TMS 4100

Torque Metering System

User's Manual

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1 System Description

The TMS 4100 is a system for monitoring torque, speed, and power. The system consists of a Torque Sensor/Transmitter, a Torque/Speed Receiver, and a Monitor.

1.1 Torque Sensor/Transmitter

The Sensor/Transmitter is a disc or collar mounted on the shaft. It is powered inductively by the Receiver, senses the torque via strain gages connected to it, and transmits a torque signal back to the Receiver.

1.2 Torque/Speed Receiver

The Receiver is mounted below the shaft and has a ring that surrounds the Sensor/Transmitter. It provides power to the Sensor/Transmitter, receive the torque signal, senses rotating speed, and provide outputs to the Monitor. The electronics are enclosed in a painted steel NEMA 4 enclosure with mounting ears.

1.3 Monitor

The Monitor provides power to and receives signals form the Receiver, converts the raw signals to calibrated values, calculates power, displays information, and provides 4-20mA outputs for torque and speed. The Monitor is housed in a 19" Rack Mounted Enclosure.

The display is a Quarter VGA color LCD touch-screen. The display area is 4.6" wide by 3.5" high. The Monitor will display torque, speed, and power as values and horizontal bar graphs.

The Monitor will display the following at a minimum: Average Torque, Peak Torque, Running Peak Torque, and Fluctuating Peak-Peak Torque. The user can optionally display the Fluctuating RMS Torque.

1.4 Torque Definitions

The Torque Transmitter/Receiver has a frequency response of 1000Hz. The computer and A-to-D converter in the Monitor have a frequency response of about 400Hz. To do the best job of obtaining all data of possible interest, the Monitor includes analog circuitry to do averaging, peak detection, and provide the RMS valued of the fluctuating torque. The signal from the Transmitter/Receiver will be considered the "instantaneous" torque as its frequency response is relatively high compared to typical machine operating speeds and possible torque anomalies.

Average Torque - The "instantaneous" torque is filtered to provide an average value that is measured and displayed by the Monitor.

Peak Torque - The "instantaneous" torque goes to a peak detector with a slow bleed off. The output is measured and the computer keeps track of the highest value

measured since the last "reset". When the value is "reset", it will be set to next instantaneous value and increased as appropriate.

Running Peak Torque - The "instantaneous" torque goes to a peak detector with a slow bleed off. The output is measured and the computer keeps track of the highest value measured during the last 60 seconds. Therefore that is a moving-window peak detector.

Fluctuating Peak-Peak Torque - The minimum and maximum values of "instantaneous" torque are determined on a second by second basis. The minimum value is subtracted from the maximum value to yield a peak-to-peak value. This provides an indication of the spikes in the torsional vibration.

Fluctuating RMS Torque - The "instantaneous" torque is AC coupled to an RMS measuring device and output is filtered and measured. This provides an indication of the energy in the torsional vibration.

2 Wiring

Cable/cord grips are provided for the receiver. As the Monitor is rack mounted, the customer is responsible for all cable protection and fittings, as required. Standard PVC jacketed cable is provided for connecting the Receiver to the Monitor. Two cables run between the Torque/Speed Receiver and the Processor; one for 12VDC power and one for analog signal wiring. These may be pre-wired for ease of installation.

The Monitor is provided with a plug-in line cord.

A second pluggable connector is provided for user connection of the two 4-20mA outputs.

A Dynamic Output BNC connector is provided for monitoring the "instantaneous" torque. This is not a calibrated output.

Digital inputs and relay outputs may also be provided for future capabilities.

An RS-232 Software Update Port is provided for loading revised software, if needed.

An RS-232 Configuration Port is provided for accessing real-time and configuration information.

3 Normal Operation

The system, as delivered, is ready for operation. After installation, apply power by turning on the power switch at the rear of the Monitor. The company logo will appear momentarily when the LCD powers up, an informational screen will then be displayed for two seconds, and then the "normal display screen" will appear with values and bar graphs.

4 User Interface

The display has a touch screen that allows the user to access information and change the configuration. The touch screen is relatively sensitive, so a light press is all that is needed.

IMPORTANT NOTE

Never use sharp or pointed objects to actuate the touch screen.

Press "Riverhawk" to display company contact information. Then press "Exit" to return to the normal display.

Press on the area around the speed value to display information on the color code for the torque and speed. Then press "Exit" to return to the normal display.

