Operation/Reference Guide

AxLink Wiring Considerations

Control System Accessories

Last Revised: 2/10/2012

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Table of Contents

AxLink Wiring Considerations

Overview

This document describes AxLink, wiring topologies, electrical timing and characteristics, compatible cable types, wiring distance calculations, and wiring diagram examples. AxLink is a proprietary communication protocol designed by AMX to control up to 255 devices with a Central Controller using common copper conductors.

- The AxLink communication protocol supports multiple wiring topologies, including star, daisy-chain, home run, or any combination.
- AxLink devices are electrically wired in parallel and require a minimum of 3 conductors for signal/power ground, AXM, and AXP.

  An optional fourth conductor can be used for 12 VDC power distribution.
- The AXM and AXP AxLink data signals are differential and require one pair of twisted conductors.

Axlink Specifications

Axlink Specifications	
• Transmission method:	Half-Duplex
• Transmission medium:	Shielded pseudo differential twisted pair
• Data rate:	20.8K
• Signal level:	5 volts peak to peak typical
• Input impedance:	220K ohms typical
• Total devices allowed on link:	255
• Protocol:	Proprietary Asynchronous Polled Access
• Total distance:	3000 feet (914.4 m) when using shielded low capacitance cable. UTP limited to 1000 feet (304.8 m).
• Packet size:	Proprietary Variable, payload limited to 64 bytes.
• Suitable topologies:	Star, Daisy-Chain, or a combination of both

AxLink Maximum Cable Distances

The wiring distance specifications describe the total wiring distance between external devices and the Central Controller. For example, FIG. 1 illustrates a star wiring topology, in which the total wiring length is 1,200 feet (366 m).

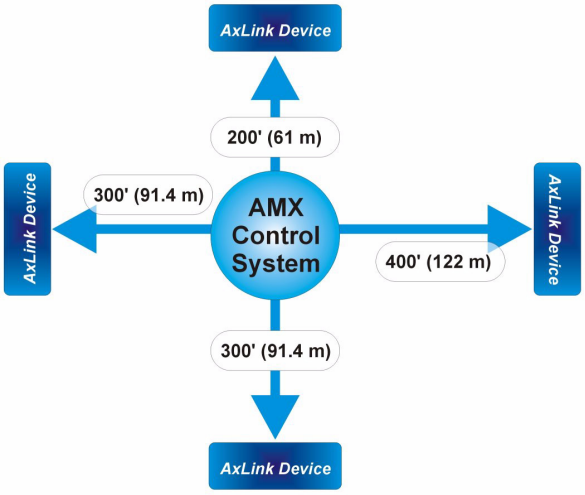

FIG. 1 Star wiring topology example

NOTE

The wiring distances for the AXB-MPE Master Port Expander and AXB-SPE Slave Port Expander devices are calculated on a per-port basis. The ports on these devices are isolated and electrically independent with respect to each other.

The following table lists the maximum cable lengths by electrical current and wire gauges (AWG). These distances are based on a min. of 13.5 volts available at the Central Controller's power supply.

Maximum AxLink current and cable lengths by wire AWG

Maximum Current	Cable length by wire AWG			
Milliampere (mA)	18 AWG	20 AWG	22 AWG	24 AWG (UTP)
50	2,347	1,485	926	584
100	1,174	743	463	292
250	469	297	185	117
500	235	149	93	58
1,000	117	74	46	29

Calculating Axlink Wiring Distances

All AxLink devices require a minimum of 12 VDC power to operate properly. The power can be supplied by the Central Controller's AxLink cable (remote power configuration) or with an optional 12 VDC power supply (local power configuration).

WARNING

Most power supplies are factory set to 13.5 VDC. Never use a power supply that exceeds 18 VDC for remote or local power configurations. Contact AMX for a complete list of products and their power consumption ratings.

The maximum wiring distance between the power supply and AxLink device is determined by power consumption, supplied voltage, and the wire gauge used for the cable.

