



High Speed End of Shaft Telemetry

Model: T8

User Manual

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Contents

Cover	2
Introduction	4
System Overview	6
Full System	6
T8 High Speed Telemetry Transmitter	7
M460 Transmitter	8
Primary Inductive Coil Paddle	9
Receiver and Induction Power Supply Box	10
Power Cable	10
Signal Output Cable	11
System Set-Up	12
Precautions	12
Install T8 on Shaft	13
Connect Thermocouples	14
Install T8 Customer Access Cover	15
Install T8 Cover	16
Induction Power Primary	17
Receiver Box Set-up	18
Sensitivity (Shunt Calibration)	20
Appendix	21
System Troubleshooting	21

T8 High Speed End of Shaft Telemetry System

- Proven to 20,000 revolutions per minute
- Eight channel package
- 2,200 updates per second
- No components to wear out or maintain

Specifications

Transmitter	
Data transmission method	2.4 GHz carrier with FSK modulation
Analog channels	8 Channels
ADC resolution	16-bit
Data bandwidth	DC to 1.0 kHz
Operating temperature	-40 °C to +125 °C (-40 °F to +257 °F)
Temperature measurement range	-40 °C to +450 °C (-40 °F to +752 °F) (Other Ranges Available)
Power requirement	6 Vdc to 9 Vdc / 65 mA
Weight	34 g (1.2 oz)
Receiver	
Output at full Scale	±10 V
DAC output resolution	16-bit
Data filter cutoff selections	100 Hz, 1 kHz at -3 db
Channel filter type	2-pole Bessel
Current output per channel	±35 mA
Operating temperature	-40 °C to +70 °C (-40 °F to +158 °F)
RF antenna connector	Reverse polarity SMA
Power requirement	9 Vdc to 36 Vdc / 2.5 A
Dimensions (L x W x H)	180 mm x 89 mm x 64 mm (7.0 in x 3.5 in x 2.5 in)
System General	
RF channels available	16

System Overview

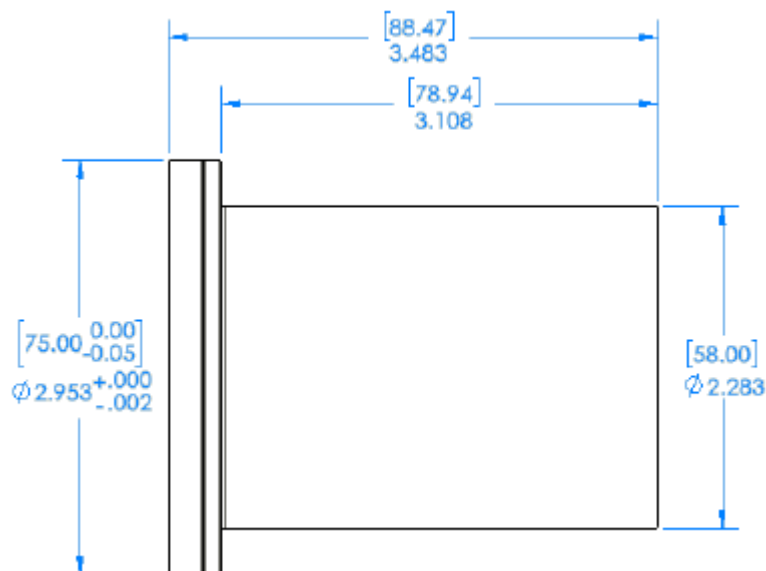
The T-Series System is comprised of the following components:
T-Series Transmitter, T-Series Cover, Receiver/Induction Supply Box,
Primary Inductive Coil, receiver power cable, and receiver signal
output cable.

Full System



T8 High Speed Telemetry Transmitter

The T8's compact, bearing free housing was specifically designed to minimize size and weight to allow for long term, high-speed testing. The system has no wear components and requires no periodic maintenance. The T8 has been proven at 20,000 rpm, and an upper speed limit has not been established.



