RS-485 Shielding and Troubleshooting

Affects: All ASI Products

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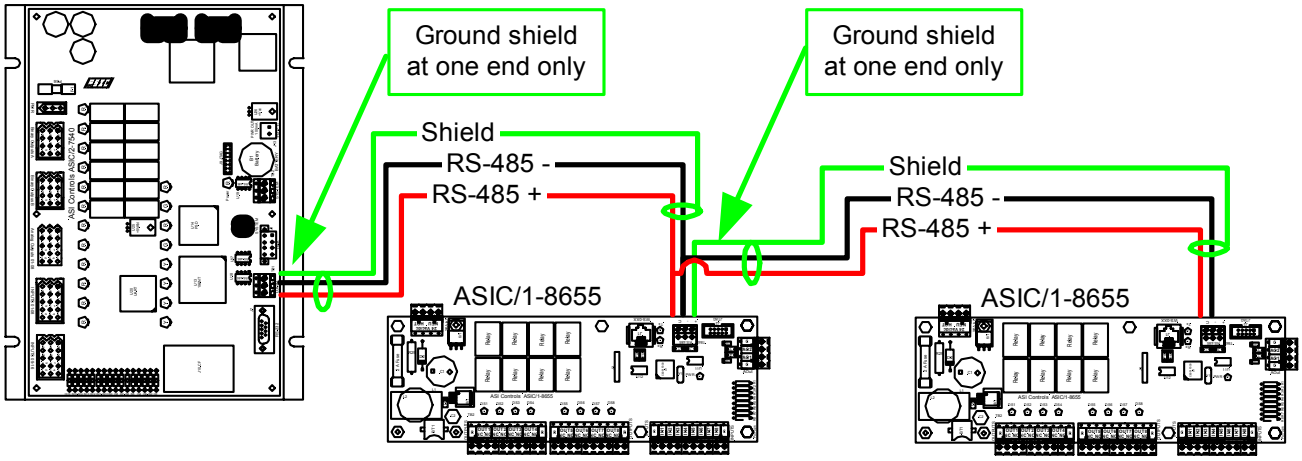
ASI Controls Technical Note Series

Note No. TE-023

Shielded RS-485 Communications

Buildings are noisy environments. Shielded RS-485 communication wire is used to meet the CE requirements for emission and immunity. Although CE conformance is not a requirement in the U.S, shielding markedly reduces susceptibility to noise.

Although ASI has endorsed unshielded twisted pairs in ceilings for many years, we recommended using shielded communication wire in any noisy environment including on roofs and between buildings. The shield should always be grounded at only one end of each segment starting with the SINC/3 or ASIC/2 controller.



Installation Rules

RS-485 communication is highly noise resistant. However, a few basic rules must be followed to avoid communication problems. Taking the time to make sure communication wiring is installed properly in the beginning helps avoid communication problems latter.

- **Every controller MUST be grounded.** Ground the shield at only one end of each segment to the controller ground.
- Avoid splicing communication cables. Use continuous pieces of cable between controllers.
- If possible, keep communication wiring away from electrical noise sources such as power wiring, large power consuming or power-generating equipment, etc.. If possible, cross power wiring at right angles.
- Route input, output, power and communication wire neatly inside the enclosure. Avoid looping excess wire. Use tie-wraps to dress and bundle loose groups of wires.
- **Do NOT bundle communication or input wiring with output and power wiring**. It can disrupt communication and/or interfere with controller input measurements.
- Do not run communication wiring close to AC power wiring. Always route controller wiring separate from high voltage wiring to reduce the possibility of excessive EMI noise. If you must run communication with power, make sure the shield is solidly grounded.

- Do not physically stress the communication cables, especially when pulling the communication cable around sharp bends and over rough surfaces.
- Do not exceed 32 controllers on the local communication bus. If more than 32 controllers are connected together, use an RS-485 repeater to strengthen the signal.
- Make sure all connections to the controller are mechanically tight. Intermittent contact of connections can cause electrical noise.
- Verify communication as you go. As each controller is connected to the remote communication bus, verify communication with both the current controller, and the one previous, on the network.
- Install only communication cable which meets the ASI Controls stated specifications. Use only factory fabricated and tested wall sensor cables, SCP-0XX .
- If a multiple- pair cable, such as CAT-5, is used, all wires must be terminated so that it does not act like an antenna. Strip and connect unused wires and terminate at one end to the controller ground

Communication Wire Specification

Shielded communication wire is required to meet CE certification.

