooling Setpoint the unit will be set to COOL mode with a setpoint of 19ºC.
If between the Heating and Cooling Setpoints the unit will be set to FAN mode.

10. Setpoint Offset

Note: The 4 degree offset AND dual setpoint features must be disabled on the indoor unit for the Setpoint Offset feature to operate correctly.

10.1. Settings

There are two settings which are applicable to the Setpoint Offset feature, *BMS Room Temperature* and *BMS Virtual Setpoint*.

The BMS Virtual Setpoint can be changed using Modbus and is stored in non-volatile memory so the value is retained if the MelcoRETAIL MINI loses power.

The BMS Room Temperature can be changed using Modbus but is not stored in non-volatile memory, so the value is lost and reset to zero upon the MelcoRETAIL MINI losing power.

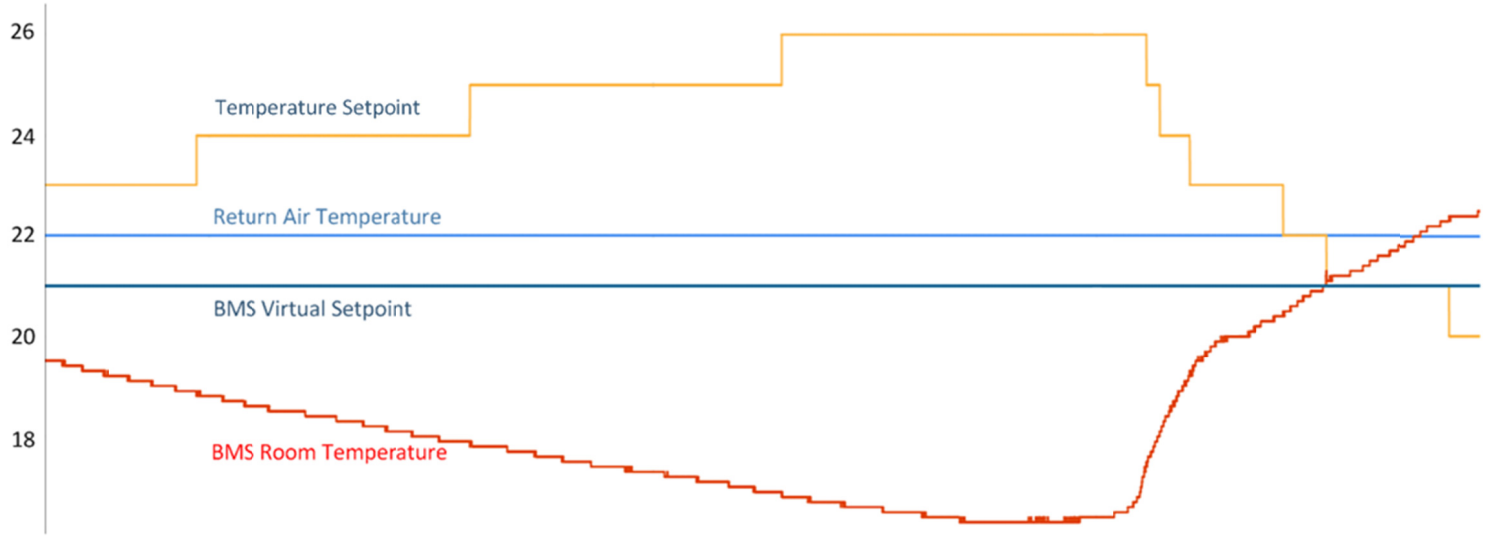
10.2. Operation

In some situations a 3rd party room temperature sensor connected to a BMS or other controller may provide a more accurate temperature reading than the return air temperature of the indoor unit. The MelcoRETAIL MINI can calculate the difference between these two temperature readings and compensate by adjusting the indoor unit's temperature setpoint.

The new temperature setpoint is calculated using the following equation:

Temperature Setpoint = Return Air Temperature – (BMS Room Temperature – BMS Virtual Setpoint)

As a hypothetical example, consider the BMS Virtual Setpoint being set to 21ºC and the indoor unit return air temperature remaining constant at 22ºC. As the BMS Room Temperature decreases the MelcoRETAIL MINI increases the indoor unit's temperature setpoint.
When the BMS Room Temperature reaches 18ºC the Temperature Setpoint = 22 – (18 – 21) = 25ºC.



