



Clamping Induction Telemetry

Model: CIT

Installation Manual





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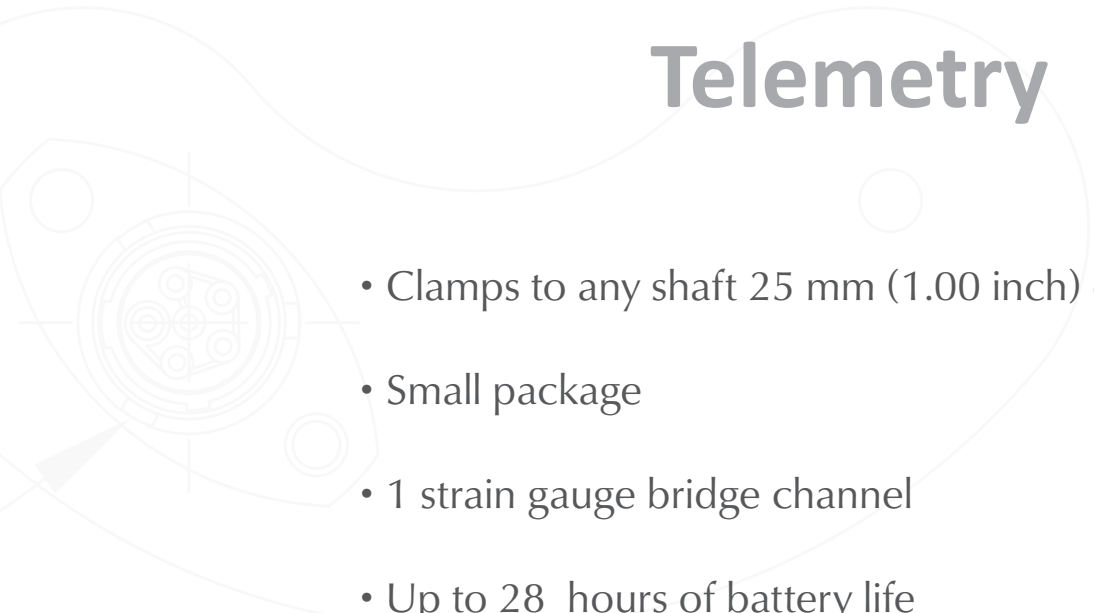
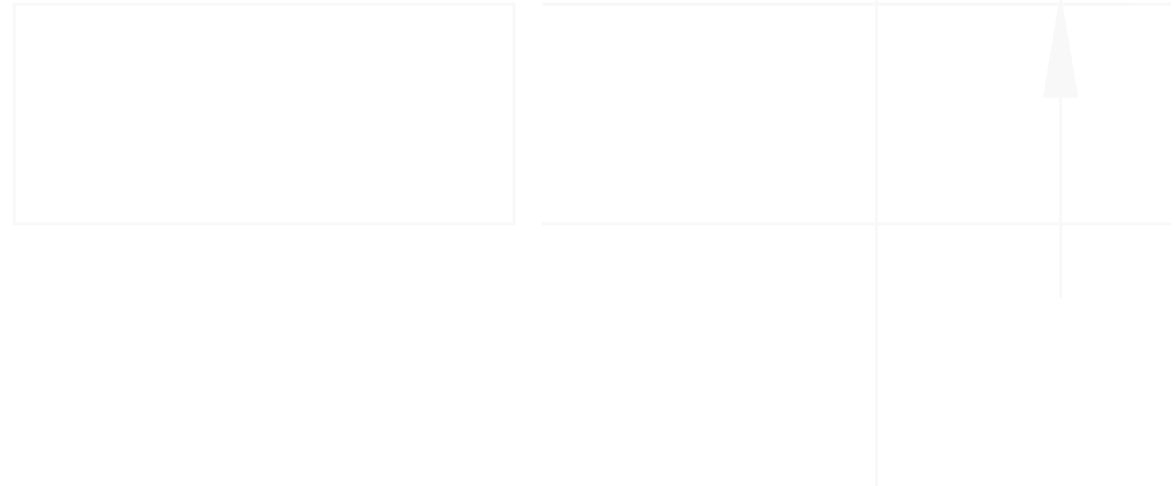
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Clamping Induction Telemetry

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- Clamps to any shaft 25 mm (1.00 inch) or larger
 - Small package
 - 1 strain gauge bridge channel
 - Up to 28 hours of battery life
 - Lightweight rugged IP67 housing
 - Digital 2.4 GHz RF link for reliable transmission without interference or spikes

The Michigan Scientific Clamping Induction Telemetry (CIT) is a wireless, inductively powered, signal transmitter for strain gauges that easily mounts to shafts with a minimum diameter of 25 mm (1 inch) or larger, making it very versatile. It can conveniently be strapped to a shaft with load-rated plastic zip ties or stainless steel banding. The Primary Induction Coil (PICT) is mounted on the stationary side and provides power to the CIT. The CIT provides excitation and signal conditioning to the strain gauges, then digitally transmits the signals via RF in the 2.4 GHz broadcast frequency range. For higher speed shafts when shaft balancing is required, a counter weight can be purchased and should be mounted 180 degrees opposite the CIT. With a small and rugged housing, the CIT is designed to provide accurate data in hostile environments.