Press "TMS 4100" to access the menus. The menus provide a mechanism for modifying the setup/configuration of the system and performing calibration (primarily intended for the factory, but also usable in the field).

The menus can be passcode protected by establishing a passcode other than zero. It is called a "passcode" rather than a "password", as it is numeric, not alphanumeric.

To do this, press "Change Passcode" and enter a value using the numeric touch pad. The next time someone tries to access the menus, they must first enter the passcode.

IMPORTANT NOTE

If you forget the passcode, there is a factory passcode that can be used to gain access and establish a new passcode. Establishing a passcode of zero disables the passcode protection.

5 Menus

Section 8 lists the menus essentially as they appear in the display. All of the selections not listed as "(for factory use)" may be used to reconfigure the system as desired. The parameters that are most likely to be changed by the user are:

Passcode

Units - ft-lbs or in-lbs

Torque, Speed, and Power bar graph full scale values

Touch screen beeper on/off

Display of Fluctuating RMS Torque on/off

Torque Offset (always in in-lbs regardless of selected units)

6 Torque Resolution

The torque values displayed at zero torque will not likely be zero. There will likely be some apparent torque caused by strain induced when the torque blocker, spacer tube, and hubs are bolted together. There will also be some noise in the system and fluctuations caused by the lease significant data bits changing. If the full scale torque was 350,000 in-lbs, with a system resolution of 1 in 2000, the resolution is 175 in-lbs. The displayed torque value is an averaged, so the fluctuations seen may be smaller.

The Peak Torque, Running Peak Torque, and Fluctuating Peak-to-Peak Torque are not averaged. They are the result of instantaneous measurements on different circuitry used. Therefore, these values will not be exactly the same as the main Torque value shown at the top of the display and will increase by larger discrete values.

7 Torque Offset - Receiver installation

There may be a reasonable offset created (non-zero reading/display at zero torque) when the torque blocker, spacer tube, and hubs are bolted together. If so, the offset can be eliminated by entering a Torque Offset value equal in value but opposite in sign to the displayed value. This value is always in in-lbs regardless of selected units.

After installing the Torque Receiver, it is important to adjust its offset so that its output represents "zero" torque when no torque is being applied. First mount the Torque Receiver around the collar as shown in the figures:

Note positioning of receiver; roughly a 1/4-to-3/4" gap between the stator ring and rotor ring should be sufficient, but the closer distance would require less power thus more efficient.

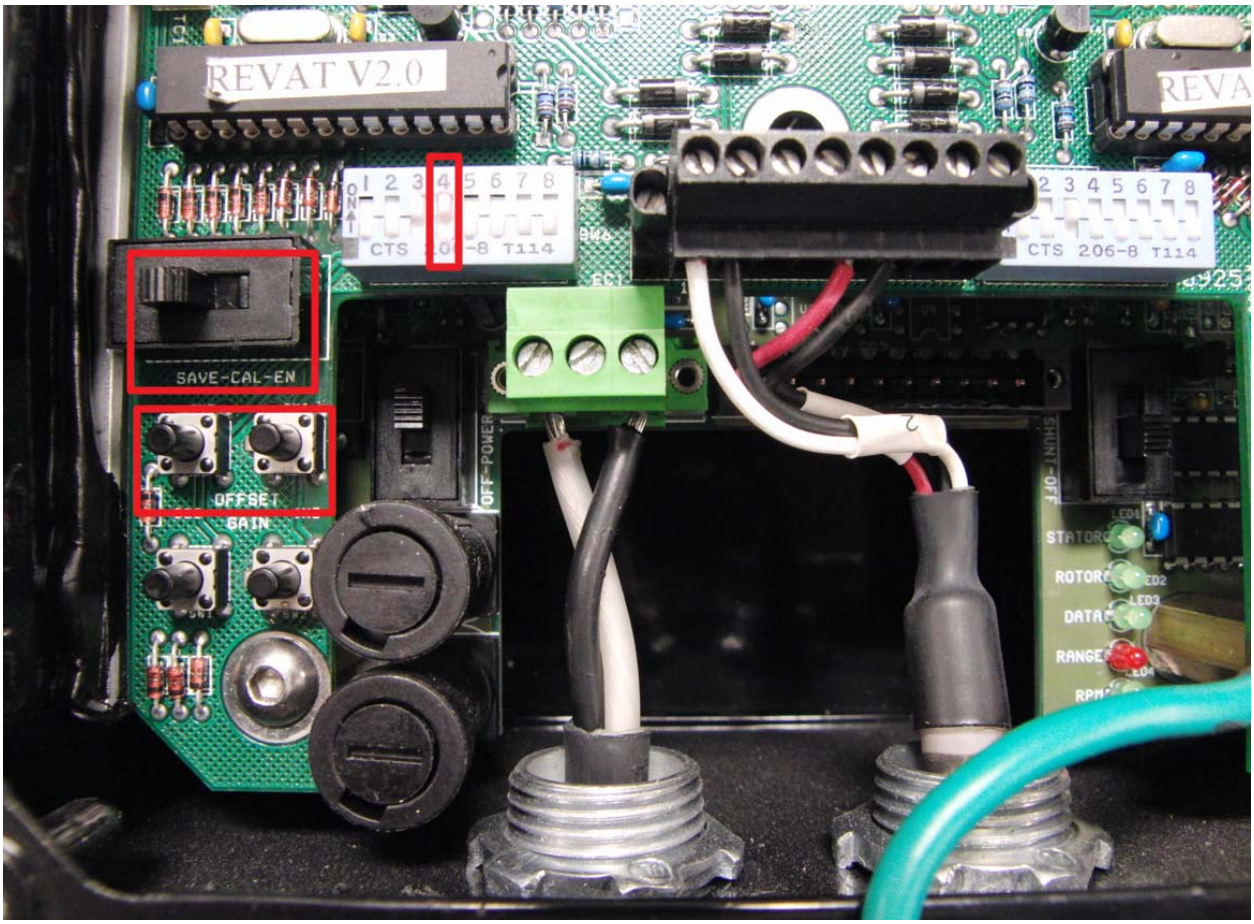
RED stickers were placed on the side of stator ring that must face the rotor ring.