Hysteresis has been built in to prevent the temperature setpoint from rapidly changing.

The setpoint offset will only operate correctly if the BMS Room Temperature is periodically updated via Modbus, to ensure the MelcoRETAIL MINI always has an up to date reading.

If the BMS Room Temperature is set to 0ºC (which it will be on power up) the setpoint offset feature will be disabled. It will only activate when the BMS Room Temperature is greater than 0ºC.

Note: To disable the feature without removing the MelcoRETAIL MINI power, simply set the BMS Room Temperature to 0ºC via Modbus.

11. Modbus RTU

11.1. Modbus background

Modbus is a master-slave protocol, which means there are two types of Modbus device, Modbus *Masters* and Modbus *Slaves*.

Slave devices simply wait until they receive a command from a Master, act upon that command and send a reply to the Master. Slaves do not have the ability to send commands to other devices on the bus. Master devices are responsible for sending commands to slave devices and receiving data. Modbus only permits there to be one Master device on the bus at any one time, but up to 247 slaves can be connected at a time.

Modbus is most commonly used over RS-485, which is a hardware standard allowing multiple devices to be connected on the same bus.

Each Slave device must have a unique ID on the bus, which is referred to as a *Slave ID*. Each Modbus command the Master sends will contain this Slave ID and only the Slave with that Slave ID will reply.

11.2. Modbus registers

Modbus Slave devices store data in registers. There are four register types and each type has its own register bank. The register types are summarised below:

Register Name	Register Type	Description
Discrete Input	Digital Input	Read only register used for holding status information which holds a value of 0 or 1.
Coil	Digital Output	Read and write accessible register which holds a value of 0 or 1.
Input Register	Analogue Input	Read only register used for status information which holds a 16-bit value (0-65535)
Holding Register	Analogue Output	Read and write accessible register used for status information which holds a 16-bit value (0-65535)

11.3. Modbus connections

For communication over RS-485 all 3 connections are needed. These are labeled A, B and GND. Please refer to the connection diagrams below.

⚠ **Caution:**

The RS-485 cable must be a shielded data cable. Mains flex or other unshielded cable should not be used. The cable shield should be connected to GND at one end only.

⚠ **Caution:**

RS-485 has polarised data connections. It is crucial that all 'A's are connected together, all 'B's are connected together and all 'GND's are connected together.

⚠ **Caution:**

The RS-485 cable must be daisy-chained in a bus network. T-junctions (e.g. star network wiring) are not permitted.

12. Modbus register tables

Some BMS controllers can only read Modbus Holding Registers, so the MelcoRETAIL MINI also exposes all Discrete, Coil and Input Registers as Holding Registers. The Discrete Input registers and Input registers are not writable so their equivalent Holding Register is read only and marked [**READ ONLY**].

Some BMS controllers may not be able to read signed register values (i.e. values which can be negative in value), so the MelcoRETAIL MINI also exposes an unsigned version of those registers (these registers will not return a negative value).

12.1. Holding registers

Holding Registers are read using function code 03 and written to using either function code 06 or 16. Function code 06 is used when writing to a single holding register, function code 16 is used for writing to multiple holding registers in the same command.

Holding Registers (Analogue Outputs)			
Register Name	Address	Modicon Address	Details
Drive Mode	0	40001	1 = Heating 2 = Humidity reduction 3 = Cooling 7 = Ventilation, clean air operation 8 = Auto Operation 9 = i-see heating operation* 10 = i-see humidity reduction* 11 = i-see cooling * * indicates a read only value, writing this value will have no effect
Temperature Setpoint	1	40002	Temperature value in °C multiplied by 10. e.g. value 200 = 20°C
Fan Speed	2	40003	0 = Auto 2 = Quiet 3 = Weak 5 = Strong 6 = Very strong (SH i)
Air Direction	3	40004	0 = Auto 1 = Position 1 2 = Position 2 3 = Position 3 4 = Position 4 5 = Position 5 7 = Swing
Modbus Slave ID	4	40005	Values 1 – 247 valid

