UNIT CONTROLLER 8 (UC8)
Master – slave connection

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Note: Information in this document applies to UC8 controllers programmed with software version 1.5.

Contents

1. Summary

The UC8 controller is designed to control a single compressor system. A unit with more than one compressor requires one UC8 controller per compressor. A few options exist for the configuration of a unit equipped with more than one UC8 controller. The various options offer different control possibilities and are subject to particular restrictions. This document presents the options, when an option should be used or not used and restrictions that may apply.

2. When is it necessary to connect UC8 boards as master and one or more slaves?

Master-slave connection of UC8 controllers is necessary when one or more of the following applies:

1. A multiple compressor unit is controlled by a single TZT-100 or SAT-3 thermostat or by the zone controller using Modbus. Only one board can communicate with the thermostat. The UC8 board that does will be the master. All other UC8 boards must be configured as slaves and connected to the master UC8.
2. A multiple compressor outdoor unit connects to an indoor unit with only one indoor unit controller (IUC), or two indoor units each with one IUC and both IUC are connected to the same UC8. As with Modbus thermostats, only one UC8 can communicate with the IUC. And again, that will be the master. The master will control the indoor fan on behalf of all compressors. The master will also pass on temperature readings taken by the IUC to the appropriate slave. Since the IUC can only handle two refrigeration circuits, such a system is limited to only two compressors. Options exist if more than two compressors are needed in a split system with IUC, these are not discussed in this document.
3. A reverse cycle unit with multiple compressors has a shared (common) outdoor fan chamber. Here all systems must de-ice all at the same time or else de-icing may be ineffective or fail altogether. The UC8 solves the problem by coordinating de-icing via the master-slave connection.

Chapter 3 gives details how to configure multiple UC8 controllers as master and slave(s).

If none of the above applies it is recommended to operate multiple UC8 controllers as independent systems. The advantages this can provide are greater control flexibility, better monitoring facility via Modbus connections, enhanced system reliability and more effective de-icing of the outdoor coils.

Chapter 5 gives details how to configure multiple UC8 controllers as independent systems.

## 3. How to configure the UC8 as master and slave(s)?

The following table lists the UC8 DIP switch settings for master and slave controllers:

| Switch		Function
11	**12**	**# System**
OFF	OFF	1 Master. This selection also applies to single compressor units.
ON	OFF	2 First slave system.
OFF	ON	3 Second slave system.
ON	ON	4 Third slave system.