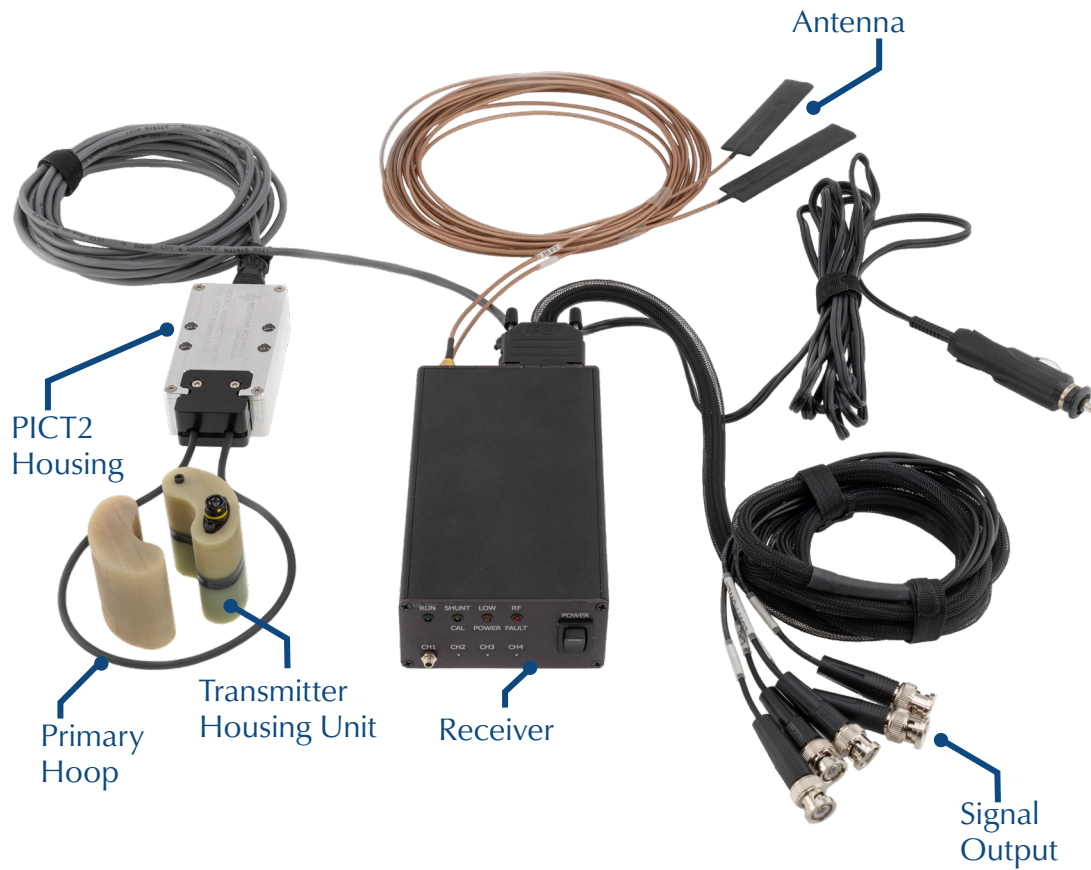
CIT System Specifications

	M320 Telemetry	M540
RF Frequency Range	2.4 GHz	
Channel Type	Strain Gauge, Full Bridge, 350 Ω or higher	
Channel Count	1 or 2	
Programmable Gain	Yes, with USB programmer	No, fixed gain
Input Range	0.1 to 10 mV/V	
Shunt Resistor	Fixed 100 k Ω standard, other shunt resistor values available	
Typical Broadcast Distance	1-2 meters, line of sight	3-4 meters, line of sight
Channel Sampling Rate	3 kHz	7 kHz
Signal Output	± 10 V Analog	
System Resolution	12 Bit	14 Bit
Operating Temperature (CIT & PICT)	(-40 °F to +185 °F) (-40 °C to +85 °C)	
Power Requirement	9 to 36 Vdc, 2 A	
Total System Delay (Unfiltered Data)	< 670 μ s	<300 μ s
RF Channels Available	16	

System Overview

The CBT-mini System is comprised of the following components:
CBT-mini transmitting unit, M540 Receiver, two receiving antennas, receiver power cable, and receiver signal output cable.

