SENSOR TECHNOLOGY LTD

ORT/RWT/SGR Series Transducer CAN Bus Interface

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Introduction

The ORT/RWT/SGR series CAN bus interface is fully compliant with the CAN 2.0B protocol and uses standard 11bit message identifiers.

The data available on the CAN bus is limited to torque and speed, but also includes a transducer zero function.

The baud rate, message identifiers, data format and output rate can be customised by using our Transducer Control software program, which accompanies our digital based torque transducers. The customisation is done via the USB interface on the transducer.

Compatible Models

This CAN bus manual is for transducers from the advanced ORT, RWT and SGR family of products. Transducers must be running MKIII electronics with firmware version 4.3 or higher, and have CAN bus enabled. Some features may be unavailable on older firmware versions.

The table below lists compatible models:

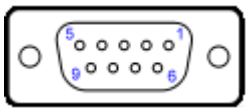
Transducer Family	Model Range	Models
Optical (ORT)	ORT240	ORT240/ORT241
Rayleigh Wave (RWT)	RWT420	RWT420/RWT421/RWT422
	RWT440	RWT440/RWT441/RWT442
Strain Gauge Rotary (SGR)	SGR520	SGR520/SGR521/SGR522
	SGR540	SGR540/SGR541/SGR542

Hardware Implementation

The CAN bus interface is implemented using an ARM Cortex M3 processor and its embedded CAN module.

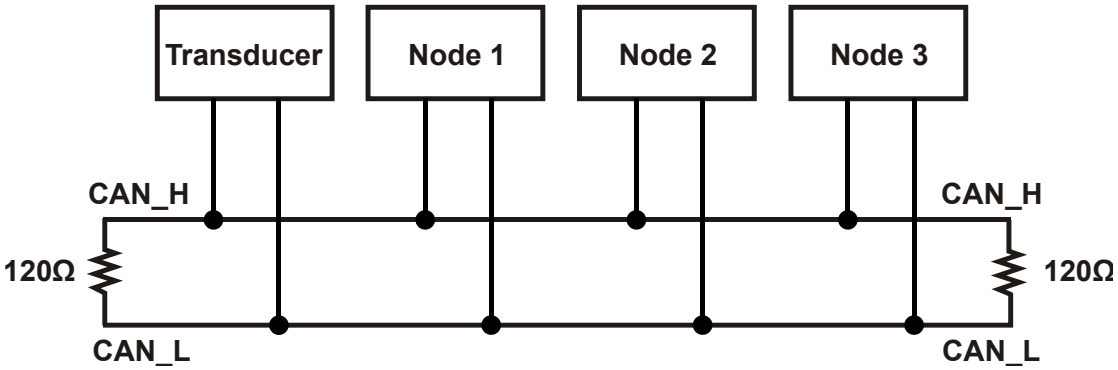
The CAN bus interface replaces the standard RS232 capability of the transducer. In order for the signals to be properly received the CAN bus needs to be correctly terminated. This can be accomplished by using a 120Ω resistor across the two data lines at both ends of the bus.

CAN bus 9 pin D connector pin out



Pin	Signal Name	Signal Description
2	CAN_L	Dominant Low
3	CAN_GND	Ground
7	CAN_H	Dominant High

Recommended CAN bus termination



Software Implementation

The CAN interface is configured with the settings detailed in Table 1.

Table 1:

Baud rate Selectable with Transducer Control	1 Mbps 500 Kbps 250 Kbps 100 Kbps
Sample point	75%
Sampling mode	3 samples per bit
Synchronisation jump width (SJW)	2
TSEG1 (PROP_SEG + PHASE_SEG1)	11
TSEG2 (PHASE_SEG2)	4

Transducer data is output on to the CAN bus automatically without application synchronisation. The output rate can be set by Transducer Control.

The CAN messages output from the transducer use standard 11bit message identifiers, the identifiers can be set to anything between 1 and 2047, and can be configured using Transducer Control.

CAN Messages

The data format output in each data frame is configurable by Transducer Control. The user can output torque in 3 different formats (floating-point, fixed point integer or in ASCII). Speed can be output as either an integer or ASCII.

The Endianness or byte order for non-ASCII formats can be controlled by Transducer Control. Table 2 gives an overview of the data and functions available.