Use the 3-step formula below to calculate the maximum wiring lengths allowable between the Central Controller and external AxLink devices (FIG. 2):

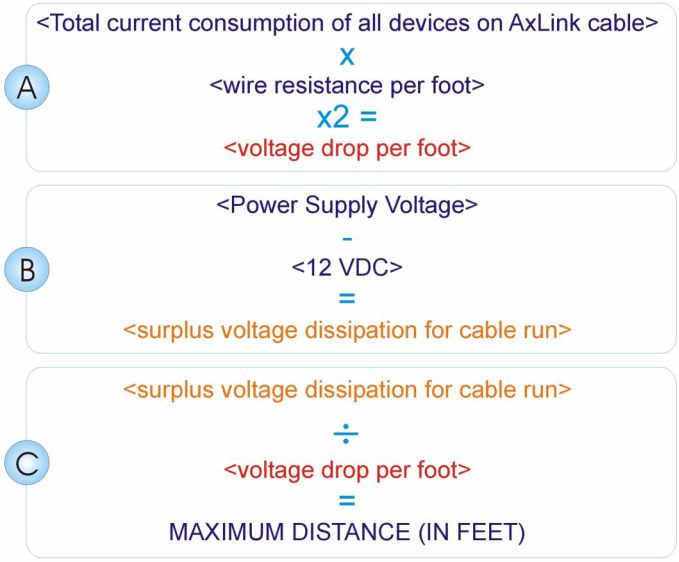

FIG. 2 AxLink Wiring Distance Formula For Data and Power

Refer to *Gauge/Resistance Factors* on the next page to determine the *Wire Resistance Per Foot* used in the formula.

Gauge/Resistance Factors

The following table lists the resistance factors used in the formula shown in FIG. 2.

Gauge/Resistance Factors

Wire gauge	Wire Resistance Per Foot	
	Solid Copper Wiring	Stranded Copper Wiring
18 AWG	.00639	.00692
20 AWG	.0101	.01090
22 AWG	.0162	.01690
24 AWG (UTP)	.0257	.02770

AxLink Electrical and Timing Characteristics

FIG. 3 shows the electrical and timing characteristics of AxLink. The table below describes each characteristic.

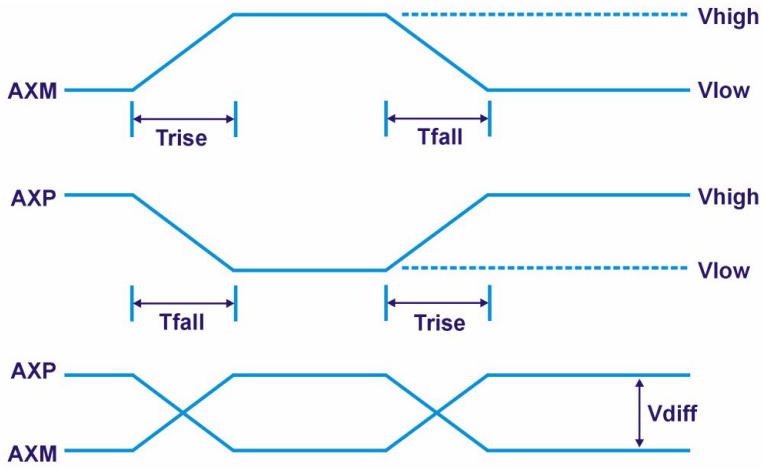

FIG. 3 AxLink electrical and timing characteristics

Electrical timing characteristics					
Parameter	**Description**	**Min.**	**Typical**	**Max.**	**Units**
• **Trise**	Rise time for AXM and AXP	0		20.0	µS
• **Tfall**	Fall time for AXM and AXP	0		20.0	µS
• **Vhigh**	AXM and AXP voltage with respect to AxLink ground		4.6	5.1	V
• **Vlow**	AXM and AXP voltage with respect to AxLink ground	-0.7	0.4		V
• **Vdiff**	Voltage difference between AXM and AXP	1.0	4.2	5.0	V
• **Capacitance**	Total capacitance of AxLink bus wiring			37,500	pF

Compatible AxLink Cable Types

Overview

Compatible AxLink cable types include those manufactured by Liberty Wire & Cable Inc., and cables that comply with Category 5 or Belden 8102 standards.