Full System



Transmitter Housing unit

The CIT transmitting unit contains a Michigan Scientific M320 Series Digital Telemetry Transmitter, a power indicating LED, and 1 to 2 input connectors depending on the configuration. The M320 Transmitter conditions low level strain gauge bridge signals, transmits signals wirelessly, and ultimately provides a high level analog voltage signal for recording. The external primary hoop from the PICT provides power to the Telemetry Transmitter. The LED indicator turns on when the transmitter has power. The input connector(s) allows for up to two channels from two full strain gauge bridges.



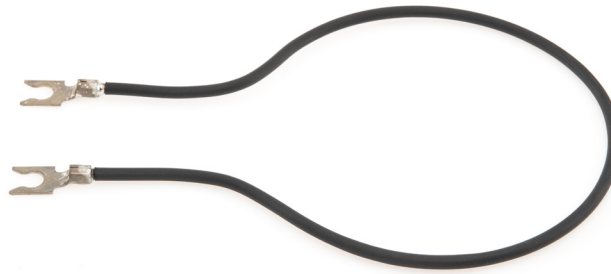
PICT2 Housing

PICT – Primary Induction Coil Telemetry acts as the wireless inductive power supply to the CIT transmitter. PICT2 housing contains the driving electronics PCB which reduces RF data transmission losses through the PICT-Receiver cable. The PICT easily attaches / detaches to the primary hoop to ease assembly and set up. Primary hoops are made to size to fit a wide range of shaft sizes.



Primary Hoop

The primary hoop must be aligned along the center of the CIT for maximum efficiency but does allow some movement in the axial and radial direction to account for shaft motion. If the PICT is not previously installed by MSC, the primary hoop easily connects and disconnects from the PICT housing using its secure snap on snap off feature. Assembly / disassembly process shown on page 19. Ideal hoop diameter creates ~0.5" air gap between the hoop and the CIT transmitter housing when installed properly.



Receiver

After detection by a receiving antenna, the digital signal is converted to a high level analog signal by the Receiver. A jumper selectable low-pass filter in the receiver provides data output bandwidths of either 100 Hz or 1000 Hz. The system shipped to you has been set at the factory for a bandwidth of 1000 Hz.



Receiving Antennas

Two receiving Antennas are provided with the system. For best reception, use both antennas and place them on opposite sides of the shaft from each other.



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 four BNC connectors. The connectors are labeled: CH1, FAULT, LOW POWER, & CAL.

CH1: Channel 1, which is the strain gage bridge connected to the CBT-mini

The remaining 3 signals are diagnostic signals.

FAULT: RF Fault (loss of telemetry signal)

LOW BATTERY: Indicates low battery or insufficient power to transmitter

CAL: Indicates an active Shunt Calibration Sequence



Power Cable

The Receiver must be powered by a DC power source between 10-36 Volts. A cigarette plug power cable is provided.



PICT - Receiver Cable

Signal Cable connects from the Receiver to the PICT.



Mounting Tape

Tape applied to the mounting surface to prevent CIT slip during operation.



Mounting Instructions

Retention Methods

Cable Ties

Heavy duty cables ties secure the CIT and counter weight to the shaft during operation. Cable ties are tensioned with a cable tie tensioning tool to ensure consistent tension is applied to keep the CIT secure during rotation.



Hose Clamps

Stainless Steel hose clamps may also be used as a retention method for the CIT and are recommended depending on shaft size and RPM. SS Hose clamps can be applied using a simple flat head screw driver or ratchet and can be reused after CIT removal.



WARNING

Stainless Steel hose clamps reduce CIT mobility limits in the axial and radial direction and cause higher current draw.

Before Assembly

- Be sure that all mating surfaces are free of dirt
- Inspect mating surfaces for nicks and scratches
- Use care when mounting the transmitter to avoid damaging or dropping the CIT system
- Use care when installing the PICT hoop to prevent unnecessary deformation

Mounting - CIT

Identify gauge locations and lead wire lengths.

