FAC-2000 FAIRNET Wiring Guide

Version 1.0

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Introduction

Fairmount Automation's FAIRNET protocol uses a 2-wire EIA RS-485 interface as its physical layer. This interface can connect up to 32 FAC-2000 controllers at a maximum network speed of 115,000 bps (note: the number of devices on the network can be increase to a maximum 250 through use of isolators/repeaters.) Network cable lengths of approximately 2,500 feet can be achieved using the 115,000 bps data rate. Slowing down the transmission speed can increase cable length to a maximum 4000 ft – see the recommended reading section at the end of this document for more information.

Topology and Wire Selection

The ideal topology for a RS-485 network is a bus (see Figure 1).

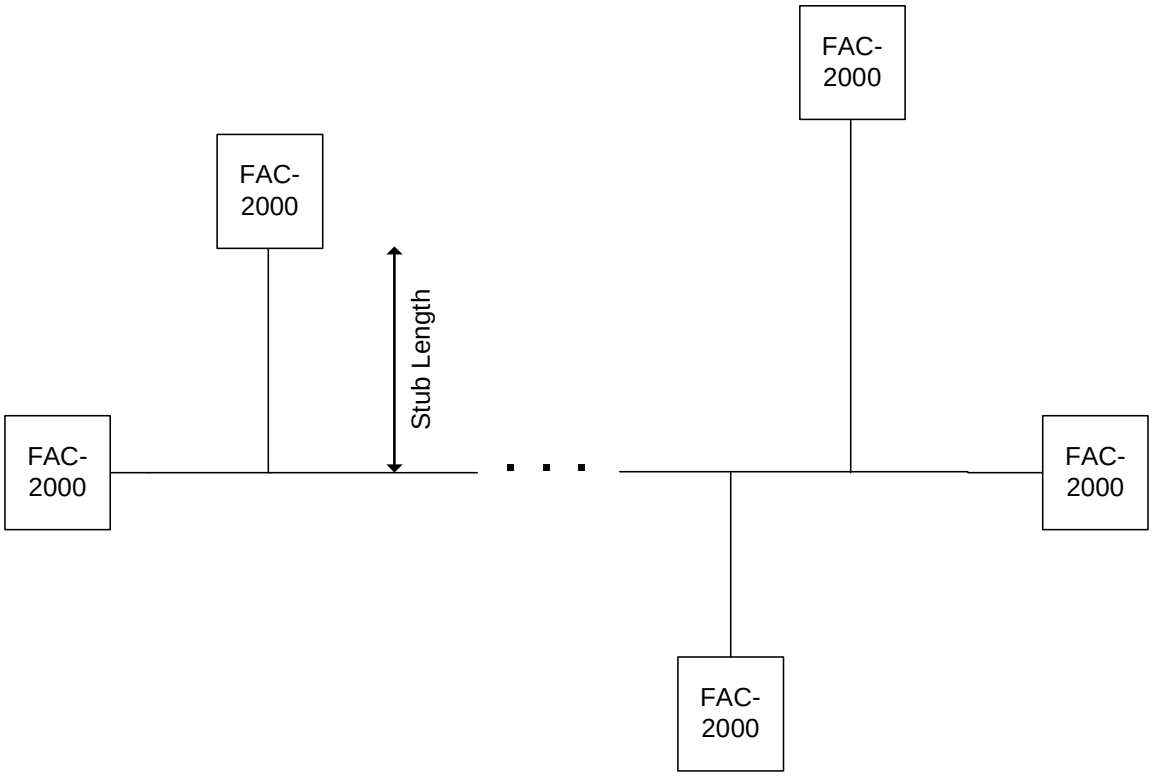

Figure 1: RS-485 Bus Topology

RS-485 may be implemented using a wide variety of topologies (not including a ring) depending on cable length and transmission speed. In general it is recommended that the system designer keep the topology as close as possible to a bus with stub lengths (see Figure 1) as short as possible.

Hook-up and Wire Selection

The FAC-2000 controllers use the 2-wire version of RS-485 physical layer standard – these wires are labeled Tx/Rx+ and Tx/Rx-. Keep in mind that it is also required to connect a ground (label Gnd) between all devices on the network. Typically the designer should use a cable with at least three conductors and a shield wire. Note that the shield should be connected to earth/case ground at one end of the network (note that earth/case ground is NOT the same connection as Gnd – see the FAC-2000 Hardware Reference Guide for more information.)