To determine the maximum distances, refer to the *AxLink Maximum Cable Distances* section on page 2.

Pre-Manufactured AxLink Cable

Liberty Wire & Cable Inc. manufactures AxLink cable that contains two pairs of conductors:

- **Data (AXP/AXM)**: 22 AWG stranded shielded twisted pair (STP) with a single drain wire,
- **Power (+12V/GND)**: pair of 18 AWG stranded wire.
- The nominal capacitance between the data conductors is **12.5 pF/ft**.

Maximum Overall Cable Distance

Using Liberty Wire & Cable Inc. AxLink cable, the maximum overall cable distance between the Central Controller and all external devices for data communication is 3,000 feet with no remote power.

Liberty Cable & Wire Inc. Cables

FIG. 4 shows a wiring diagram for AxLink cables manufactured by Liberty Cable & Wire Inc.

- The PWR connection shown in the diagram is only used when supplying 12 VDC via the AxLink cable.
- The PWR connection should not be used when a local power supply is connected directly to the external AxLink device.

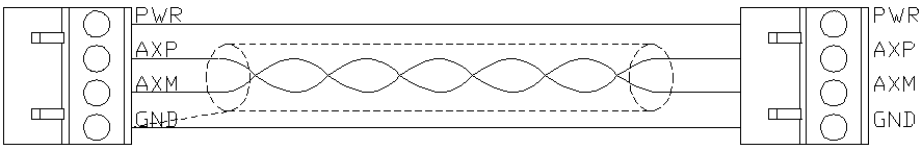

FIG. 4 Standard AxLink power/data wiring diagram

Belden 8102-Compliant Cables

Belden 8102-compliant cable contains two single twisted pairs (STP) of 24 AWG with a single drain wire. The nominal capacitance between conductors is 12.5 pF/ft.

Using Belden 8102-compliant cable for AxLink data communication, the maximum overall cable distance between the Central Controller and all external devices is 3,000 feet with no remote power.

FIG. 5 shows a wiring diagram for the AMX-approved Belden 8102 AxLink cable.

- The PWR connection shown in the wiring diagram is only used when supplying 12 VDC via the AxLink cable.
- The PWR connection should not be used when a local power supply is connected directly to the external AxLink device.

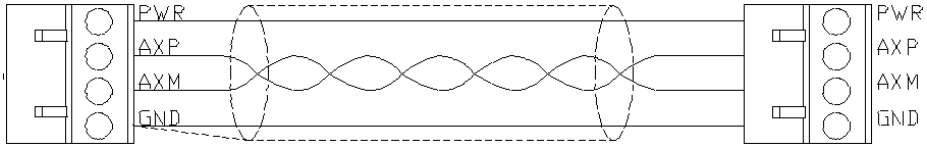

FIG. 5 Belden 8102 wiring diagram

Ground Shielding

Under normal circumstances ground shielding should not be necessary. Only use ground shielding when experiencing noise in the line. The shield connection should only be tied on one end - the Master side.

Tying both ends can result in a ground loop. Tie the ground shield connection to the Master side only.

You can contact Liberty Wire & Cable Inc. at 4630 Forge Road, Suite A, Colorado Springs, CO 80907 or by calling (800) 530-8998.

AxLink Over UTP Network Cable

Overview

You can use standard UTP (Category 5/5e/6) network cabling for AxLink data communications, as outlined below:

- **When using UTP cable for AxLink data communication, do not split the AxLink data lines (AXP/AXM wires) across pairs.**
- When using UTP cable for AxLink data communication, the maximum overall distance between the Central Controller and all external devices is **1,000 feet (304.8 m)**.
- If the installation site's UTP wiring conforms to EIA/TIA 568 standards, AxLink data communication will function properly.

UTP Cable Requirements

AxLink has no special UTP cable requirements; standard off-the-shelf UTP network cable will work. High-performance cabling is not required for AxLink data transmission.