NOTE ➔ The unit must be secured in place and free of movement before zeroing takes place.

Once everything is set in place the unit may then be powered up. Place a high-precision, calibrated ammeter in line with the Torque Signal's 4-20mA output line (J102, pins 4 & 5 on back of monitor). It's recommended to use an in-line resistor while monitoring the output current (ex; 249-OHM).

With no torque applied the receiver's output is to be adjusted: Slide the SAVE-CAL-EN switch to the right (EN position). Use the top two OFFSET pushbutton switches to adjust the output to **4.000mA** (*NOTE* - It doesn't need to be exactly this value, but the closer the better). When near that value, flipping DIP-switch #4 should not affect the output and should still remain in the 3.995mA to 4.005mA range. If not then readjust. Once completed make note of the monitor's display. It should be close to 0% torque (+/- 1,000 in-lbs).

The system is now zeroed. Slide the SAVE-CAL-EN switch to the left, the SAVE position. That will save the adjustment in memory. Verify the output. Cycle power on the system and verify it again.



Performing Zero-Offset. Only the buttons/switches shown above in the RED squares should be modified.

8 Torque Sign

The system could measure positive and negative torque, but the hardware that captures the peak torque only works on a positive signal, so the system has been setup for unidirectional torque.

IMPORTANT NOTE

If the system displayed a negative torque value when torque is being applied, a switch in the Receiver needs to be changed to reverse the signal polarity.

To change the polarity of the torque signal, change the position of switch #4 as shown in Section 9. There is also a picture of the switches and notes on the inside of the Receiver cover.

9 Menu List

Main Menu

Change Passcode	Enter a new value
Display	Go to the Display menu
Beeper & RMS Torque	Go to the Beeper & RMS Torque menu
Corrections	Go to the Corrections menu
More	Go to a menu with more selections
Exit	Exit to Normal Display

Display

Torque Bar FS	Enter Torque Bar Graph Full Scale value
Speed Bar FS	Enter Speed Bar Graph Full Scale value
Power Bar FS	Enter Power Graph Full Scale value
Torque in IN-LBS	Switch units to IN-LBS
Torque in FT-LBS	Switch units to FT-LBS
Exit	Exit to the previous menu

Beeper & RMS Torque

Beeper On	Turn Touch Pad Beeper On
Beeper Off	Turn Touch Pad Beeper Off
Fluct. RMS Torque On	Display the Fluctuating RMS value
Fluct. RMS Torque Off	Don't display the Fluctuating RMS value
Exit	Exit to the previous menu

Corrections

Torque Gain	Enter a user adjustment value - typically 1.0
Torque Offset	Entered value as required
Exit	Exit to the previous menu

