Seamless integration into CANopen networks

Wika (Germany) and other pressure sensor manufacturers provide pressure sensors compliant with CiA 404-1. Such products can be integrated seamless into CANopen networks.

The German supplier has developed several CANopen pressure sensors (Photo: Wika)

Getting networked hardware to communicate seamlessly can be a challenge, if you have not interoperable devices. To address this, Wika and other suppliers offer certified CANopen pressure sensors. CANopen is a set of communication protocol and device profile specification for networked equipment. The term “open” refers to the open, interlinked capability of such networks. The CAN in Automation international users’ and manufacturers’ group (CiA) is the nonprofit organization that sets the specifications to ensure compatibility and interoperability of devices.

Generally, a CAN network consists of a linear bus with termination resistors at both ends. Data and power supply lines are combined in one shielded CAN cable, which is routed from one bus node to the next. This type of connection is achieved via products designed with integrated Y-junction boxes or via external T-pieces.

ABI, a manufacturer of construction machinery used in civil engineering, is an industrial company that puts CANopen networks to good use. In machinery, networked pressure sensors replace analog pressure sensors. CANopen networks contain angle encoders, inclination, I/O modules, and pressure sensors used for valve control feedback. These pressure sensors measure, record, and control working pressures during piling and drilling processes. Logging such data is critical out of concern for nearby communities and buildings. In most situations, bid requests spell out these data-logging requirements.

Because of the high shock and vibration associated with CAN network projects, as well as limited mounting space, ABI opted to connect its devices via short stubs instead of the conventional T-piece. In principle such stubs are no problem as long as they do not exceed a maximum length – if they are too long, bus traffic might be compromised. This principle underscores the need to be mindful of bit rate when configuring a bus: the longer the line, the lower is possible bit rate.

At a bit rate of 50 kbit/s, the maximum bus length is 1 km. In CAN networks with short bus lengths, the bit rate can be up to 1 Mbit/s. In order to ensure the best possible resistance to interference, the cable shield is coupled to the sensor’s housing through the connector. Digital data transmission avoids the line-born signal disturbances found in analog systems. All devices should be connected to an equipotential ground, if possible, and additional galvanic isolation is recommended if potential differences exist (such as distributed measurement points).

Distributed intelligence gives these pressure sensors in a CAN network additional functions besides measurements. Every CANopen device features an object dictionary, which describes its complete functionality and can be read and, to a limited extent, altered through indices and sub-indices. Section I, the CiA communication profile parameter range, includes basic information such as device type and designation, hard and software version, error status, and CAN-identifiers used. For pressure sensors, Section II includes such distributed intelligence features as information on pressure ranges, pressure units, calibration functions, filter settings, and other measurements.

Unlike the previous two, Section III, the manufacturer-specific section, is not standardized. This means manufacturers of CANopen devices can implement their own distributed-intelligence features—such as in-house service functions, intelligent/diagnostic functions or enhancements—that are not covered by the profile.

In order for the devices to communicate distributed intelligence information, all bus nodes operate at the same bit rate but with different node identifiers (node-ID). In principle, there are two options to configure the node ID and bit rate: via a DIP-switch, or via layer setting services (LSS) services as specified in CiA 305. The third opportunity is not recommended by CiA: changing proprietary parameters for node-ID and bit rate in the object dictionary, The DIP switch configuration has the advantage that additional hardware or software tools are not required to reconfigure or replace a device. ABI’s machines operate in very harsh conditions, so the company chose sensors with an all-welded construction. This construction made the DIP-switch option impossible for ABI.

CiA 305 specifies the procedure for setting node ID and bit rate. When LSS are used, the devices are not addressed with LSS address; instead, the device address consists of a manufacturer ID (assigned by CiA), serial number, product number, and version number. With these four parameters, all CANopen devices can be uniquely identified worldwide. However, this relatively complicated procedure is best used in cases in which the configuration of the plant changes frequently, such as for engine test benches. Distributed intelligence in this case means that the LSS addresses of the devices are stored in a database. From it the user selects the devices they use; the software then assigns the addresses automatically.

(Photo: Wika)

Supporting CANopen and J1939

With the model MHC-1, Wika has launched already in 2013 a pressure transmitter for mobile hydraulic applications, available with CANopen and J1939 outputs. In mobile hydraulics, this product is exposed to extreme operating conditions. To ensure its long-term reliability, all requirement parameters were simulated in a specific test program. The instrument has been designed to be durable, is intended for measuring ranges from 0 bar to 60 bar up to 0 bar to 1000 bar, and offers an accuracy to 0,5 % of span. The transducer has suitable temperature characteristics and with EMC protection it is particularly immune to interferences.

Measured values are transmitted via PDO (process data object) messages. These messages can be configured to be schedule on events (e.g. change-of-state), periodically, and on the reception of a dedicated Sync message. Device monitoring for network management purposes is done my means of the Heartbeat message. For configuration of devices, SDO client/server messages are used in CANopen. This is a confirmed communication service, in which the SDO client has the initiative and the SDO server responses. In case of a write access, the SDO server confirms that the data has been received correctly. The SDO server confirms a read access by sending the requested data. Which data is sent respectively received is indicated by means of the address (16-bit index plus 8-bit sub-index in the CANopen object dictionary.

The reduced wiring requirements, system flexibility, standardized communication mechanisms, and distributed intelligence within sensors are reasons for changing from conventional analog sensors to a CANopen network.

Not all device manufacturers have implemented all of the functions described earlier, such as LSS. Wika recommends to carefully consider application requirements, then to select CANopen devices that will both meet your organization’s needs, conform to corresponding CiA specification, and offer the reliability needed.

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