Table 2:

Transducer Data/Function	Default Identifier	Data Type	Bytes
Torque	50	IEEE-754 Float	4
		Integer (Fixed Point)	4
		ASCII	8
Speed	111	Unsigned Integer	4
		ASCII	8
Zero Command	156	-	0

The CAN message output rate is either the internal capture rate for the data, or a fixed rate. If the fixed rate is greater than the internal capture rate, the last captured value will be repeated. The output rate can be configured using Transducer Control.

Each baud rate carries a maximum output rate, if the capture rate exceeds this, it will be capped, see the maximums in the CAN Configuration section (Table 5a/5b).

When selecting the output rate, it is important to consider how it may affect the other devices on the CAN bus, if the rate is too high, then the bus will become congested,

overwhelming the receivers or blocking devices from transmission. If a high rate is important, the message identifiers can be used to prioritise messages, lower numeric identifiers have bus priority.

Torque

(Default Identifier 50)

Torque data can be output as a floating-point, fixed point or ASCII number. The byte order for non-ASCII formats is controlled by Transducer Control.

Floating-point

The floating-point format uses the IEEE-754 standard (32bit). The floating-point format is shown below:

SEEE EEEE EMMM MMMM MMMM MMMM MMMM MMMM

S – Sign Bit, E – Exponent, M – Mantissa.

Fixed-point

The fixed-point format is a 32bit signed integer number. The number is fixed with 3 decimal places (i.e. torque x 1000). For example, 100.1231, would be output as 100123

ASCII

The ASCII format outputs data in a human readable text format. Text strings are 8 characters long and are prefixed with a sign character. The placement of the decimal point is dependent on the full scale of the transducer, see Table 3:

Table 3:

Transducer Scale	Decimal Places	Example
< 100	3	+001.000
< 1000	2	-1101.00
< 10000	1	-01010.0
>= 10000	0	+1000000

Output Rate

The output rate is dependent on the configuration selected. If internal capture rate is selected, the actual output rate is dependent on the baud rate, transducer technology and transducer tuning. RWT/SGR transducers achieve a capture rate of around 5kHz. ORT transducers have a capture rate of upto 50kHz.

Each baud rate carries a maximum output rate, if the capture rate exceeds this, it will be capped, see the maximums in the CAN Configuration section (Table 5a/5b).

Speed

(Default Identifier 111)

Speed data can be output as either a fixed-point or ASCII number. The byte order for non-ASCII formats is controlled by Transducer Control. The speed output is based on the fast capture system, which uses a period count. The period count works by measuring the time between pulses from a speed grating.

Fixed-point
The fixed-point format is a 32bit unsigned integer number.

ASCII
The ASCII format outputs data in a human readable text format. Text strings are 8 characters long and prefixed with a sign character (always positive). There is no decimal point.

Example: +1000000

Output Rate
The output rate is dependent on the configuration selected. The internal capture rate in period count mode, is dependent on the rotational speed. The capture rate will increase and decrease as the transducer speed increases and decreases.

The output rate can be calculated from the information shown in Table 4:

Table 4:

Rotational Speed (RPM)	**Update Rate (Hz)**
0	1 Hz
< 2000	RPM
> 2000	RPM x (1 / (⌊ (RPM - 1) / 2000 ⌋ + 1))

As previously mentioned, each baud rate carries a maximum output rate, if the capture rate exceeds this, it will be capped, see the maximums in the CAN Configuration section (Table 5a/5b).

Zero Command

(Default Identifier 156)

The zero command, zero's the transducer torque value, and offsets all subsequent torque readings, by the torque amount present when zeroed.

To request this command, send a data frame with the zero command identifier and 0 bytes in the data field.

