



Table of Contents

Introduction	2
Network topology with RS-485	2
Maximum Network Length.....	2
Cable Type.....	2
Can you get away with unshielded cable?	3
CAT 5 Ethernet cable.....	3
Shield Wiring Recommendations.....	3
Terminating Resistors	3
Cable Routing	4
Summary.....	4

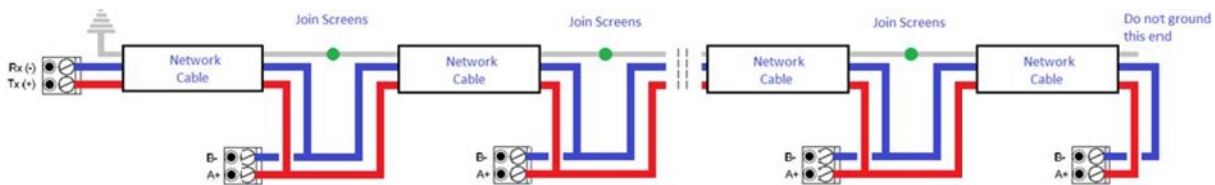
1. Introduction

Two of the most popular data protocols used in the BMS industry are Modbus RTU and BACnet MS/TP. Both of these can use the RS-485 (more accurately called EIA-485) medium for data transmission and reception. RS-485 is the physical layer standard for data transmission.

2. Network Topology with RS-485

The RS-485 communications standard supports 32 devices in a party line or multi-drop mode, on a cable of up to 1200 meters for balanced differential signal transmissions.

The communication wiring must be installed in a configuration means that there is only one main cable proper daisy chain format. Daisy chain and every network device is connected in parallel directly along its path. Never use a free topology and/or star configuration on the network.

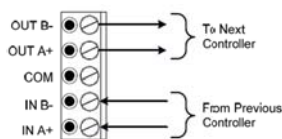


3. Maximum Network Length

RS-485 allows the total length of the twisted pair bus to be up to a maximum of 1200 meters using data rates from 9,600 to 100,000bps. **NB** This condition is only valid when proper installation and cables are used. The maximum baud rate supported by Sontay devices is 76k8 for BACnet MS/TP or 56k7 for Modbus RTU.

If a network requires to be longer than 1200 meters in length, then physical layer repeaters must be used to extend the network length.

Sontay products don't use "In" and "Out" terminals for RS-485. If products which do use this terminal arrangement are used on the network, be aware that removing the terminal block from the PCB will cause the network to be broken.



4. Cable Type

Sontay recommend using low capacitance, RS1485, 22 or 24 AWG shielded twisted pair cables such as Belden 9841, 3106A or 3107A, or equivalent. These cables have a characteristic impedance of 120Ω.

RS-485 ideally needs 2 conductors and a shield. Two conductors are used to carry the RS-485 differential voltage signal, while the shield is connected to earth/ground at one end only and provides shielding against induced noise.

NB Don't ruin the effect of the cable twists by unwinding them by more than a couple of cms at each end.

It's always good practice to connect the ground conductor before you connect the differential conductors. If this isn't done, you run the risk of large noise and transient spikes being induced into the differential (A+ and B-) conductors. This can lead to damage to the RS-485 driver components on the sensors.

4.1 Can you get away with unshielded cable?

In theory, yes. If it's not easy to terminate the shield at least tell the installer to coil and tape the shield and/or drain wire so that you can use it later if you want or need to. However, there is a greatly enhanced risk of loss of communications and/or damage to the devices if shielded cable isn't used. This is the single biggest cause of product failure found in RS-485 installations. It might be expected that all the electrical equipment in an installation is ultimately connected to the same ground, but in practice this is extremely unlikely, and ground potentials are common.

4.2 CAT 5 Ethernet cable

CAT 5 cables are the most common Ethernet cables in use today and are relatively inexpensive, commonly less than half the price of specialty RS-485 cables. In fact, CAT 5 cables almost meet the electrical requirements for RS-485 cables, as the capacitance is similar, but there is a small impedance mismatch (typically 100Ω for CAT 5, 120Ω for RS485). In practice, CAT 5 cables have been used successfully in many installations, but there are potential problems, especially if unshielded types are used.

The most common cable type is CAT 5e-UTP (unshielded twisted pair), which may work over shorter distances in less demanding applications with low EMI noise levels.

5. Shield Wiring Recommendations

Do not use any reference (COM) terminal on the controllers to wire the cable shields. Shields from each cable section of the network should be wired together. Attention must be taken to ensure that the shields are well protected (ends taped or covered in heat shrink, for example) to prevent any connection to ground that could influence the shield reference. This could create ground loops and change the reference level of the network. The shield in a daisy chain format is then grounded at one end only (usually on the supervisory controller or router end). Do not ground the shield at more than one location, as you may induce ground loop noise.

6. Terminating Resistors

If you elect to use cable designed for an RS-485 bus (see part 4), you may not need to use terminating resistors. Terminating resistors are used to correct impedance mismatches between the cable of the sensor hardware, which result in standing waves or reflections on the cable. This impedance mismatch can affect the shape (and sometimes magnitude) of the data pulses present on the cable, which in turn can affect the quality of communications on the whole RS-485 bus. The standard impedance is 120Ω for RS-485, and Sontay's sensors have switchable terminating resistors of this value built on to the PCB.

If you use a cable with a different impedance, such as CAT 5, you may need to use slightly different value terminating resistors. Check the datasheet for the cable you have used, and fit resistors of the same impedance as the cable impedance.

NB Only fit (or switch into circuit) terminating resistors at each end of the RS-485 bus, and never on devices anywhere else along the length of the bus.

7. Cable Routing

- 7.1. Never run RS-485 cables in the same cable tray or containment as mains cables.
- 7.2. Where possible, avoid running RS-485 cables alongside cables carrying low voltage AC or DC, if those cables are used to switch loads on or off (for example, contactors or actuators).
- 7.3. Never run RS-485 cables near known sources of EMC, such as VFD pump and fan drives.

8. Summary

- Never exceed more than 32 devices on the bus unless you use a physical layer repeater.
- Never exceed a bus length of more than 1200 meters unless you use a physical layer repeater.
- Always use a single, daisy-chain bus topology
- Never use a star or free bus topology
- Always connect the shield to ground before connecting the differential conductors.
- Wherever possible, use shielded cable designed specifically for RS-485 data buses.
- Only connect the screen or shield of the bus cable at one end.
- Only use terminating resistors if necessary, and if the bus cable has an impedance of anything other than 120Ω, don't use the built-in terminating resistors on the Sontay sensors, but use terminating resistors which match the installed cable impedance (for example, 100Ω for CAT 5).
- Only fit terminating resistors at the ends of the data bus.
- Never fit a single terminating resistor at one end only.
- Never route the RS-485 bus cable near mains or other power supply cables.
- Never route the RS-485 bus cable near VFD drives, or similar potential sources of noise and transients.