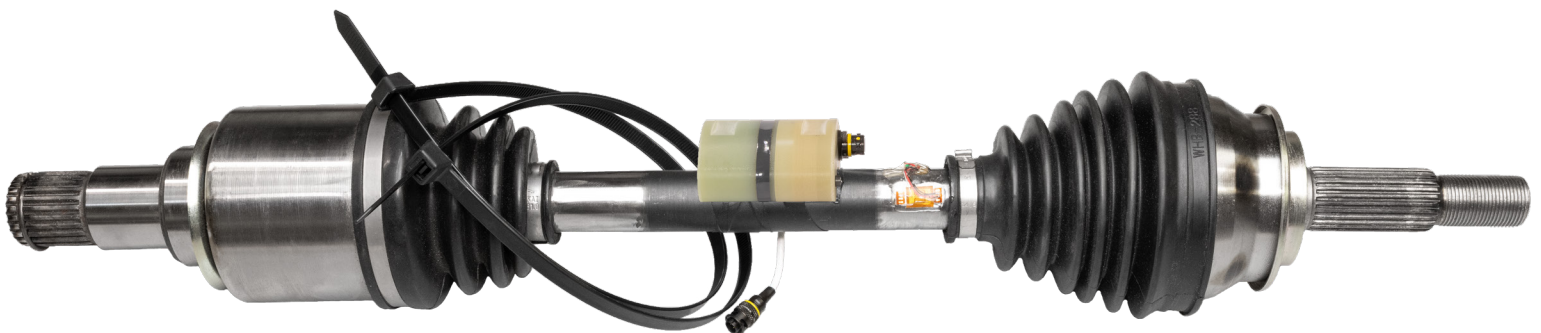
- Wire your full 350 Ohm strain gage bridge to the provided Deutsch connector that mates with the CIT. Proper wiring to the strain gage bridge is shown below.

CIT Strain Gauge Bridge Diagram			
Pin #	Deutsch Connection (6S)		Transmitter
1	Red	→	P+
2	Green	→	S+
3	White	→	S-
4	Black	→	P-

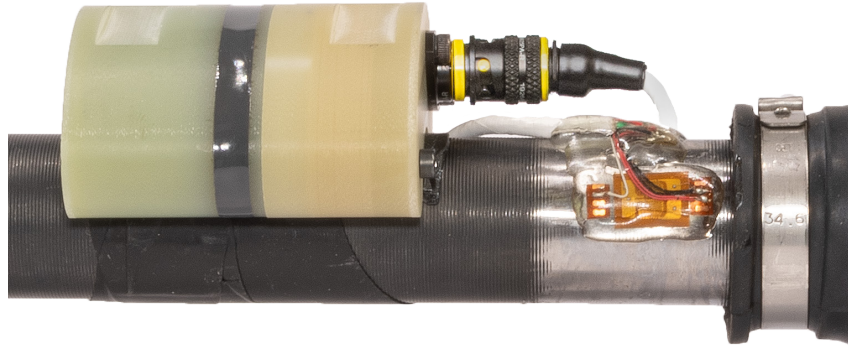
Apply fusion tape under CIT mounting location.



Pre-attach cable tie / metal bands.



Connect auto sport connector and mount the CIT and counterweight on the shaft.



Partially tighten retention cable tie #1 around the CIT and counterweight.

Align counterweight 180 degrees from CIT Transmitter housing.

