



MICHIGAN SCIENTIFIC

Corporation



MICHIGAN SCIENTIFIC Corporation



Charlevoix

Milford



Company Profile

- **Incorporated in 1960**
- **Manufacturer of measurement equipment**
 - Slip ring assemblies
 - Telemetry
 - Strain gaged based transducers
 - Signal conditioning electronics
- **Provider of engineering services**
 - Data acquisition and analysis
 - Failure analysis
 - FEM and dynamic computer simulation
 - Product (re)design



Instrumentation Slip Ring Assemblies

SLIP RING



END-OF-SHAFT
APPLICATION
EXAMPLE



SLIP RING



OVER-SHAFT
APPLICATION
EXAMPLE

MANY OPTIONS INCLUDING:

- End-of-shaft and over-shaft (thru-bore) types
- Solder terminals and/or connectors
- *Built-in* encoders, F-V electronics, strain gage & TC amplifiers
- Weatherproof
- Custom builds



Instrumentation Slip Ring Assemblies

some end-of-shaft types (many sizes and ring counts available)



All models feature:

- Instrumentation quality rings and brushes
- Permanently lubricated bearings
- Rugged construction



Instrumentation Slip Ring Assemblies

some over-shaft types (many sizes and ring counts available)



All models feature:

- Instrumentation quality rings and brushes
- Permanently lubricated bearings
- Rugged construction



Automotive Half Shaft Slip Ring Assemblies



- Mounts on shafts up to 1.2" in diameter
- Weatherproof system
- Optional **built-in** strain gage amplifier
- Optional 60 pulse/rev encoder

MICHIGAN SCIENTIFIC CAN TAKE YOUR PRODUCTION SHAFT, STRAIN GAGE, CALIBRATE, MOUNT SLIP RING, AND RETURN COMPLETE WEATHERPROOF ASSEMBLY READY TO INSTALL IN YOUR VEHICLE



Strain Gage & Thermocouple Spinning Amplifiers

(for slip rings without built-in amps)

Specifically designed to “stack-on” most MSC end-of-shaft slip ring rotors. Locates amplifier close to the spinning sensor for improved signal quality. Particularly beneficial for noisy environments.



1-ch Strain Gage Amp



3-ch TC Amp



STRAIN GAGE AMP

- Very stable bridge excitation voltage
- Adjustable gain and shunt-cal resistor
- Remote shunt-cal and bridge-excitation-kill control

TC AMP

- Thermocouple models available with 2 or 3 channels (all TC types)
- Built-in cold junction compensation



Strain Gage & Thermocouple Spinning Amplifiers Amplifier Power and Control Box



A single "Amplifier Power Unit" ...



...runs multiple MSC "Spinning Amp's"

- One box can power and control 20+ amplifiers
- 12 VDC and 120 VAC powered types
- Remote shunt-cal and bridge-excitation-kill control
- Use with any MSC spinning amplifier



Custom Design & Build Slip Ring & Signal Conditioning



Automatic transmission turbine shaft slip ring



Rail wheel spinning amp package



Automatic transmission pancake slip ring



6-ch 1/4 arm strain gage spinning amp package

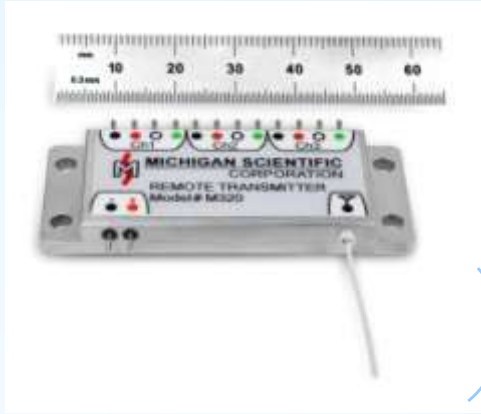


Strain gaged crankshaft with spinning amps



Telemetry

Non-contact digital systems

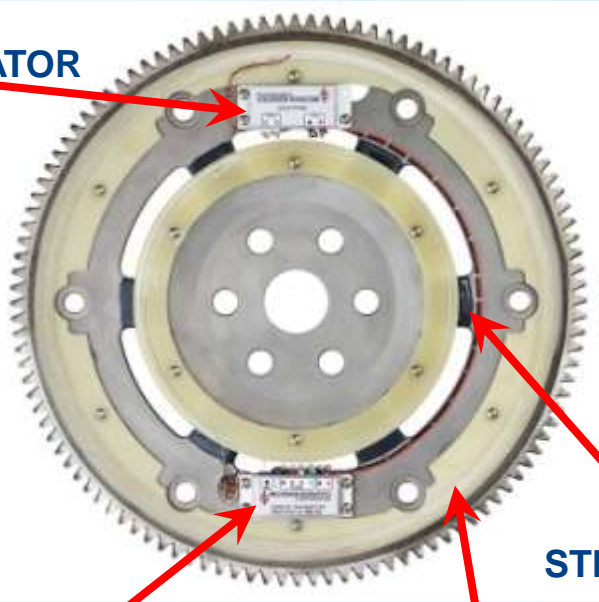


- For strain and thermocouple sensors
- Up to 6 channels per transmitter
- Battery or induction powered
- Up to 1 kHz bandwidth
- Automatic calibration and bridge-kill check on power-up

