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INNOVATIVE ENGINEERING DESIGN

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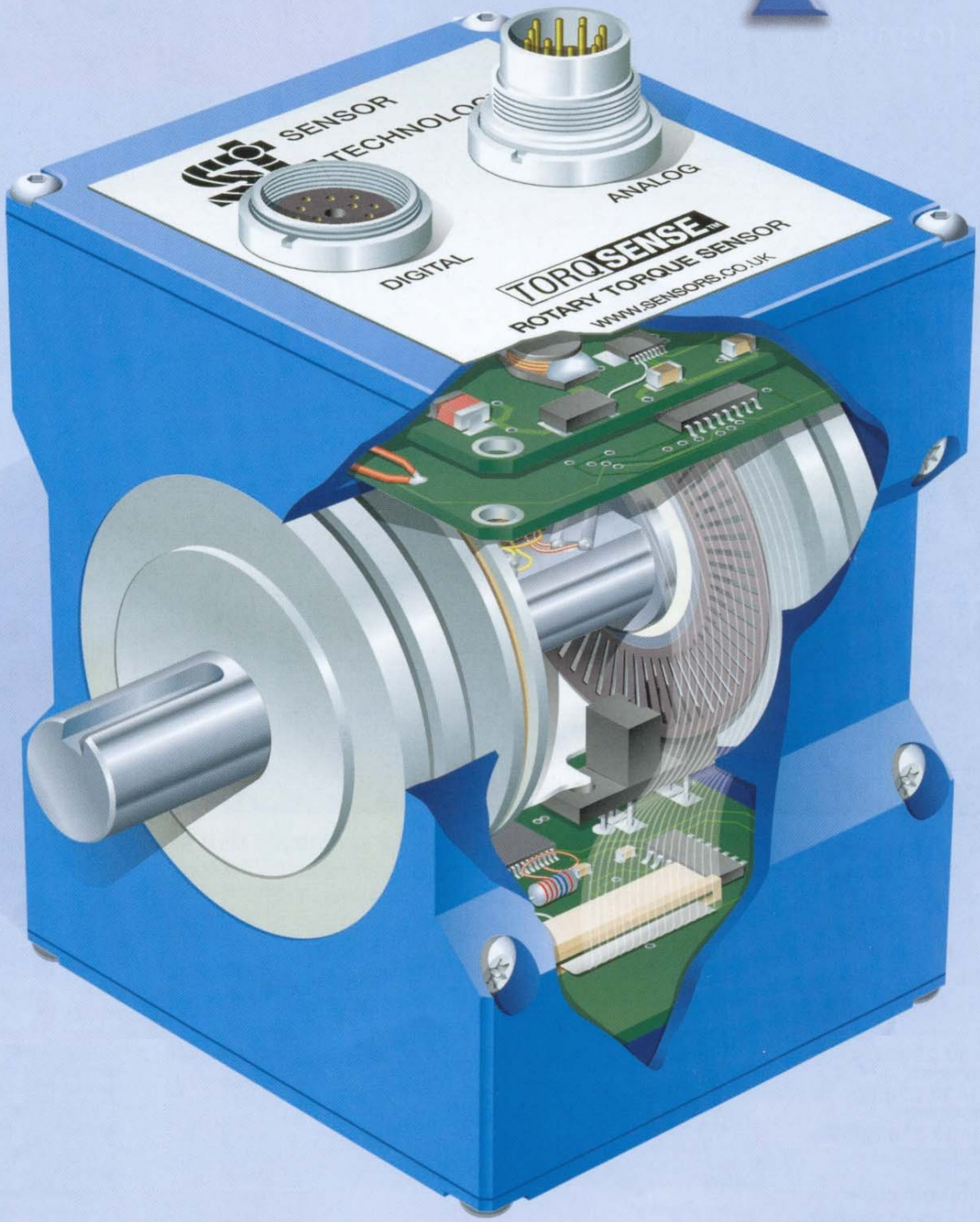


Torqueing to the outside world

Compact smart sensor breaks all boundaries

Torqueing sense to the outside world

A torque transducer has been developed that uses the latest electronics, offering users a variety of communication options, writes Dean Palmer

POINTERS

- The sensor takes data communication to the next level for users, offering a variety of digital and analogue outputs, including a USB connection. The company says it has a wireless Bluetooth sensor in the pipeline
- It uses the very latest integrated electronics positioned within the transducer itself
- The sensor is around an eight of the size of its predecessor, the 300 series

A technological breakthrough has occurred in the world of sensors that will almost certainly grab the attention of machine designers who are looking to measure power in drive shafts and other rotating machine elements.

The new device is a rotary torque transducer that takes data communications to the next level for users and is so compact that it's hard to believe how the company that designed it managed to squeeze all the technology into such a tight space.