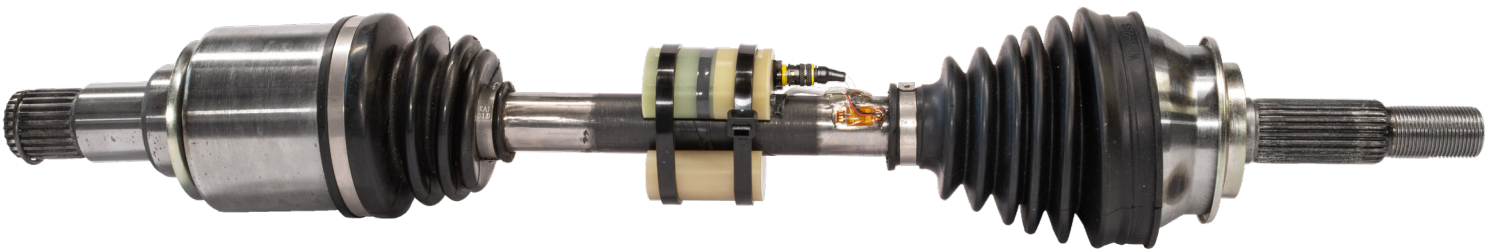
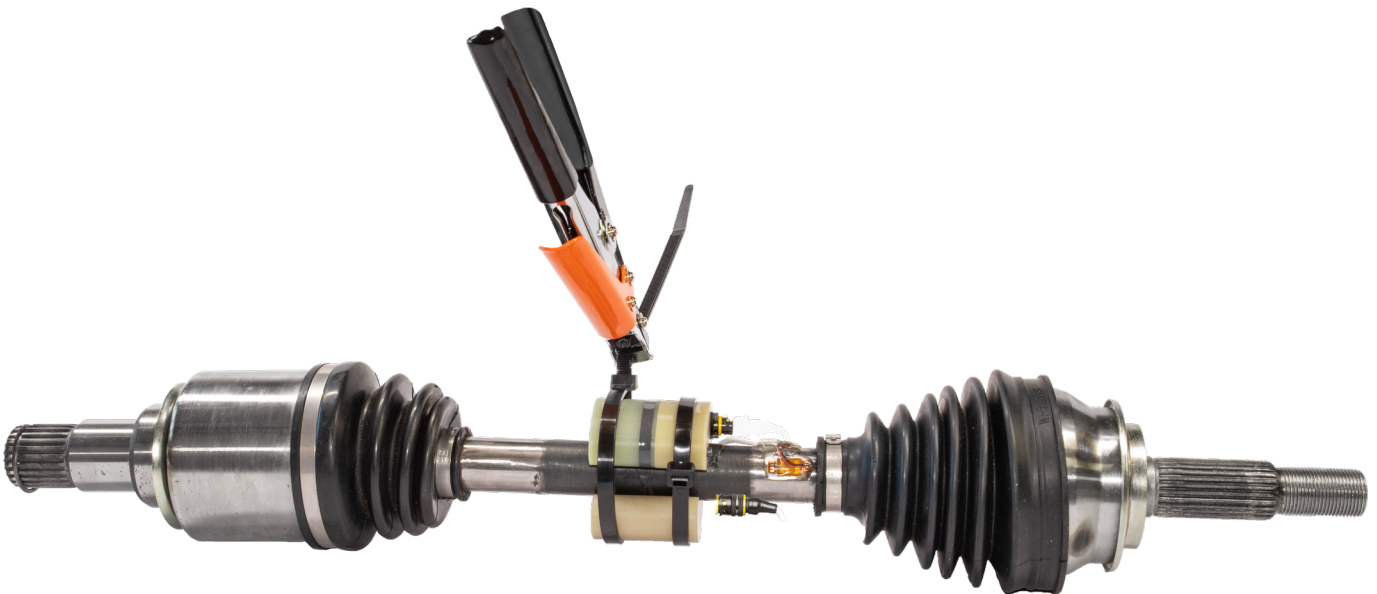
Tighten cable tie #1 to hold the CIT and counterweight into place.



Tighten cable tie #2 around both CIT and counterweight.



Use cable tie tool to tighten cable ties and cut excess cable tie material.