More

Cal 4-20 Inputs	(for factory use)
Cal 4-20 Outputs	(for factory use)
View Values	(for factory use)
Entered Values	(for demonstration and factory use)
Exit	Exit to the previous menu

Entered Values

Entered Torque	Must be Zero for normal operation
Entered RPM	Must be Zero for normal operation
Exit	Exit to the previous menu

10 Receiver Configuration

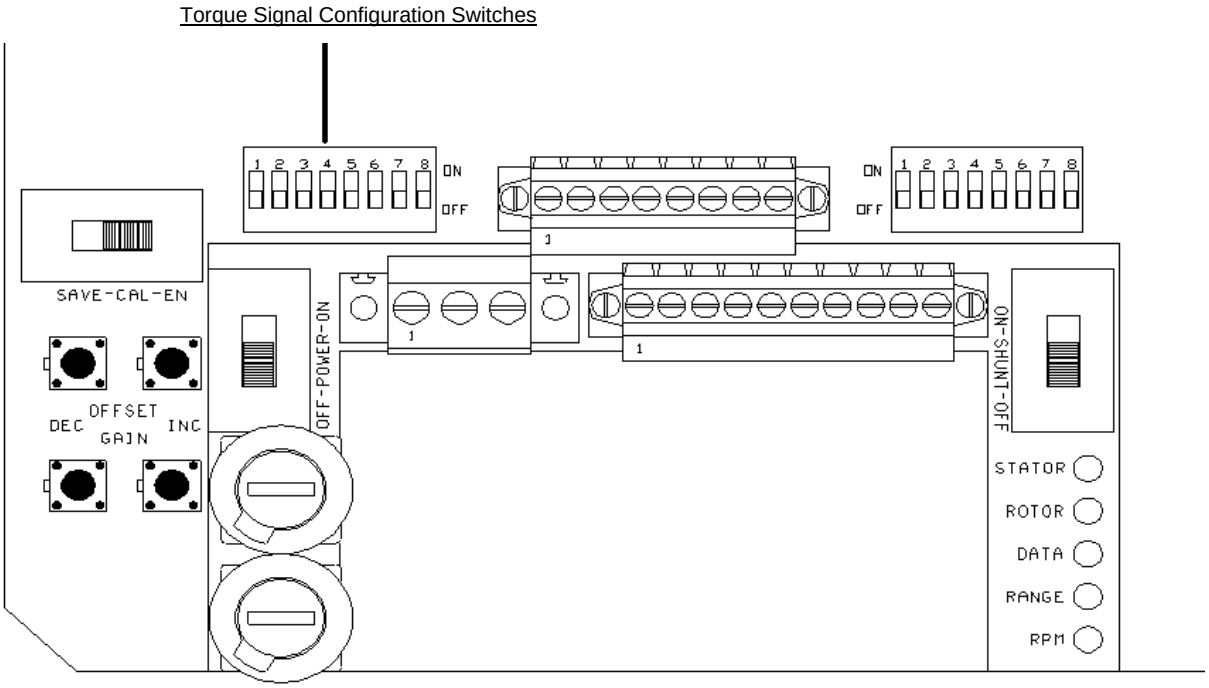
Switch	Function when switch is ON:
3	Changes output at zero torque load from 12 mA to 4 mA
4	Reverses the polarity of the torque signal

Switch #3 effectively changes the zero-to-positive full scale output range from 12-20 mA to 4-20 mA. This is most useful for torque data that is unidirectional.

Switch #3 should be in the ON position.