Holding Registers (Analogue Outputs)			
Register Name	Address	Modicon Address	Details
Modbus RS-485 Baud Rate	5	40006	0 = 9600 1 = 1200 2 = 2400 3 = 4800 4 = 9600 5 = 14400 6 = 19200 7 = 28800 8 = 38400 9 = 56000 10 = 57600 11 = 115200
RS-485 Parity Type	6	40007	0 = None 1 = Even 2 = Odd
Drive On/Off	7	40008	0 = Drive OFF 1 = Drive ON
Room Temperature [**READ ONLY**]	8	40009	Temperature value in °C multiplied by 10. e.g. value 200 = 20°C
Fault Code (hex) [**READ ONLY**]	9	40010	0x8000 = No error 0x6999 = Bad communication with indoor unit (Refer to indoor unit documentation for description of other fault code values)
Firmware Version [**READ ONLY**]	10	40011	MelcoRETAIL MINI firmware version
Modbus Comms Counter [**READ ONLY**]	11	40012	Value of a counter which increments upon every valid Modbus command received. Value is automatically reset to zero when value exceeds 65535.
Fault Code (decimal) [**READ ONLY**]	12	40013	8000 = No error 6999 = Bad communication with indoor unit (Refer to indoor unit documentation for description of other fault code values)
System Type Detected [**READ ONLY**]	13	40014	0 = ATA 1 = ATW
Deadband Enabled State [**READ ONLY**]	14	40015	0 = Deadband disabled (DIP switch 8 OFF) 1 = Deadband enabled (DIP switch 8 ON)
BMS Room Temperature (signed)	15	40016	Signed temperature value in ºC multiplied by 10. 0xFF9C = -10ºC … 0x01F4 = 50ºC
BMS Room Temperature	16	40017	Temperature value in ºC multiplied by 10. 0 = 0ºC … 500 = 50ºC
BMS Virtual Setpoint	17	40018	Temperature value in ºC
Deadband Heating Setpoint	18	40019	Temperature in ºC (default 19ºC). Value must be at least 2ºC lower than the Deadband Cooling Setpoint.
Deadband Cooling Setpoint	19	40020	Temperature in ºC (default 23ºC). Value must be at least 2ºC higher than the Deadband Heating Setpoint.
Auto Mode Setpoint High Limit	32	40033	Temperature in ºC (default 30ºC).
Auto Mode Setpoint Low Limit	33	40034	Temperature in ºC (default 16ºC).

Holding Registers (Analogue Outputs)			
Register Name	Address	Modicon Address	Details
Cooling Mode Setpoint High Limit	34	40035	Temperature in ºC (default 30ºC).
Cooling Mode Setpoint Low Limit	35	40036	Temperature in ºC (default 16ºC).
Heating Mode Setpoint High Limit	36	40037	Temperature in ºC (default 30ºC).
Heating Mode Setpoint Low Limit	37	40038	Temperature in ºC (default 16ºC).
--- Occupancy Mode --- In Occupancy Cooling Setpoint	38	40039	Temperature in ºC (default 23ºC). Value must be at least 2ºC higher than the In Occupancy Heating Setpoint.
--- Occupancy Mode --- In Occupancy Heating Setpoint	39	40040	Temperature in ºC (default 21ºC). Value must be at least 2ºC lower than the In Occupancy Heating Setpoint.
--- Occupancy Mode --- Staff In Cooling Setpoint	40	40041	Temperature in ºC (default 24ºC). Value must be at least 2ºC higher than the Staff In Heating Setpoint.
--- Occupancy Mode --- Staff In Heating Setpoint	41	40042	Temperature in ºC (default 18ºC). Value must be at least 2ºC lower than the Staff In Heating Setpoint.
--- Occupancy Mode --- Unoccupied Cooling Setpoint	42	40043	Temperature in ºC (default 26ºC). Value must be at least 2ºC higher than the Unoccupied Heating Setpoint.
--- Occupancy Mode --- Unoccupied Heating Setpoint	43	40044	Temperature in ºC (default 16ºC). Value must be at least 2ºC lower than the Unoccupied Heating Setpoint.
Deadband Cooling Setpoint	44	40045	Temperature in ºC (default 23ºC)
Deadband Heating Setpoint	45	40046	Temperature in ºC (default 19ºC)
Auto Mode Timeout	46	40047	Value in seconds (default 300 seconds). The length of time before Auto Mode ends and the unit switches to FAN mode.
Relay Manual Override Start/Stop	51	40052	Write value 1 to allow relay outputs to be overridden using Modbus registers 52 – 55. Write value 0 to end the manual override and return relays to their normal operating state. Note the manual override will timeout after 20 minutes and the relays will return to their normal operating state.
Relay 1 Override State (ON/OFF)	52	40053	If the relay manual override has been enabled using Modbus register 51 then writing a value 0 to this register will de-energise the relay. Writing value 1 will energise the relay.
Relay 2 Override State (HEATING)	53	40054	If the relay manual override has been enabled using Modbus register 51 then writing a value 0 to this register will de-energise the relay. Writing value 1 will energise the relay.
Relay 3 Override State (COOLING)	54	40055	If the relay manual override has been enabled using Modbus register 51 then writing a value 0 to this register will de-energise the relay. Writing value 1 will energise the relay.

