

# Design Guidelines for Customer Supplied encoder Interface Cables

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## PURPOSE

This document is an overview of the required guidelines for MicroE encoder extension and adapter cables. It will allow customers to design cables which will ensure the best quality and most reliable encoder performance.

## BACKGROUND

In many encoder applications, an extension cable or an adaptor cable needs to be created in order to route encoder cables through a machine and connect the encoder to the desired feedback input device. These devices commonly include digital readout displays (DRO), quadrature counting boards and servo amplifier and controllers and there are many different connect styles and pin-outs. MicroE routinely manufactures encoder models with custom cable lengths, connectors and pin-outs suited to match customer application needs. Many customers also design and build their own cables. This document provides key recommendations and guidelines for customers who are making their own cabling.

## SOLUTION

Follow these recommendations for any customer supplied interface cable.

Maximum Length between encoder sensor head and receiving circuitry

- Analog Sin/Cos outputs:
  - Optira, Mercury and Mercury II: 3 meters
  - Veratus\*: 5 meters
- Digital quadrature outputs:
  - Encoders specified as "422 compatible" (Mercury, MTE\*): 5 meters
  - Encoders specified as "422 compliant" (Optira, Veratus\*, Mercury II 5000): 10 meters
  - Mercury II 6000 drives the quadrature from the interpolation circuitry in the DB15 connector. Maximum length from Mercury II 6000 connector to receiving circuitry: 10 meters

### Cable Characteristics

- Twisted pair cables. Encoder signals should be transmitted in differential pairs whenever possible to take advantage of common-mode noise rejection at the receiving end. Twisted pairs

keep these differential signals in close proximity to each other to ensure that any noise pickup will be equal on both signals.

- 100 $\Omega$  Characteristic impedance
- 26AWG conductors or larger
- Single shielded with aluminum polyester or double shielded with a tinned copper braid giving  $\geq 65\%$  coverage. A solid insulation between double shields is preferred over a spiral wrap insulation to prevent short-circuits between shields which can result from tight bends.
- Polyurethane cable jacket for robustness and high flex life.

## Connections

- Use shielded connectors to maintain the cable shield continuity, and therefore noise protection, all the way from the head to the receiver. See MicroE tech note 'Optical Encoder Grounding and Shielding Recommendations' for more detailed grounding instructions.
- Some MicroE encoders require all conductors be preserved in extension/adaptor cables in order for the applicable MicroE alignment tool to function properly. While some applications may not require all the available signals (left and right limits for example), MicroE alignment tools such as the AT-OPS\* and ATMII5000 require these connections for serial communication to the encoder's processing electronics.

### **Suggested cables for low flex applications (typically the grating/scale moves):**

- Belden 9834 (9 pairs) or 9831 (4 pairs)
- Alpha Wire 45484 (4 pairs)

### **Suggested cables for high flex applications (typically the sensor head moves):**

- Gore 205
- Gore 218

### **Suggested connectors:**

- NorComp 172-015-202R001 (DB15 Female connector with solder cup pins)
- TE Connectivity 5-745172-3 (DB15 back shell, clear chromate plated zinc)

## DO'S & DON'TS:

- Do use twisted pair cables and receive signals differentially whenever possible.
- Do not pair dissimilar signals within twisted pairs (ex: A+ twisted with B+).

- Do design your system with proper shielding and grounding in mind.
- Do not use unshielded cables or connectors.
- Do consult the applicable encoder datasheet or interface drawing for pin map information.
- Do not transmit encoder signals on cables containing other signals like motor drive current.

\*Veratus, MTE, and OPS products are legacy products.