

RWT320/340/360 Series Transducer Communication Protocol

Introduction

The RS232 and USB option interfaces on the RWT320/340/360 series transducers provide a method for extracting digital operational data from the transducer. Functions for controlling aspects of the transducer's operation are also available.

The same communication protocol is used for both RS232 and USB. However, due to the USB's more complex nature it is recommended that the STDLL is used when interfacing your own application to a RWT320/340/360 transducer. Should you not wish to use the STDLL then further information and guidance can be supplied from the company.

RS232 Settings

The RS232 interface provides a full-duplex communication channel; each byte of data is transmitted in a packet of 10 bits. The data packet consists of one start bit, 8 data bits, no parity and one stop bit.

Data Packet Format (D0 – Least Significant Bit)

Start Bit	D0	D1	D2	D3	D4	D5	D6	D7	Stop Bit
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The RS232 interface can operate at 3 different baud rates; 9600, 38400 and 115200bps (default). The baud rate can be changed by using the "Transducer Control Utility" on RWT320/340/360 series transducers.

Protocol Description

The RWT320/340/360 series transducers use a simple request and send communication protocol. Commands are one byte in length and either request data or switch transducer functions on or off.

To request data transmit a byte equal to the command of the function you want, the transducer will then reply with the relevant data or action your request, some commands may require some extra parameters. Please refer to the descriptions on the following pages for more information.

The data returned from request commands will be output in various formats; the format used depends upon the type of data requested. Multi-byte number types are output with the least significant byte (LSB) first, as with Little-Endian systems.

The data types used are C type variables; int type variables are 2 bytes in size.

The following outlines the variable types used.

Float Data Type (4 bytes): IEEE-754 standard floating point number format.

Floating-point format:

SEEE EEEE EMMM MMMM MMMM MMMM MMMM MMMM
 S – Sign Bit, E – Exponent, M – Mantissa.

LSB Byte 0	Byte 1	Byte 2	MSB Byte 3
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Unsigned Long Data Type (4 bytes): Long type unsigned integer.

LSB Byte 0	Byte 1	Byte 2	MSB Byte 3
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Unsigned Int Data Type (2 bytes): Unsigned integer variable.

LSB Byte 0	MSB Byte 1
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Unsigned Char (1 byte): Single byte unsigned integer variable.

Strings: C has no string variable as such; strings output from the transducer are in the format of an array of Char type (1 byte) integer values terminated with a NULL character.

PeakMinMax: A structure containing two Float data types

Torque Peak Max			
LSB Byte 0	Byte 1	Byte 2	MSB Byte 3
Torque Peak Min			
LSB Byte 4	Byte 5	Byte 6	MSB Byte 7

Unit Key

Some of the commands use a number to represent the transducer units or to indicate which units to convert to. The table below shows which number represents each unit, e.g. 7 = N.m.

0	ozf.in
1	lbf.in
2	lbf.ft
3	gf.cm
4	Kgf.cm
5	Kgf.m
6	mN.m
7	N.m

Revision 2 RWT3xx Transducers (Serial No above 12200)

In Q1 2008 a new hardware revision of the RWT3xx series transducers was released; the output stage electronics were revised to improve the analogue output capability (resolution/output current), data processing power and data throughput.

The transducer firmware has thus been updated but retains the same output protocol with the addition of some new commands. This new firmware improves the capture speed and processing and adds some significant features.

Revision 2 transducers can be identified by having a serial number above 12200 or a firmware revision equal to or above 3.0.

One of the fundamental changes in the transducer firmware is the method for capturing speed. Many of the Speed/Power protocol commands refer to Slow or Fast modes and the definition of these modes is below:

Slow – The slow method uses a frequency count. Pulses are counted over a period of a second, and then calculated into RPM. As the name suggests this method is slow, measurements are produced at a rate of 1/sec. This method is good if you have a variable drive and wish to even out the speed measurement, basically acting as a filter.

Fast – The fast method uses a period count. The period count measures the time between pulses, then computes the RPM by turning the time into frequency. The fast methods measurement rate is fully dependant on the speed and subsequent pulse frequency, a measurement can be produced every 3 pulses, up to 2000RPM, at which point to preserve measurement accuracy measurements will occur at 2 KHz.