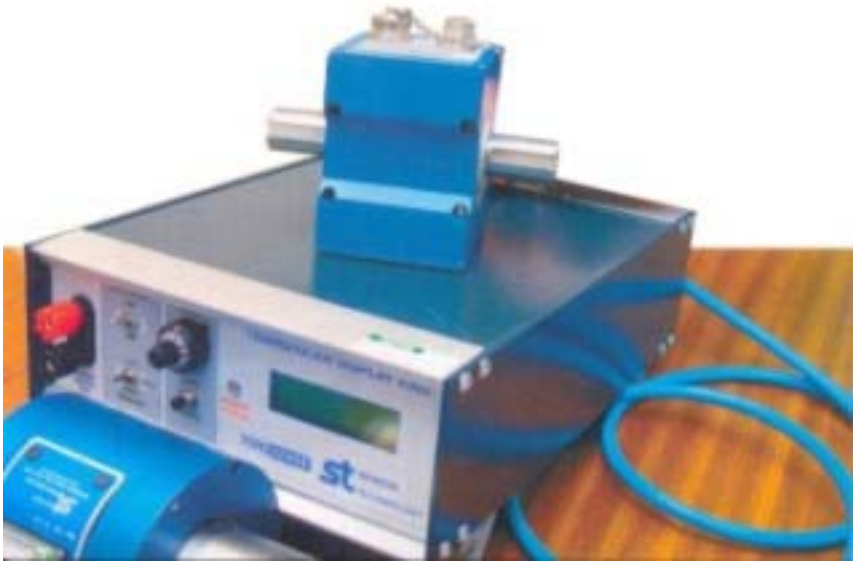
Sensor Technology, based in Banbury, is the company behind the development. Bryan Lonsdale, founding director of the business, told *Eureka*: "Transducers traditionally come with an analogue output voltage, which was fine 10 years ago, but users want more sophistication now. So we re-designed our existing range of torque transducers to a new 'plug and play' sensor which has built-in electronics that make it more connectable, and its around an eighth of the size of its predecessor."

The new transducer, TorqSense RWT310/320, is radically different from its predecessor, the 300 series and other sensors on the market. First, it is smaller because the complex electronics are smaller and have been placed within the transducer itself, whereas normally the transducer and electronics are provided separately. Lonsdale continued: "It really is a radically different product. Three years ago we simply couldn't have sourced the required small-sized electronics devices and circuit boards that go into the sensor. The integration level of electronic components [driven by mobile phone technology] has allowed us to radically reduce the overall size of the sensor."

When questioned about the innovation behind TorqSense, Lonsdale remarked: "To my knowledge, nobody else can provide users with the ability to measure and analyse a range of rotary torque sensors at such high resolutions in such a compact device."

Unlike traditional slip ring transducers, the RWT make use of a simple non-contact measurement technique of an RF (radio frequency) couple for power and signal communication. This means the device is mechanically straightforward and easier for machine designers, who up to now have had to put a lot of time and money into getting accurate torque measurements for machine and production control.

As part of the non-contact operation, SAW (surface acoustic waves) devices are used as frequency dependent strain gauges to measure the change in resonant frequency caused by strain experienced in the drive shaft. This measurement is directly related to the torque experienced in the rotating machine element. While SAW technology is certainly not new (Eureka covered Sensor Technology's first breakthrough SAW sensor in September 1993), the way the technology has been applied here is novel.



Integrated Electronics

Inside the sensors are two miniature processors, supplied by US-based electronics firm Cygnal. These in effect replace all the peripheral processors and chips, AC connectors and I/O devices that were used on the 300 series. The actual number of external chips has been reduced by 10 and the new sensor still has 128k of on-board flash memory, 8k of RAM and a very low power consumption of 25mA.

Sensor Technology started developing the sensor in November 2002 and the first assembled device was ready in January this year. Lonsdale: "We started by analysing the capabilities of three or four different chip devices which took several months to complete. The two processors we chose have different tasks within the sensor. One communicates with the SAW sensors, the other communicates with the outside world, digitally if required via a USB port."