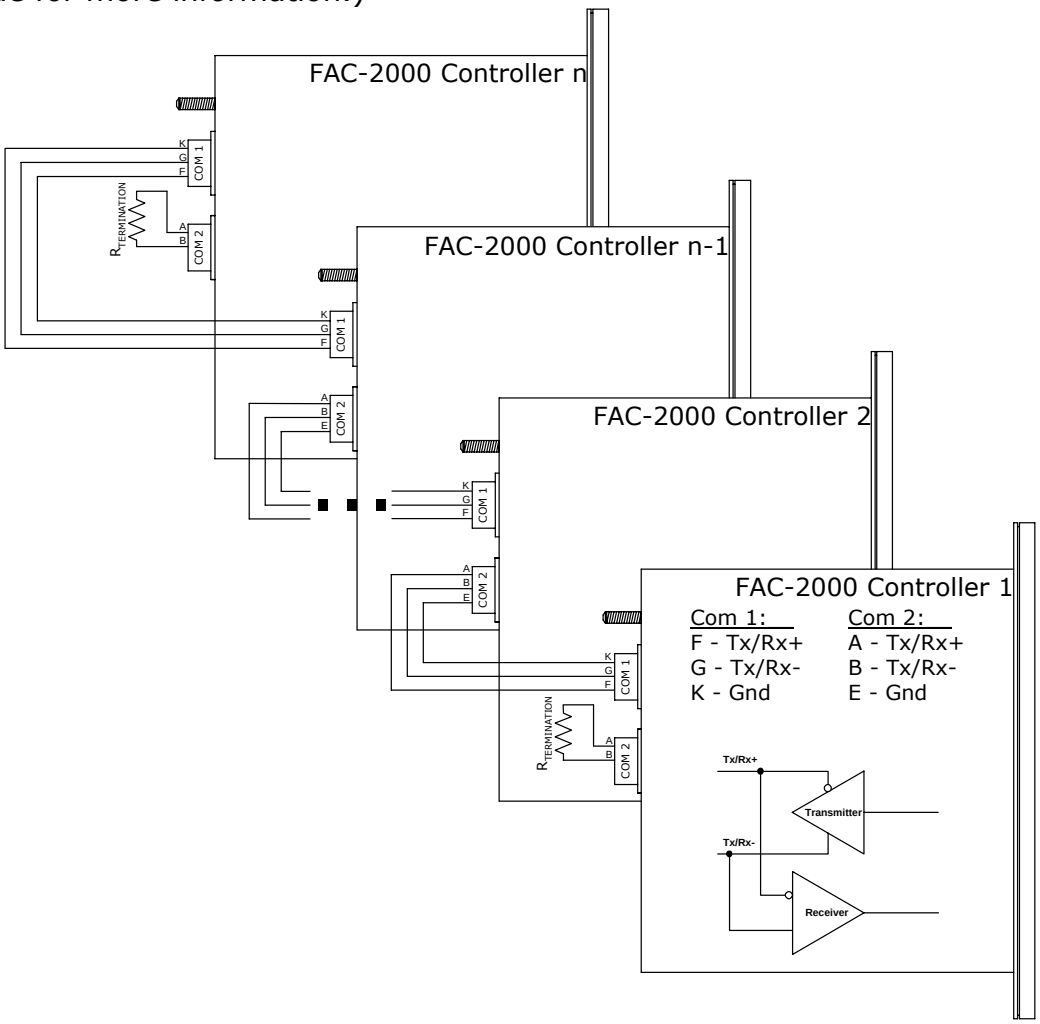

Figure 2: Example FAC-2000 multi-drop RS-485 network

The cable used for RS-485 must be low capacitance (typically less then 35 pf/ft) and have a characteristic impedance of between 100 and 120 ohms. Cable manufacturers often sell cable specifically designed for low capacitance EIA RS-485 applications. In addition, category 5 twisted pair Ethernet cable can usually be used as a qualified alternative for EIA RS-485 cable.

Biasing and Termination

Figure 3 shows the circuit layout for a typical terminated and biased FAIRNET network.