- UTP cable contains four unshielded twisted pairs of 24 AWG solid wire.
- The nominal capacitance between conductors is 15.0 pF/ft.

Wiring Diagrams

AxLink Over UTP With Local Power Supply

The recommended method of using UTP cable for AxLink data communications is to use local power supplies to provide power to the AxLink bus devices.

When a local power supply is used, the free GND wire of the GND pair should be connected as shown in FIG. 6.

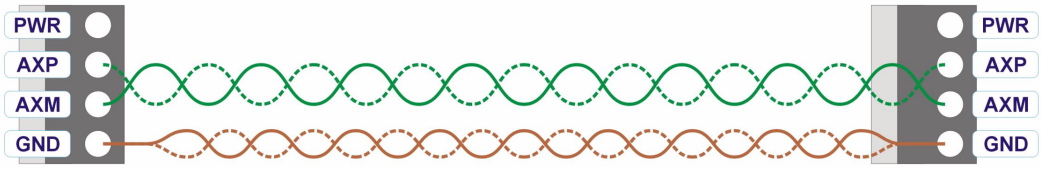

FIG. 6 UTP wiring diagram - without PWR connection (recommended method)

This is the recommended method, and is compatible with existing network installations.

NOTE

Green and brown pairs are shown here as an example. Orange or blue pairs may be used instead, if desired.

AxLink Over UTP With Power Supplied Via AxLink

While it is recommended that local power supply be used for AxLink bus devices, it is possible to use UTP cable to provide 12 VDC power to connected devices, as shown in FIG. 7:

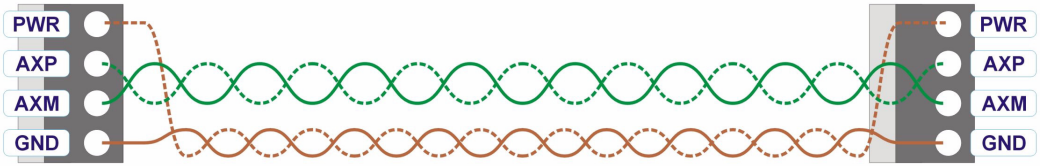

FIG. 7 UTP wiring diagram (with PWR connection)

This method should only be used in limited cases:

- Relatively short cable runs - distance limitations of running 12 VDC power over UTP cable is a function of resistance based on the power requirements of the AxLink bus devices, as well as the wiring used in the UTP cable (typically 24 AWG).

  Refer to the *AxLink Maximum Cable Distances* section on page 2 for details.

  As an example, a 1000 mA device on UTP cable (using 24 AWG wires) with a power connection (as in FIG. 7) would be limited to approximately 29 feet (8.83 m).

  You can also use the "AMX Power Calculator" utility to calculate the cable distance that you can achieve using this wiring method. "AMX Power Calculator" is available to download from www.amx.com, and is included with the VisualArchitect software application.
- In situations where you will not be interfacing with existing punch-blocks or patch bays.
- Commonly used UTP terminations can severely limit power handling capability. Check the specifications of the device you are connecting. When in doubt, supply power with a local power supply instead of via UTP.

Using one pair for GND and another pair for PWR will increase the power carrying capability. For example: use Brown pair for GND, Blue pair for PWR.

UTP Cable Recommendations

Some basic recommendations for installing UTP cable are provided below. Note that these are generally network cabling-related concepts, not necessarily specific to AxLink data transmission over UTP.

- Avoid installing UTP cabling in close proximity to electrical conduit or other high-voltage electrical sources. Allow at least 18" (45.72 cm) of separation between electrical and data lines. Always check local codes and other applicable regulations.
- Avoid installing UTP cabling in any area that is likely to see sustained temperatures lower than -4°F (-20°C), or higher than 150°F (65°C).
- Install cable with gradual bends at corners. Kinks or sharp bends can create line interference.
- Only use staples or fasteners that conform to the cable's shape. When using staples or fasteners, be careful not to crimp the wires inside.

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