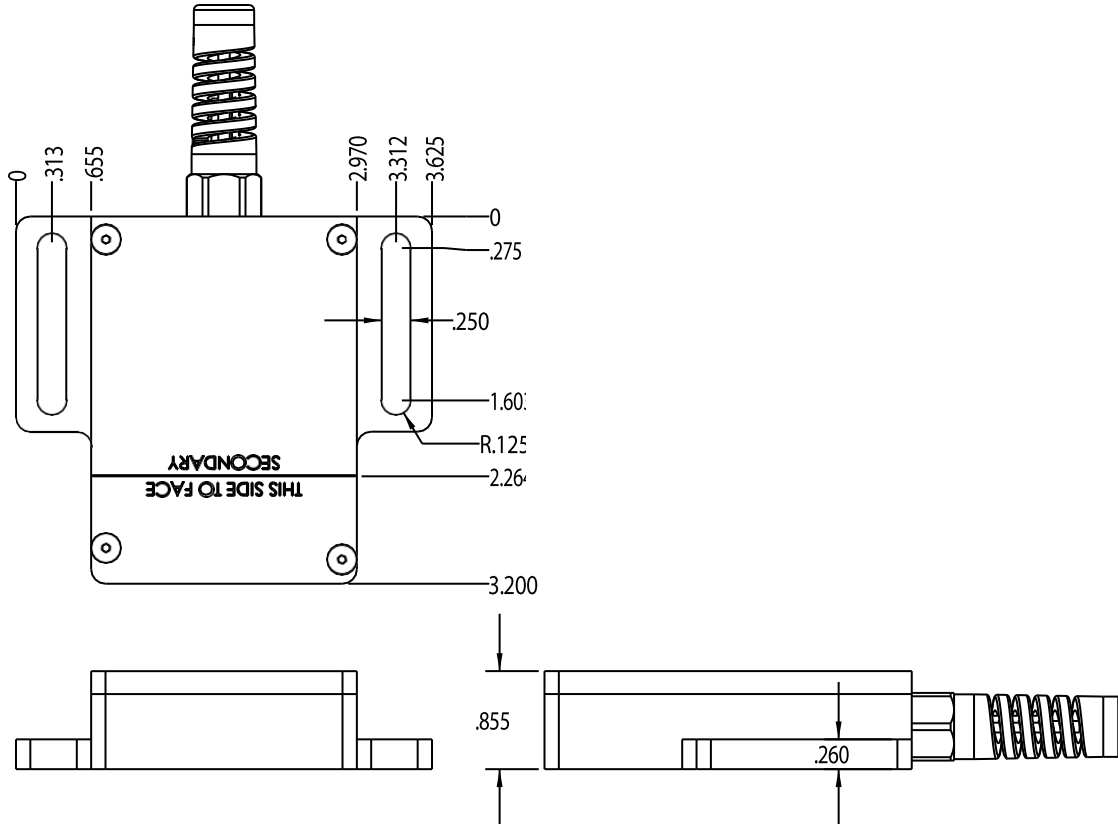
M460 Transmitter

The M460 transmitter is housed in the T8 body. It sends the output signal via radio frequency (RF). The RF carrier transmits the digital data. For strain bridge, each time the power is switched on to the transmitter, a 3-second-long shunt calibration sequence is initiated. This is the best way to set-up strain gage bridge sensitivity, which is explained further on page 16.



Primary Inductive Coil Paddle

The Primary Inductive Coil provides power to the rotating telemetry unit. The receiving antennas are connected to the telemetry receiver which provides ± 10 V analog output for each channel.



Receiver and Induction Power Supply Box

The telemetry receiver and induction power supply are contained in a single enclosure.

The telemetry receiver converts the RF signal from the telemetry transmitter, decodes the signal, and provides an analog signal that corresponds to the temperature on the shaft.

The induction power supply provides the high frequency AC power to the Primary Paddle. The Primary Paddle inductively couples with the secondary coil located in the T8, mounted on the shaft. The secondary coil power is regulated with electronics inside the T8, and this regulated power is provided to the telemetry transmitter.



Power Cable

The Receiver must be powered by a DC power source between 9 V to 36 V. A cigarette plug power cable is provided.



Signal Output Cable

A signal output cable is provided which mates to the 15 pin D-sub connector on the back of the receiver. The Signal output cable has several BNC connectors. The connectors are labeled: CH1, FAULT, LOW POWER, & CAL.