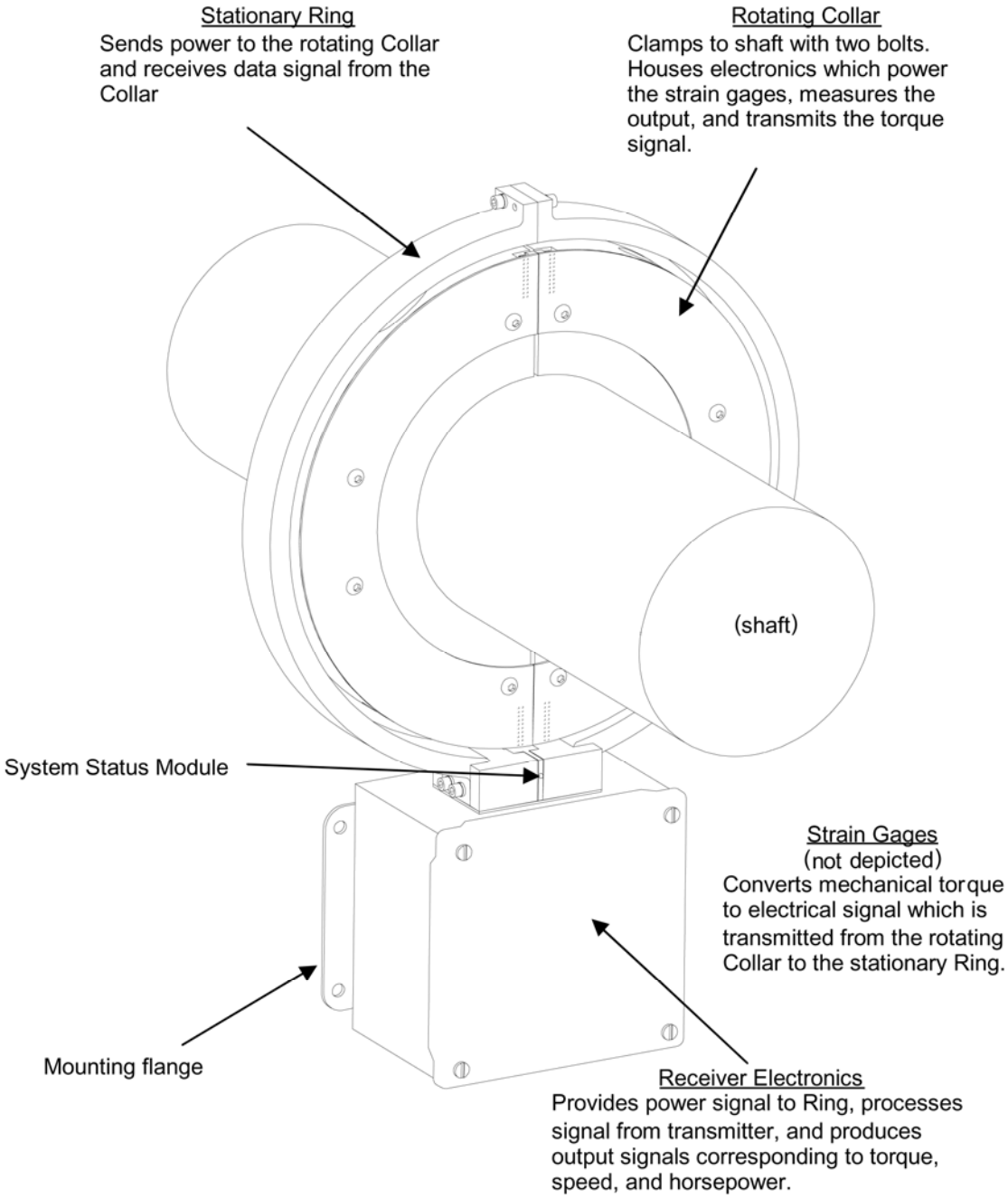
Switch #4 should be changed as needed to provide a positive torque output (See Section 7, Torque Offset – Receiver Installation).