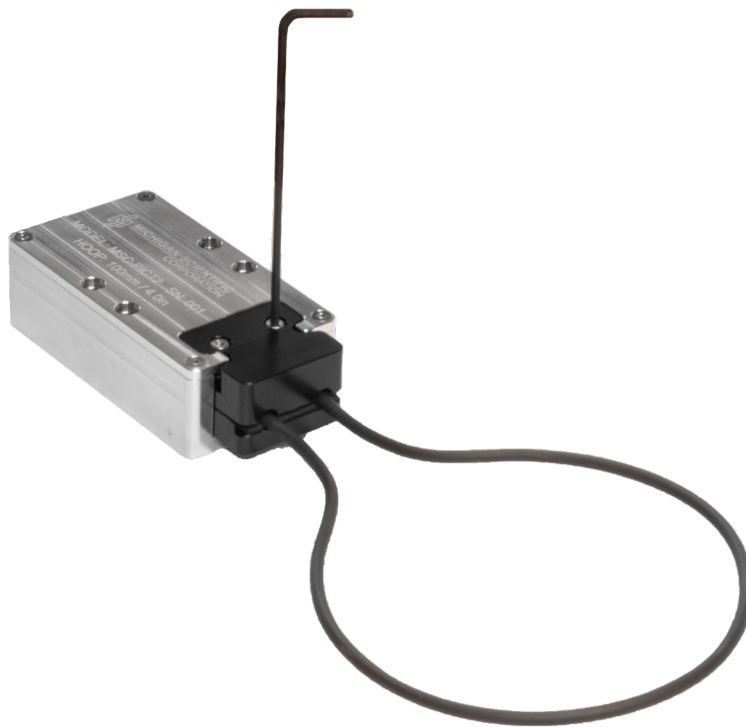


Mounting - PICT

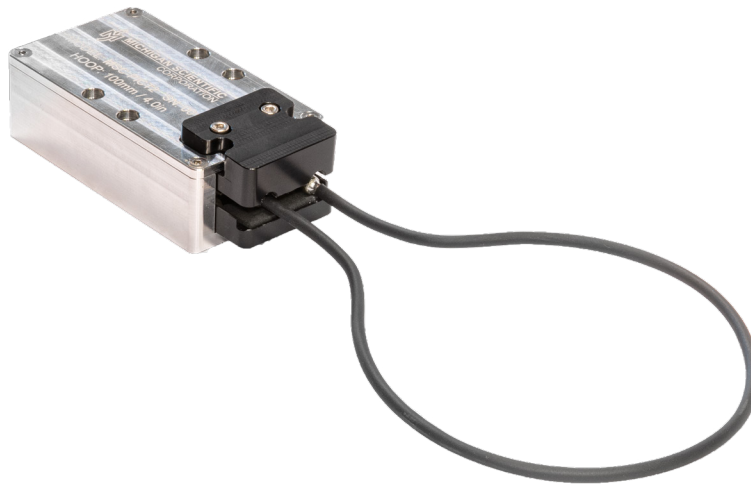
If the PICT hoop is unable to slide over the end of the gauged shaft or not previously mounted by MSC, PICT disassembly is required.



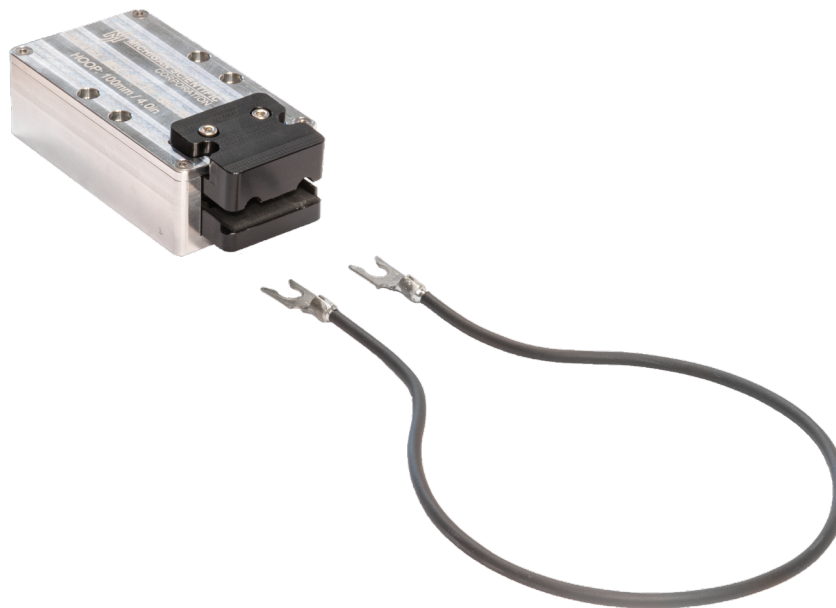
Unbolt the top two insulator compression screw to release the hoop from the PICT housing.



Slightly lift up on the hoop close to the PICT housing.



Pull hoop out of PICT housing.



Notes

Hoop should come out easily. If hoop is not coming out easily, the hoop terminals are misaligned and further alignment is needed before removal

Slightly bend the hoop opening, causing as little deformation to the hoop as possible, around the gauged shaft.

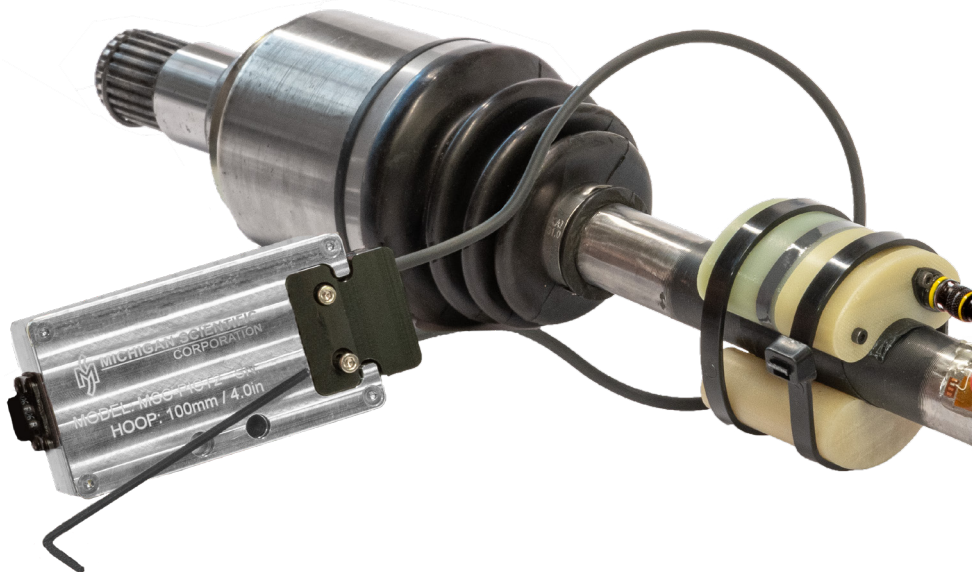


Once the hoop is around the gauged shaft, slightly re-bend the hoop until terminals are aligned with the PICT housing opening.