CH1-8: Channel analog output. $\pm 10V$.

FAULT: RF FAULT indicator. 0 V is good – no faults. 1.9 V indicates RF Faults (loss of telemetry signal). Check Primary Paddle connections and make sure that the transmitter is powered.

LOW Power: Low Power indicator. When the voltage level powering the transmitter drops below 5.6 V, the low power indicator will come on. The Low Power Indicator being off (0 V) is good. The low Power Indicator being on (1.9 V) indicates that adjustment to the induction power settings are needed.

CAL: On (1.9 V) during start up calibration sequence. Off (0 V) otherwise. Used to indicate an active shunt sequence.



System Set-Up



Precautions

T8 High Speed Telemetry Transmitter

- Be sure that all mating surfaces are free of dirt and debris
- Mating surfaces should be free of nicks and scratches that raise material

Receiver and Induction Power Supply

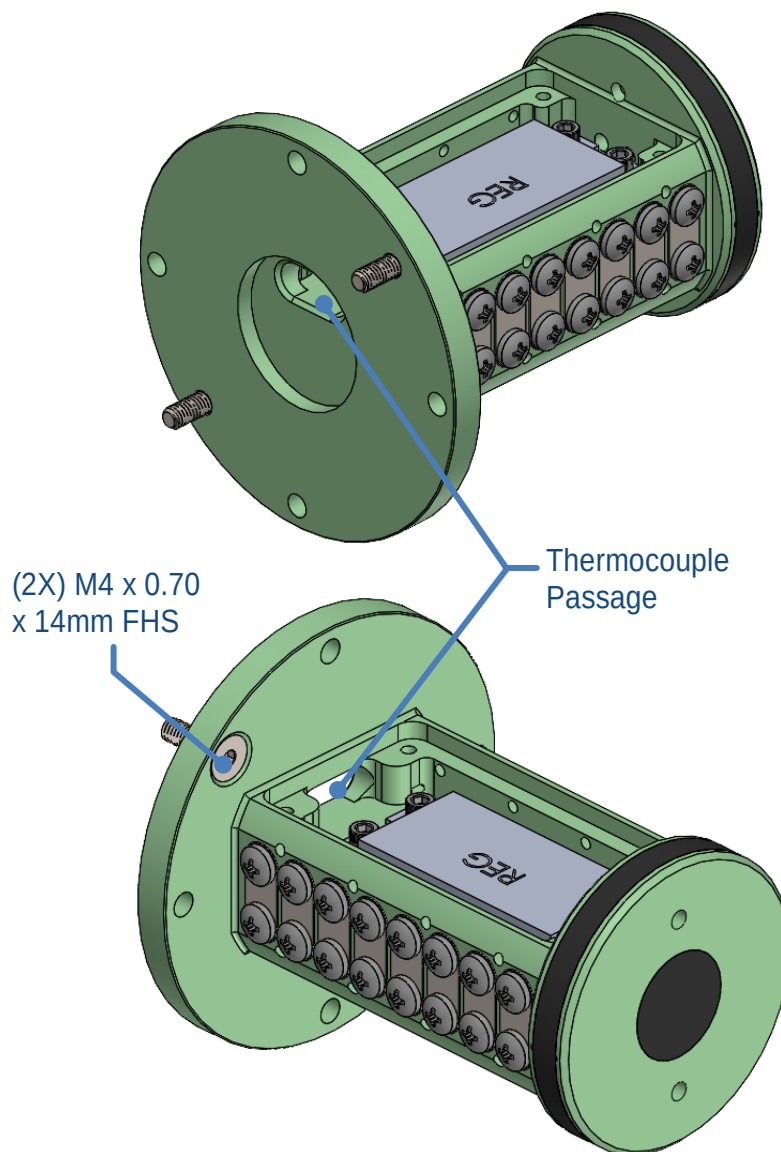
- Be sure not to block the side or rear panel cooling fan vents
- High voltages are produced across the Primary Induction Coil Paddle under normal operating conditions

Install T8 Base on Shaft

The T8 is designed to be installed on the end of a shaft with thermocouple wires passing through the center. If needed, an adapter can be made to support the T8 base and/or route thermocouple wires.

