

Power Wiring



ATTENTION: National Codes and standards (NEC, VDE, BSI etc.) and local codes outline provisions for safely installing electrical equipment. Installation must comply with specifications regarding wire types, conductor sizes, branch circuit protection and disconnect devices. Failure to do so may result in personal injury and/or equipment damage.

Cable Types Acceptable for 200-600 Volt Installations

A variety of cable types are acceptable for drive installations. For many installations, unshielded cable is adequate, provided it can be separated from sensitive circuits. As an approximate guide, allow a spacing of 0.3 meters (1 foot) for every 10 meters (32.8 feet) of length. In all cases, long parallel runs must be avoided. Do not use cable with an insulation thickness less than or equal to 15 mils (0.4mm/0.015 in.). Use Copper wire only. Wire gauge requirements and recommendations are based on 75° C. Do not reduce wire gauge when using higher temperature wire.

Unshielded

THHN, THWN or similar wire is acceptable for drive installation in dry environments provided adequate free air space and/or conduit fill rates limits are provided. **Do not use THHN or similarly coated wire in wet areas.** Any wire chosen must have a minimum insulation thickness of 15 Mil and should not have large variations in insulation concentricity.

Shielded/Armored Cable

Shielded cable contains all of the general benefits of multi-conductor cable with the added benefit of a copper braided shield that can contain much of the noise generated by a typical AC Drive. Strong consideration for shielded cable should be given in installations with sensitive equipment such as weigh scales, capacitive proximity switches and other devices that may be affected by electrical noise in the distribution system. Applications with large numbers of drives in a similar location, imposed EMC regulations or a high degree of communications/networking are also good candidates for shielded cable.

Shielded cable may also help reduce shaft voltage and induced bearing currents for some applications. In addition, the increased impedance of shielded cable may help extend the distance that the motor can be located from the drive without the addition of motor protective devices such as terminator networks. Refer to *Reflected Wave* in “Wiring and Grounding Guidelines for PWM AC Drives,” pub. DRIVES-IN001.

Consideration should be given to all of the general specifications dictated by the environment of the installation, including temperature, flexibility, moisture characteristics and chemical resistance. In addition, a braided shield should be included and be specified by the cable manufacturer as having coverage of at least 75%. An additional foil shield can greatly improve noise containment.

A good example of recommended cable is Belden® 295xx (xx determines gauge). This cable has four (4) XLPE insulated conductors with a 100% coverage foil and an 85% coverage copper braided shield (with drain wire) surrounded by a PVC jacket.

Other types of shielded cable are available, but the selection of these types may limit the allowable cable length. Particularly, some of the newer cables twist 4 conductors of THHN wire and wrap them tightly with a foil shield. This construction can greatly increase the cable charging current required and reduce the overall drive performance. Unless specified in the individual distance tables as tested with the drive, these cables are not recommended and their performance against the lead length limits supplied is not known. See [Table A](#).

Table A Recommended Shielded Wire

Location	Rating/Type	Description
Standard (Option 1)	600V, 90°C (194°F) XHHW2/RHW-2 Anixter B209500-B209507, Belden 29501-29507, or equivalent	<ul style="list-style-type: none"> • Four tinned copper conductors with XLPE insulation. • Copper braid/aluminum foil combination shield and tinned copper drain wire. • PVC jacket.
Standard (Option 2)	Tray rated 600V, 90°C (194°F) RHH/RHW-2 Anixter OLF-7xxxxx or equivalent	<ul style="list-style-type: none"> • Three tinned copper conductors with XLPE insulation. • 5 mil single helical copper tape (25% overlap min.) with three bare copper grounds in contact with shield. • PVC jacket.
Class I & II; Division I & II	Tray rated 600V, 90°C (194°F) RHH/RHW-2 Anixter 7V-7xxxx-3G or equivalent	<ul style="list-style-type: none"> • Three bare copper conductors with XLPE insulation and impervious corrugated continuously welded aluminum armor. • Black sunlight resistant PVC jacket overall. • Three copper grounds on #10 AWG and smaller.

Cable Trays and Conduit

If cable trays or large conduits are to be used, refer to the guidelines presented in the *Wiring and Grounding Guidelines for PWM AC Drives*, publication DRIVES-IN001.