The new firmware extends the peak capturing facilities to include monitoring of the peaks in both clockwise and counter clockwise directions, and monitoring change from a fixed reset point. Each peak can be reset individually.

Transducer Peak Data

The RWT3xx series transducers have an inbuilt peak torque capture feature, which monitors the torque value measured by the device. One of the benefits of having this built into the transducer is that every data point captured can be analysed, meaning no data points are missed.

The peak torque facility essentially monitors the incoming data and compares it against a set of stored values using various criteria. If the value matches the criteria then that value replaces the stored value. On the whole the criterion is mostly related to whether the captured value is greater than the stored value, recording the maximum torque applied since reset.

Peak values assume a reset position on start-up or activation, when peak values are reset they are set to zero, PeakMinMax values are set to the current torque value.

The peak torque facility is enabled all the time in revision 2 transducers; revision 1 transducers have an on/off switch.

Peak Torque

The Peak Torque value indicates the highest torque applied to the transducer in either direction. The value is signed to indicate the direction that the torque was applied in

Peak Torque AutoReset

The Peak Torque Auto Reset is an extension of the Peak Torque feature. It works in the same way by recording the maximum torque except that the peak auto reset value will automatically reset when the torque value drops a below percentage of the peak.

The Auto Reset feature is especially useful when calibrating torque wrenches or for using the transducer as a torque wrench in applications such as bottle top tightening.

The Auto Reset percentage is 80%, unless the user has configured a different value using the "Transducer Control Utility".

Revision 2 firmware adds a peak hold feature to the auto reset, which is triggered when the peak is reset, i.e. the peak is recorded at 10Nm and drops to 1Nm the reset is triggered, 10Nm is held for a few seconds and then reset to zero. Revision 1 transducers are reset without the delay and immediately start acquiring again.

Peak Torque CW

The Peak Torque CW feature records the highest torque value measured in the clockwise direction.

Peak Torque CCW

The Peak Torque CCW feature records the highest torque value measured in the counter clockwise direction.

PeakMinMax

The PeakMinMax feature monitors the captured torque values and records the lowest and highest value from a reference position. This reference is given via a command and assumes zero on power on. An example of the PeakMinMax feature is as follows: if the reference is set to 10, then the torque value increases by 10 and decreases by 12. Max would be 20 and Min would be -2.

Any of the peak values can be retrieved either in the transducers native units or converted to an alternative by specifying the required unit.

The table below outlines the data retrieval and reset commands.

Peak Mode	Command	Command with Conversion	On/Reset Command (*Revision 2)	Revision Compatibility
Peak Torque	51	61	150, 146*, 147*, 148*, 149*	1, 2
Peak Torque with AutoReset	52	62	152, 146*, 147*, 148*, 149*	1, 2
Peak Torque CW	53	63	146, 147, 148, 149	2
Peak Torque CCW	54	64	146, 147, 148, 149	2
PeakMinMax	55, 56, 57	65, 66, 67	146, 147, 148, 149	2

Command Set

The table below outlines the commands available; revision 2 commands are denoted by an asterisk (*).