Holding Registers (Analogue Outputs)			
Register Name	Address	Modicon Address	Details
Relay 4 Override State (FAULT)	55	40056	If the relay manual override has been enabled using Modbus register 51 then writing a value 0 to this register will de-energise the relay. Writing value 1 will energise the relay.
Auto Mode Timeout Override	56	40057	If the Auto Mode input has been triggered the unit will run in Auto mode for a configurable length of time. This register can be used to temporarily override this timeout value. e.g. Trigger Auto Mode and wait for the unit to switch to Auto mode. Now write value 60 to this Modbus register. Now after 60 seconds the unit will leave Auto Mode and run in Fan mode.
Heating Relay Temperature Offset	57	40058	When in Heat or Auto mode this value determines how far the return air temperature must decrease below the temperature setpoint for the HEATING relay to energise. The value is in ºC.
Cooling Relay Temperature Offset	58	40059	When in Cool or Auto mode this value determines how far the return air temperature must increase above the temperature setpoint for the COOLING relay to energise. The value is in ºC.
Relay Switching Delay	59	40060	This value determines how long the delay will be before the ON/OFF, HEATING and COOLING relays change state. The value is in Seconds.

12.2. Input registers

Input Registers are read using function code 04.
Note the values of all Input registers have corresponding Holding registers which can be used instead.

Input Registers (Analogue Inputs)			
Register Name	Address	Modicon Address	Details
Room Temperature	0	30001	Temperature value in °C multiplied by 10. e.g. value 200 = 20°C
Fault Code (hex)	1	30002	0x8000 = No error 0x6999 = Bad communication with indoor unit (Refer to indoor unit documentation for description of other fault code values)
Firmware Version	3	30004	MelcoRETAIL MINI firmware version
Modbus Comms Counter	5	30006	Value of a counter which increments upon every valid Modbus command received. Counter is reset to zero when value exceeds 65535.
Fault Code (decimal)	8	30009	8000 = No error 6999 = Bad communication with indoor unit (Refer to indoor unit documentation for description of other fault code values)
Unused	9	30010	
Current DIP Switch Values	10	30011	
Occupancy Mode Input Value (Least significant register)	11	30012	Value in mV if inputs are set to Voltage type. Value in Ω if inputs are set to Resistance type.
Occupancy Mode Input Value (Most significant register)	12	30013	
Fan Speed Input Value (Least significant register)	13	30014	Value in mV if inputs are set to Voltage type. Value in Ω if inputs are set to Resistance type.
Fan Speed Input Value (Most significant register)	14	30015	
Mode Input Value (Least significant register)	15	30016	Value in mV if inputs are set to Voltage type. Value in Ω if inputs are set to Resistance type.
Mode Input Value (Most significant register)	16	30017	
Setpoint Input Value (Least significant register)	17	30018	Value in mV if inputs are set to Voltage type. Value in Ω if inputs are set to Resistance type.
Setpoint Input Value (Most significant register)	18	30019	

12.3. Discrete Inputs

Discrete Input Registers are read using function code 02.