ATTENTION: To avoid a possible shock hazard caused by induced voltages, unused wires in the conduit must be grounded at both ends. For the same reason, if a drive sharing a conduit is being serviced or installed, all drives using this conduit should be disabled. This will help minimize the possible shock hazard from “cross coupled” motor leads.

Motor Cable Lengths

Typically, motor lead lengths less than 91 meters (300 feet) are acceptable. However, if your application dictates longer lengths, refer to the *Wiring and Grounding Guidelines for PWM AC Drives*, publication DRIVES-IN001.

Cable Entry Plate Removal

If additional wiring access is needed, the Cable Entry Plate on 0-3 Frame drives can be removed. Simply loosen the screws securing the plate to the chassis. The slotted mounting holes assure easy removal.

Important: Removing the Cable Entry Plate limits the maximum ambient temperature to 40 degrees C (104 degrees F).

I/O Wiring

Important points to remember about I/O wiring:

- Use Copper wire only. Wire gauge requirements and recommendations are based on 75 degrees C. Do not reduce wire gauge when using higher temperature wire.
- Wire with an insulation rating of 600V or greater is recommended.
- Control and signal wires should be separated from power wires by at least 0.3 meters (1 foot).

Important: I/O terminals labeled “(-)” or “Common” are not referenced to earth ground and are designed to greatly reduce common mode interference. Grounding these terminals can cause signal noise.



ATTENTION: Configuring an analog input for 0-20mA operation and driving it from a voltage source could cause component damage. Verify proper configuration prior to applying input signals.



ATTENTION: Hazard of personal injury or equipment damage exists when using bipolar input sources. Noise and drift in sensitive input circuits can cause unpredictable changes in motor speed and direction. Use speed command parameters to help reduce input source sensitivity.

Signal and Control Wire Types

Table B Recommended Signal Wire

Signal Type/ Where Used	Belden Wire Type(s) (or equivalent)	Description	Min. Insulation Rating
Analog I/O & PTC	8760/9460	0.750 mm ² (18 AWG), twisted pair, 100% shield with drain ⁽⁵⁾	300V, 75-90° C (167-194° F)
Remote Pot	8770	0.750 mm ² (18 AWG), 3 cond., shielded	
Encoder/Pulse I/O <30 m (100 ft.)	Combined: 9730 ⁽¹⁾	0.196 mm ² (24 AWG), individually shielded	
Encoder/Pulse I/O 30 to 152 m (100 to 500 ft.)	Signal: 9730/9728 ⁽¹⁾	0.196 mm ² (24 AWG), indiv. shielded	
	Power: 8790 ⁽²⁾	0.750 mm ² (18 AWG)	
	Combined: 9892 ⁽³⁾	0.330 mm ² or 0.500 mm ² ⁽³⁾	
Encoder/Pulse I/O 152 to 259 m (500 to 850 ft.)	Signal: 9730/9728 ⁽¹⁾	0.196 mm ² (24 AWG), indiv. shielded	
	Power: 8790 ⁽²⁾	0.750 mm ² (18 AWG)	
	Combined: 9773/9774 ⁽⁴⁾	0.750 mm ² (18 AWG), indiv. shielded pair	

⁽¹⁾ 9730 is 3 individually shielded pairs (2 channel + power). If 3 channel is required, use 9728.

⁽²⁾ 8790 is 1 shielded pair.

⁽³⁾ 9892 is 3 individually shielded pairs (3 channel), 0.33 mm² (22 AWG) + 1 shielded pair 0.5 mm² (20 AWG) for power.

⁽⁴⁾ 9773 is 3 individually shielded pairs (2 channel + power). If 3 channel is required, use 9774.

⁽⁵⁾ If the wires are short and contained within a cabinet which has no sensitive circuits, the use of shielded wire may not be necessary, but is always recommended.

Table C Recommended Control Wire for Digital I/O

Type	Wire Type(s)	Description	Minimum Insulation Rating
Unshielded	Per US NEC or applicable national or local code	–	300V, 60 degrees C (140 degrees F)
Shielded	Multi-conductor shielded cable such as Belden 8770 (or equiv.)	0.750 mm ² (18 AWG), 3 conductor, shielded.	