Telemetry Hardware & Applications

Automotive flexplate torque transducer

POWER
REGULATOR



TRANSMITTER
AND AMPLIFIER

SECONDARY COIL

STRAIN GAGED
BEAMS

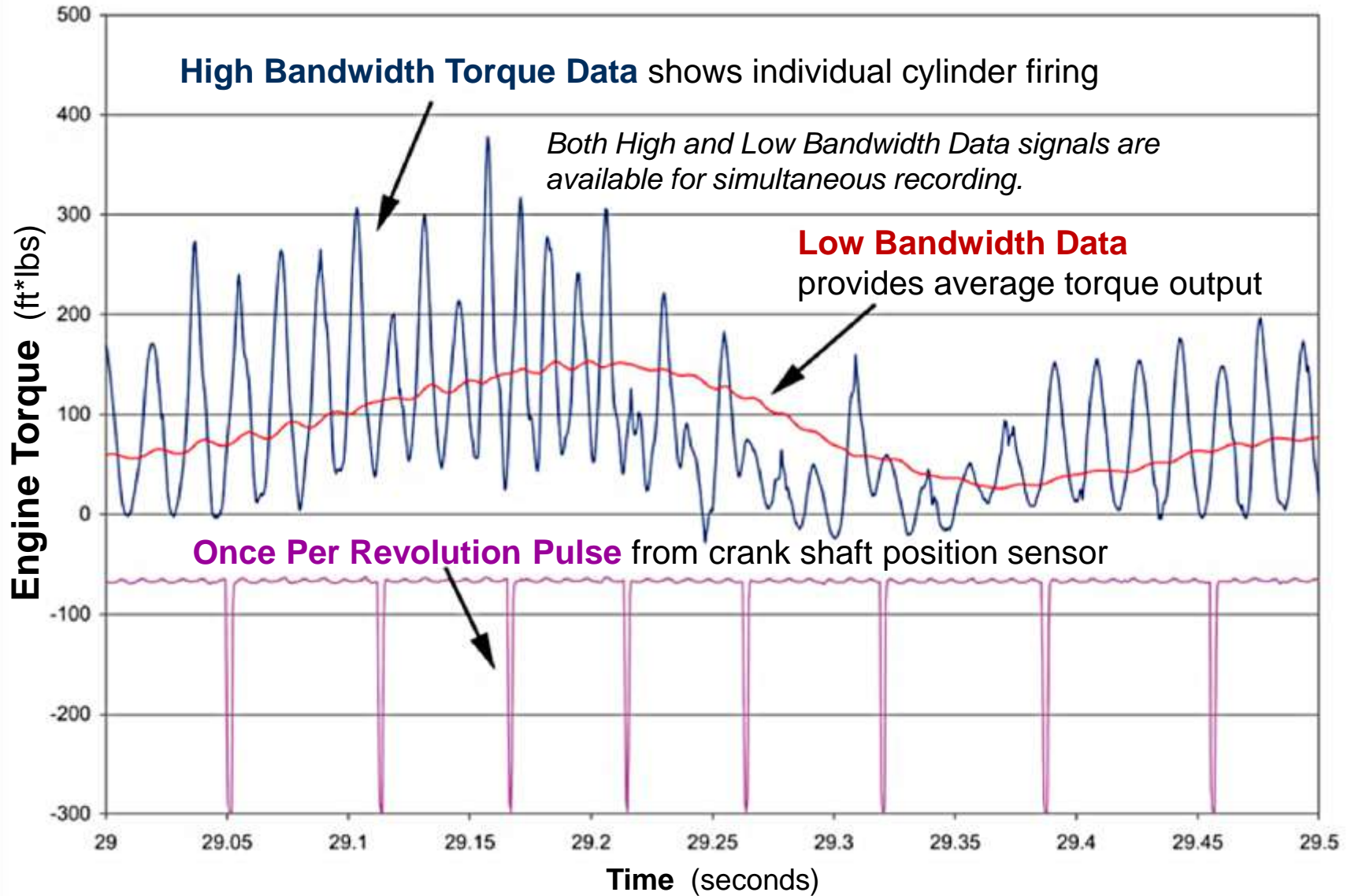


RECEIVER BOX

PRIMARY
(STATIONARY)
INDUCTION COIL

- Measures high frequency **dynamic engine torque** input to transmission
- Induction powered (no battery)
- Customer's flexplate is custom engineered to accurately measure torque
- Complete build-up and balance by MSC - we ship ready to install