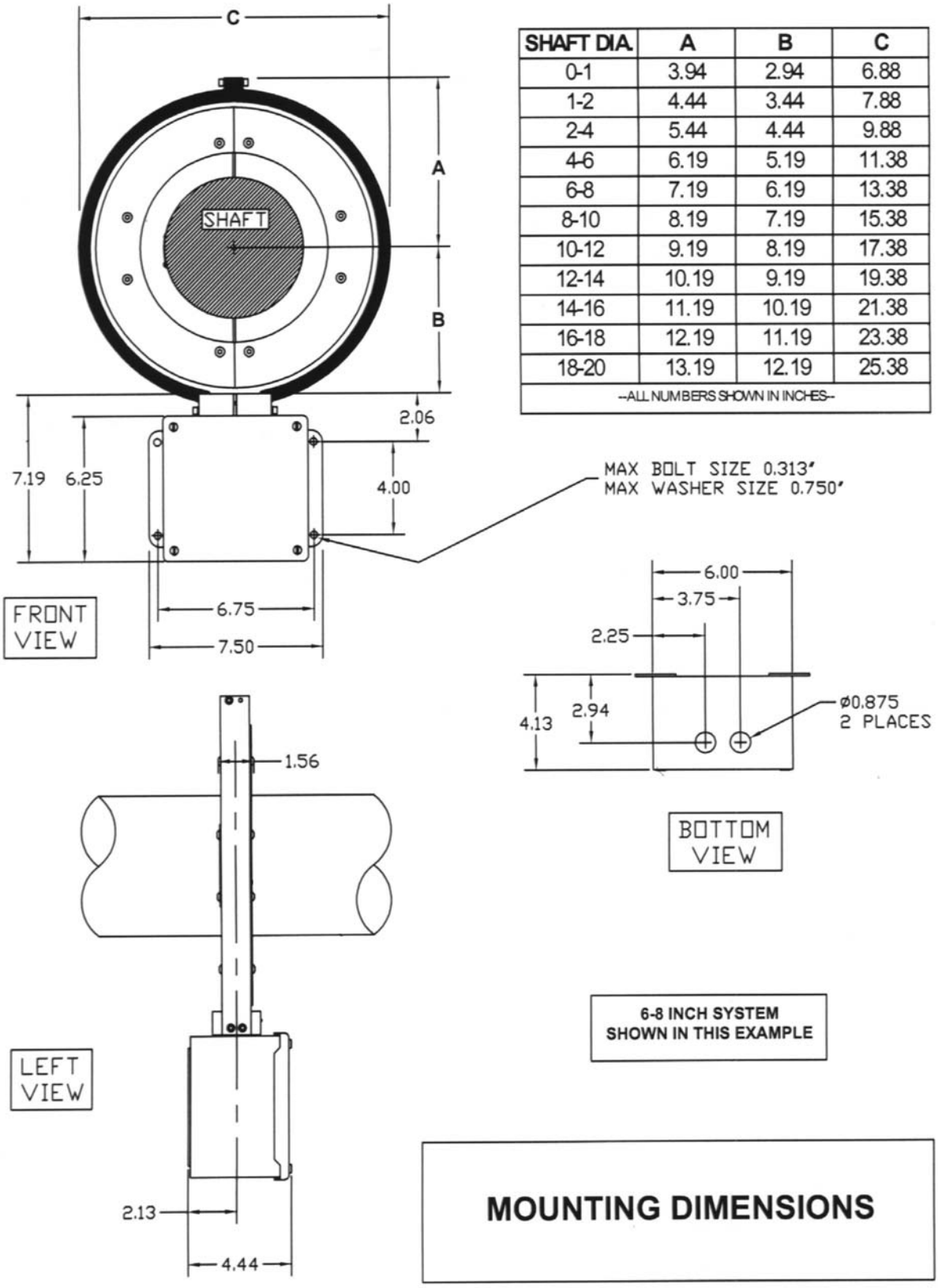
All other switches (1, 2, 5-8) should be in the OFF position.



Torque Signal Configuration Switches

11 Torque Sensor/Transmitter and Receiver





SHAFT DIA.	A	B	C
0-1	3.94	2.94	6.88
1-2	4.44	3.44	7.88
2-4	5.44	4.44	9.88
4-6	6.19	5.19	11.38
6-8	7.19	6.19	13.38
8-10	8.19	7.19	15.38
10-12	9.19	8.19	17.38
12-14	10.19	9.19	19.38
14-16	11.19	10.19	21.38
16-18	12.19	11.19	23.38
18-20	13.19	12.19	25.38
--ALL NUMBERS SHOWN IN INCHES--			

