



Guidelines for Proper Wiring of an RS-485 (TIA/EIA-485-A) Network (Including Termination Resistors)

This technical notice provides basic guidelines for wiring an RS-485 network. The RS-485 specification (officially called TIA/EIA-485-A) does not specifically explain out how an RS-485 network should be wired. The specification does, nonetheless, give some guidelines. These guidelines and sound engineering practices are the basis of this note. The suggestions here, however, are by no means inclusive of all the different ways that a network can be designed.

Wire

RS-485 is designed to be a balanced system. Simply put, this means there are two wires, other than ground, that are used to transmit the signal.

What is “Twisted-Pair” and Why is it Used?

As its name implies, a twisted pair is simply a pair of wires of equal length and twisted together. Using an RS-485-compliant transmitter with twisted-pair wire reduces two major sources of problems for designers of high speed, long distance networks: radiated EMI and received EMI.

Characteristic Impedance of a Twisted-Pair Wire

Depending on the geometry of the cable and the materials used in the insulation, twisted-pair wire has characteristic impedance associated with it that is usually specified by its manufacturer. The RS-485 specification recommends, but does not specifically dictate, that this characteristic impedance be 120Ω.

Accutech recommends the use of 120Ω impedance wire.

Termination Resistors

Due to the high frequencies and the distances involved, proper attention must be paid to transmission-line effects. A thorough discussion of transmission-line effects and proper termination techniques is well beyond the scope of this application note. With this in mind, terminations will be briefly discussed in their simplest form as they relate to RS-485.

A terminating resistor is simply a resistor placed at the extreme end or ends of a cable. An RS-485 network can have from 2 to 32 devices connected to it in a daisy chain fashion. Regardless of the number of devices there are always two devices at the ends of the daisy chain. It is the end devices that must have termination resistors. The other devices between the two end devices must NOT have termination resistors. (See examples A and B below)

The value of the terminating resistor is ideally the same value as the characteristic impedance of the cable. When the termination resistance is not the same value as the characteristic impedance of the wiring, reflections will occur as the signal travels down the cable. Although some reflections are inevitable

due to cable and resistor tolerances, large enough mismatches can cause reflections big enough to cause errors in the data.

Accutech recommends the use of 120Ω terminating resistors. Leaded termination resistors are provided with all Accutech RS-485 devices.