Biasing the network insures that when all the controllers deactivate their transmitters that the network remains in a valid state. In general, you should **always** bias the network. In Figure 3, the following components are used in the biasing circuit: 28VDC power source (this can range from 16VDC to 32VDC), R_{bias}, D_{reg}, and R_{reg} ($R_{termination}$ is not part of the biasing circuit).

Recommended values for the biasing components are:

- R_{bias}(QTY 2): Ideally, this resistor value will change with the number of controllers on the network. Our past experience tells us that 700Ω resistors will work fine for a network consisting of 2 to 32 controllers. These resistors should be at least ¼ Watt with a 10% tolerance.
- D_{reg}: This is a 5.6V Zener diode, 1 Watt. The 1N4734A from Motorola can be used.
- R_{reg}: 3.3kΩ, at least ¼ Watt with a 10% tolerance (minimum).

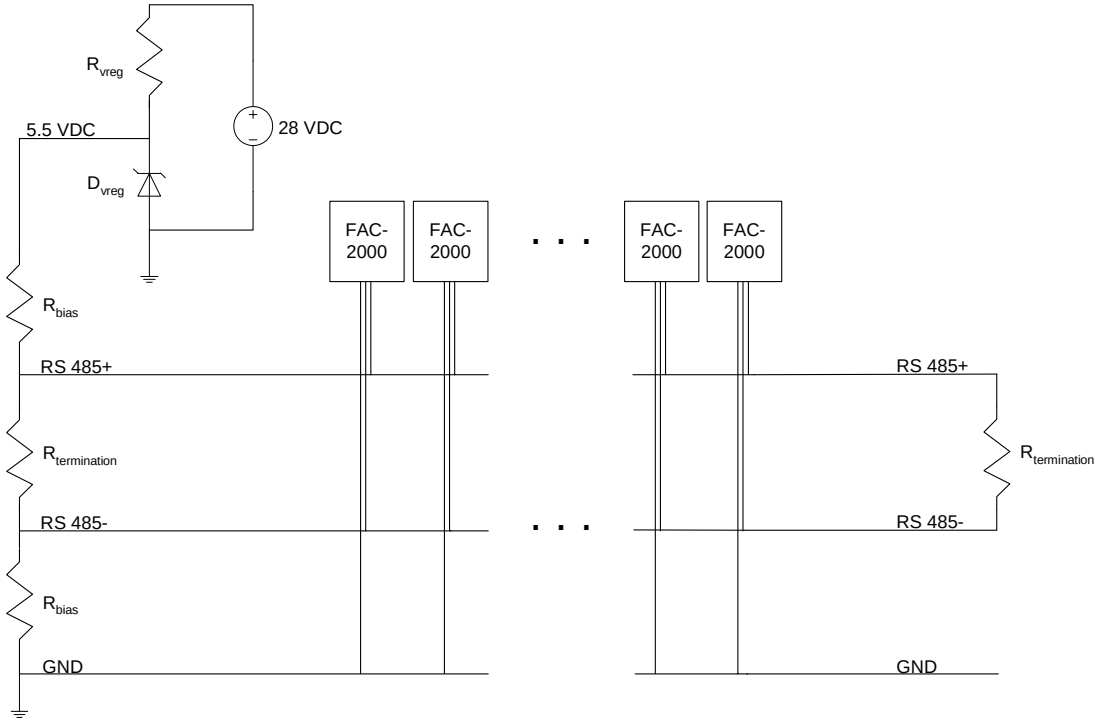

Figure 3: FAC-2000 RS-485 Network with biasing and termination

Termination helps control electro-magnetic signal reflections in the wires and should only be inserted at the two ends of the network. In general, termination should *only* be used after long cable runs (approximately 150 feet) *as required*. As a rule of thumb, always test the network performance

first without the termination resistors. If problems are experienced, add the termination resistors in one at a time – it is OK to only use one termination resistor. Remember, use a maximum of two termination resistors at the ends of the network only!

The recommended resistance for the termination resistors ($R_{termination}$) should be the same as the characteristic impedance of the cable used (typically between 100Ω and 120Ω).[1] The resistors should be at least ¼ Watt with a 10% tolerance (minimum).

Recommended Reading

The RS-422/485 Application note from B&B Electronics is an excellent source of additional information on this topic. This application note is available for download from www.bb-elec.com.

[1] Ideally the termination resistor on the same side on the network as the biasing circuit should be increased to take in account the parallel resistance of biasing resistors. In practice, this effect can be ignored.