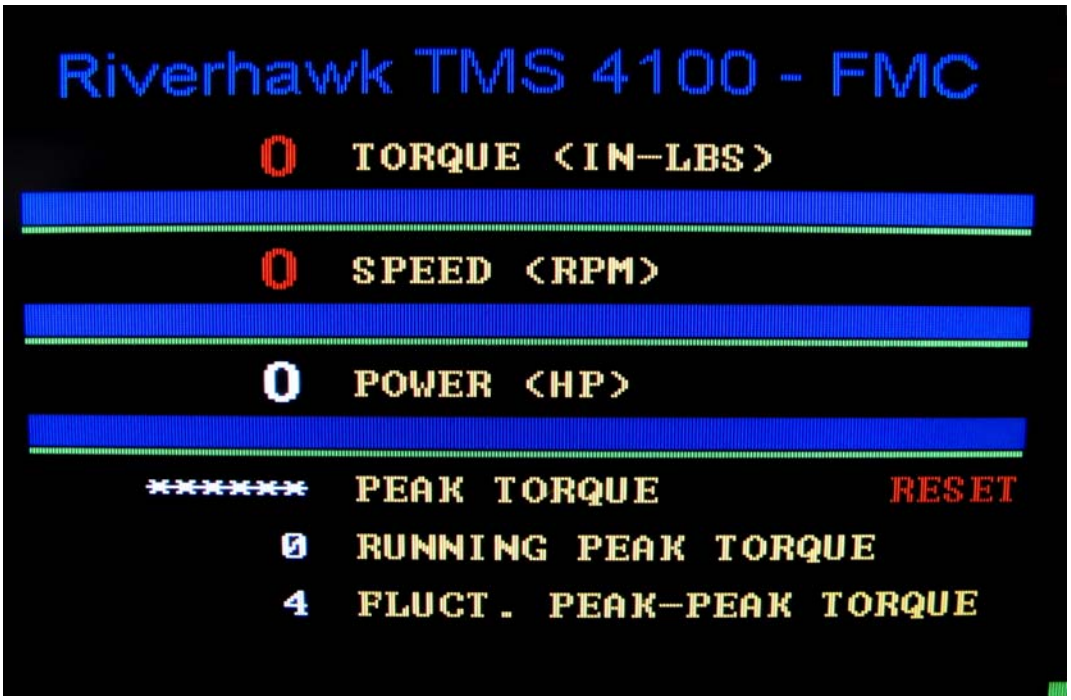
6-8 INCH SYSTEM SHOWN IN THIS EXAMPLE

MOUNTING DIMENSIONS

12 Monitor Enclosure and Display

19" Rack Mounted Monitor

(The above image depicts the enclosure only.)



LCD Image

13 Specifications

Sensors

Torque Sensor	Strain gages
Sensing Range	+/-500 microstrain
Speed Sensor	Hall-effect sensor
Torque Accuracy	1% of full scale worst case
Typical Torque Accuracy	Better than 0.5%
Torque Frequency Response	1000Hz
Measurement Rate	100Hz minimum See previous sections for details on the measuring capabilities

Display

Type	TFT Color LCD Touch-Screen
Viewing Area	4.6" wide by 3.5" high
Resolution	Quarter VGA – 320 by 240 pixels

Analog Output

Quantity	2, for torque and speed
Nominal Output	4-20 mA
Compliance	Load resistance less than 500 ohms
Actual range	0-22mA
Accuracy	0.5% of full scale value
Voltage Output	Can be configured as a 1 to 5VDC output via a hardware jumper

Relay Contacts

Contacts	SPDT, rated 5A resistive
Usage	Suitable for signal level switch until they actuate a high current load

Field Wiring Connectors

Type	Pluggable Phoenix type connectors with captive wire clamps

Operating Power

Voltage	85 to 265 VAC, 50/60 Hz
Power Consumption	40 watts maximum
Fuse Rating	0.5 A (Type 3AG, Fast Acting)

Isolation

Analog Output	Isolated from case/earth ground and power
Isolation	350 VAC, 500 VDC

Mechanical

Torque Sensor/Transmitter	See drawing
Torque/Speed Receiver	See drawing
Instrumented Shaft	5.25" OD
Dimension "A"	6.19" (refer to drawing)
Dimension "B"	5.19" (refer to drawing)
Dimension "C"	11.38" (refer to drawing)
Monitor Enclosure	19" Rack Mounted, 3U
Minimum Opening	17.06" wide by 5.25" high
Depth	14" (excludes connectors and clearance)
Handle Protrusion	1.06" from the mounting surface

Environmental

Ambient Operation Temperature	32ºF to 131ºF (0ºC to 55ºC)
Humidity	0 to 100% RH, non-condensing
Transportation Vibration	IAW Commercial Handling/Shipping

Warranty

Standard	1 year

14 Status Indicators

There is one Main Status Indicator light located outside the Receiver at the base of the Power Ring and four secondary system status indicator lights inside the unit.

Main Status - Red LED on Receiver (not on the board)
On solid * No errors
Fast flash a) Remote Shunt Switch is on
b) One or more system errors present

Stator - Green LED - LED1
On Solid * Input power to system is in range
Fast flash Input power to system is too high
Slow flash Input power to system is too low

Rotor - Green LED - LED2
On Solid * Rotating Collar Power is in range and no data errors present
Fast flash Rotating Collar Power is too high
Slow flash Rotating Collar Power is too low
Off Data transmission errors

Data - Green LED - LED3
On solid * Data received without errors
Off Data transmission errors
(A flickering Data light indicates intermittent data transmission.)