Telemetry data from Flexplate Transducer



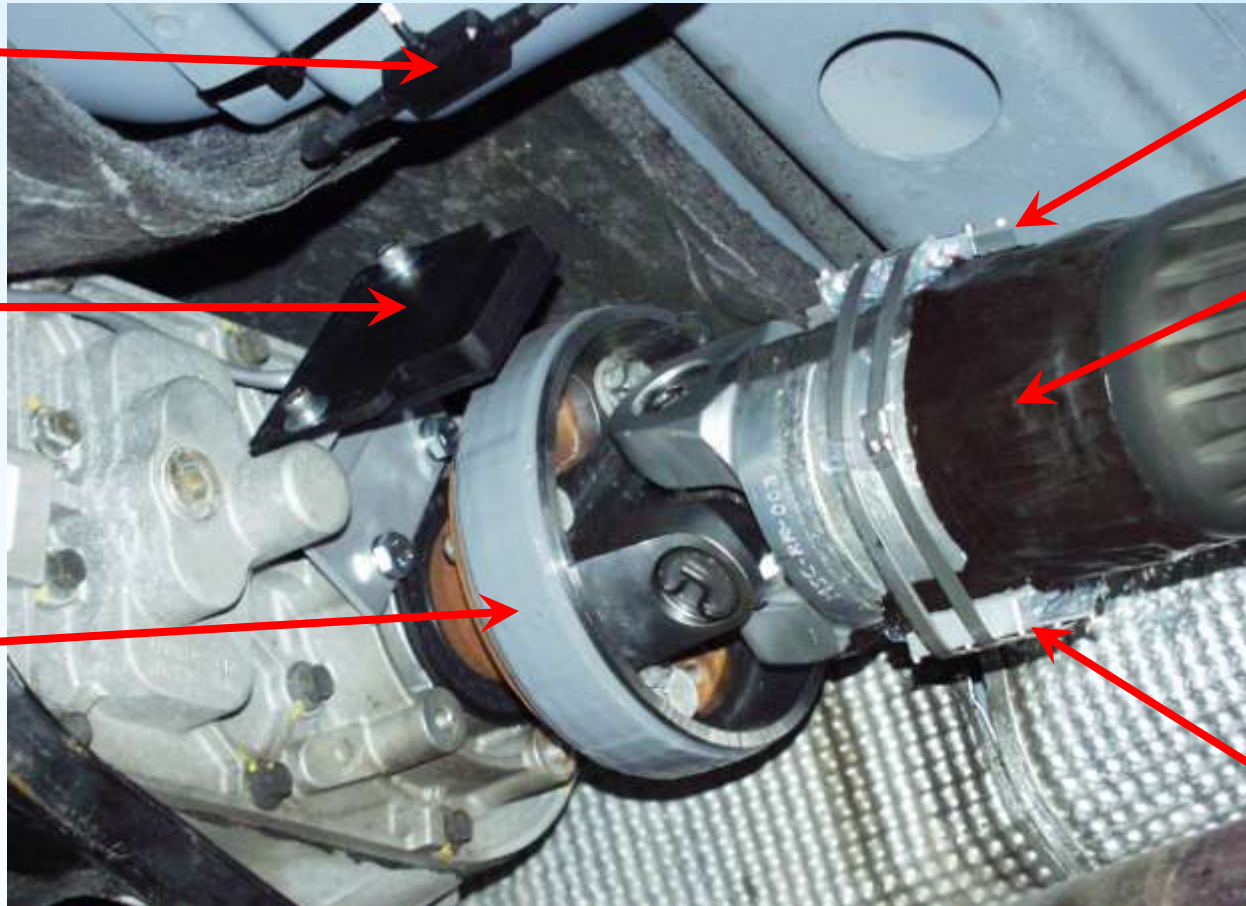
Telemetry Hardware & Applications

Automotive propshaft transducer

RECEIVING
ANTENNA

PRIMARY
INDUCTION
COIL

SECONDARY
INDUCTION
COIL



POWER
REGULATOR

STRAIN
GAGED TUBE
SECTION

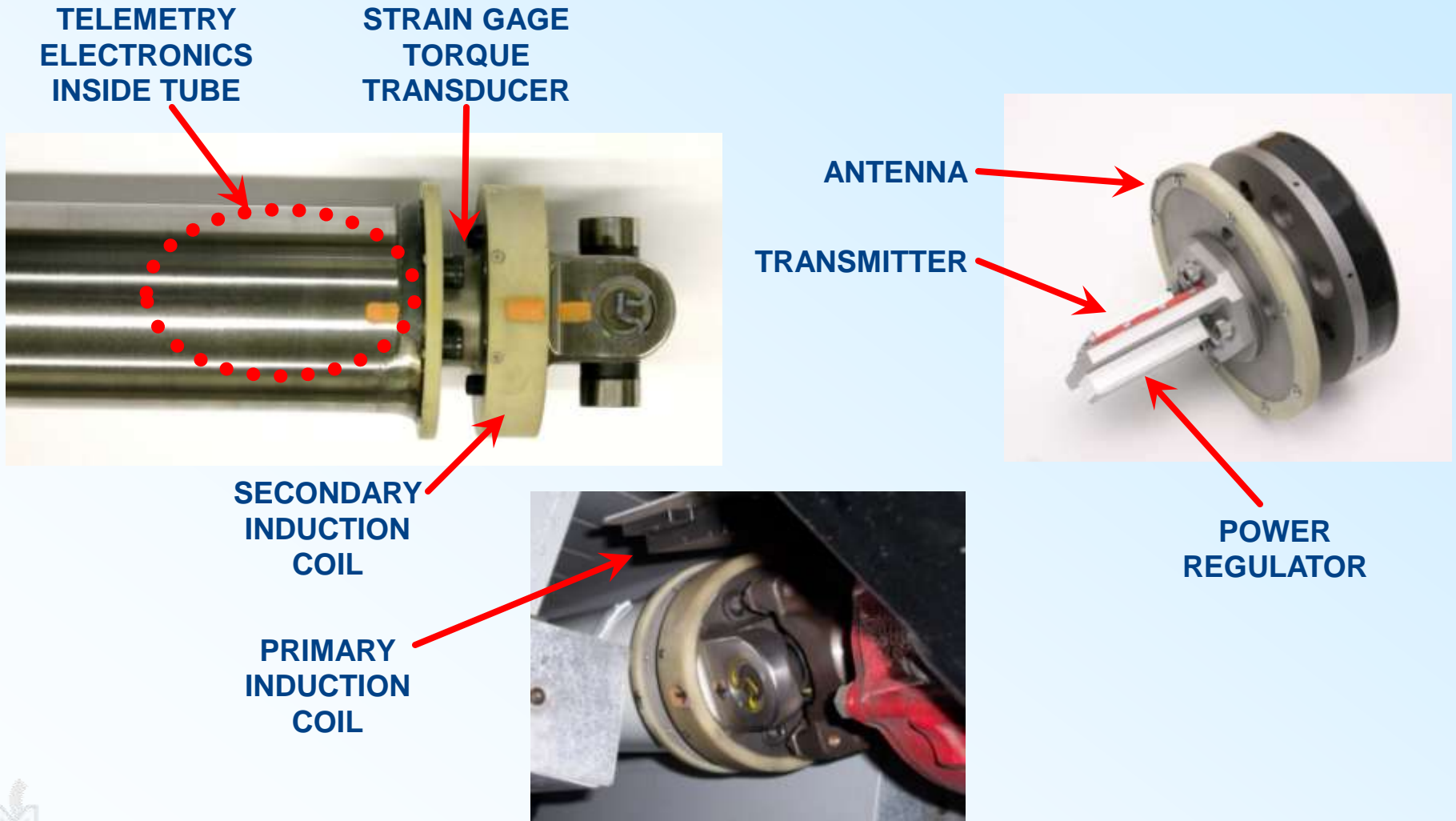
TRANSMITTER



Telemetry Hardware & Applications

Motorsports propshaft transducer

(internally mounted electronics & gages)



Strain Gage Based Transducers

Standard Three-Directional Load Cells



- For 3-D force measurement at component interfaces
- Mount in tandem to calculate roll, pitch, and yaw moments
- Capacities from 250 lbs (1110 N) to 100,000 lbs (444,000 N)



Strain Gage Based Transducers

Pedal Force Transducers (round & low-profile-rectangular)



- 500 lb (2200 N) capacity
- High accuracy even with off-center loading
- Fits standard brake and parking-brake pedals



Strain Gage Based Transducers

Wheel Torque Transducer, with Thermocouples



Wheel torque
transducer element



Complete assembly with
slip ring, thermocouples,
and spinning amp

- Available in various capacities and sizes (*13" and larger*)
- MSC can make your custom wheel and hub adapters
- High resolution models available
- Environmentally protected & temperature compensated
- Optional Thermocouple channels

Strain Gage Based Transducers

Wheel Force Transducers (6-axis)



A.T.V.