Push the terminals back into the PICT housing. Terminals should snap into place around the terminal poles.

Press the insulator cap down to ensure the terminals are aligned and mated to the PICT.

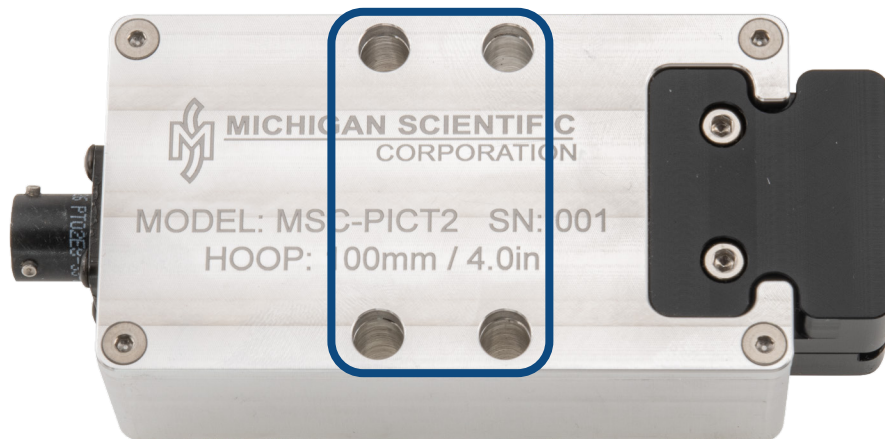
Retighten the two insulator compression screws.



Mount the PICT housing and hoop perpendicular to the axial direction of the gauged shaft directly over the center of the CIT.



There are four mounting holes (0.25" clearance holes) on the PICT housing to secure the PICT to a mounting surface.



Power and Shunt Sequence

The CIT transmitting unit contains a Michigan Scientific M320 Series Digital Telemetry Transmitter, a power indicating LED, and an input connector. The M320 Transmitter conditions low level strain gauge bridge signals, transmits signals wirelessly, and ultimately provides a high level analog voltage signal for recording. The PICT mounted close by provides power to the Telemetry Transmitter. The LED indicator turns on when the transmitter has power. The input connector is for connection to a full strain gage bridge. Immediately upon power up a 3 second Shunt sequence is initiated. The shunt sequence is used to set up sensitivity of your strain gage bridge.

Transmitter Full Scale and Shunt

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. It is important for the receiver to have adequate ventilation.

Plug the antenna coax (Figure 28) into the appropriate connector on the back panel of the receiver box (Figure 27). With the transmitter off, power-on the receiver. The front panel RF FAULT LED should be lit. Now turn on the transmitter and mount the antenna as close to the CIT as practical. It is usually better to position the antenna away from large bodies of metal that will weaken or block the transmitted and received RF signals. The RF FAULT LED on the front panel of the receiver box will help determine the best antenna position and orientation during installation. RF FAULT LED on is bad, off is good. Some experimentation with antenna location and orientation will be needed to obtain the best signal as indicated by the RF FAULT LED.

Each receiver can accept 2 receiving antennas. The receiving radio listens to both inputs and selects the input with the best reception. Receiving antennas should ideally be in different locations, ideally 180 degrees apart.

The receiver box is shown in Figure 26. There is an RF FAULT LED on the front panel of the receiver. The FAULT LED will light to indicate to the user any faults in the received RF signal. The receiver checks each transmission from the transmitter. If a fault is detected, the LED is turned on. When the power to the transmitter is off, the FAULT LED is on constantly.

The BATT LED on the front panel will light when the induction power is not adequately powering the CIT transmitter. When this LED is lit, make sure the primary hoop is properly aligned over the center of CIT and the CIT is centrally located within the primary hoop.

The CAL LED will be lit when the transmitter is in the start-up calibration sequence. This calibration sequence lasts for approximately 3 seconds immediately after the transmitter is powered. Additional information on the calibration sequence can be found below.

The front panel has a zero adjustment potentiometer. This potentiometer can be used to adjust for minor zero offset at zero load. To use, first insure that there is zero torque applied to the strain gauge bridge or transducer. With a voltmeter connected to the CH 1 output connector, adjust the voltage output level to zero by turning the potentiometer. You may also monitor your data acquisition system, and after putting the transducer in a zero torque condition, Zero your data acquisition equipment. NOTE: There is NO provision for zeroing the transducer bridge at the transmitter. If the bridge unbalance is too high (above about 5% of full scale), the strain gauge bridge can be padded with a resistor across one arm.