Command	Function	Parameters	Return Value
<i>Transducer Identification</i>			
0	Get Transducer ID	None	Transducer ID String (Char [59])
1	Get Transducer Information	None	Transducer Setup Information
<i>Transducer Data</i>			
50	Get Torque	None	Torque (Float)
51	Get Peak Torque	None	Peak Torque (Float)
52	Get Peak Torque Auto Reset	None	Peak Torque Auto Reset (Float)
53	Get Peak Torque CW*	None	Peak Torque CW (Float)
54	Get Peak Torque CCW*	None	Peak Torque CCW (Float)
55	Get PeakMinMax Max*	None	PeakMinMax Max (Float)
56	Get PeakMinMax Min*	None	PeakMinMax Min (Float)
57	Get PeakMinMax*	None	PeakMinMax Structure
60	Get Torque Convert Unit To	Units (Unsigned Char)	Torque (Float)
61	Get Peak Torque Convert Units To	Units (Unsigned Char)	Peak Torque (Float)
62	Get Peak Torque Auto Reset Convert Units To	Units (Unsigned Char)	Peak Torque Auto Reset (Float)
63	Get Peak Torque CW* Convert Units To	Units (Unsigned Char)	Peak Torque CW (Float)
64	Get Peak Torque CCW* Convert Units To	Units (Unsigned Char)	Peak Torque CCW (Float)
65	Get PeakMinMax Max* Convert Units To	Units (Unsigned Char)	PeakMinMax Max (Float)
66	Get PeakMinMax Min* Convert Units To	Units (Unsigned Char)	PeakMinMax Min (Float)
67	Get PeakMinMax* Convert Units To	Units (Unsigned Char)	PeakMinMax Structure
100	Get Speed	None	Speed (Float)
101	Get Power	None	Power in Watts (Float)
102	Get Temperature Ambient	None	Temperature Ambient (Float)
103	Get Temperature Shaft	None	Temperature Shaft (Float)
110	Get SlowCap Speed*	None	Speed (Unsigned Long)
111	Get FastCap Speed*	None	Speed (Unsigned Long)
112	Get SlowCap Power in Watts*	None	Power in Watts (Float)
113	Get FastCap Power in Watts*	None	Power in Watts (Float)
114	Get SlowCap Power in HP*	None	Power in HP (Float)
115	Get FastCap Power in HP*	None	Power in HP (Float)

Transducer Control			
146	Reset specified Peaks*	Refer to function description.	
147	Reset all Peak Torque values*	None	None
148	Reset all Peaks*	None	None
149	Reset System Values*	None	None
150	Peak Torque ON / Reset	None	None
151	Peak Torque OFF	None	None
152	Peak Torque Auto Reset ON / Reset	None	None
153	Peak Torque Auto Reset OFF	None	None
155	Zero Transducer with Average*	None	None
156	Zero Transducer	None	None
173	PeakMinMax Retrieve & Reset*	None	PeakMinMax Structure
180	Set Torque filter	Filter Setting (Unsigned char)	None
181	Get Torque filter	None	Filter Setting (Unsigned char)
182	Set Speed filter	Filter Setting (Unsigned char)	None
183	Get Speed filter	None	Filter Setting (Unsigned char)
253	Get Status Code	None	Status Code (Unsigned Char)

Transducer Identification

Get Transducer ID

Command: 0

Description: Requests an ID string from the transducer. The ID string contains the Transducer Model Name, Firmware Revision and Serial Number.

The ID string has the following format:

RWT321-DA - Firmware Revision: 2.1 Serial Number: 12345678

Parameters: None.

Return Value: Char [59] – Transducer ID String.

Get Transducer Information

Command: 1

Description: Requests information on the transducers configuration. The information details the transducers internal setup; this includes Model Name, Transducer Type, FSD, Units, Serial Number, Manufacture Date, last Calibration Date and Options enabled (USB, RS232 etc.)

Parameters: None.

Return Value: The following C structure defines in what order and format the data is transmitted in. The data is transmitted in one block of 50 bytes.

Struct

```
{
char Model_Name[10];           // Transducer Model Name
unsigned char Type;           // For future use (SAW/Optical)
unsigned int FSD;             // Transducer FSD rating
unsigned char Units;         // Transducer Torque Units, Refer to
                             //Units Key.
unsigned long Max_Speed;     // Transducer maximum rated Speed
char Serial_Number[9];       // Transducer Serial Number
char Manufacture_Date[11];   // Manufacture Date (DD/MM/YYYY)
char Calibration_Date[11];   // Calibration Date (DD/MM/YYYY)
unsigned char Options;       // Options Enabled/Present
}
```

This table shows the structure of the Options byte, Bit=1 Enabled, Bit=0 Disabled							
Bit0 (L)	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7 (M)
USB	RS232	Advanced User Control	Current Output	None	Speed Encoder	Angle Encoder	IP65

Transducer Data

Get Torque

Command: 50

Description: Requests the current torque value, if averaging has been enabled then this value is averaged.

Parameters: None.

Return Value: Float – torque in the transducers native units.

Get Peak Torque

Command: 51

Description: Requests the current Peak Torque value.

Parameters: None.

Return Value: Float – Peak Torque in the transducers native units.

Get Peak Torque Auto Reset

Command: 52

Description: Requests the current Peak Torque Auto Reset value.