Pass thermocouple leads through opening in the bottom of the T8 Base. Secure the T8 Base to the shaft using two M4 x 0.70 x 14mm Flat Head Screws. Suggested torque: 20 in-lbf

Michigan Scientific can machine adapters or consult on designs.

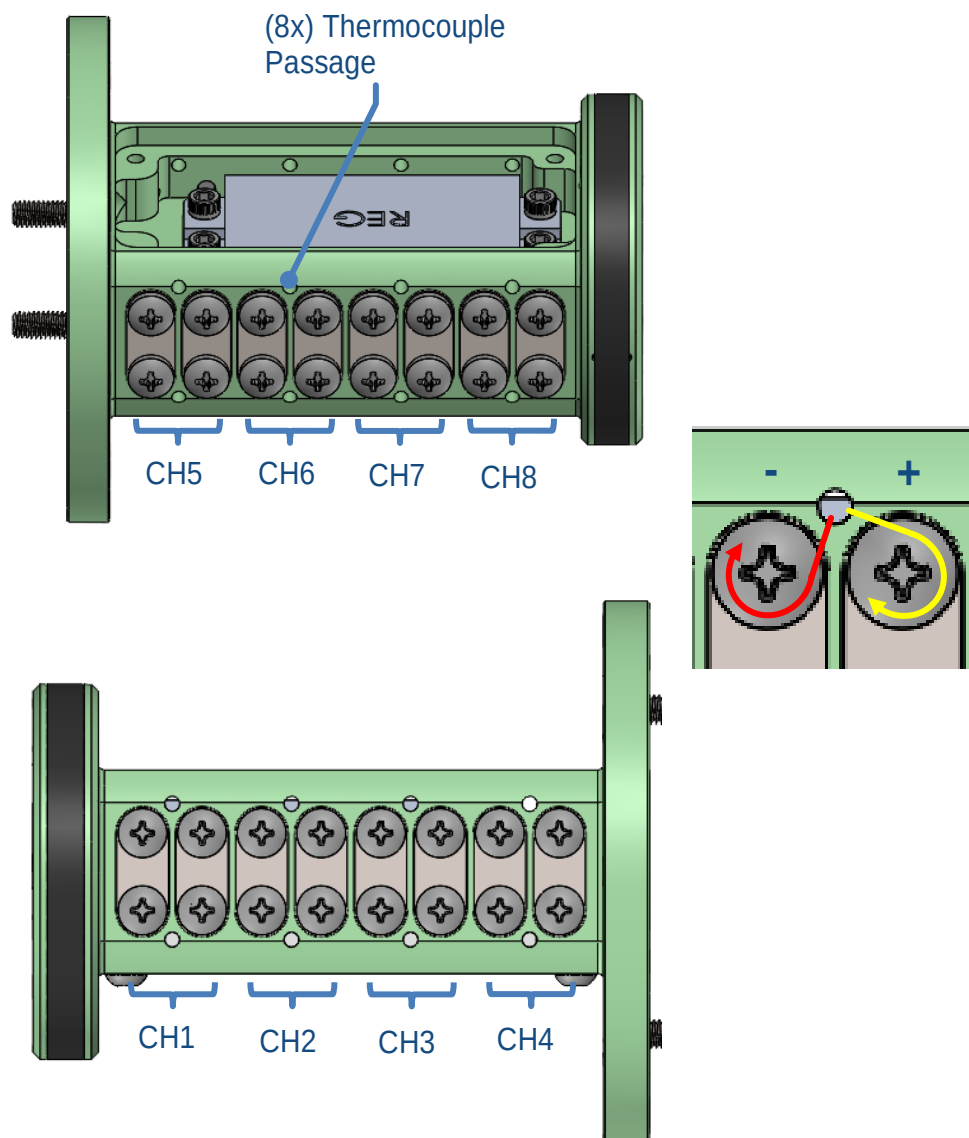


Connect Thermocouples

Guide the thermocouple leads through the hole corresponding to the desired channel.