The diagram below shows how to connect UC8 boards as master and slave when a TZT-100 or SAT-3 room thermostat or a zone controller is used:
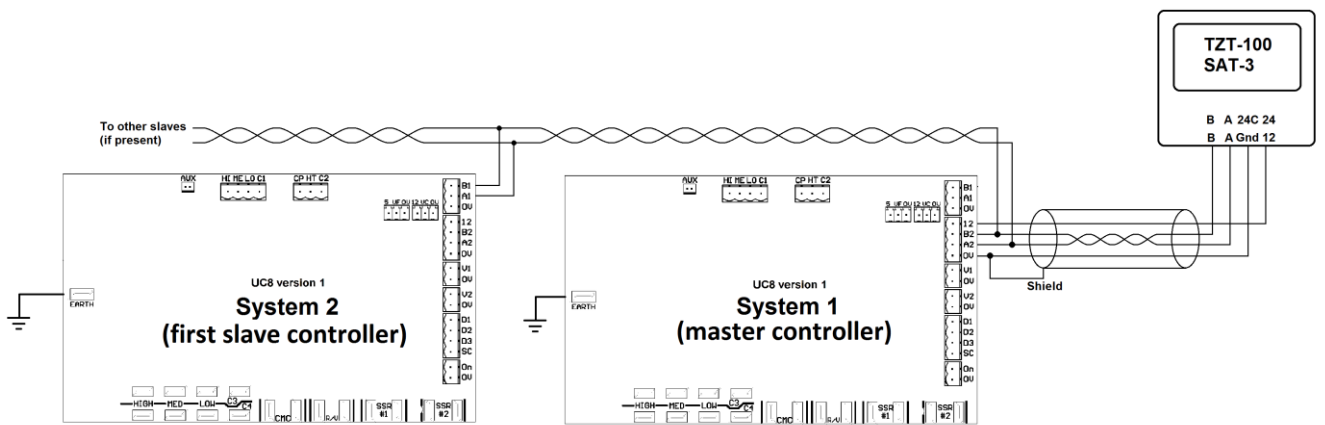
The diagram below shows how to connect UC8 boards as master and slave when the unit is controlled by a communicating BMS:
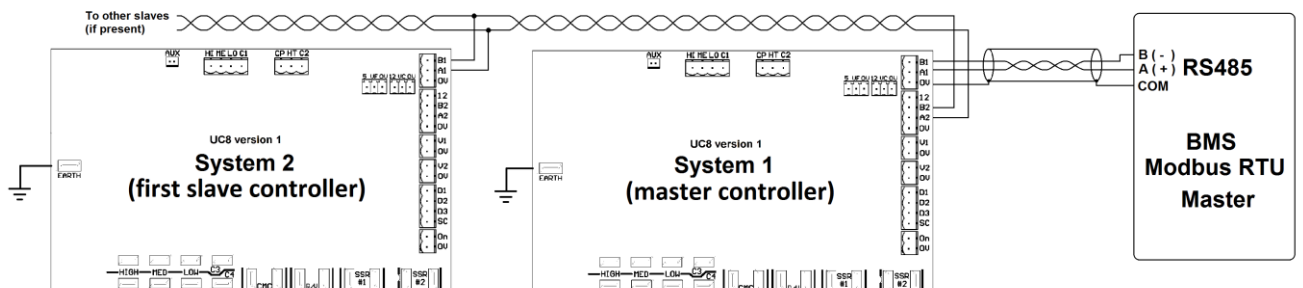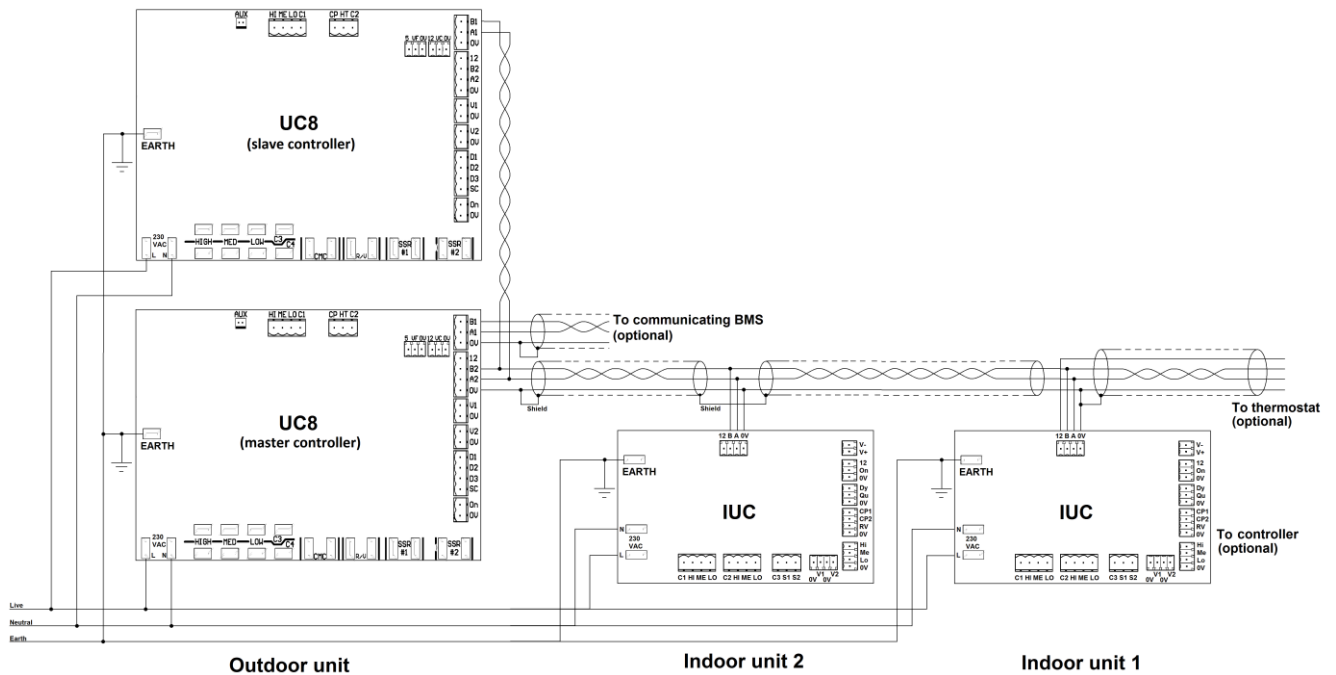