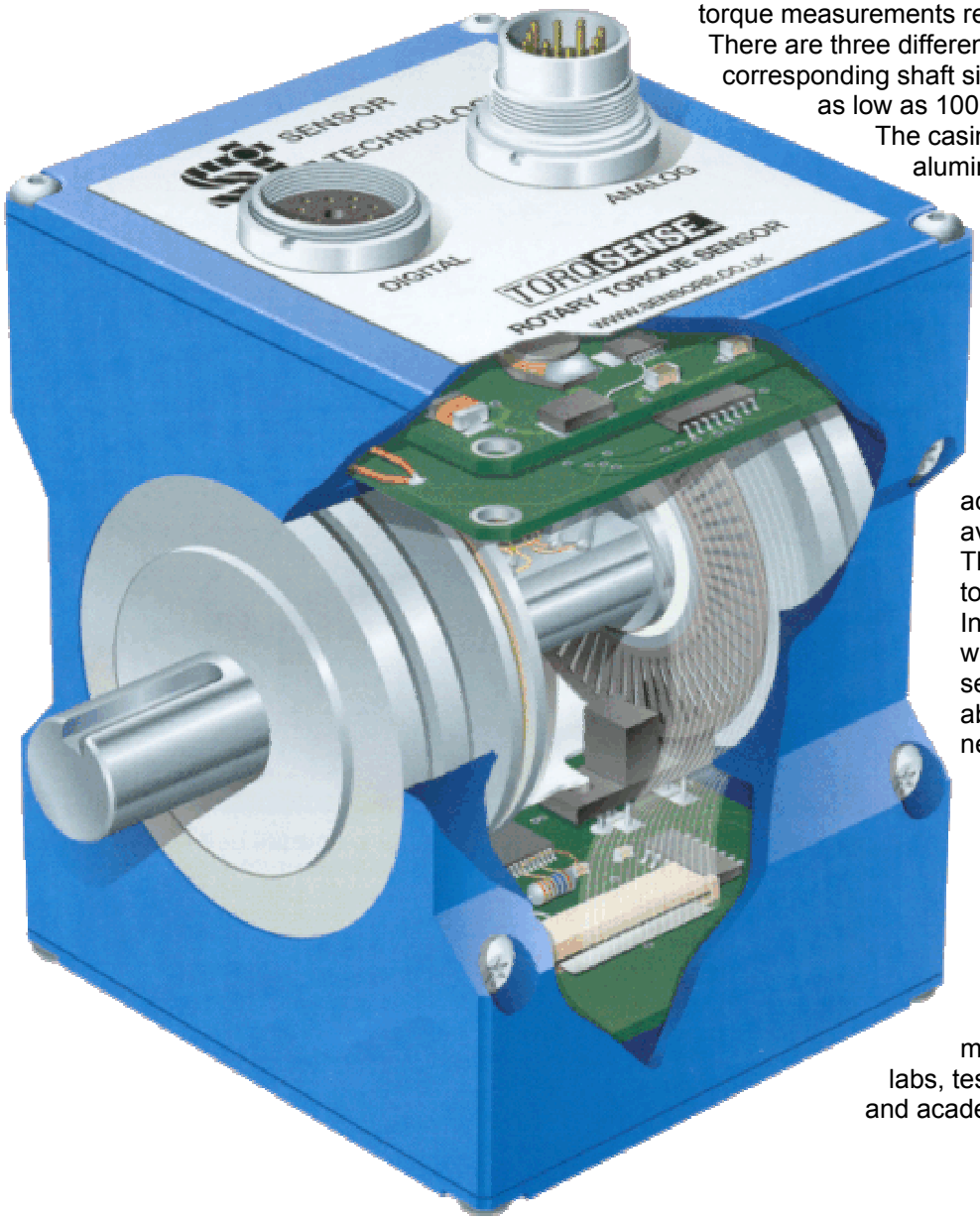
Surface Acoustic Wave (SAW) technology

To achieve the non-contact operation that makes TorqSense unique, SAW devices are used as frequency dependent strain gauges to measure the change in resonant frequency caused by strain experienced in the drive shaft. This measurement is directly related to the torque experienced in the rotating machine element.

In SAW sensors, surface waves are produced by passing an alternating voltage across the terminals of two interleaved comb-shaped arrays, laid onto one end of a piezoelectric substrate. A receiving array at the other end of the transducer converts the wave into an electrical signal.

The current model has an impressive bandwidth of 5kHz but Lonsdale reckons the company should achieve 10kHz very shortly – that's around 10 times the normal bandwidth found in other 'smart' sensors. The sensors work between 11V and 32V, although Lonsdale hinted that a 44V version for the automotive industry was also in the pipeline.

RWT is very versatile and has several channels of output, for speed, torque, power and angle, which can be used simultaneously or separately. It has a digital RS232 output, an analogue option and even has a USB connection for a PC. Mark Jeffs, software engineer at the firm, commented: "In April at the Hanover Fair, we will be launching a sensor which has an extra circuit board inside, will be no larger than the current one, but will have a wireless [Bluetooth] connection for communication to handheld devices. This is for customers that want to interrogate the torque measurements remotely."



There are three different body sizes and seven corresponding shaft sizes. Torque ratings start from as low as 100mNm up to around 10,000 Nm. The casing is CNC-machined aluminium and so fulfils all the relevant EMC regulations. Prices start at £800 for the basic factory-set sensor which has a ±1V, ±5V or ±10V output. The more advanced model will set you back around £1,450, but for this you get all the advanced user configurable features, additional software for averaging and scale changing. The Company is also planning to bundle 'TorqView2' Virtual Instrumentation Software written in NI LabVIEW with its sensors. Clients will also be able to download the necessary drivers for writing their own applications from NI's website.

Sensor Technology has 25 employees, is privately owned and funded with an annual turnover of £1m. 50% of this revenue is ploughed back into R&D and the company supplies most of its product to R&D labs, test and instrumentation firms and academic institutions.

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