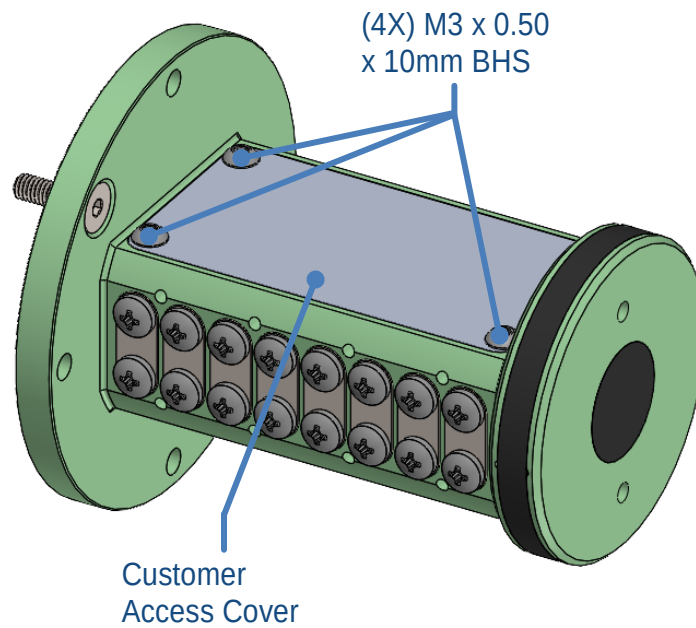
Wrap the stripped portion of the thermocouple wire around the terminal screw. Tighten the terminal screw to secure the thermocouple lead. Suggested torque: 12 in-lbf.

Extra thermocouple lead length can be pulled into T8 Base and secured with easily removed coating or packing to minimize movement. For example, RTV or foam.



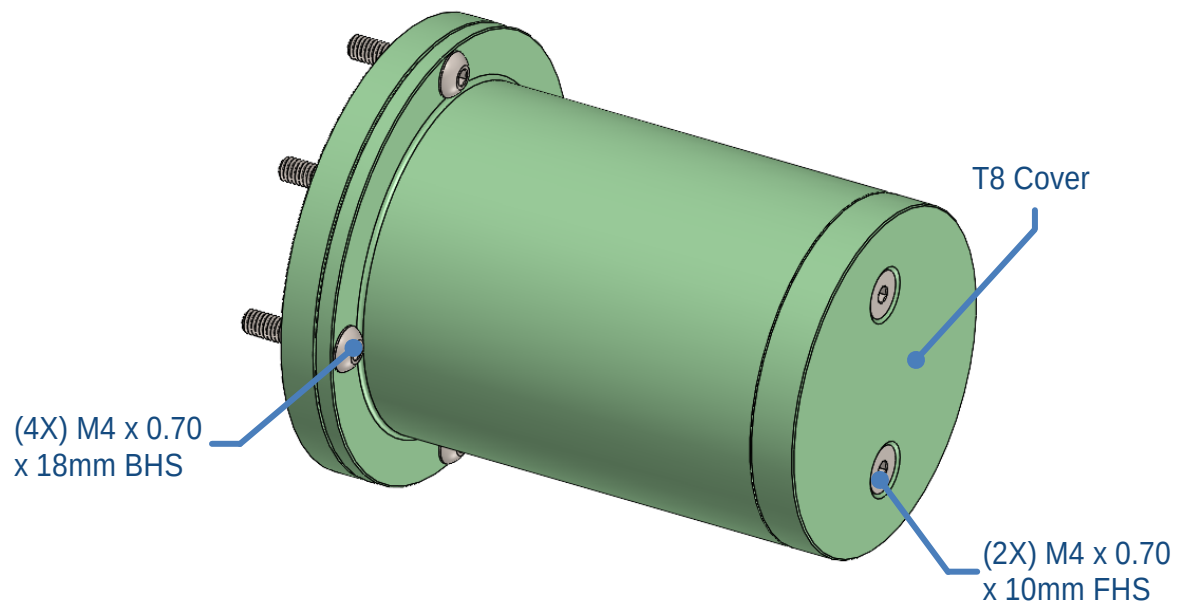
Install T8 Customer Access Cover

Pilot the customer access cover on T8 Base and secure with four M3 x 0.50 x 10mm Button Head Screws. Suggested torque: 8 to 10 in-lbf.