The diagram below shows how to connect UC8 boards as master and slave when the unit connects to an indoor unit with one IUC:
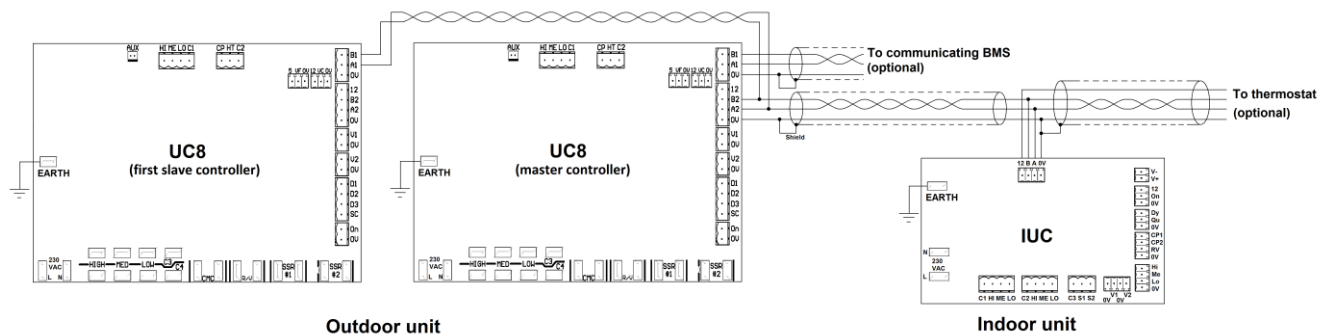
The diagram below shows how to connect UC8 boards as master and slave when the unit connects to two indoor units each with one IUC:

4. What are the limitations of master-slave connection of the UC8?

The following issues may affect installations with master-slave connection:

- **Control and monitoring by a BMS of slave units can present issues.**
  If the unit is controlled and/or monitored by a communicating BMS (Modbus or BACnet via a suitable converter) the BMS can connect only to the master UC8 because the BMS input of the slave board is already connected to the master UC8. Any control and monitoring of the slave unit must pass through the master. This is possible and is implemented but, due to the command passing through the master, the response to a command from the BMS is delayed by up to 2 seconds. The delay can be longer still on systems with more than two compressors. Many devices using Modbus communications cannot tolerate such long delays and are likely to indicate 'no response' faults.

- **Master-slave connection can affect system reliability.**
  If the master UC8 controller stops operating the whole installation will stop. If the multiple compressor installation was purchased with the express intention to have backup this will be considered unacceptable. The UC8 master-slave connection thus can have a negative impact on total system reliability.

- **Compressor run-time sharing, lead-lag operation and user control of when a slave compressor should switch on or off may not be feasible.**
  If the unit is controlled by a TZT-100 or SAT-3 thermostat the master UC8 decides when a slave compressor is needed and when it is not. This capacity control is by a PI closed control loop that uses the room temperature reading and the setpoint (and time elapsed) as inputs. The software does not implement compressor run-time sharing nor lead-lag logic. Furthermore, although settings for the PI closed control loop are made conservatively, they may not be appropriate for all installations and in some cases temperature control could be less than satisfactory.

- **PI closed control loops sometimes confuse customers.**
  Some customers expect the compressors to be switched on and off purely based on distance from setpoint: essentially a form of proportional (P) control only. That method almost guarantees the room temperature never actually reaches setpoint unless the system has significant excess capacity. In contrast a PI closed control loop will (eventually) always deliver the required capacity to reach setpoint, provided the system has adequate capacity.

5. Multiple independent UC8 controllers.

When possible it is recommended to operate multiple UC8 controllers as independent systems and not use master-slave connection. This can provide greater control flexibility, better monitoring facility via Modbus connections, enhanced system reliability and better de-icing of the outdoor coils.