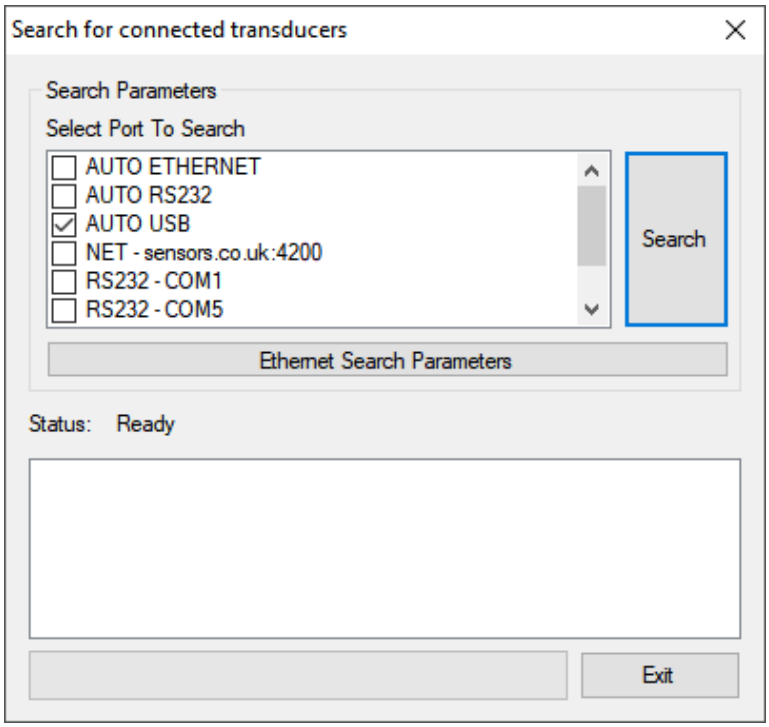
Transducer Control

Transducer Control can be used to customise the message identifiers, baud rate, data format, and output rate of the CAN bus interface.

To customise the settings, power on the transducer and connect the USB lead to a PC.

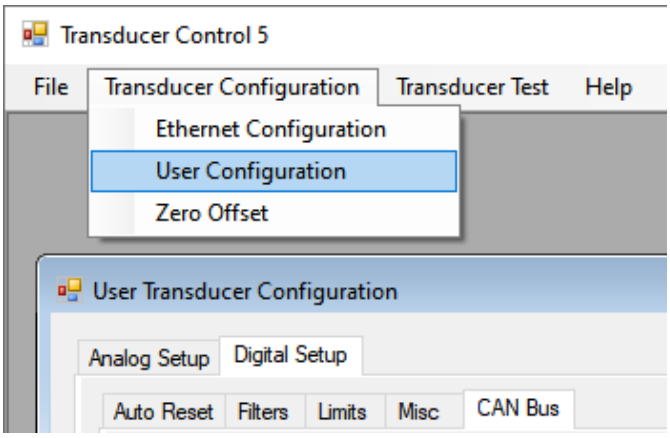
Run the Transducer Control program by clicking on the Start/Windows button, then “Sensor Technology” > “Transducer Control 5”.

Once the program has loaded, a “Search for connected transducers” dialog box will be shown. Select “AUTO USB” from the “Select Port To Search” list and click “Search”.