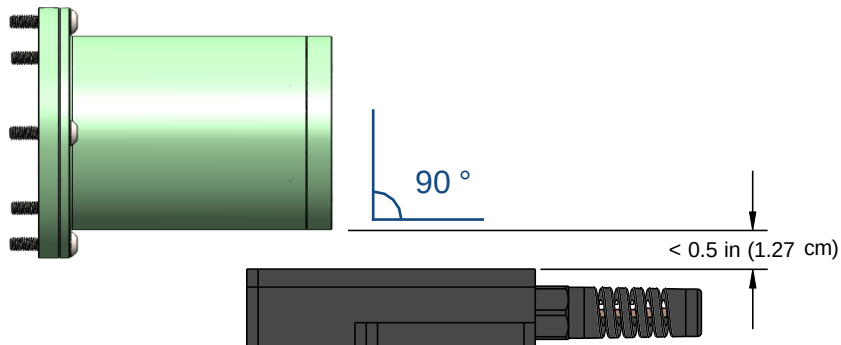
Install T8 Cover

Pilot the T8 Cover over the T8 Base and secure with two M4 x 0.70 x 10mm Flat Head Screws and four M4 x 0.70 x 18mm Button Head Screws. Suggested torque: 20 in-lbf

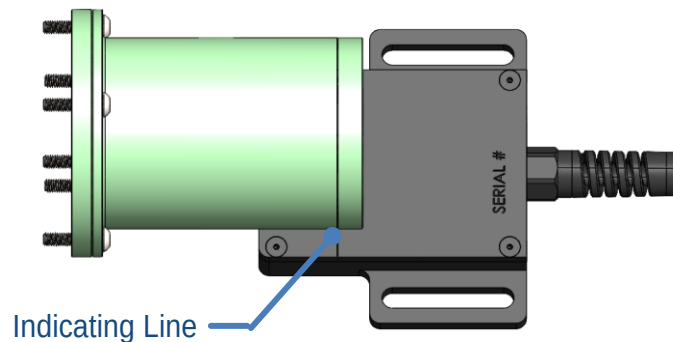


Induction Power Primary

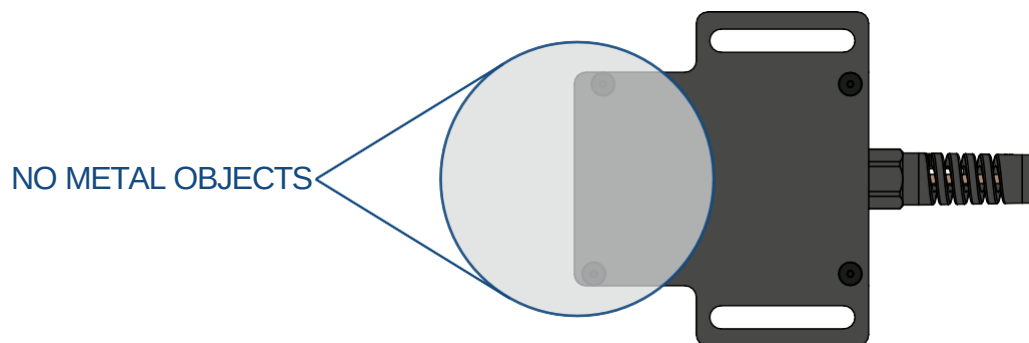
To maximize efficiency of the primary, the orientation and spacing to the T8 is critical.



The T8 should be placed perpendicular to the Primary Paddle active surface and the gap should be less than 0.5 in (1.27 cm).



The end of the T8 Indicating Line should line up with the Indicating Line on the front face of the Primary Paddle.



Keep metallic objects, including the mounting bracket, away from the active area of the primary coil.

Receiver Box Set-up

The receiver box should be placed in an area protected from the weather. The power cable and the antenna cables need to connect to the rear panel.

Plug the Induction Power Primary Cable into the appropriate connector on the rear panel of the Receiver box. Plug in the two small connectors for the receiver antennas that are built into the Induction Power Primary Paddle. It does not matter which connector is plugged into which receptacle.

Locate and mount the Primary Paddle close to the end of the T8 housing as shown on page 17.

Turn on the Power Switch located on the upper right corner of the Receiver front panel.