Communication wire should meet the following specifications:

Shielded Pair Specification	
Wire:	22-24 gauge
# of conductors:	2, (1 twisted pair)
Nominal Capacitance	
Between Conductors:	24 pF/ft
Between 1 Conductor and Shield:	42 pF/ft

If run inside buildings the wire should be Plenum Rated.

Note: We do not recommend using wire with more than one pair for communication between controllers! If communication wire has more than 1 pair, then the other wires should be terminated at ground on one end to prevent induced noise.

Surge Protection

The RS-485 communication lines are protected against voltage spikes with Transient Voltage Suppressors.

Additional lightning protection should be used to protect the RS-485 communication if the lines are run between buildings or are otherwise exposed.

Troubleshooting RS-485

If you are having trouble communicating with a network of ASI controllers, you must establish where the communication breaks down.

If there are only one or two controllers failing, you can focus on those. Check the communication directly at the device. Check the pico-fuses. Make sure that each controller has a unique device address. If two controllers have the same address, then communication is intermittent at best. Talk to the controllers directly off the network and give them correct addresses.

If an entire branch of controllers is down, then there could be an open wire, a short, or the RS-485 +/- swapped. Use a binary search to isolate the problem. Break the communication line somewhere in the middle and verify communication to each side. On the side that is still bad, break the communication line somewhere in the middle again. Repeat until you find the problem.

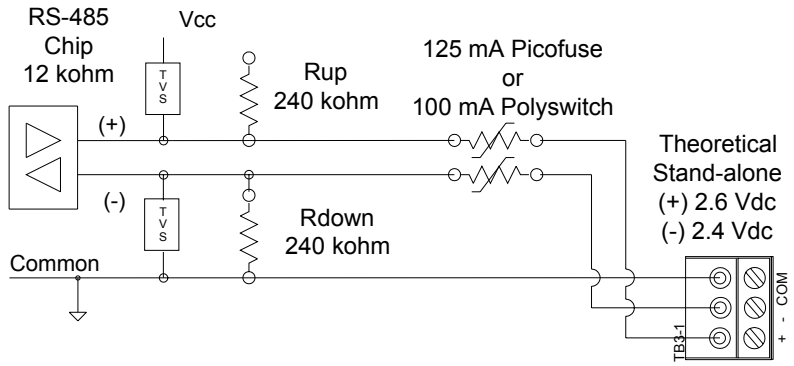
If ASIC/1 controllers are on the network the problem could be in the Wall Sensor, or Sensor Cable. Disconnect the sensor cable at the controller and see if the network branch begins communicating.

If the controllers have Green and Red transmit (Tx) and receive (Rx) LEDs you can watch the lights with ASI Expert or front end software trying to communicate to determine how far the communications get.

You may also find it useful to measure the quiescent voltage on the (+) and (-) RS-485 line when there **NO COMMUNICATION!** The voltage s are in the range 0 to 5 Vdc with respect to controller common or ground. There should be NO AC voltage on the lines. The observed voltages depend on the type of controller and on the number of controllers connected. The voltages on a single isolated controller are different than for a network of controllers. If there is NO voltage on either side it may indicate that the picofuse, polyswitch or the RS-485 chip has failed. If either reads + 5Vdc, it indicates that the RS-485 chip has failed.

ASIC/1 Controller Family - ASIC/1-8x55, ASIC/1-8655, ASIC/1-6000

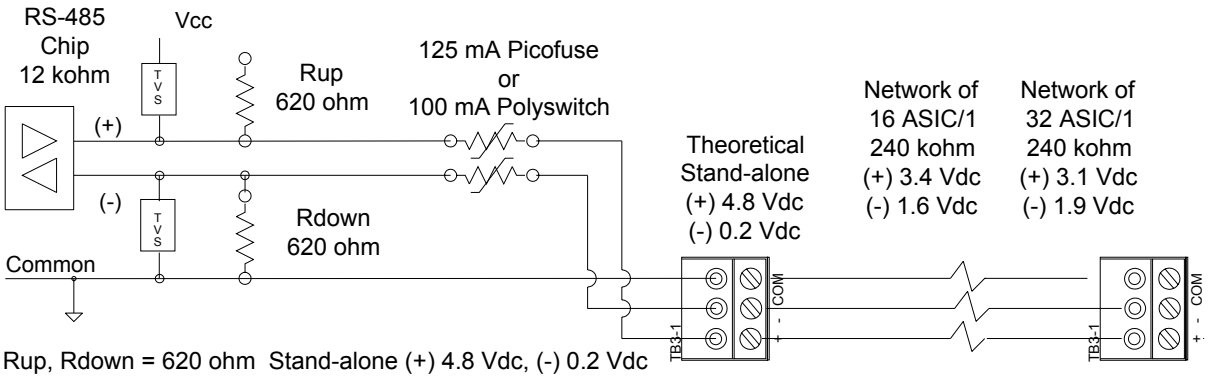
The ASIC/1 family of controllers has weak pull-up resistors and pull-down resistors, 240 kohm, on the RS-485 communication line. When there is no communication and the controllers are stand alone, the (+) is pulled up to about 2.6 Vdc, and the (-) is pulled down to about 2.4 Vdc.



Rup, Rdown = 240 kohm Stand-alone (+) 2.6 Vdc, (-) 2.4 Vdc
Typical 8655 (2.56 V, 2.24 V); 6000 (2.56 V, 2.24 V); 8x55 (2.57 V, 2.28 V)

SINC/1-1030, ASIC/2 Local Bus, SINC/2-2000 Field

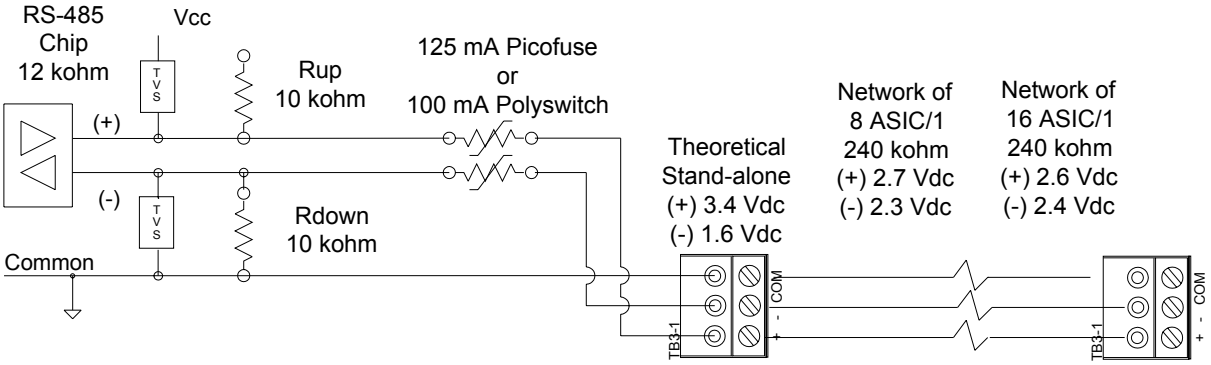
The SINC/1-1030, ASIC/2 Local Bus and SINC/2-2000 Field have a strong pull-up resistors and pull-down resistors, 620 ohm, on the RS-485 communication line. When there is no communication and the controllers are stand alone, the (+) is pulled up to about 4.8 Vdc, and the (-) is pulled down to about 0.2 Vdc. When additional controllers are added to the communication line, the voltage will shift as shown.



Rup, Rdown = 620 ohm Stand-alone (+) 4.8 Vdc, (-) 0.2 Vdc
Measured: 7540 Local (4.74 V, 0.32 V); 7040 Local (4.89 V, 0.09V);
8040 Local (4.89 V, 0.09V); 1030[Vcc=4.0V] (3.89 V, 0.01 V)

ASIC/2 System Bus, SINC/3, ASI C/R, SINC/2-2000 Repeater

The ASIC/2 System Bus, SINC/3, ASI C/R, and SINC/2-2000 Repeater have modest pull-up resistors and pull-down resistors, 10 kohm, on the RS-485 communication line. When there is no communication and the controllers are stand alone, the (+) is pulled up to about 3.4 Vdc, and the (-) is pulled down to about 1.6 Vdc. When additional controllers are added to the communication line, the voltage will shift as shown.



Rup, Rdown = 10 kohm Stand-alone (+) 3.4 Vdc, (-) 1.6 Vdc
Measured: 7540 System (3.62 V,1.30 V); 7040 System (3.53 V,1.34 V);
8040 System (3.56 V,1.30 V); 3000 (3.98 V, 0.94 V)

Tech Support

If you have any further questions please contact: ASI Controls Technical Support support@asicontrols.com, or call 925-866-8808