Model: AC Top Drives Serial #: N/A	June 12, 2013
Product Bulletin # TD-132	

Top Drive Encoder System Operation, Reliability, and Troubleshooting

Part Numbers Affected

- N10260 (5-25 VDC, 2048 Pulse Encoder)
- N10843 (5-15 VDC, 2048 Pulse Encoder)
- All other 2048 or 1024 Pulse Encoders

Issue

Although encoder reliability has been increased through design improvements, there can still be issues with the encoder or encoder circuit. In most cases, it is not the actual encoder that is faulty; instead, a problem with the electrical circuit may be keeping a clean signal from getting back to the VFD.

Discussion

The encoder has an internal thermal fuse that will shut down the encoder if it exceeds the temperature rating of 221°F (105°C). This temperature is affected not only by the ambient temperature but also by the heat produced from power flowing through the encoder circuitry. The thermal fuse protects the encoder from damage and automatically resets when the temperature drops below the shutdown temperature.

The next section has a breakdown of the areas in the encoder system that may affect reliability or performance.

1. System Wiring and Connections

Before an encoder is assumed to be faulty and changed out, several items should be checked first:

- Use a scopemeter (such as a Fluke model 123) to view the encoder signal at the encoder board in the VFD (see Figure 1 on page 2). The waveform should consist of square waves, although the lines themselves may appear a bit fuzzy. Nevertheless, if any of the “fuzz” or voltage spikes are larger than the height of the waveform itself, there is likely a problem with a power cable or encoder cable shield.

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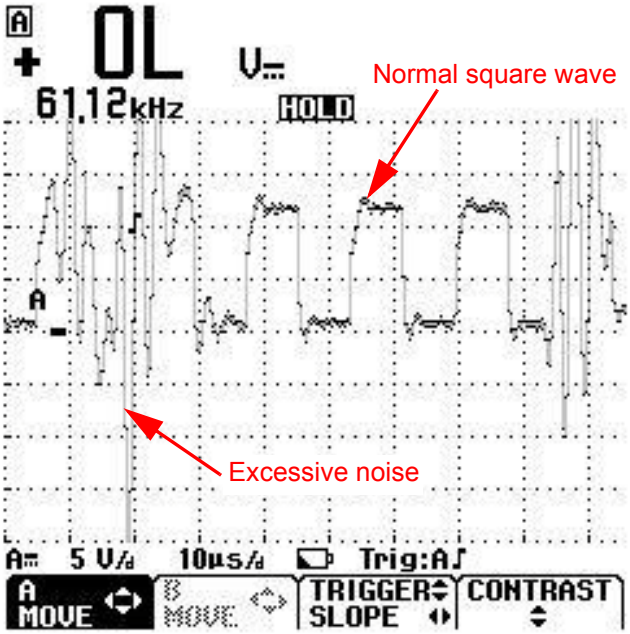

Figure 1: Encoder Waveforms

- Check the AC motor power cable shields/armor. The shielding for each motor power lead must be securely grounded at *both* ends of each section of cable (i.e., at each J-box).
- Make sure that the shield for the encoder cable(s) is properly connected and grounded. *Only one end* of the shield circuit should be connected to ground (usually at the VFD). The other ends of the encoder cable shield (i.e., from the Top Drive to the torque guide J-box and from the torque guide J-box to the VFD) should be daisy-chained together and *not* connected to grounding terminal strips in the J-boxes. This is important to avoid a ground loop from developing in the shields.
- To reduce the amount of electrical interference that may affect the encoder cable, separate the encoder cable as much as possible from the large AC power cables in cable trays or in other areas where the two types of cables may run together.

2. Encoder Cable (Interconnection)

Verify that Canrig-approved encoder cable is used throughout the circuit, including any sections that may be customer supplied between the TG and VFD house. Canrig-approved cable (P/N E14168 or E15489) is specially designed low-impedance and low-capacitance "4 twisted pair" cable that reduces

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the amount of power that the encoder consumes to get the signals from the TD to the VFD. A typical cable, or even a standard encoder cable, may cause the encoder to overload, overheat, and periodically shut down to protect itself (the thermal fuse resets automatically). Even runs of the Canrig encoder cable should be kept to less than 300 ft, after which a signal repeater or booster should be used (contact RigLine 24/7™ Support if a repeater is required). If non-Canrig encoder cable is used, the maximum run length will likely be significantly less. Unlike regular cables, which require the shield braids to be twisted together to form a wire, Canrig encoder cable has an integrated shield wire.

3. Encoder Voltage

Measure the voltage that is supplying power to the encoder, which may be from the VFD or a separate power supply/power converter. Verify that the voltage is within the specifications on the encoder name plate. The new encoder (plug style, P/N N10843) that began to be used in 2013 is only suitable for 5-15 VDC and may not be compatible with some older or customer-supplied VFDs that supply 24 VDC without the addition of a power supply or power converter. Figure 2 shows the addition of a 24V-15V power converter and how it can be integrated into the encoder circuitry if required. Figure 3 on page 4 shows a typical 15V encoder wiring schematic.