The LED's will momentarily flash. Immediately afterward, the Run LED should be lit and the CAL LED should be on for approximately 3 seconds during the start up calibration sequence. The RF Fault LED should be off.

The induction power was tuned at the factory, but may require re-tuning.

To tune the induction power, check to ensure that the Primary Paddle is properly aligned with the secondary (T8). While the Receiver and Induction Power Supply is powered, momentarily depress the "Tune" button. On the vertical row of LED's, the blue "Tuning" LED will be lit during the tuning process. This process will take approximately 1 minute. Once tuned, the green "Tuned" LED will be illuminated.

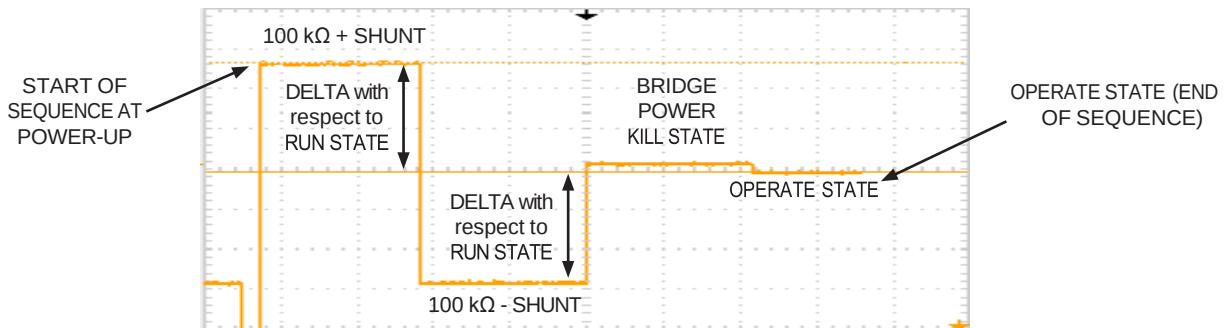
During operation, it is not uncommon to observe some flickering of the RF Fault LED. If the receiver detects a fault, the output D/A converter in the receiver holds the last valid sample. The sample rate for the transmitter is approximately 2200 samples per second.



Sensitivity (Shunt Calibration)

A power-up calibration sequence is generated to provide the user a means to relate output voltage (the voltage recorded) to engineering units of torque, strain, ect. The calibration sequence can also help the user monitor bridge-offset or gain changes which may indicate a problem.

When powered up, the transmitter generates a calibration sequence that lasts approximately 3 seconds. An example of this sequence is shown below.



The sequence begins with a 100 kΩ shunt calibration resistor applied across the positive excitation (P+) and positive signal (S+). This is referred to as the +SHUNT MODE. This shunting produces an electrical unbalance of the bridge that produces a positive voltage shift as shown. The amount of voltage shift (or delta) is equivalent to a corresponding voltage shift that would result from a physical strain applied to the transducer as determined by the factory calibration of the transducers.

The shift or delta to use must be with respect to the OPERATE MODE voltage level (OPERATE MODE ends the sequence).

The next part of the sequence directly following the +SHUNT mode is the -SHUNT MODE. As for the +SHUNT mode this likewise electrically offsets the bridge but now in the negative direction due to placement of the shunt resistor across the positive excitation (P+) and negative signal (S-) leads of the transducer bridge.

The next sequence mode is BRIDGE KILL MODE. During this mode the bridge excitation is removed but the signal amplifiers remain active. This provides an opportunity to check for background noise (for example due to EMI). Any dynamic signal that is present during bridge kill mode is noise.

The end of the sequence is noted by OPERATE MODE. This is the normal "measurement-taking" mode.

Appendix

System Troubleshooting

The following are guidelines to help in determining the cause of problems you may experience with the telemetry torque measurement system. These guidelines are arranged in categories of failure symptoms. Areas to check for problems are listed for each specific symptom.

1. Receiver Power Indicator Light Does Not Come On
 - a) Ensure that the power cord is plugged into a reliable 9 VDC to 36 VDC source
2. Fault/Signal strength LED is always ON
 - a) Try a different Primary location or orientation
 - b) Reduce the gap between the Primary and T8
 - c) Re-tune the induction power
 - d) Carefully increase the induction power