Passenger car and truck



Heavy truck (single and dual wheels)

- Measures 3 forces and 3 moments
- Low crosstalk
- Environmentally protected and temperature compensated
- Mates to same wheel and hub adapters as MSC Wheel Torque Transducers

Strain Gage Based Transducers

Wheel Force Transducer: Passenger Car Hardware



HUB ADAPTER



WHEEL ADAPTER

Connectors to
Amp Assembly



TRANSDUCER INSTALLED



**SLIP RING & SPINNING
AMPLIFIERS ASSEMBLY**



COMPLETE ASSEMBLY



Strain Gage Based Transducers

Wheel Force Transducer: *LWCT* Interface Electronics



- On-the-fly coordinate transformation
- Automated zeroing of transducer
- Automated shunt-based sensitivity set-up via “*smart chip*”
- Bridge power kill for noise check
- Fault alert LED
- One box per transducer (stackable)
- Handheld remote control



Wheel Force Transducer - Usage Examples



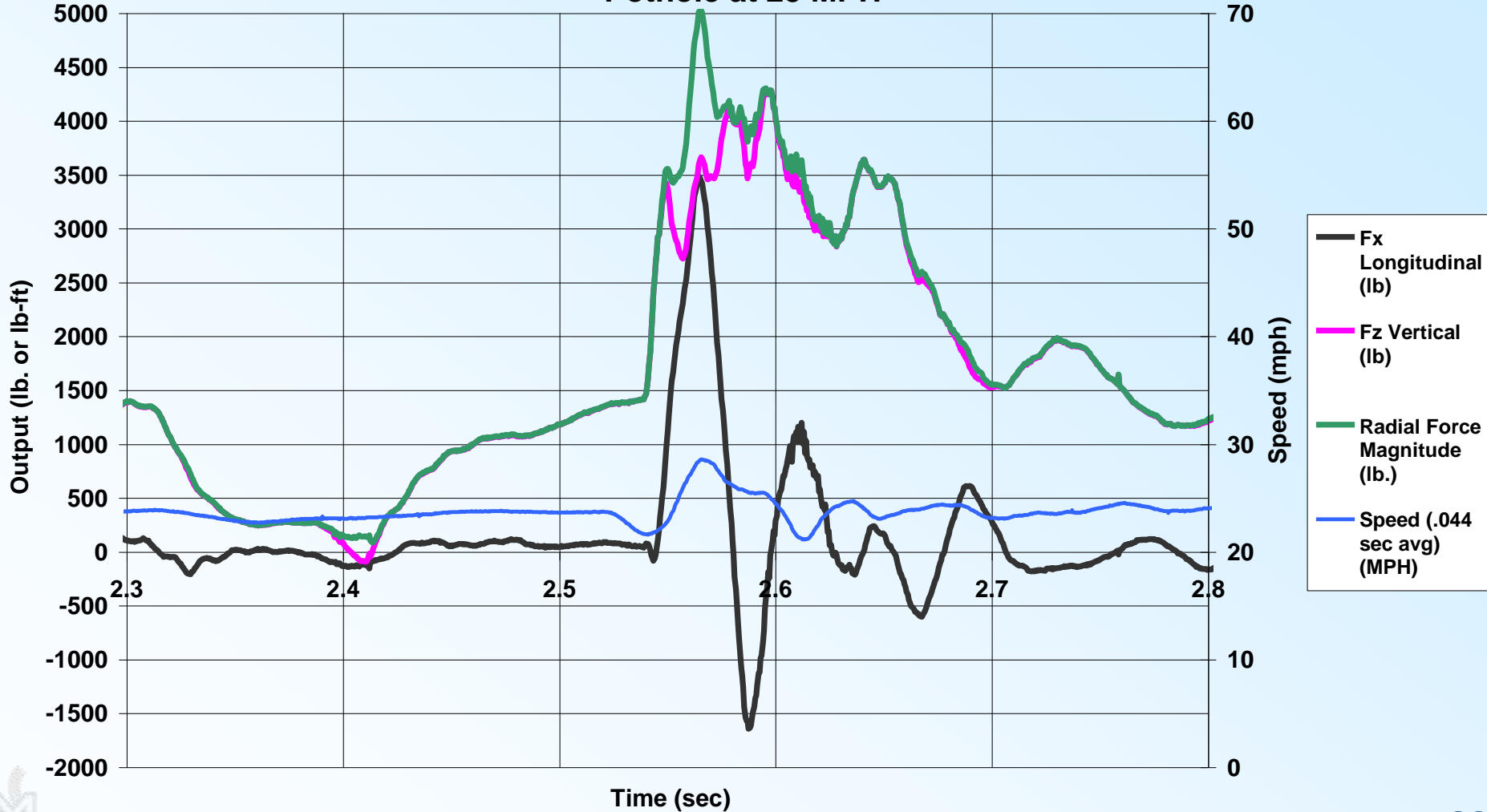
- Vehicle rollover potential
- Traction studies
- Brake development & testing
- Suspension forces
- Suspension durability lab testing
- Tire wear
- Road to lab correlation
- etc...etc...