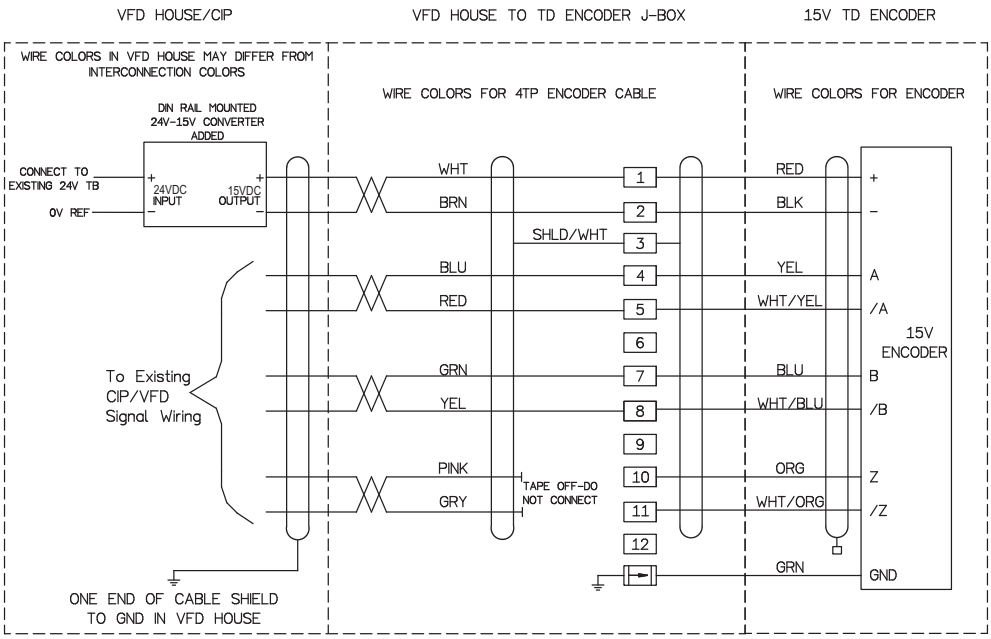

Figure 2: Wiring Schematic with Added 24V-15V Power Converter

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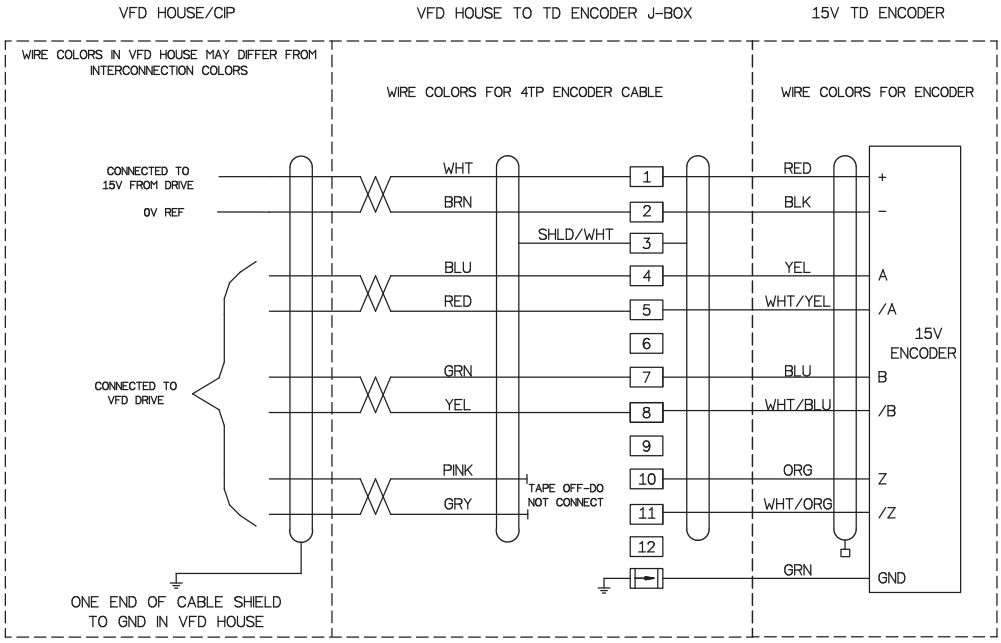

Figure 3: Typical 15V Encoder Wiring Schematic

4. Mechanical Connections

Check that the clamp securing the encoder to the shaft is tight and that the plastic insert between the shaft and encoder ID is in good shape. A slipping encoder will cause intermittent problems that are difficult to diagnose. Similarly, make sure that the anti-rotation bracket is secure. If the bracket is loose, it can cause somewhat erratic behavior of the VFD and, therefore, of the top drive.

5. Brake Operation

The brakes are intended to statically hold the top drive's motor position. If the brakes are used dynamically (e.g., to slow the quill shaft or to control backspin), excessive heat may be produced in the brakes, possibly leading to overheating or damage to the encoder. If the brakes must be used in an emergency situation to control rotation, inspect the brakes and encoder for damage. The brakes should also be checked periodically for proper operation. If any of the brake pads are dragging on the disc while the top drive is rotating, excessive heat may build up and overheat or damage the encoder.

Return faulty encoders to Canrig-Magnolia for failure analysis; include a description of the symptoms that lead to the encoders' replacement.

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