Parameters: None.

Return Value: Float - Peak Torque Auto Reset in the transducers native units.

Get Peak Torque CW (Revision 2)

Command: 53

Description: Requests the current clockwise Peak Torque value.

Parameters: None.

Return Value: Float – Peak Torque value in the transducers native units.

Get Peak Torque CCW (Revision 2)

Command: 54

Description: Requests the current counter clockwise Peak Torque value.

Parameters: None.

Return Value: Float – Peak Torque value in the transducers native units.

Get PeakMinMax Max (Revision 2)

Command: 55

Description: Requests the current Max value from the PeakMinMax data.

Parameters: None.

Return Value: Float – PeakMinMax Max torque value in the transducers native units.

Get PeakMinMax Min (Revision 2)

Command: 56

Description: Requests the current Min value from the PeakMinMax data.

Parameters: None.

Return Value: Float – PeakMinMax Min torque value in the transducers native units.

Get PeakMinMax (Revision 2)

Command: 57

Description: Requests the PeakMinMax data.

Parameters: None.

Return Value: PeakMinMax structure consisting of two torque values in the transducers native units.

Get Torque - Convert Units To

Command: 60

Description: Requests the current torque value and converts the native units to the selected units.

Parameters: Unsigned Char – Conversion Unit; select the unit of conversion by sending in a byte after the command, equal to the unit of torque required (for unit values refer to the Units key).

Return Value: Float – Torque in the selected unit.

Get Peak Torque - Convert Units To

Command: 61

Description: Requests the current Peak Torque value and converts the transducers native units to the selected units.

Parameters: Unsigned Char – Conversion Unit; select the unit of conversion by sending in a byte after the command, equal to the unit of torque required (for unit values refer to the Units key).

Return Value: Float – Peak Torque value in the selected unit.

Get Peak Torque Auto Reset - Convert Units To

Command: 62

Description: Requests the current Peak Torque Auto Reset value and converts the transducers native units to the selected units.

Parameters: Unsigned Char – Conversion Unit; select the unit of conversion by sending in a byte after the command, equal to the unit of torque required (for unit values refer to the Units key).

Return Value: Float - Peak Torque Auto Reset value in the selected unit.

Get Peak Torque CW - Convert Units To (Revision 2)

Command: 63

Description: Requests the current clockwise Peak Torque value and converts the transducers native units to the selected units.

Parameters: Unsigned Char – Conversion Unit; select the unit of conversion by sending in a byte after the command, equal to the unit of torque required (for unit values refer to the Units key).

Return Value: Float – Peak Torque value in the selected unit.

Get Peak Torque CCW - Convert Units To (Revision 2)

Command: 64

Description: Requests the current counter clockwise Peak Torque value and converts the transducers native units to the selected units.

Parameters: Unsigned Char – Conversion Unit; select the unit of conversion by sending in a byte after the command, equal to the unit of torque required (for unit values refer to the Units key).

Return Value: Float – Peak Torque value in the selected unit.

Get PeakMinMax Max - Convert Units To (Revision 2)

Command: 65

Description: Requests the current Max value from the PeakMinMax data and converts the transducers native units to the selected units.

Parameters: Unsigned Char – Conversion Unit; select the unit of conversion by sending in a byte after the command, equal to the unit of torque required (for unit values refer to the Units key).

Return Value: Float – PeakMinMax Max torque value in the selected unit.

Get PeakMinMax Min - Convert Units To (Revision 2)

Command: 66

Description: Requests the current Min value from the PeakMinMax data and converts the transducers native units to the selected units.

Parameters: Unsigned Char – Conversion Unit; select the unit of conversion by sending in a byte after the command, equal to the unit of torque required (for unit values refer to the Units key).

Return Value: Float – PeakMinMax Min torque value in the selected unit.

Get PeakMinMax - Convert Units To (Revision 2)

Command: 67

Description: Requests the PeakMinMax data and converts the transducers native units to the selected units.

Parameters: Unsigned Char – Conversion Unit; select the unit of conversion by sending in a byte after the command, equal to the unit of torque required (for unit values refer to the Units key).

Return Value: PeakMinMax structure consisting of two torque values in the selected unit.