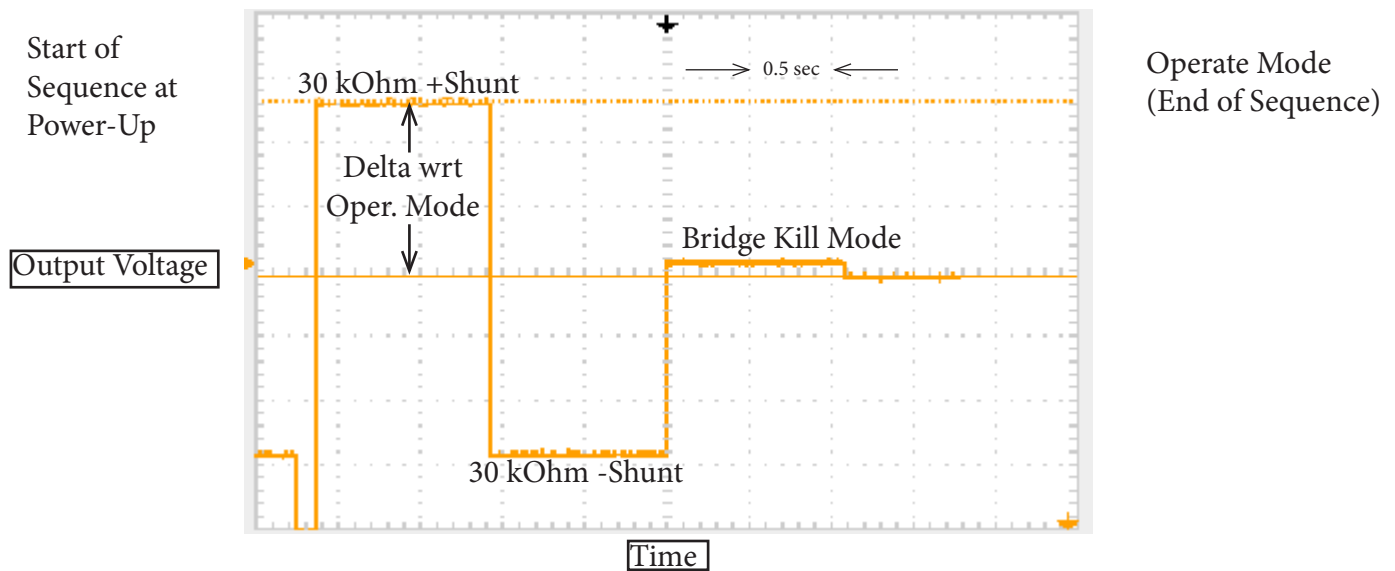
During operation, it is not uncommon to observe some flickering of the RF Fault LED. If the receiver detects a fault, the output D/A converter in the receiver holds the last valid sample. The sample rate for each transmitter is approximately 3000 samples per second.



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. This sequence also allows for background noise checking. 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 in Figure 13.



The sequence begins with a 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.

Notes

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

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). The vehicle should be running (wheels turning) to best evaluate the level of background noise. 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.

The SAC is the easiest and most accurate of the three methods. The SAC installs to the vehicle just like the MVSR, however the Stator rod is measured as it changes angle with respect to vertical and the wheel rotational angle is automatically corrected before coordinate transformation, preventing any error when steering. The SAC should be zeroed with the wheels straight and stator rod perpendicular to the ground in 2 planes as shown below. Once positioned properly zero the SAC by pressing and holding the button on the side for 2 seconds, and waiting until the button light stops flashing. Detailed SAC operation info is provided in the SAC manual.

Notes

The calibration sequence may show a negative voltage shift, then a positive shift, if the receiver internal polarity jumper has been changed. A polarity change will not affect the system calibration or channel sensitivity (other than changing the sign of the output).

Programmable Gain

CIT PINOUT		
Pin #	Transducer Bridge Input	Function
1	Red	P+
2	Green	S+
3	White	S-
4	Black	P- (GND)
Gain Programmer		
4	Green	GND
5	Blue	Ch 1.
6	Red	+7 v Power

The M320 transmitter has programmable gain capabilities. With the MSC Gain Programmer tool (Provided by MSC), the gain can be programmed to specific gains depending on application.

To program the M320 transmitter, simply disconnect the CIT transmitter housing from the bridge and connect the gain programming tool to CIT transmitter housing. Connect the programming tool to a computer / laptop via USB and open the MSC gain programming tool software from the provided MSC USB memory stick.



