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Data_Link 2000

APPLICATION NOTE AN008

Using Incremental Shaft Encoders with ***Nano_Link*** outstations and ***Micro_Link*** base-stations

Summary

Many methods of measuring water depth are available. Most rely on analogue transducers that inevitably exhibit errors due to temperature effects, mechanical tolerances etc. The most accurate depth transducers currently available are shaft encoders producing digital outputs. This application note describes their operation and the techniques employed within the *Data_Link 2000* system to interface with them

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Outline

Shaft encoders use a float and a counterbalance weight connected via a cable that passes over a pulley of a defined diameter. The pulley is attached to an optical encoder that measures angle of rotation, typically to a resolution of better than one degree. The pulley diameter is arranged such that each digital increment represents a defined unit of depth, such as one millimetre. This provides a high resolution over an effectively unlimited range. The only source of inaccuracy is the tolerance on the pulley diameter, which can obviously be closely controlled.

A battery-powered ***Nano_Link*** outstation can be configured to power and read one or two shaft encoders. It includes an alphanumeric display which can be activated as required to show the current reading and to set the zero reference.

A ***Micro_Link*** base-station can output the level of each shaft encoder as an analogue value, a BCD-encoder digital output, and/or on a 4-digit seven-segment LED display module, as well as being able to pass it serially to other systems over a Modbus interface.

The optical encoder comprises a disc with slots around its circumference, and two opto-electronic sensors that detect the slots. By counting pulses from these sensors the angular rotation from a given starting point can be measured. The counter must be reset to zero when the float is at a defined reference point, and will thereafter give a direct reading in millimetres from that reference.

The opto-electronic sensors are relatively low power, but still not suitable for direct operation from batteries in applications which lack mains power. Special techniques are therefore needed to minimise power consumption by pulsing power to them.

Outstation Implementation

A ***Nano_Link*** outstation can be configured to interface to one or two shaft encoder transducers. It uses its standard digital inputs, and one specially-configured digital output. It also provides a local display of the current reading, and provides means of setting the zero reference.

Digital output 4 provides a power source of 5VDC to the shaft encoder. It is pulsed to minimise power consumption. ***Nano_Link*** senses the state of the digital inputs shortly after power is applied to the transducer. If it detects no movement it removes power until the next cycle. However, if the shaft has started to rotate it keeps the encoder powered. By this means power is minimised without risking missing counts if the shaft rotates rapidly.

It should be noted that, although power consumption is minimised by these techniques, it is not negligible. An outstation powered from an internal battery pack of 3 alkaline D cells and interrogated by radio every 15 minutes will run for around one year rather than the two year life that could be achieved normally.

The software within ***Nano_Link*** detects the direction of movement and either increments or decrements the relevant counter. Counter 1 records movement on a shaft encoder connected to inputs 1 and 2, and counter 2 records movement on inputs 3 and 4. (If the outstation is configured for only one shaft encoder, digital inputs 3 and 4 can be used as normal for monitoring digital status or flow meters).

A ***Micro_Link*** base-station can read the counters as normal and copy them to analogue outputs if required. Any SCADA system can read them via the Bus_Link interface as full 16-bit values. However, ***Micro_Link*** can also be configured to copy the counters to arrays of digital outputs to give BCD encoded outputs. They could be scaled if required to give a digital display of, for example, 3.000…4.500m with 1mm accuracy.

Outstation Configuration

When a ***Nano_Link*** outstation is used with shaft encoders it requires the addition of a 7075-1 alphanumeric display module. This includes four pushbuttons, marked **Select**, **Scroll Up**, **Scroll Down** and **Exit**. A reed switch can also be connected to the module, which can be attached to the inside wall of the enclosure. To activate the display a magnet must be brought close to the reed switch. This allows the display to be activated without breaking the seal of the enclosure.

When the display is active it shows the current count on the shaft encoder(s). If the user wishes to set the zero reference he must move the float (which is linked to the shaft encoder via a cable over the pulley) to the required point, then press the **Scroll Up** button and follow the instructions given.

Base-station Implementation

A ***Micro_Link*** base-station can read the outstation counters and display them in various formats. All formats allow scaling factors and offsets to be applied so the reading can be shown in true engineering units.

Alternatively the counter value can be presented on digital outputs in BCD format. The user can define the number of digits, remembering that each BCD digit requires four digital outputs. For example, copying a counter to 12 digital outputs will implement 3 BCD digits, giving a value in the range 0…999mm. If 20 digitals are used 5 BCD digits will be available, allowing the full 16-bit range of 0…65535mm to be used.

Another option is to use 7075-2 Digital Display modules, which are fitted with four 0.8" seven-segment LED digits. These can therefore display any value in the range 0…9999, with a user-selectable decimal point.

Display modules connect to ***Micro_Link*** via a 'daisy-chained' serial cable, in the same way as all other expansion modules. Up to 32 display modules can be driven from a ***Micro_Link*** module. The display modules can be fitted to any control panel via their integral bezel.

Base-station Configuration

The format of the base-station output is defined in the table created by the user in the DCD configuration terminal. Counters copied to analogue outputs can be calibrated by applying scaling factors and offsets as required to keep them within the 0…4000 range required to give 0…20mA.

The 7075-2 digital display module appears the same as an analogue output, except it is capable of displaying values in the range 0…9999. As well as defining scaling factors and offsets, the user can also define the position of the decimal point within the configuration table.

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