Wheel Force Transducer



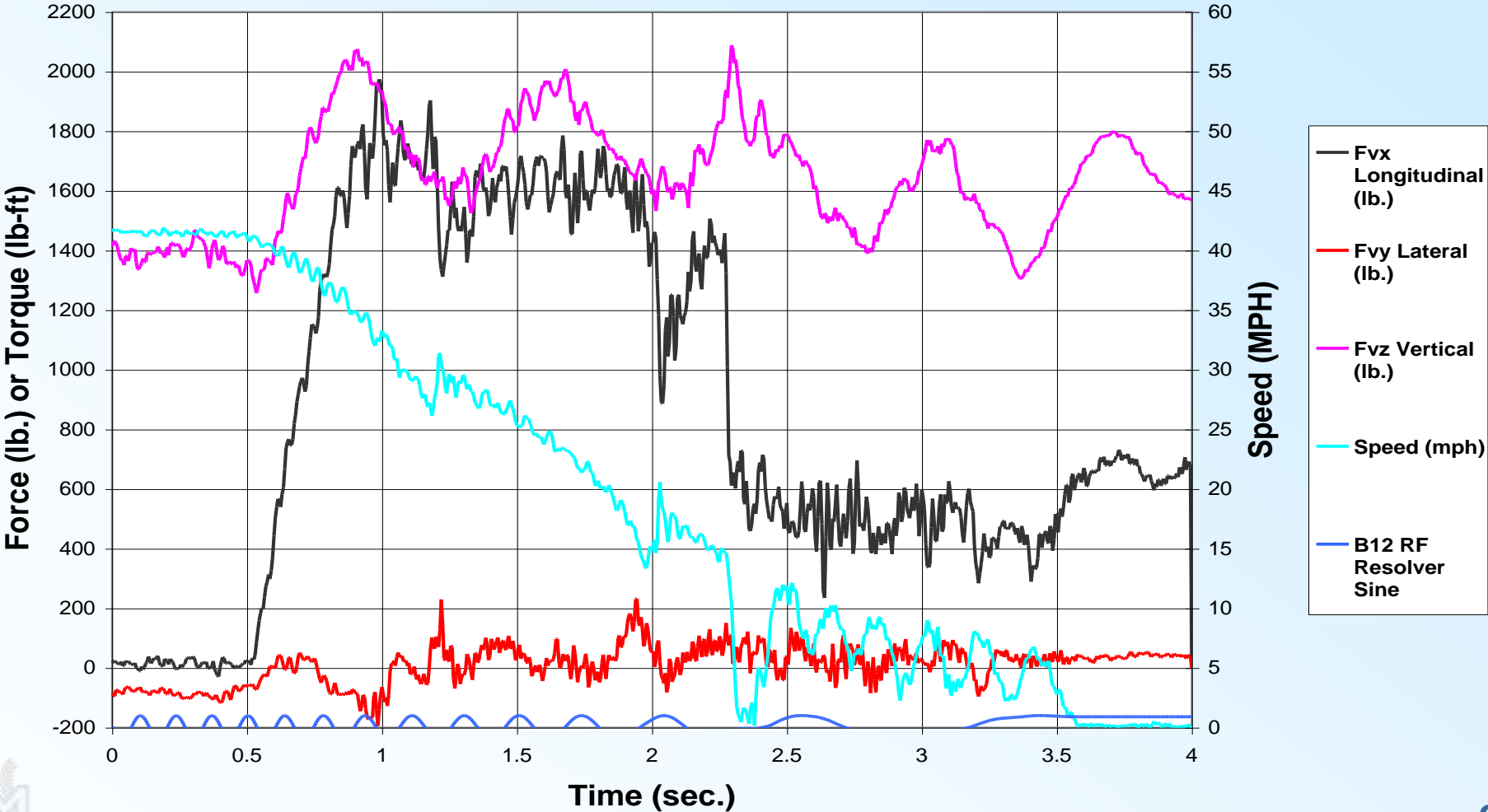
Suburban Right Front Wheel Loads
Pothole at 25 MPH