5.1. Connections

The diagram below shows how to connect multiple independent UC8 boards to a communicating BMS using Modbus over RS485:
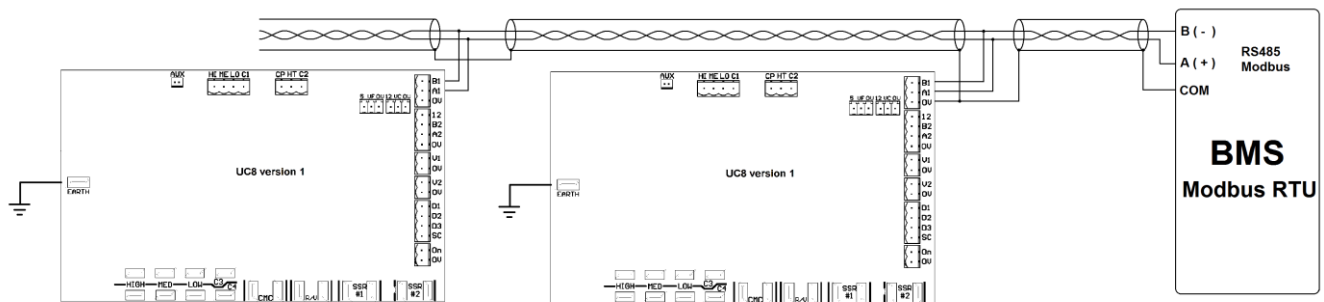

In the configuration above each UC8 controller must be assigned a unique Modbus device address. This is most easily done using the following procedure:

- Turn mains power on.
- The compressor and the thermostat must be off.
- Press and hold the pushbutton on the UC8 controller board until the display shows the letter "**A**", then release the button. The controller is now in "Modbus address setup" mode.
- The display will show the Modbus device address. The factory set default value is 44. Subsequent button presses will increase the address. After address 99 the address will cycle back to 1 in round-robin fashion.
- When the desired address has been selected then wait for 30 seconds. The controller will leave setup mode and return to normal mode. If the address was changed then the controller will save a new address in non-volatile memory. The new address will be retained even after mains power has been switched off.

The diagram below shows an example of how one can connect multiple independent UC8 boards to a BMS or other controller with voltage-free relay contacts:
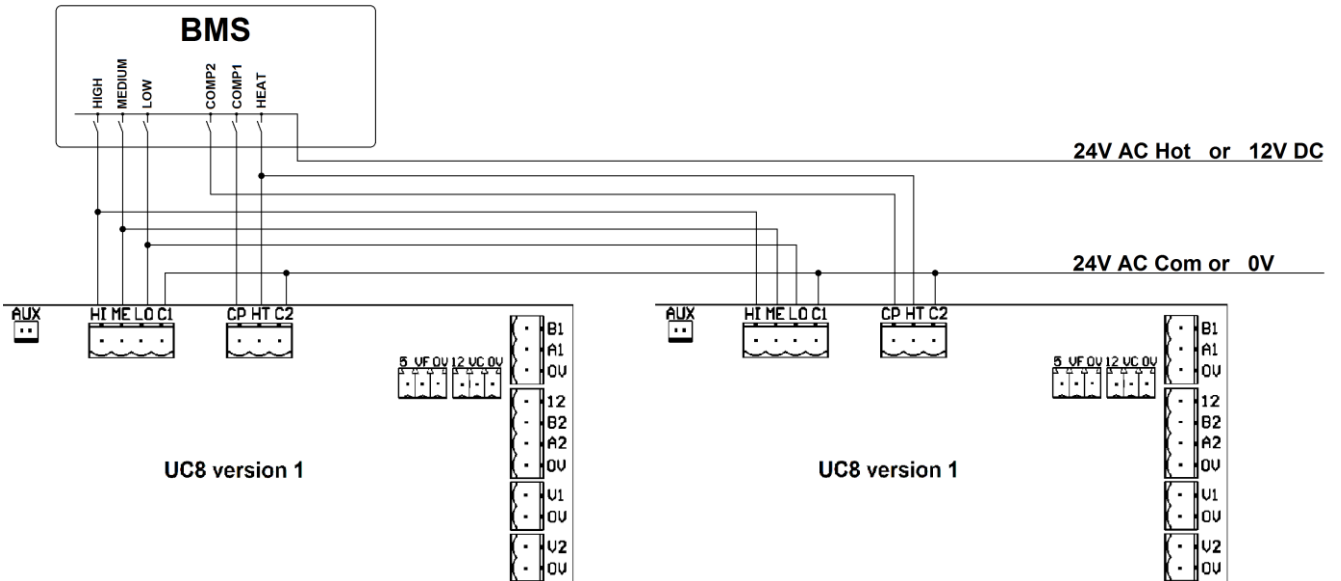
5.2. Implications for control of the indoor fan