Discrete Inputs (Digital Inputs)			
Register Name	Address	Modicon Address	Details
Force ON Input State	0	10001	0 = Input off (open contact) 1 = Input on (closed contact)
Force OFF Input State	1	10002	0 = Input off (open contact) 1 = Input on (closed contact)
Lock/Auto Input State	2	10003	0 = Input off (open contact) 1 = Input on (closed contact)
External Fault Input State	3	10004	0 = Input off (open contact) 1 = Input on (closed contact)
Running Status Relay State	4	10005	0 = Relay de-energised 1 = Relay energised
Heating Status Relay State	5	10006	0 = Relay de-energised 1 = Relay energised
Cooling Status Relay State	6	10007	0 = Relay de-energised 1 = Relay energised
Fault Relay State	7	10008	0 = Relay de-energised 1 = Relay energised
Comms Settings Switch State (DIP switch 1-6)	8	10009	0 = Fixed 9600 baud, no parity (DIP Switch off) 1 = Software selectable settings (DIP Switch on)
Protocol Selection Switch State (DIP switch 1-7)	9	10000	0 = Reserved (DIP Switch off) 1 = Modbus RTU (DIP Switch on)
Auto/Lock Mode Selection Switch State (DIP switch 1-8)	10	10011	0 = Auto Mode selected (DIP Switch off) 1 = Lock Mode selected (DIP Switch on)
Deadband Enabled Switch State (DIP switch 2-1)	11	10012	0 = Deadband Mode disabled (DIP Switch off) 1 = Deadband Mode enabled (DIP Switch on)
Setpoint Limiting Enabled Switch State (DIP switch 2-2)	12	10013	0 = Setpoint Limiting disabled (DIP Switch off) 1 = Setpoint Limiting enabled (DIP Switch on)
Timeout Enabled Switch State (DIP switch 2-3)	13	10014	0 = Timeout disabled (DIP Switch off) 1 = Timeout enabled (DIP Switch on)
Analogue Input Type Selection Switch State (DIP switch 2-4)	14	10015	0 = Voltage input type selected (DIP Switch off) 1 = Resistance input type selected (DIP Switch on)

12.4. Coils

Coils are read using function code 01 and written to using either function code 05 or 15. Function code 05 is used when writing to a single coil register, function code 15 is used for writing to multiple coil registers in the same command. Note the values of all Coil registers have corresponding Holding registers which can be used instead.

Coils (Digital Outputs)			
Register Name	Address	Modicon Address	Details
Drive On/Off *(Note: Holding register address 7 can also be used to change the Drive)*	0	00001	0 = Drive OFF 1 = Drive ON

Appendix A – Compatible Air-To-Air units

UK Models

M Series
MSZ-SF25/35/50VE
MSZ-GF60/71VE
MSZ-EF25/35/50VES/VEW/VEB
MSZ-FH25/35VE
MSZ-FD25/35VA
MSZ-GE22/25/35/50/60/71VA
MSZ-GC22/25/35VA
MSZ-GB50VA
MSZ-GA22/25/35/50/60/71VA
MFZ-KA25/35/50VA

Mr Slim
PCA-RP50/60/71/100/125/140KAQ
PEAD-RP35/50/60/71/100/125/140JAQ
PEAD-RP35/50/60/71/100/125/140EA/EA2
PEA-RP200/250GAQ
PKA-RP35/50HAL
PKA-RP60/71/100KAL
PLA-ZRP35/50/60/71/100/125/140BA/BA2
PLA-RP35/50/60/71/100/125/140BA/BA2/BA3
PLA-RP35/50/60/71/100/125/140AA/AA2
PSA-RP71/100/125/140KA
PSA-RP71/100/125/140GA
SEZ-KD25/35/50/60/71VAQ
SEZ-KA35/50/60/71VA
SLZ-KA25/35/50VAQ
SLZ-KA25/35/50VA

Models Not Supported:
MSZ-HJ25/35VA
MSZ-HC25/35VA/VAB
PCA-RP71/125HA/HAQ
PEA-RP400/500GAQ

Electrical Safety

E114220

Please be sure to put the contact address/telephone number on this manual before handing it to the customer.

MITSUBISHI ELECTRIC UK

MITSUBISHI ELECTRIC UK, TRAVELLERS LANE, HATFIELD, HERTFORDSHIRE, AL10 8XB