Wheel Force Transducer

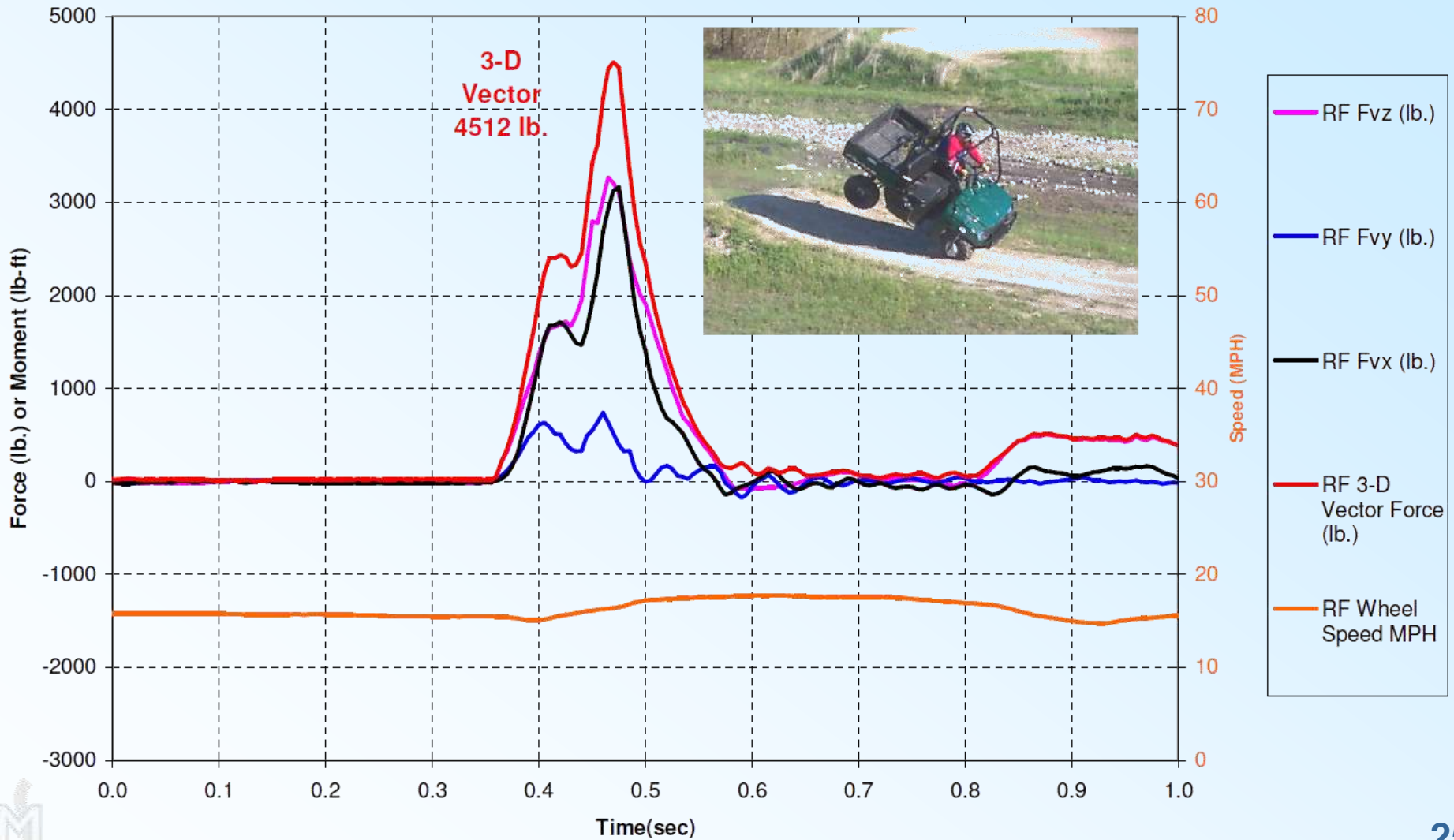


Right Front Wheel Loads Recorded on Suburban at Milford
Severe Braking with Transition from Dry Surface to Wet Tile Surface



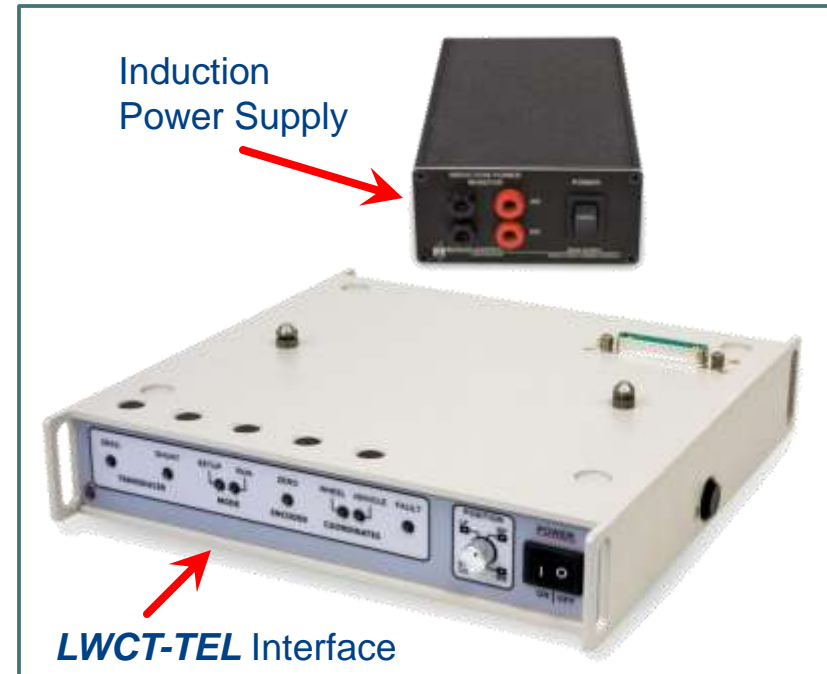
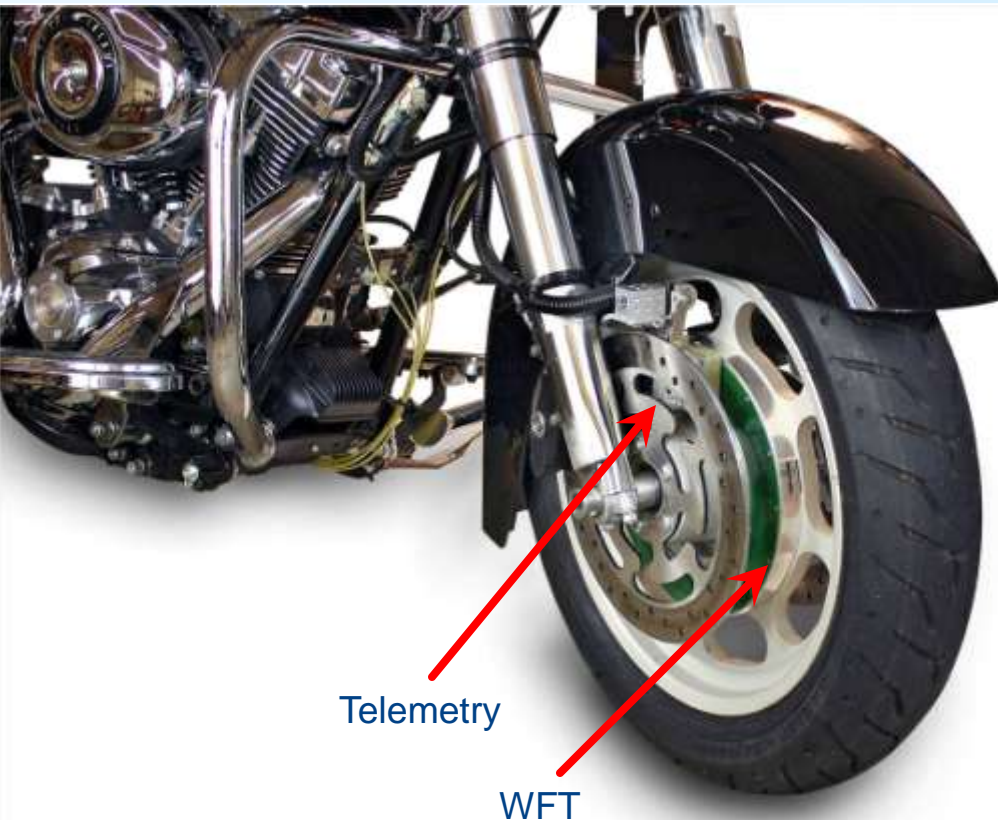
Wheel Force Transducer