On systems with multiple independently operating UC8 controllers careful consideration must be given to the control of the indoor fan. In many cases a packaged unit has only one single compartment where all indoor coils and indoor fans are located. Many split units also have only one indoor unit with again all indoor coils and indoor fans in a common compartment. In both cases the indoor fan(s) must operate in the correct manner for all compressor circuits. Below are two examples how the indoor fan(s) can be controlled.
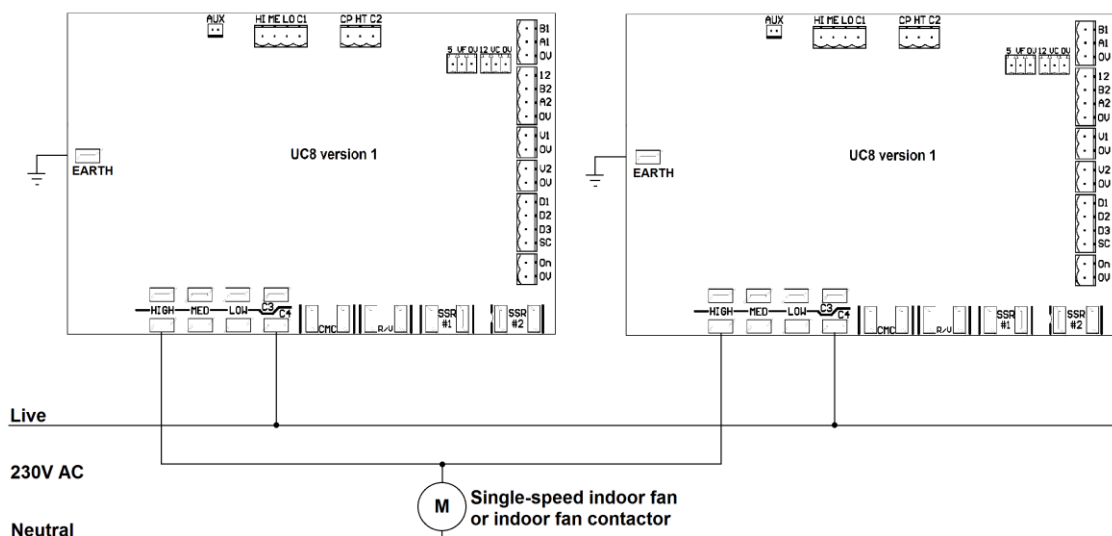
With continuously variable speed (0-10V) EC indoor fan(s):
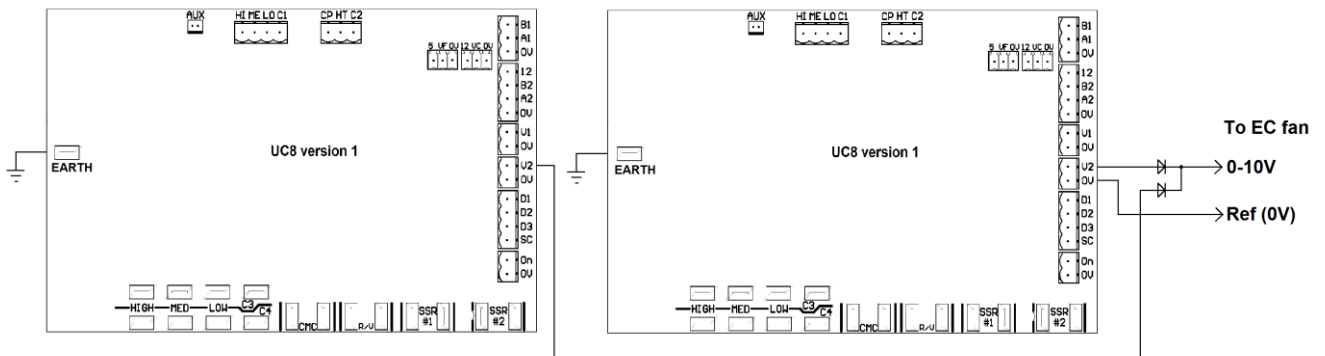
Suitable lead part numbers: 201 000 015 (600 mm long), 201 000 018 (1200 mm long)

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With single speed indoor fan(s):

It is also acceptable if the indoor fan(s) is (are) controlled by means external to the UC8 controllers e.g. directly by a thermostat or BMS. In this case it is the responsibility of the system-designer and installer to ensure proper and safe operation of the indoor fan, and the system as a whole, under all operating conditions.