Get Speed

Command: 100

Description: Requests the current Speed value. Revision 2 transducers use the slow speed capture value for this command.

Parameters: None.

Return Value: Float – Speed in RPM.

Get Power

Command: 101

Description: Requests the current Power value in Watts. Revision 2 transducers use the slow speed capture value for this command.

Parameters: None.

Return Value: Float – Power in Watts.

Get Temperature Ambient

Command: 102

Description: Requests the transducers internal ambient temperature. The temperature is influenced by the running temperature of the internal electronics.

Parameters: None.

Return Value: Float – Temperature in degrees C (°C).

Get Temperature Shaft

Command: 103

Description: Requests the transducers shaft temperature. The temperature is read using an infrared sensor

Parameters: None.

Return Value: Float – Temperature in degrees C (°C).

Get SlowCap Speed (Revision 2)

Command: 110

Description: Requests the current speed value from the slow speed capture system.

Parameters: None.

Return Value: Unsigned Int – Speed in RPM.

Get FastCap Speed (Revision 2)

Command: 111

Description: Requests the current speed value from the fast speed capture system.

Parameters: None.

Return Value: Unsigned Int – Speed in RPM.

Get SlowCap Power in Watts (Revision 2)

Command: 112

Description: Requests the current power value in Watts using the current torque and speed value from the slow speed capture system.

Parameters: None.

Return Value: Float – Power in Watts.

Get FastCap Power in Watts (Revision 2)

Command: 113

Description: Requests the current power value in Watts using the current torque and speed value from the fast speed capture system.

Parameters: None.

Return Value: Float – Power in Watts.

Get SlowCap Power in HP (Revision 2)

Command: 114

Description: Requests the current power value in Horse Power (HP) using the current torque and speed value from the slow speed capture system.

Parameters: None.

Return Value: Float – Power in HP.

Get FastCap Power in HP (Revision 2)

Command: 115

Description: Requests the current power value in Horse Power (HP) using the current torque and speed value from the fast speed capture system.

Parameters: None.

Return Value: Float – Power in HP.

Transducer Control

Reset Specified Peaks (Revision 2)

Command: 146

Description: Resets stored peak values or zero's the transducer in accordance with binary flags specified in an input value.

The input value is an unsigned int, which is 2 bytes and thus some handshaking is required to ensure that no overflows occur in the transducer's internal processor.

The procedure for transmitting the value is outlined below:

1. Transmit the command byte (unsigned char) with a value of 146.
2. Receive a byte (unsigned char); the byte will have a value of 145, the value has no significance.
3. Transmit the 2 byte (unsigned int) reset request parameter, LSB first.
4. Receive a byte (unsigned char), this second byte acts as a confirmation, its value will be 145, again the value has no significance.

The input parameter specifies what stored values should be reset. The value is made up of binary flags, each flag signifying a value to reset. A 1 signifies reset value, a '0' do not reset.

The input value is calculated by adding together or OR'ing the flag values. The table below shows the reset flags and there respective values.

Flag Value	Value to be reset	Description
0x01	Transducer Zero	Zero's the Transducer.
0x02	Transducer Zero with Average	Zero's the Transducer with an average value.
0x04	Peak Torque	Resets the Peak Torque to zero.
0x08	Peak Torque Auto Reset	Resets the Peak Torque Auto Reset to zero.
0x10	Peak Torque CW	Resets the Peak Torque CW to zero.
0x20	Peak Torque CCW	Resets the Peak Torque CCW to zero.
0x40	PeakMinMax	Resets the Min and Max values to the current torque value.
0x80	Peak FastCap Speed	Resets the Peak FastCap Speed value to zero.
0x100	Peak SlowCap Speed	Resets the Peak SlowCap Speed value to zero.
0x200	Peak FastCap Power	Resets the Peak FastCap Power value to zero.
0x400	Peak SlowCap Power	Resets the Peak SlowCap Power value to zero.

Example

To reset all the torque values (Peak Torque: 0x04, Peak Torque Auto Reset: 0x08, Peak Torque CW: 0x10, Peak Torque CCW 0x20, PeakMinMax: 0x40), the input value would be 0x7C

Input Value 0x7C = 0x04 + 0x08 + 0x10 + 0x20 + 0x40

Reset ALL Peak Torque Values (Revision 2)

Command: 147

Description: Resets the entire memory bank of stored peak values related to torque, values are reset to zero, except for the PeakMinMax values which are reset to the current torque value.