LW9.5 Load Wheel Acceptance Test



Strain Gage Based Transducers

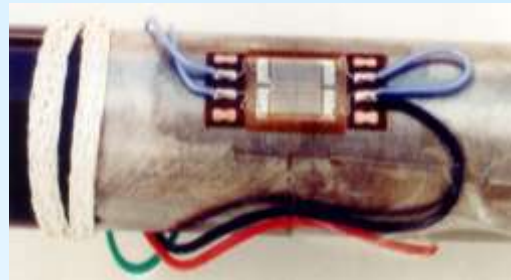
Motorcycle with Wheel Force Transducer



- Telemetry (no slip rings)
- Measures 3 forces, 3 moments, wheel position and speed
- On-the-fly Coordinate Transformation and crosstalk compensation
- Michigan Scientific can make custom front & rear wheel and hub adapters

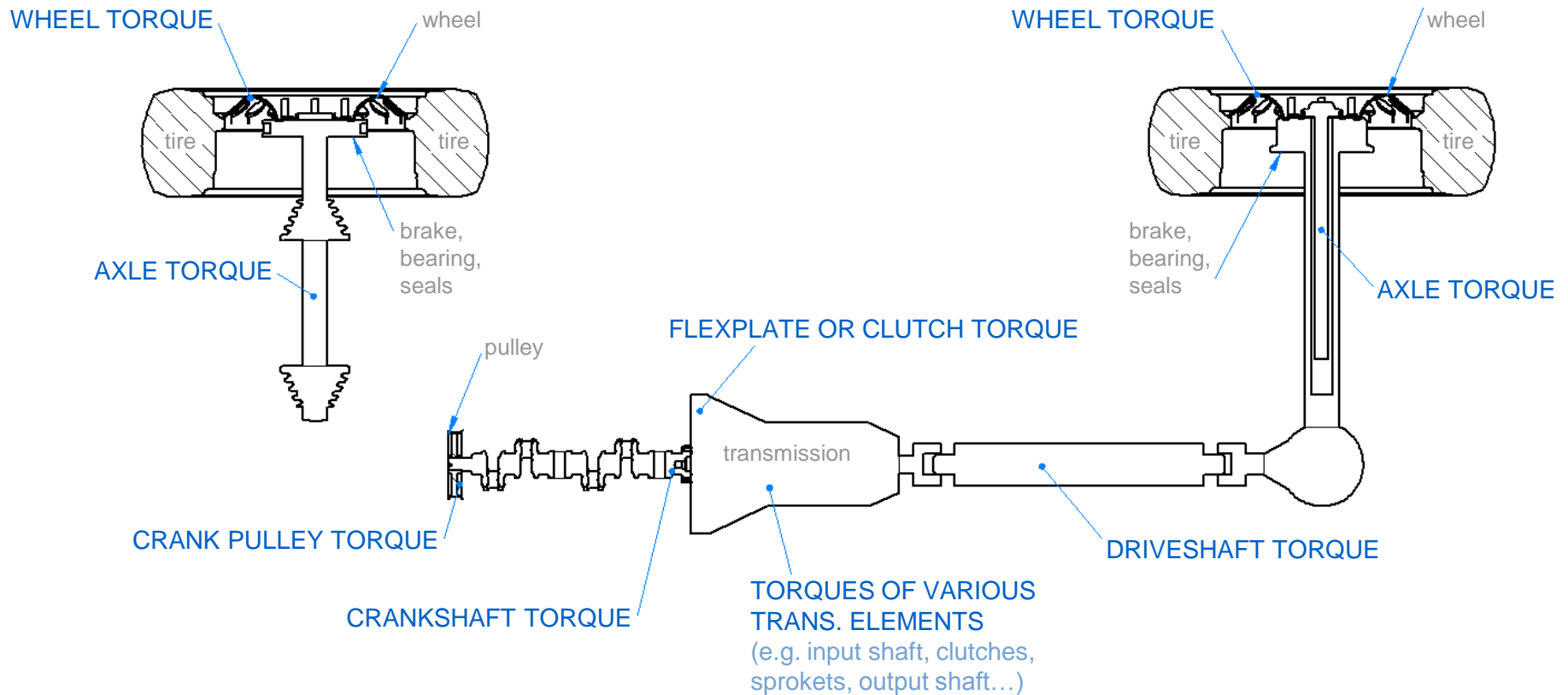
Strain Gage & TC Services

Custom strain gage & TC transducers from a variety of prototype & production components.



Powertrain Torque Measurements

Michigan Scientific can make transducer systems to measure the various powertrain torques shown.