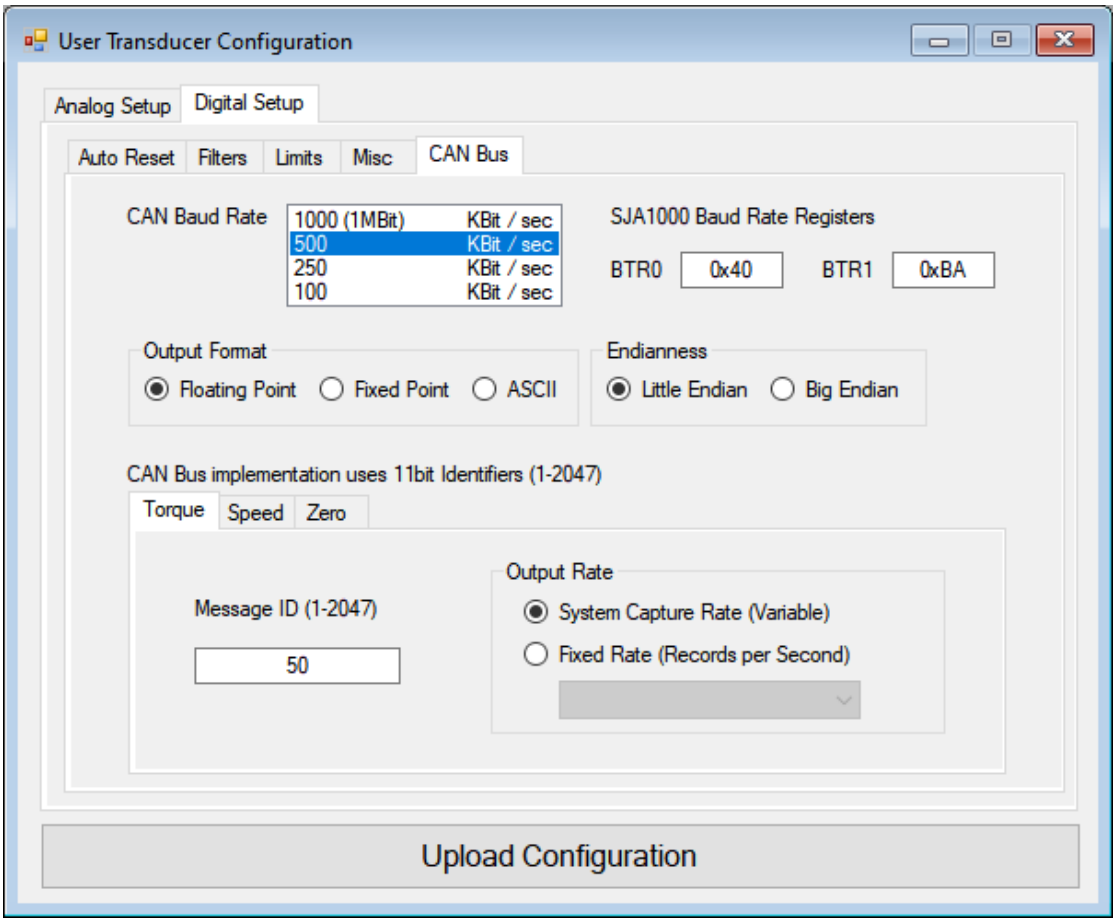
The purpose of this dialog box is to search for transducers for use with Transducer Control. Once the search is complete, the program will automatically load the discovered transducer, if more than one transducer is discovered, a list will be shown for selection.

To load the CAN configuration page, select “Transducer Configuration” > “User Configuration” from the menu bar. On the resulting window, select the “Digital Setup” tab, followed by the “CAN Bus” tab.



CAN Configuration

Configure the CAN bus interface by selecting the baud rate, identifiers, data format, and output rate. Update the transducer by clicking the “Upload Configuration” button. A progress bar will be shown while the configuration update takes place, on completion, close Transducer Control and power cycle the transducer.



CAN Baud Rate

The CAN Baud Rate list box selects the baud rate used by the CAN bus interface.

SJA1000 Baud Rate Registers

The BTR0 and BTR1 values show the equivalent register settings for a Philips/NXP SJA1000 - stand-alone CAN controller, running with a 16 MHz clock and operating in Intel mode.

This data is for information only, and is provided as a guide to enable correct CAN bus synchronisation.

Output Format

The output format of the CAN message data field can be configured to be either a binary format (floating/fixed), or ASCII. This setting is primarily for Torque values, for Speed values, floating/fixed point options output as fixed. Refer to the CAN Messages section.

Endianness

The byte order for floating-point and fixed-point output formats can be set to Little or Big Endian.

CAN Messages

Each of the CAN messages supported by the transducer are shown and configured on different tabs.

Messages

- ***Torque*** Torque value.
- ***Speed*** Speed value from the fast capture system.
- ***Zero*** Zero transducer.

For each CAN message, enter a message identifier and select an appropriate output rate.

Message ID

Message identifiers must be unique and be between 1 and 2047.

Output Rate

- ***System Capture Rate (Variable)***

  CAN messages are output at the internal capture rate of the data value. If the capture rate exceeds the maximum allowed for the selected baud rate, the output rate will be capped. The maximums for each baud rate are shown in Table 5a/5b.

- ***Fixed Rate (Records per Second)***

  CAN messages are output from the transducer at a fixed rate. If the output rate is greater than the capture rate, the last captured value will be resent.

  The output rates available are based on the selected baud rate and the output format. Table 5a and 5b show the output rates available.

  Table 5a (Binary Modes – 4 bytes)

Records per Second	Baud Rate			
	1 Mbps	500 Kbps	250 Kbps	100 Kbps
1				
10				
100				
500				
1000				
2000				
3000				
4000				
5000				

Table 5b (ASCII Mode – 8 Bytes)

Records per Second	Baud Rate			
	1 Mbps	500 Kbps	250 Kbps	100 Kbps
1				
5				
50				
250				
500				
1000				
1500				
2000				
2500				