Parameters: None.

Return Value: None.

Reset ALL Peak Values (Revision 2)

Command: 148

Description: Resets the entire memory bank of stored peak values related to torque, speed and power. Values are reset to zero, except for the PeakMinMax values which are reset to the current torque value.

Parameters: None.

Return Value: None.

Reset System Values (Revision 2)

Command: 149

Description: Resets the entire memory bank of stored peak values related to torque, speed and power, then zero's the transducer using an averaged zero. All subsequent torque values are offset by the zero value. Peak values are reset to zero, except for the PeakMinMax values which are reset to the current torque value.

Parameters: None.

Return Value: None.

Peak Torque ON / Reset

Command: 150

Description: Resets the stored Peak Torque value to zero. This command will switch ON the Peak Torque functionality in Revision 1 transducers. If the Peak Torque function is already active the current Peak value will be reset to Zero.

Parameters: None.

Return Value: None.

Peak Torque OFF (Revision 1 Only)

Command: 151

Description: Switches OFF the Peak Torque function.

Parameters: None.

Return Value: None.

Peak Torque Auto Reset ON / Reset

Command: 152

Description: Resets the stored Peak Torque AutoReset value to zero. This command will switch ON the Peak Torque Auto Reset functionality in Revision 1 transducers; if the Peak Torque Auto Reset function is already active the current Auto Reset value will be reset to Zero.

Parameters: None.

Return Value: None.

Peak Torque Auto Reset OFF (Revision 1 Only)

Command: 153

Description: Switches OFF the Peak Torque Auto Reset function.

Parameters: None.

Return Value: None.

Zero Transducer with Average (Revision 2)

Command: 155

Description: Zero's the transducer torque value; all subsequent torque readings will be offset by a calculated average torque value. When the command is sent to the transducer, the firmware will average using 32 torque samples.

Parameters: None.

Return Value: None.

Zero Transducer

Command: 156

Description: Zero's the transducer torque value; all subsequent torque readings will be offset by the torque amount present when zeroed.

Parameters: None.

Return Value: None.

Get PeakMinMax & Reset (Revision 2)

Command: 173

Description: Requests the PeakMinMax data and resets the stored values to the current torque reading.

Parameters: None

Return Value: PeakMinMax structure consisting of two torque values in the transducers native units.

Set Torque Filter

Command: 180

Description: Enables and configures the internal torque filtering system.

Parameters: Unsigned Char – Filter Setting; configure the filter system by sending a byte after the command, the device will then set the filtering system to the required setting.

Valid filter samples: 0 – OFF, 2, 4, 8, 16, 32, 64, 128.
Revision 2 devices can achieve 256 by sending 255.

Return Value: None.

Get Torque Filter

Command: 181

Description: Retrieves the current internal torque filter setting.

Parameters: None.

Return Value: Unsigned Char – Filter Setting; the value of the current filter setting will be returned. The number equals the number of samples used in the filter, except 255 which is actually 256 samples and 0 which means the filter is disabled.

Set Speed Filter

Command: 182

Description: Enables and configures the internal speed filtering system.

Parameters: Unsigned Char – Filter Setting; configure the filter system by sending a byte after the command, the device will then set the filtering system to the required setting.

Valid filter samples: 0 – OFF, 2, 4, 8, 16, 32, 64, 128.
Revision 2 devices can achieve 256 by sending 255.

Return Value: None.

Get Speed Filter

Command: 183

Description: Retrieves the current internal speed filter setting.

Parameters: None.

Return Value: Unsigned Char – Filter Setting; the value of the current filter setting will be returned. The number equals the number of samples used in the filter, except 255 which is actually 256 samples and 0 which means the filter is disabled.

Get Status Code (Revision 1 Only)

Command: 253

Description: Requests the Transducer Status Code. This value reflects current transducer modes and transducer system errors. Values greater than or equal to 8 indicate system errors. If an error occurs during logging, you should stop immediately as torque results may be incorrect.

Parameters: None.

Return Value: Unsigned Char – Status Code.