Range - Red LED - LED4
On solid Sensor input to transmitter is over range
Off * Sensor input to transmitter is within range
(The Range indicator may flash or flicker with a dynamic over-range condition. When the Range light is on the torque and therefore power signals are in error.)

RPM - Green LED - LED5
On* Speed sensor triggering properly
Off Speed sensor not triggering

(Flashes 6 times per shaft revolution so will appear on solid or flashing depending on shaft speed.)

In an error condition, the receiver output will be 24 mA.
Fast flash rate = 4 Hz; Slow flash rate = 2 Hz

* Indicates normal (error free) condition

15 Troubleshooting Guide

When the Receiver is first powered up, it cycles through the startup sequence, lasting 10-15 seconds. During startup mode, all of the Indicator LEDs flash in unison. If all system checks are positive, the Main Status LED on the outside of the Receiver remains on solid, and the system is ready for operation.

Normal Operating Mode (no errors)

Indicator	Condition
Main Status (red LED on outside)	On solid
Stator (green LED inside)	On solid
Rotor (green LED inside)	On solid
Data (green LED inside)	On solid
Range (red LED inside)	Off

If an error is present, the Main Status LED will flash and the system will display an error code briefly (another 10-15 seconds) before the startup cycle repeats. Below are the most common error modes and potential corrective actions.

Error Mode: Power supply voltage is incorrect

Indicator	Condition	Suggested Corrective Action
Main Status Stator	Fast flash (4 Hz) Flashing (2 or 4 Hz)	1. Verify the approximately 12VDC powering the Receiver.

Error Mode: Weak inductive interface

Indicator	Condition	Suggested Corrective Action
Main Status Stator Rotor Data	Fast flash (4 Hz) On solid Off or slow flash (2 Hz) Off or flickering	1. Verify the voltage is about 35 mV AC across the Mounting Blocks on top of the Receiver. 2. Make certain the Power Ring is not shorted to the Receiver enclosure by water or other conductive material. 3. Remove any surrounding metal other than the shaft within 4 inches (10 cm) of the Power Ring. 4. Clean the mating surfaces of the Power Ring and tighten all the mounting screws. 5. Verify that the Rotating Coil voltage is about 120 mV AC (probe the two terminal dots on the outer surface of the Coil Boards attached to the Rotating Collar). 6. Check alignment of the Rotating Collar within the Power Ring: their midlines should be aligned. 7. Make certain the Rotating Collar terminal strips are soldered properly and not damaged.

Error Mode: Strain gage problem

Indicator	Condition	Suggested Corrective Action
Main Status Stator Rotor Data Range	Fast flash (4 Hz) On solid On solid On solid On solid	1. Verify the excitation voltage to the gage is 2.5 VDC. 2. Check solder connections and wiring to the gage. 3. Balance the gage to reduce the offset or apply a new gage.

16 Warranty Statement

Limited Warranty: Monitoring equipment and accessories are warranted by the Seller for one year to be free from defects in both materials and workmanship under normal use and service. This warranty is in lieu of and excludes any other warranty, express or implied, including, but not limited to, any implied warranty derived from quote or fitness of purpose. (Manufacturer's liability and Buyer's limited remedies under Manufacturer's warranty shall be limited solely to repair, replacement, credit or refund, at the manufacturer's option, with respect to products supported by a Return Material Authorization number obtained from the Manufacturer and returned to the Manufacturer. The Manufacturer shall not be liable, under any circumstances, for consequential or incidental damages, including, but not limited to, labor costs or loss of profits arising in connection with the use of or inability to use products purchased from the Seller)

Product Application: The Buyer is solely responsible in determining the suitability of the Manufacturer's products in its application regardless of circumstances.

Manufacturer reserves the right to make future design changes to any of its products without thereby incurring any obligations to make changes to or replacements of this product.

Manufacturer neither makes nor authorizes any person to make on its behalf any other guarantee or warranty concerning its products.

Service

To obtain service under this Limited Warranty call Riverhawk Customer Service Department in New Hartford to obtain an RMA (Return Material Authorization) number.

Pack the item(s) in its original shipping container (or equivalent)

Put the RMA number on the address label

Put the RMA number on the shipping carton

Insure it (or assume the risk of loss / damage during shipment)

Ship the product freight pre-paid to the New Hartford facility

Manufacturer is not responsible for damage to inbound product.

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