Full Service On-Site Data Acquisition



Engineering Services example: Trains

Brake Development for Subway Commuter Car

Brake parameters **measured** include:

- Torques
- Temperatures
- Strains
- Vibrations
- Speed

Actual and Emergency service conditions

Vibration, Fatigue, Thermal, and Track Interface **analyzed**



Engineering Services example: Windmills

MSC has provided various windmill manufacturers with **test equipment** and **services**

Shaft Torques and Gear Tooth Strains have been measured



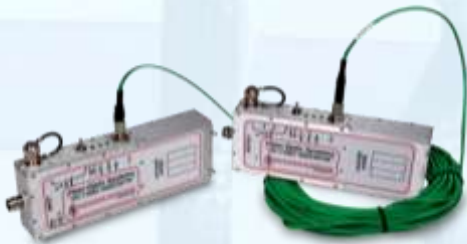
Fiber-Optic Signal Links

Component and full-scale vehicle
Electromagnetic Compatibility (EMC)
engineering and testing

Transmit signals over fiber-optic cables,
in and out of **strong electromagnetic fields**



- RF IMMUNE
- STABLE
- LONG BATTERY LIFE



← BI-DIRECTIONAL: battery powered transmitter and receiver are both **EMI / RFI Hardened**



← **Rack Mount** or Bench Top, 2 – 12 channel receiver configurations



Fiber-Optic Signal Links

MSC's most popular module types



Analog

DC – 20kHz, DC – 1MHz,
or DC – 8MHz (for **Video** signals)



Audio

20 – 20kHz



Position

0 – 32" linear displacement



Remote Power Relay

four 5A, or one 30A latching SPST

Unattended Data Acquisition Recorder

ProDAS™



RF Wireless
(transmitter for long-range monitoring)

CF slot
(storage)

Bluetooth
(short-range monitoring)



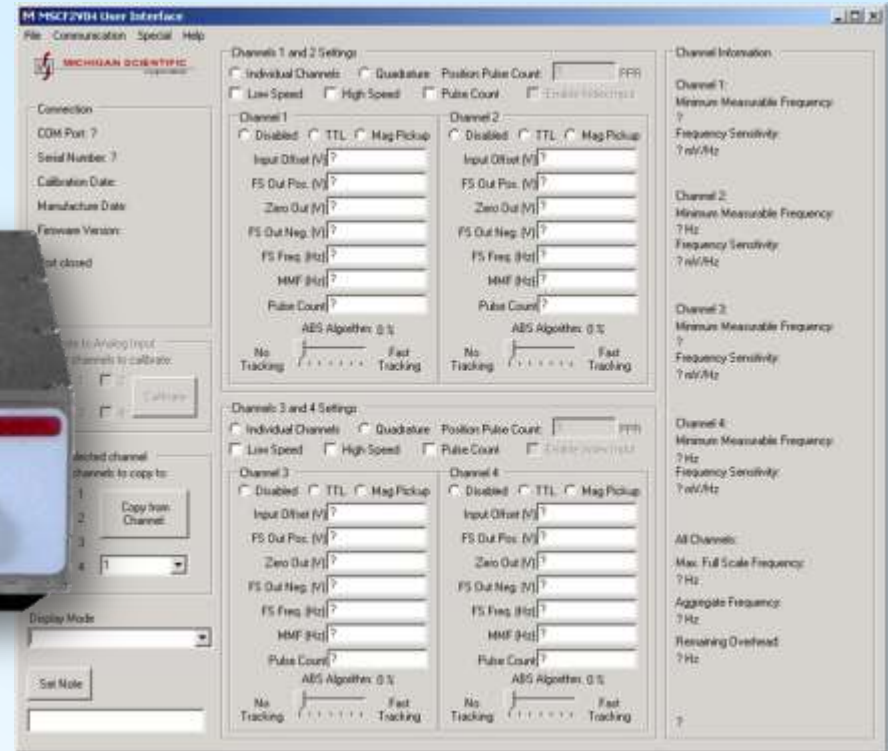
(hidden away)

- Compact Flash data memory (up to 16 GB)
- Windows XP & Vista configuration software
- USB communications
- CAN-bus data logging
- Strain gage, Temperature, Accelerometer inputs
- Anti-Aliasing filters available
- Real-time graphic data monitoring, over optional RF Wireless or Bluetooth
- GPS / vehicle tracking capable



Frequency to Voltage Electronics

Velocity (frequency) and Position (pulse count)
from most types of Encoder and Mag-pickup signals.



- 4 Single-phase (or 2-pair Quadrature) pulse inputs, with up to $\pm 120V$ range
- Input frequency range of 0.150 Hz to 120 kHz
- Additional analog input, allows easy calibration to external speed reference
- 4 FAST outputs, updated on every period of the input signals
- Outputs are 16-bit with $\pm 10V$ range
- Configured via USB cable and Windows compatible software

Volumetrics™

**Acoustical method for measuring cavity volume.
Specifically designed to determine engine compression ratios.**

- Measures compression volume
- Measures TOTAL volume
- Use to locate top dead center
- Temperature compensated
- Built-in reference volume
- Portable
- Requires shop air and 110 or 240 VAC



Summary of Engineering Services

Custom strain gage based transducer design and build

Data acquisition, analysis, documentation

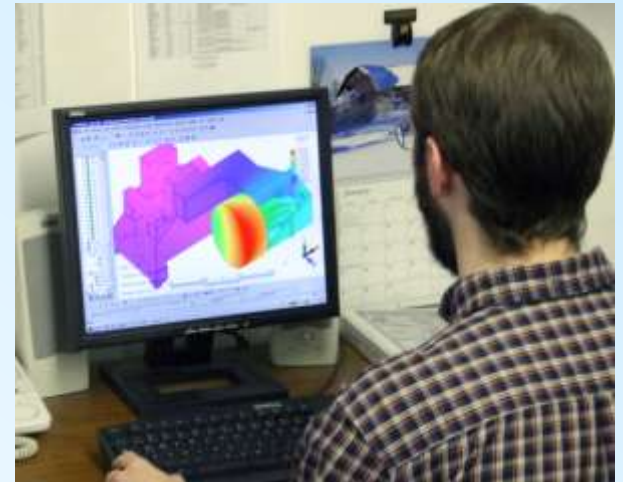
Fatigue analysis

Failure analysis

Product redesign

Finite Element Modeling (FEM)

Dynamic computer simulation



These slides can be downloaded (pdf format)
from our website:

www.michsci.com



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- THANK YOU -

