Avtron SMART Alarm and LED Output:
SMARTach II™, THIN-LINE II™ & EuroSMART™ Models
8/14/13

What they are:

The SMART Alarm electronics are the automatic sensor and gain adjustment systems used on many Avtron encoder models including: AV45, AV56, AV56S, AV67, AV85, AV115, AV125, AV485, AV685, AV850, HS45, and XT45 encoders/tachometers.

The SMART Alarm output option and standard red/green LED allow operators and/or controls to detect problems in the encoder in many cases before there is an actual failure. This allows the operator to have the problem corrected during scheduled maintenance and avoid unscheduled downtime or expensive process failures.

The alarm output and LED are the output of the SMART electronics, which make adjustments in the signal conditioning circuitry to maintain precise signal quality. No other magnetic encoder in the world offers this advantage: both self-adjusting, and self-monitoring. The Avtron SMART electronics compensate for a broad range of variations in sensor/rotor position due to field installations, bearing wear, and sensor replacement.

How they work:

The SMART electronics perform their main functions after power up: First, the Avtron SMART sensor electronics test for the presence of a rotor, and check the sensor for damage. The electronics turn the LED green and open the alarm contact circuit. Then as the shaft begins to turn the light remains green and the SMART tuning electronics go to work, adjusting and tuning the output for precise 50/50 duty cycle, and providing accurate 90 degree phase separation.

This is a key characteristic of SMARTach II, THIN-LINE II and EuroSMART encoders—they will not violate quadrature. This greatly reduces false drive trips caused by “dumb” encoders, which mindlessly repeat errors in A and B track phasing (optical or magnetic). Avtron encoders first measure the wheel position very accurately then build the quadrature signal. As long as the electronics are working properly, the signal will stay within quadrature limits.

If the SMART electronics reach a limit of adjustment for any reason or sense a failure they trigger the alarm output and turn the LED red. If the alarm is ON and the encoder still has an acceptable signal the SMART electronics are nevertheless warning the user that they have reached a limit. The sensor and/or encoder should be checked for proper installation and alignment at the earliest convenient opportunity. Replace faulty modules or rotors as determined by troubleshooting steps from the product manual.

The alarm is indicated when the LED turns red and the alarm logic output goes low (open collector). This alarm is “latched” until power is cycled. If a fault occurs that turns the alarm ON, the alarm will stay ON even if the encoder stops turning, as long as power is maintained. If power is removed and re-applied, the alarm may be off and LED may be green until the encoder starts rotating again and the fault recurs.

The key to Avtron reliability is that the encoder will continue to output signals as long as it can—even though the light is red and alarm contact closed/low, the encoder will continue to output the best signals it can. This gives operators the opportunity to schedule maintenance and avoid unscheduled downtime.

What types of failures will they detect?

The SMART electronics will trigger the alarm output for any failure which prevents the electronics from generating an internal 50:50 duty cycle with 90 degree phase separation between A and B. This sensing will detect any failure in the sensor itself or any of the signal conditioning circuitry, or if the rotor is mis-gapped or mis-positioned (encoder signals are present but can not be adjusted into the allowable range, or missing entirely.) Even magnetic interference with the sensor will be detected.

What types of failures will they not detect?

If an output line driver is damaged, there will be no alarm output. If the encoder has no output and the alarm is not on, check for a wiring error. Then check the encoder for proper output using an oscilloscope. Output on one channel, but not the other, is a sign of a damaged line driver. However the "#8" (4125) line drivers in Avtron units are nearly indestructible within allowable voltage ranges. Shorts to ground, power, or between phases will give the appearance that the encoder is not working or damaged, but if the short is removed, the output will resume proper operation.

If power to the encoder is reversed or power is applied to an output terminal instead of V+, the LED will be "dark" (neither red nor green), and there will be no alarm output. In this case, all the encoder outputs other than the alarm output will show logic "high" output, a condition that cannot occur with correct power polarity. Note that this will not cause any damage to the encoder.

If there is a wiring error to the drive or PLC the encoder will not be able to detect this problem.

If there is a phasing error between the encoder and the drive (A Leads B for rotation in the clockwise/counterclockwise direction), the drive will typically trip immediately upon start. Follow the instructions in the encoder manual to reverse phasing or use software settings in the drive to reverse the expected encoder phasing.

If there is a failure of the cable shielding to the drive or PLC or differential signals are not wired through cable signal pairs (ex: A paired with B=incorrect instead of A with A NOT=correct), and the encoder's pulses are diminished or affected by external signal noise. This noise, if any, can be monitored using an oscilloscope at the drive panel (typically not at the encoder).

However, note that the powerful line driver (#8) of Avtron encoders often cause overshoot (a spike at the beginning of each square wave), and a slight ring (a small spike in the middle of the opposite phase). Neither of these phenomenon affects drives or PLCs wired with differential (A, A/, B, B/) signals. See Avtron's white paper on single-ended wiring solutions. These signals are not noise. Higher voltages are simply clipped and ignored. See the attached diagram. Note that A & B voltages are offset for clarity on this snapshot: