Honeywell

TMS 9250 Product User Manual

Rev B
April 2012

© 2012 – Honeywell International Inc. All rights reserved

This page is intentionally left blank.

About This Document

Release Information

Document Name	Document ID	Release Number	Publication Date
TMS 9250 Product User Manual		V 1.1a	January 2012
		Rev B	April 2012

© 2012 – Honeywell International Inc. All rights reserved

This page is intentionally left blank.

Symbol Definitions

The following table lists those symbols used in this document to denote certain conditions.

Symbol	Definition
	**ATTENTION:** Identifies information that requires special consideration.
	**TIP:** Identifies advice or hints for the user, often in terms of performing a task.
	**REFERENCE - EXTERNAL:** Identifies an additional source of information outside of the booklet.
	**REFERENCE - INTERNAL:** Identifies an additional source of information within the booklet.
CAUTION	Indicates a situation which, if not avoided, may result in equipment or work (data) on the system being damaged or lost, or may result in the inability to properly operate the process.
	**CAUTION**: Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices. **CAUTION** symbol on the equipment refers the user to the product manual for additional information. The symbol appears next to required information in the manual.
	**WARNING**: Indicates a potentially hazardous situation, which, if not avoided, could result in serious injury or death. **AVERTISSEMENT** : Indique une situation potentiellement dangereuse. L'inobservation de ce symbole risque d'entraîner des blessures graves, voire mortelles." **WARNING** symbol on the equipment refers the user to the product manual for additional information. The symbol appears next to required information in the manual. Ce symbole d'AVERTISSEMENT apparaît sur l'équipement et renvoie l'utilisateur aux informations qui se trouvent dans le manuel du produit. Dans le manuel, ce symbole apparaît à côté de l'information correspondante.
	**WARNING, Risk of electrical shock**: Indicates potential shock hazard where HAZARDOUS LIVE voltages greater than 30 Vrms, 42.4 Vpeak, or 60 VDC may be accessible. AVERTISSEMENT, risque d'électrocution : Indique un risque d'électrocution car des tensions supérieures à 30 Vrms, 42,4 Vpic ou 60 Vcc, POUVANT ETRE MORTELLES, sont accessibles.

© 2012 – Honeywell International Inc. All rights reserved

Symbol	Definition
	**ESD HAZARD:** Indicates danger of an electro-static discharge to which equipment may be sensitive. Observe precautions for handling electrostatic sensitive devices.
	**Protective Earth (PE) terminal**: Provided for connection of the protective earth (green or green/yellow) supply system conductor.
	**Functional earth terminal**: Used for non-safety purposes such as noise immunity improvement. NOTE: This connection shall be bonded to Protective Earth at the source of supply in accordance with national local electrical code requirements.
	**Earth Ground**: **Functional earth connection.** NOTE: This connection shall be bonded to Protective Earth at the source of supply in accordance with national and local electrical code requirements.
	**Chassis Ground**: Identifies a connection to the chassis or frame of the equipment shall be bonded to Protective Earth at the source of supply in accordance with national and local electrical code requirements.

© 2012 – Honeywell International Inc. All rights reserved

Contents

1. TMS 9250 TORQUE MEASUREMENT SYSTEM 9

1.1 Important General and Safety Warnings 9

1.2 Certification Information 11

1.3 In The Box 12

1.4 Intended Use 14
Torque Sensor 14
Usage Scenario of TMS 9250 14

1.5 Installation and Setup 15
Bolting Information 15
Torque Sensor 15
Caliper Coupling Module 16
Signal Processing Module 17
SPM External Connection 17
SPM Internal Connection 18
Powering of Device 18
Toolkit Installation 18

2. MODES OF OPERATION 25

2.1 Normal Mode Operation Detailed Description 25
Normal Mode Operation 25

2.2 Fast Mode Operation Detailed Description 26
Fast Mode Operation 26

2.3 Analog Output Characteristics 30

3. CALIBRATION 31

3.1 System Calibration Method 31

3.2 Shunt Calibration 32

3.3 Recalibration 32

4. TROUBLESHOOTING 33

4.1 “Power On” Light Not Showing 33

4.2 “Rotor Active” Light Not Showing 33

4.3 SHUNT Calibration Not Operating 34

4.4 No Communication 34

5. PRODUCT SPECIFICATIONS 37

6. APPENDICES 39

© 2012 – Honeywell International Inc. All rights reserved

6.1 APPENDIX A 39
Principle of Telemetry 39

6.2 APPENDIX B 39
Manual Supplement for TMS 9250 SPM Remote SHUNT CAL Option 39
Overview 39
Setup 39

6.3 APPENDIX C 40
Filter Operation General Description 40
Filter Operation Detailed Description 40
Filter Settling Time 41
Example 42
Sample Charts 44

6.4 APPENDIX D 46
Conversion Table 46

6.5 APPENDIX E 50
Power Supply Positioning and Cleaning 50

6.6 APPENDIX F 51
SPM cable connections 51

6.7 APPENDIX G 58
Manual Supplement for TMS 9250 SPM SQUAREWAVE output Option 58
Overview 58
Setup 58

© 2012 – Honeywell International Inc. All rights reserved

1. TMS 9250 Torque Measurement System

1.1 Important General and Safety Warnings

Before you work on any electronic equipment, review and follow the safety guidelines to help protect the system from potential damage and to ensure personal safety.

	**WARNING** **MISUSE OF DOCUMENTATION** • Complete installation, operation, and maintenance information is provided in the instructions supplied with each product. • Failure to comply with these instructions could result in death or serious injury. **AVERTISSEMENT** **MAUVAIS USAGE DE LA DOCUMENTATION** • Les informations complètes d'installation, d'utilisation et d'entretien sont fournies avec les instructions accompagnant chaque produit. • L'inobservation de ces instructions risque d'entraîner des blessures graves, voire mortelles.
	**WARNING** **PERSONAL INJURY** • DO NOT USE these products as safety or emergency stop devices or in any other application where failure of the product could result in personal injury. • Failure to comply with these instructions could result in serious injury or death. **AVERTISSEMENT** **PERSONNELS BLESSURES CORPORELLES** • NE PAS UTILISER ces produits en tant que dispositifs d'arrêt d'urgence ou de sécurité, ni dans aucune autre application où la défaillance du produit pourrait entraîner des personnels blessures corporelles. • L'inobservation de ces instructions risque d'entraîner des blessures graves, voire mortelles.
	**CAUTION** • For continued protection from electrical shock, all connectors on the SPM and CCM shall be connected to equipment providing low voltage (not more than 33Vac rms / 46.7V peak or 70Vdc total) double insulated (SELV) sources of supply. • When you are adjusting the CCM to align with the torque sensor, you must lock out power to the prime mover and ensure that you are trained prior to accessing these areas of the installation.

© 2012 – Honeywell International Inc. All rights reserved

	**CAUTION** • The SPM is intended only for connection to the specific power supply shipped with the system. • The system was evaluated for use with a specific SELV power supply of limited energy output that affords electrical fire and shock hazard protection. • The use of another power supply with this system may result in electrical shock or fire hazards or non-compliance of certification standards. • The CCM is intended only for connection to the SPM with cables provided by the manufacturer. • Refer to the APPENDIX F for connecting cables to the SPM. • This equipment provides only low voltage double insulated signal I/O for connection to other equipment.
	**ATTENTION:** • The product shall be in “POWER ON” condition for minimum period of 30-45 minutes for meeting the product output specifications and emission standards.
	**ATTENTION:** • Ensure that the interface cables are shielded before connecting to the product. • Due to the multitude of variations possible for connection of the torque sensor to the load and prime mover, you must increase the guarding for the end application to meet provisions of the machinery directive. • The equipment is evaluated only with respect to the Low Voltage Directive and RTTE Directives and is not evaluated to the machinery directive for the reasons stated. Therefore, you must ensure the compliance of this equipment with the provisions of the machinery directive in the end application. This will normally mandate the need for additional guarding at the mechanical coupling points to the torque sensor.
	**TIP** • Place the power supply of the system in a place where you can easily unplug the power cords.

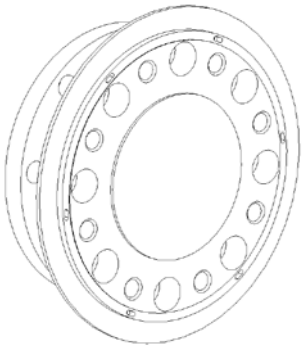
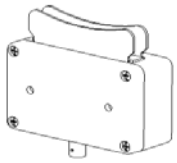
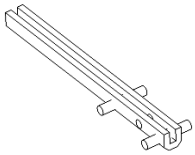
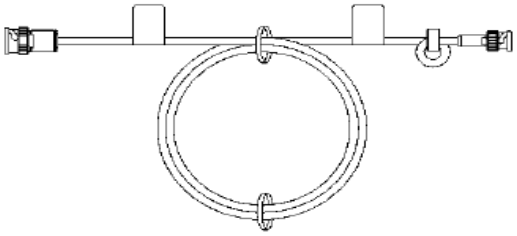
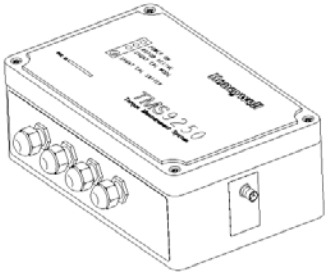
© 2012 – Honeywell International Inc. All rights reserved

1.2 Certification Information

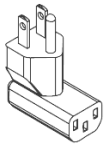
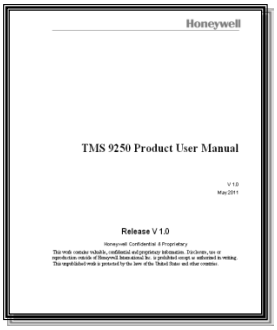
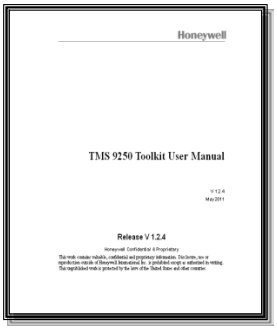
Certification	  FCC ID: XJLTMS9250FCC IC ID: 9832A-TMS9250IC FCC statement: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. IC statement: This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device. déclaration IC : Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.
EMC	Product meets EMC/EMI requirement as per following standards: • Class B FCC § 15.225(a) • Class B FCC § 15.225(d) • Class B FCC § 15.207 • IC RSS-Gen Issue3 • IC RSS-210 Issue 8 • ETSI EN 300 330-1 V1.7.1 and ETSI EN 300 330-2 V1.5.1 • ETSI EN 301 489-1 V1.8.1 and ETSI EN 301 489-3 V1.4.1
Safety	Product is meeting safety requirement as per following standard • EN 60950-1: 2006 + A11:2006 and IEC 60950-1: 2005 (second edition) • EN 61010-1: 2001 (second edition) and IEC 61010-1: 2001(second edition)

© 2012 – Honeywell International Inc. All rights reserved

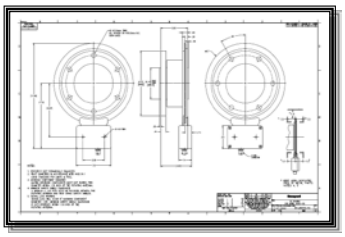
1.3 In The Box

Sl no.	Description	Part
1	Rotor	
2	Caliper Coupling Module (CCM)	
3	Alignment Tool / Setting Gauge	
4	RF Tri-Axial Cable	
5	Signal Processing Module (SPM)	

© 2012 – Honeywell International Inc. All rights reserved

6	RS232 Interface Cable (Communication cable)	
7	Plug Top	
8	Power Adapter	
9	Software Installation CD	
10	Product User Manual	
11	Toolkit Software Manual	

© 2012 – Honeywell International Inc. All rights reserved

12	Calibration Sheet	
13	Outline Dimension Drawings (ODD)	
	Note: • RS232 Interface cable connection is mentioned in APPENDIX F step 5. • Pictures shown above are for representation only, not to actual scale.	

1.4 Intended Use

Torque Sensor

Honeywell Torque Sensors are dedicated structures that perform in a predictable and repeatable manner when torque forces are applied. This torque force is translated into a signal voltage by the resistance change of strain gages, which are attached to the torque sensor structure. The change in resistance indicates the degree of deformation, and in turn, the torque force on the structure.

The strain gages are connected in a four arm Wheatstone bridge configuration which acts as an adding and subtracting electrical network and allows compensation for temperature effects as well as cancellation of signals caused by extraneous loading.

When the torque sensor is rotating, a means must be provided to transfer an excitation voltage to the rotational element from a stationary surface, and also to transfer the torque signal from the rotational element back to the stationary surface. This is accomplished through the use of digital telemetry.

Usage Scenario of TMS 9250

This product is used in controlled environment, not intended for outdoor use and designed typically for dynamometer test laboratories.

Refer to the cleaning instructions provided in the APPENDIX E.

© 2012 – Honeywell International Inc. All rights reserved

1.5 Installation and Setup

Bolting Information

Tighten all bolts, in incremental steps, to the bolt manufacturer's rated torque specification. Use the respective sequence illustration shown in Figure 1 depending on the number of bolts the sensor requires. This bolting sequence applies to both bolt circles of the torque sensor. Typical connection schematic of the product for any torque measurement is as shown in Figure 2. General guidelines shall be considered for mounting the sensor as shown in Figure 3. Outline dimension details for standard models are indicated in Figure 4 to Figure 9; contact factory for other configurations.

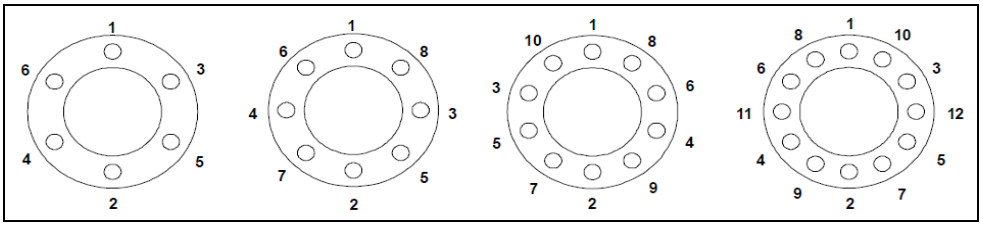
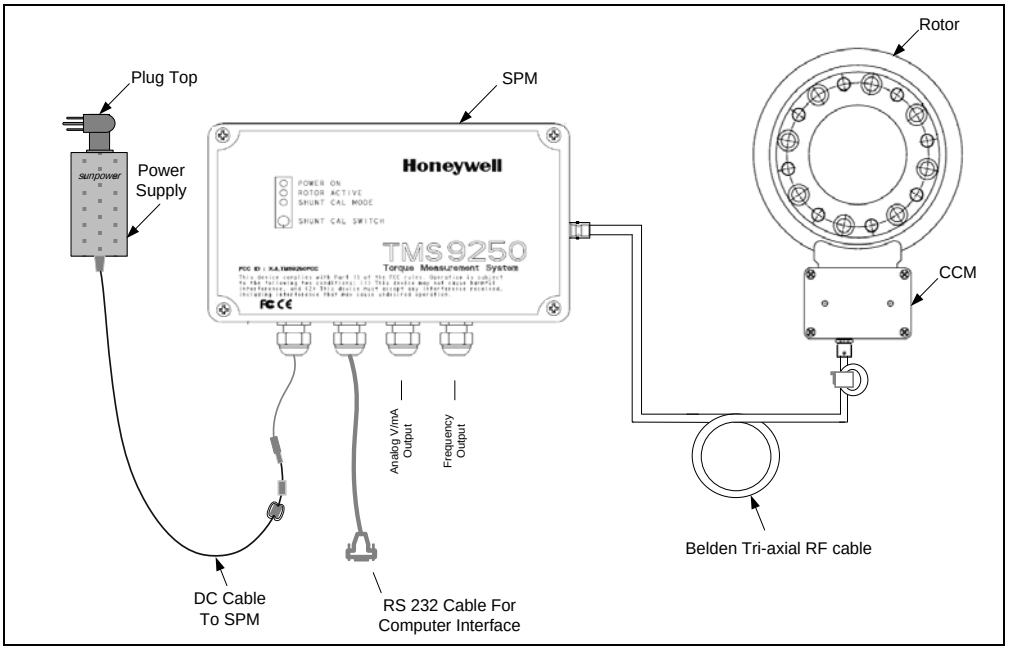


Figure 1: Bolting Pattern for Flange Model

Torque Sensor

Honeywell's TMS 9250 series torque sensors may be operated horizontally, vertically, or at any angle in between, provided the load is applied through the loading axis. All torque sensors in this series have bolt patterns that mate directly to standard DIN companion flanges. When mounted, one of the flanges should be mated to a good quality double flex coupling or a driveshaft arrangement that incorporates universal joints at each end. This is designed to compensate for angular and parallel misalignment. Avoid applications that place extraneous loads on the torque sensor.



© 2012 – Honeywell International Inc. All rights reserved

Figure 2: Complete Setup Connection Representation

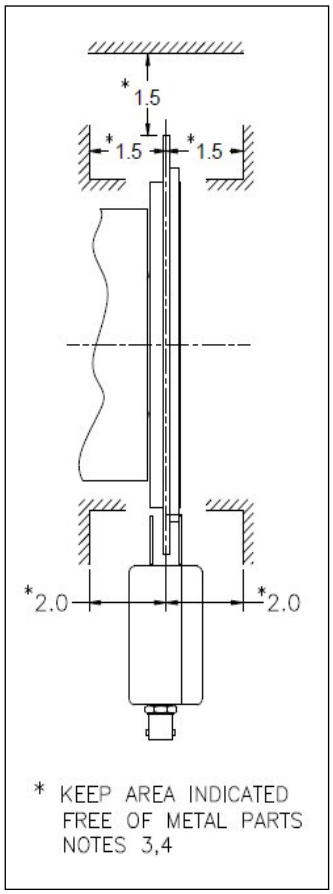


Figure 3: General Precautions to be Considered for Rotor and CCM Installation

	Note: 1. Pilot diameters in accordance with ANSI B4.1 (ANSI standards for limits and fits) 2. Mating driveline components shall be more than 1.5 inches around the rotating antenna and 2.0 inches around CCM. 3. Minimum safety shield clearance of 1.5 inches shall be provided between the rotating antenna and test stand safety shields. 4. Signal loss will occur if maximum component diameter or minimum safety shield clearance is not maintained more than 2.0 inches around CCM.

Caliper Coupling Module

The caliper coupling module must be firmly mounted to a non-rotating support structure. It must be aligned with the annular printed circuit board antenna so that the air gap between the

© 2012 – Honeywell International Inc. All rights reserved

caliper and the antenna is approximately equal on both sides. Care should be taken to avoid any items touching one another, and consideration should be given to the effects of vibration as well as the free play in any driveshaft sliding joints.

To assist in the process of aligning the caliper and the antenna, a simple plastic alignment tool is provided with each system. The tool is used to hold the required clearance between the caliper and the antenna while the caliper fixing bolts are being tightened, and then is removed before the sensor is rotated.

The tolerances for end-float (axial) are i.e. +/- 3/16 in. (+/- 3.5 mm) and for run out (radial) are +/- 1/16 in. (+/- 1.0 mm). For installations where run-out cannot be controlled within the specified tolerance, the secondary coupling position can be used. This is achieved by placing the edge of the caliper in close proximity to the edge of the antenna. In this position, the run-out tolerance can be at least doubled, at the expense of a reduced signal to noise ratio caused by the higher incidence of data drop outs. The axial tolerance is limited by the distance between the caliper sections.

The caliper can also be mounted such that only one side is in proximity to the antenna, if the mounting arrangement does not allow for placing of the antenna between the two sides of the caliper.

Successful positioning of the caliper can be confirmed by the quality test of the TMS Toolkit returning >97% result. The procedure to run the quality is explained in Toolkit manual supplied with product.

The length of the RF cable connection between the caliper coupling module and the signal processing module is critical to system performance (due to reflections and standing waves). You must use tri-axial cable only of length 14.6 meters (47 ft. 11 in.) supplied with the product.

Signal Processing Module

The receiver is mounted remotely with the tri-axial cable being the only connection between it and the caliper coupling module. The receiver has holes provided for permanent mounting. Customer shall request appropriate certified drawings from Honeywell before making fixtures for mounting in racks.

When deciding where to locate the signal processing module, consideration should be given to the type of output that will be used. If the analog voltage or current output is to be used, then the signal processing module should be mounted in an area of low electrical noise, and the connection between the module and the data acquisition equipment should be as short as possible made up of double screened twisted pair cable. If the frequency output or the digital output is to be used, then the signal processing module can be mounted in the electrically noisy area provided that good quality dual screened twisted pair cables are used.

SPM External Connection

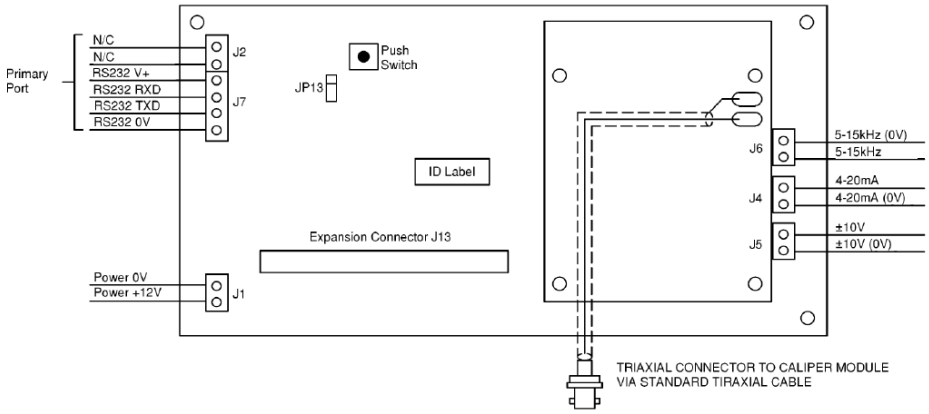
Refer to APPENDIX F for SPM IO box connections.

© 2012 – Honeywell International Inc. All rights reserved

SPM Internal Connection

The following table provides detail of internal connection for the SPM. Honeywell does not recommend that the user change these settings/ connections until/unless assisted by the factory. Table and pin connection details are listed as follows:

Connector	Function
J1	DC Power 12 V
J4	Current loop output
J5	Voltage output
J6	Frequency output
J7	Primary RS232 port NOTE: THIS IS THE DEFAULT COMMUNICATIONS PORT
J13	Expansion port
JP1	Primary RS232 default select
	**ATTENTION:** SPM shall be configured for either voltage or current output from factory hence connectors J4 and J5 are interchangeable but connector J6 is neither interchangeable with J4 nor J5. Do not attempt to interchange frequency output to any other output.



Powering of Device

After all the connections are completed, the system should be powered and allowed to warm-up for 30-45 minutes, in order to get stable outputs from the SPM.

Toolkit Installation

After all the mechanical and electrical setup is completed, software should be installed on the computer as detailed in the Toolkit Software Manual supplied with the product.

© 2012 – Honeywell International Inc. All rights reserved

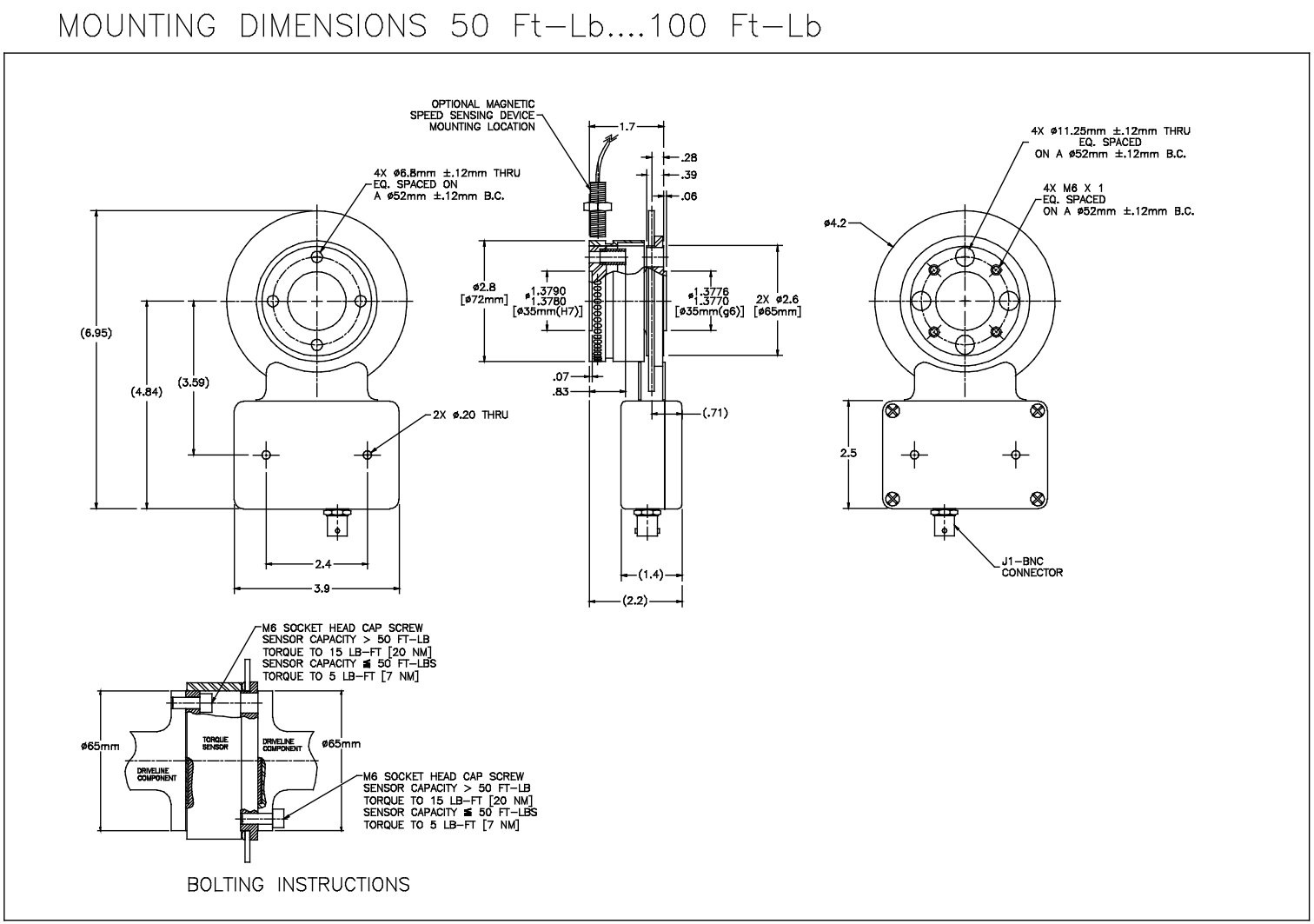


Figure 4: Mounting Dimensions for 50 ft-lb to 100 ft-lb

© 2012 – Honeywell International Inc. All rights reserved

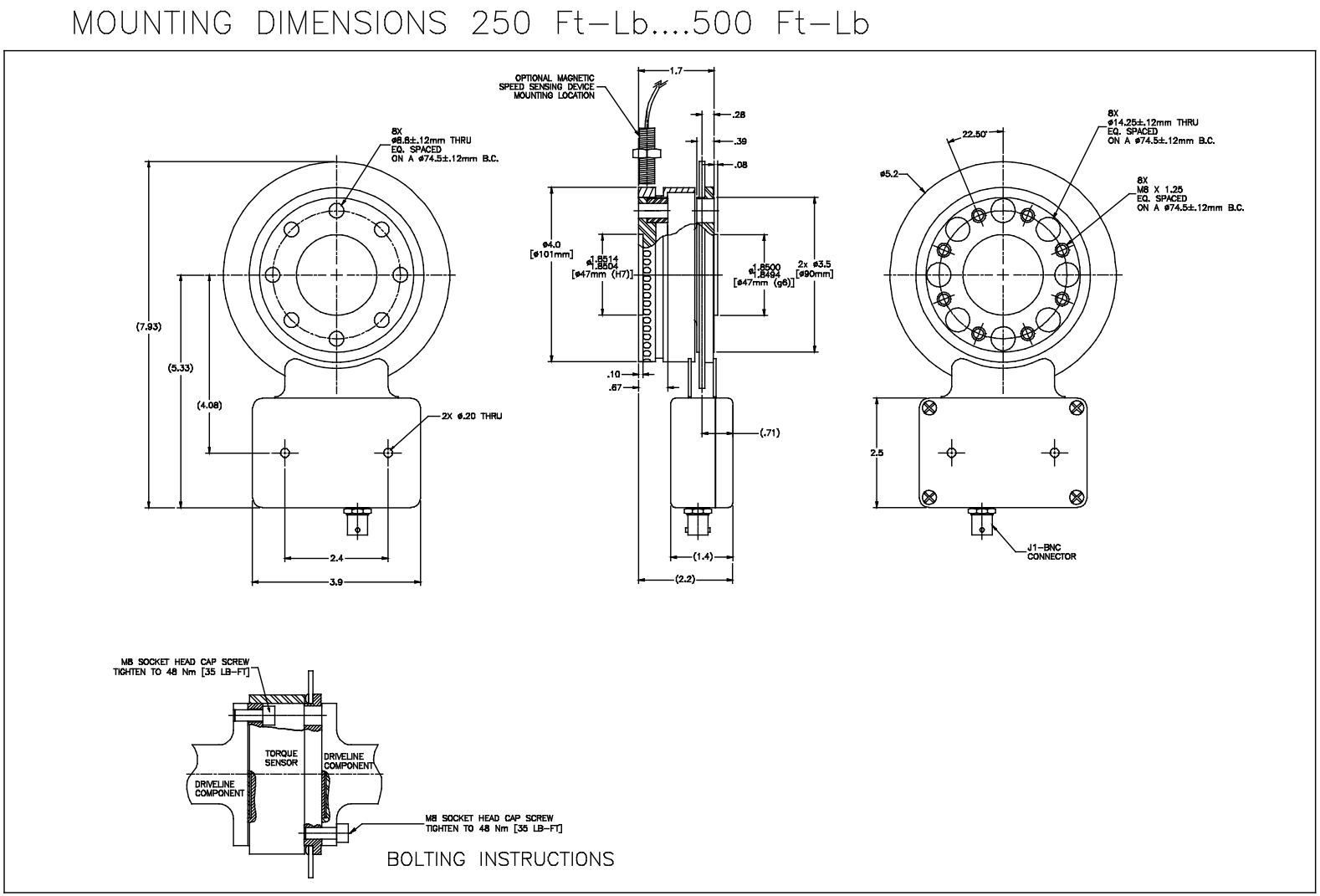


Figure 5: Mounting Dimensions for 250 ft-lb to 500 ft-lb

© 2012 – Honeywell International Inc. All rights reserved

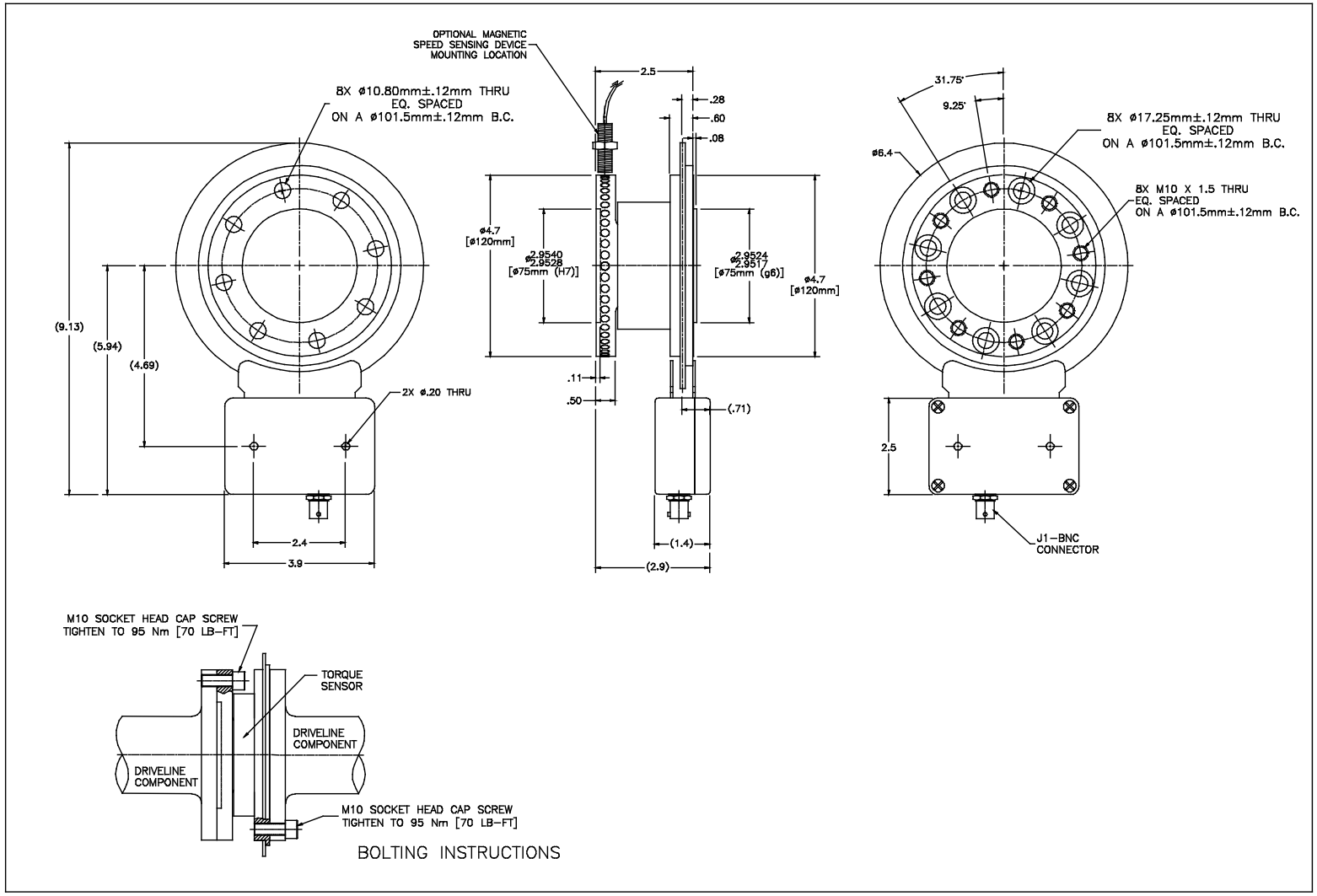


Figure 6: Mounting Dimensions for 1000 ft-lb

© 2012 – Honeywell International Inc. All rights reserved

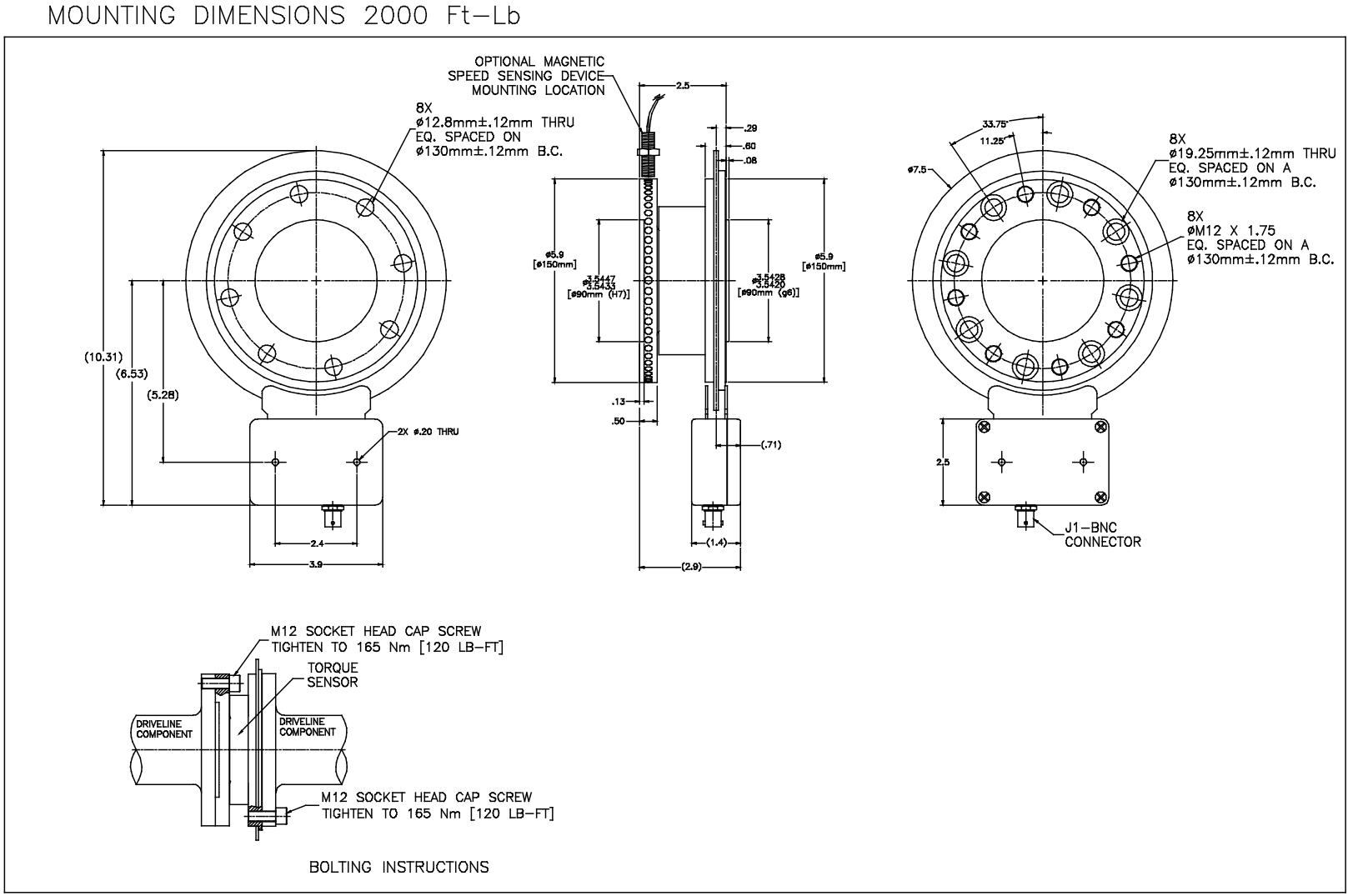


Figure 7: Mounting Dimensions for 2000 ft-lb

© 2012 – Honeywell International Inc. All rights reserved

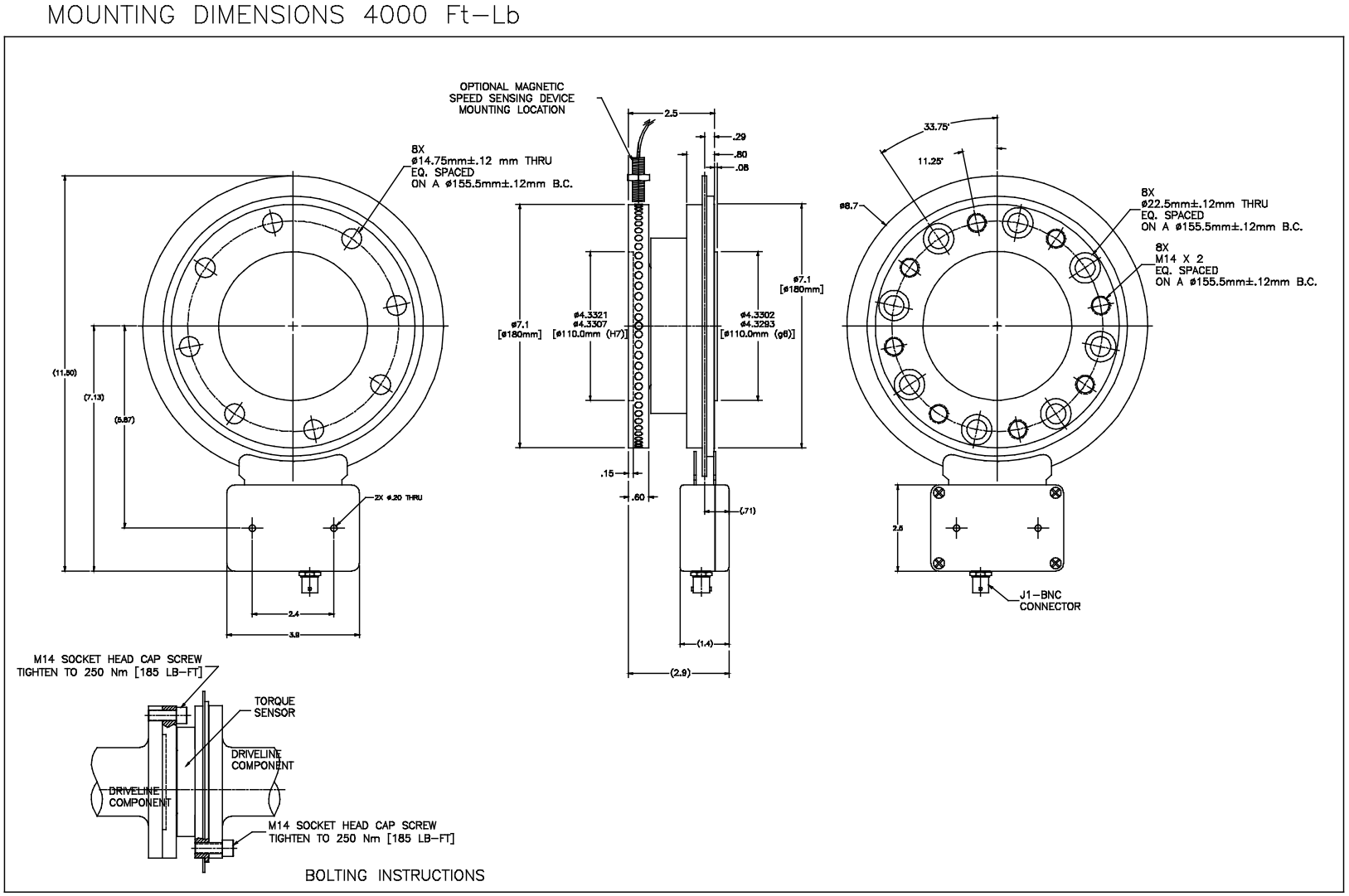


Figure 8: Mounting Dimensions for 4000 ft-lb

© 2012 – Honeywell International Inc. All rights reserved

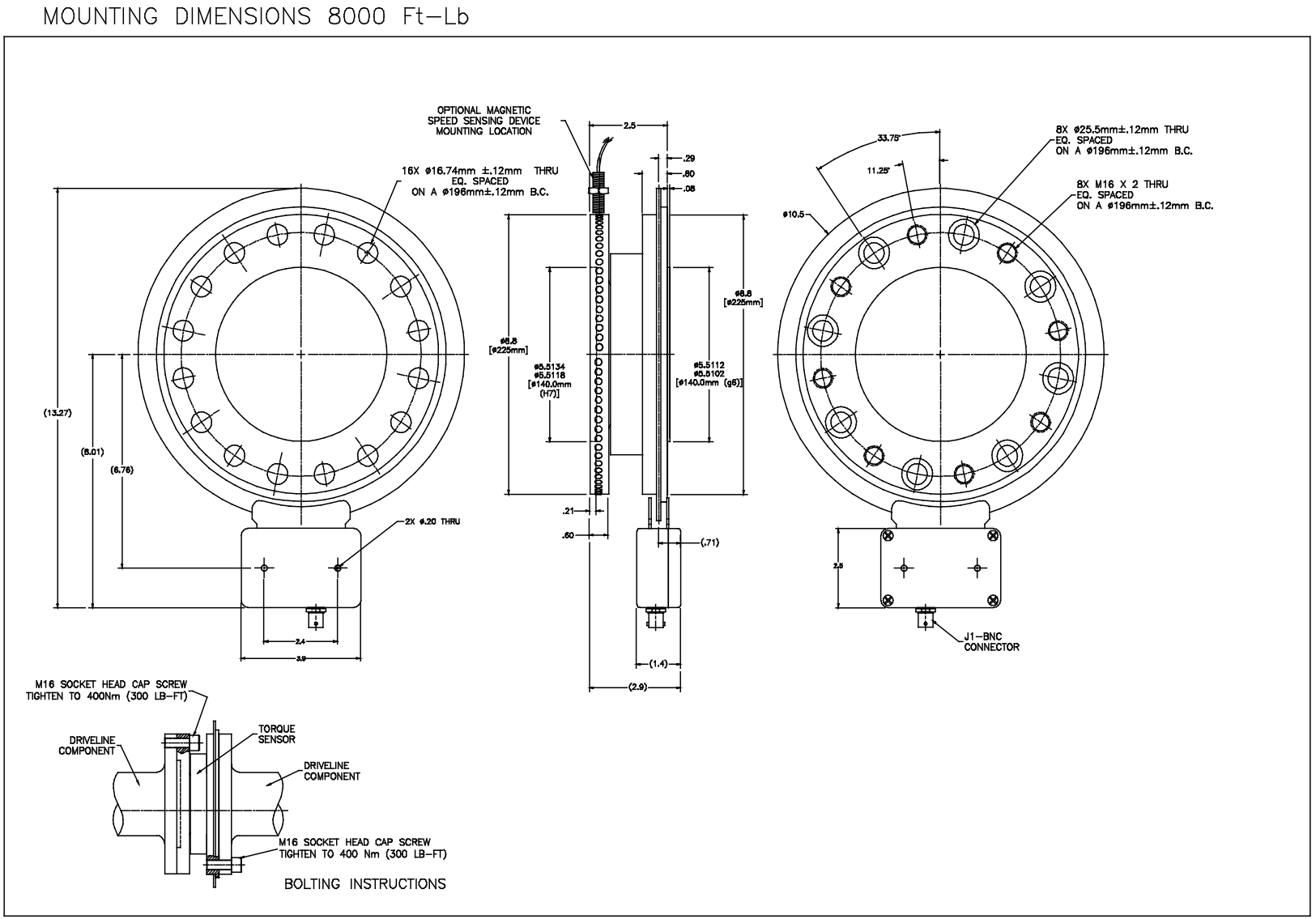


Figure 9: Mounting Dimensions for 8000 ft-lb

© 2012 – Honeywell International Inc. All rights reserved

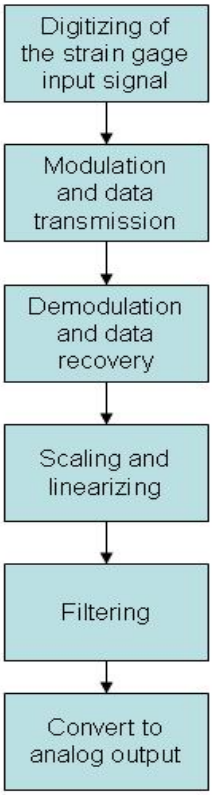
2. Modes of Operation

2.1 Normal Mode Operation Detailed Description

Normal Mode Operation

The flow of data in the TMS 9250 is subjected to various forms of processing as it passes from input to output.

This process is best described by use of a flow chart as follows:



Normal mode

The data is transmitted from the rotor at the maximum data rate but the rate has to be slowed down for linearizing and scaling due to the amount of processing required – the TMS 9250 features independent scaling of the input and output, using floating point values for convenience of the user, and the linear zing routine can use up to 9 data points (user selectable), so a significant amount of processor power is consumed during these floating point calculations.

The next process is digital filtering, using a parameter driven recursive algorithm that performs output smoothing but also provides a separate parameter that controls a filter bypass in the event of a significant change in input being required to be reflected through to the output without delay.

The filtered data is then converted to the required analog output format or formats (the TMS 9250 can drive the voltage or current loop output at the same time as providing a frequency

© 2012 – Honeywell International Inc. All rights reserved

output) by using the output scaling parameters which are independent of input calibration. The rate at which the microcontroller can perform the separate linearzing and scaling calculations is the limiting factor in determining the available bandwidth of the TMS 9250.

2.2 Fast Mode Operation Detailed Description

Fast Mode Operation

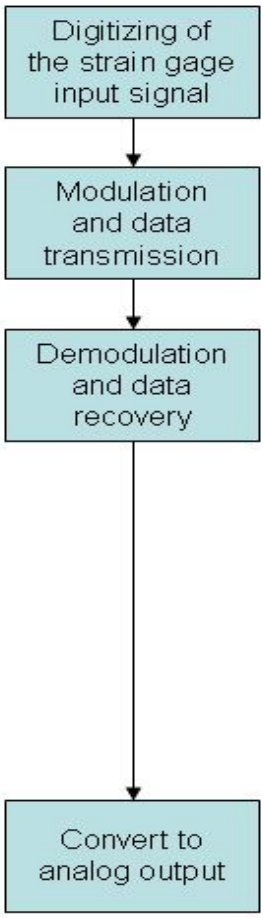
To provide a faster response for users that want to analyze the dynamic data, a FASTMODE is provided, and in this mode, the data is “piped” directly from the rotor to the analog voltage output.

The benefit of this mode is that the analog voltage output is updated at the maximum data rate, which is eight times faster than the normal mode rate.

The downside of using fast mode is that the scaling and linear zing stages are bypassed, so the relationship between input and output becomes fixed, and the only way to calibrate the output against the input is to either calculate the expected change in output value (by reference to the calibration data stored in the TMS 9250), perform a physical system calibration, or use the SHUNT CAL feature.

© 2012 – Honeywell International Inc. All rights reserved

The following diagram shows the change in data flow when using FASTMODE.



FAST mode

Because of the significant change in output characteristics that takes place when FASTMODE is selected, it is implemented as a VOLATILE setting, therefore recycling the power or performing a soft reset will return the TMS 9250 to NORMAL mode.

As an indication to the user that FASTMODE is in operation, the ROTOR ACTIVE light on the lid of the TMS 9250 SPM is de-activated.

The strain gage input value is digitized at a rate of 17,656 samples per second with 24-bit resolution, but this amount of data is in excess of the capacity of the telemetry link, so it is reduced by the simple averaging of every pair of A-D results at the rotor electronics module. The data that is transmitted across the telemetry gap consists of 8,828 results per second at a resolution of 16-bit, and it is this data that is then piped directly to the analog voltage output whenever FASTMODE is turned on.

The analog voltage output channel is a 16-bit digital-to-analog converter with a bandwidth of greater than 3 kHz, therefore the expected analog output voltage for a full scale torque measurement can be calculated by reference to the calibration data tables held in the TMS 9250.

© 2012 – Honeywell International Inc. All rights reserved

Assuming that the factory calibrated (or user re-calibrated) data tables can be accessed using the CAL user mode of the TMS Toolkit, the output calibration can be determined using this theoretical method, an example of which will be given later.

	Note: Due to the fact that the analog voltage output channel DAC is being driven directly, the factory calibration of the output voltage is also bypassed. This results in a maximum output voltage swing of approximately -12.5 to +12.5 V, instead of the normal -10.0 to +10.0.

Actual values can be determined by measurement and can be affected by power supply levels and component tolerances.

When the TMS Toolkit is not available, the user will need to perform a physical system calibration by placing a known torque on the sensor and measuring the change in the analog output voltage.

In cases where the SHUNT CALibration value is known, the change in output due to SHUNT CALibration can be measured and the result extrapolated to give a full scale equivalent. Note that this result will need to be adjusted when the SHUNT CAL scaling feature has been used (#SCSCALE is something other than 1). An example of calculating the analog output voltage by using SHUNT CAL and the #SCSCALE parameter is given below.

Normal mode and FASTMODE data update rates

The table below provides a quick reference to the data rates available in either of two available modes.

Mode	Data rate
NORMAL	When FILTSTEPS>1, data rate is 1104 results per second
NORMAL	When FILTSTEPS=1, data rate is 2207 results per second
FASTMODE	8828 results per second
	Note: The analog voltage output channel shall be the only channel in use for any data rate above 1104 results per second. Therefore OPTYPE should be set to 1. Any traffic on the RS-232 port caused by TMS Toolkit or any other communications package will disrupt the flow of data due to the interrupts that are generated by the external software.

Examples

The following examples assume that either the TMS Toolkit is available and running in CAL user mode, or that a hard copy of the parameters list is available and valid.

Example 1 – Theoretical Determination of Analog Output Value

The relationship between torque and digital counts can be determined by reference to the parameters held in the TMS 9250. When in FASTMODE, the digital counts received from the rotor are simply piped through to the analog voltage output channel, so the counts

© 2012 – Honeywell International Inc. All rights reserved

values can be used to determine the expected analog output values (actual values may vary within the calibration accuracy of the analog output channel, usually within 0.1%FS).

- Consider a sensor with a 2000 Nm full scale torque measuring range.
- Calibration values most likely to have been used will be (approximately):- 2000, 0 and +2000 Nm.
- The actual values used may have been adjusted to take account of local gravity and buoyancy and can be seen from the parameters #CALVALUE1, 2 and 3.
- Make a note of the actual values used and compare them to the values of #CALCNTS1, 2 and 3.
- The #CALCNTSx values store the digital counts values that were output by the rotor for the load conditions given by the relevant #CALVALUEx.
- The analog voltage output channel is 16-bit and it will generate an output of -12.5V when it is driven by a counts value of 0, and will generate an output of +12.5V when driven by a COUNTS value of 65535. Therefore each count generates 0.0003815V starting from a base of -12.5V.
- The analog voltage output will be generated in direct relationship to the statement above. Therefore, using the following data, the analog voltage output will be #CALVALUE1= -1998.699 #CALCNTS1= 21553.
- Therefore at a load of -1998.699 Nm, the analog Voltage will be

  (21553*0.0003815) -12.5V = -4.278V

  #CALVALUE2=0.000000 #CALCNTS2=32700.
- Therefore at a load of 0 Nm, the analog Voltage will be

  (32700*0.0003815) -12.5V = -0.026V

  #CALVALUE3=1998.500 #CALCNTS3=43842
- Therefore at a load of +1998.500 Nm, the analog Voltage will be

  (43842*0.0003815)-12.5V = +4.224V

Example 2 - Using the SHUNT CAL Feature

The SHUNT CAL feature operates by switching-in a high precision shunt resistor across one of the arms of the strain gage bride on the rotor. The change in output that occurs due to this shunting is repeatable and is often used as a means of calibration. During factory calibration, the apparent change in torque output due to SHUNT CAL will have been recorded, and this value can be used to re-calibrate the analog voltage output when in FASTMODE.

- Consider a sensor with a 2250 Lbf.in measuring range. The factory calibration certificate will include the changes due to SHUNT CAL as a list of effects such as follows:

Shunt Calibration							at Analog Output Settings		
		Lbf.in	V	mA	Hz (10)	Hz (60)	High	Low	Units
Shunt Cal	Gross	1692.2	7.553	18.025	13761	75043	2250	-2250	Lbf.in
	Zero	0	0.031	12.008	10000	60000			
	Nett	1692.2	7.522	6.017	3761	15043			
	%	75.21%	75.24%	75.21%	75.22%	75.22%			
Note: Hz (10) denotes 10 kHz range (10 kHz +/- 5 kHz), Hz (60) denotes 60 kHz range (60 kHz +/- 20 kHz)									

© 2012 – Honeywell International Inc. All rights reserved

- When in FASTMODE, the SHUNT CAL values for voltage, current and frequency are invalid because the scaling module is bypassed, so the only piece of information that remains valid and that we need to use from this data table is the apparent change in TORQUE due to SHUNT CAL, and in the case of this example, it is 1692.2 Lbf.in
- It follows that the change in analog voltage output when in FASTMODE will represent 1692.2 Lbf.in
- The exception to this case will be when a value has been set for #SCSCALE. This parameter allows the effect of SHUNT CAL to be varied, according to the value set. The default is 1 and any other value acts as a multiplier – but only when the scaling module is operating.
- For FASTMODE operation, the scaling module is bypassed so the effect of SHUNT CAL will be the original effect, as manufactured, and may be significantly different from the calibration certificate value.
- To compensate for any value of #SCSCALE, calculate as follows:
    - Certificated change in torque due to SHUNT CAL is 1692.2 Lbf.in Value set for #SCSCALE is 1.5
    - Actual change due to SHUNT CAL is 1692.2/1.5 = 1128.13 Lbf.in
    - If #SCSCALE is 1, then no calculation is necessary.

2.3 Analog Output Characteristics

The analog output channel is specified for a bandwidth of 3 kHz so there is no output filtering that follows the digital-to-analog converter (DAC). This can lead to a “stair casing” effect when the DAC is being updated at a relatively slow rate such as 1104 Hz.

For users that do not require wide bandwidth, this stair casing will not be a problem and can be eliminated from the measurement by applying a suitable sampling rate at the data acquisition end. Typically, a sampling rate of one quarter of the TMS 9250 DAC update rate (or less) would be sufficient to solve this problem.

For applications where the fidelity of the output waveform is of prime importance, the solution to stair casing is to add a filter network across the analog voltage output terminals.

When using FASTMODE, the DAC is being updated at a rate of 8828 Hz therefore stair-casing is reduced as a result of the much faster update rate.

© 2012 – Honeywell International Inc. All rights reserved

3. Calibration

3.1 System Calibration Method

The TMS 9250 features nine-point linearization and all calibration are achieved using the following parameters:

- #CalSteps
- #CalReset
- #CalValue1
- #CalValue2
- #CalValue3
- #CalValue4
- #CalValue5
- #CalValue6
- #CalValue7
- #CalValue8
- #CalValue9

The minimum number of calibration points is 2. Calibration points can be created in any order provided that the values they contain are in ascending order starting with #CalValue1. Therefore, the lowest or the most negative (counter-clockwise) calibration point should be designated as #CalValue1.

The number of calibration points that are in use is set by the parameter "#CalPoints". Any change to the value of #CalPoints should be followed by the issuance of a "#CalReset" command, to clear the old calibration values from the EEPROM memories.

Calibration is achieved by applying known loads at each of the calibration points that are selected for use and then writing the engineering units value to the appropriate #CalValuex parameter.

The analog outs are pre-calibrated in the factory, so calibration of the input to the required output range is automatic and is dependent on the values entered for the parameters:

- #AnOutHigh
- #AnOutLow

#AnOutHigh and #AnOutLow are written-to using the engineering unit's value at which the analog outputs are required to give the maximum and minimum outputs.

Available analog outputs are: Voltage range is –10 to +10 volts.

Current output range is 4 to 20 mA. Frequency range is 5 kHz to 15 kHz or alternatively, 40 kHz to 80 kHz.

© 2012 – Honeywell International Inc. All rights reserved

Calibration Example:

To calibrate from –100 to +100 Nm in five steps of -100, -50, 0, +50 and +100 Nm:

Set #CalSteps=5

#CalReset

- Apply -100 Nm and set #CalValue1=-100,
- Apply -50 Nm and set #CalValue2=-50
- Apply 0 Nm and set #CalValue3=0
- Apply +50 Nm and set #CalValue4=50
- Apply 100 Nm and set #CalValue5=100

To obtain a frequency output of 5 kHz at 10 Nm and 15 kHz at 80 Nm then the parameters would be #AnOutLow=10 and #AnOutHigh=80.

The device will then be fully calibrated. Note that for best results and to conform to accepted calibration practice, the unit under test should be exercised three times at the full load in the direction of loading prior to the setting of calibration points. This is especially important when calibrating in both the clockwise and the counterclockwise directions. Please contact the factory for a detailed description of calibration practice and procedure.

If an alternative analog output is selected at a later date, or if different settings are chosen for the #AnOutHigh/Low parameters later, it is not necessary to repeat the loading calibration because all analog outputs are digitally driven.

3.2 Shunt Calibration

An electrical signal equivalent to that produced by a known load can be obtained by activating the SHUNT CALibration function. The SHUNT CALibration function is built in to the sensor itself, and it is therefore necessary for the Rotor Active light to be showing before the function can be operated. By design, the caliper coupling module is more sensitive to receiving data than it is to transmitting data, therefore it may be necessary to adjust the caliper coupling module position to ensure good two-way communications, prior to using the SHUNT CAL function.

The SHUNT CALibration function is achieved by connecting a high-precision resistor of know value, in parallel (shunt) with one arm of the strain gage Wheatstone bridge. The connection is made by a solid state switch, under the control of the microprocessor on the rotating sensor, when commanded by the remote Signal Processing Module. This switch can be activated via the pushbutton on the face of the signal processing module. The SHUNT CALibration value is determined during factory calibration of the torque sensor.

The SHUNT CALibration function is a very useful aid when setting up the system or when fault finding. This function can be used as an alternative in applications where it is neither possible nor practical to perform dead weight system calibration. However, there can be some loss of calibration accuracy.

3.3 Recalibration

Recalibration should follow normal instrumentation certification schedule.

© 2012 – Honeywell International Inc. All rights reserved

4. Troubleshooting

The following is the sequence in which a typical installation should proceed:

4.1 "Power On" Light Not Showing

- Check that 12 VDC is being applied to the correct terminals (J1) and at the correct polarity.
- In certain cases, for example where the caliper coupling module has been left in direct contact with a metal surface for some time, the internal thermal protection circuit may have activated.
- To reset this condition, remove power and wait ten minutes before restoring power.
- Check whether the ribbon connection from the SPM digital board to the LED PCB back side of the LID connected as shown below in Figure 10.

4.2 "Rotor Active" Light Not Showing

- Check that the RF cable is in good condition and is of the correct length (look for damage to the outer sheath that may indicate that the cable has been crushed at some time).
- Check that the caliper coupling module has been correctly positioned in close proximity to the rotating antenna. Use the positioning guide that was supplied with the system to confirm the position. Move the caliper coupling module to try and achieve coupling in an alternative position.
- Check that there are no metal parts (flanges, covers, etc), within one and a half inches (40mm) of the caliper coupling surfaces.
- Check that the power supply is actually 12 VDC when the caliper coupling module is in the appropriate position (some power supplies have built-in protection circuits that cause a reduction in supply voltage when current demands increase) as shown in Figure 10.

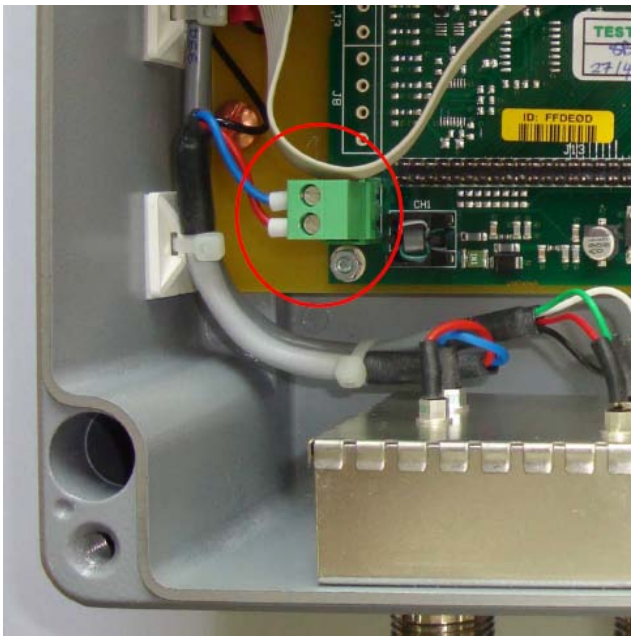


Figure 10**:** 12 VDC power supply checking

© 2012 – Honeywell International Inc. All rights reserved

- In case the SPM is removed during output configuration, check whether the ribbon connection from the SPM digital board to the LED PCB back side of the LID is connected as shown below in Figure 11.
- If after the above steps are followed, the rotor active LED is not glowing, then check for loose wires inside the SPM or contact the factory for technical support.

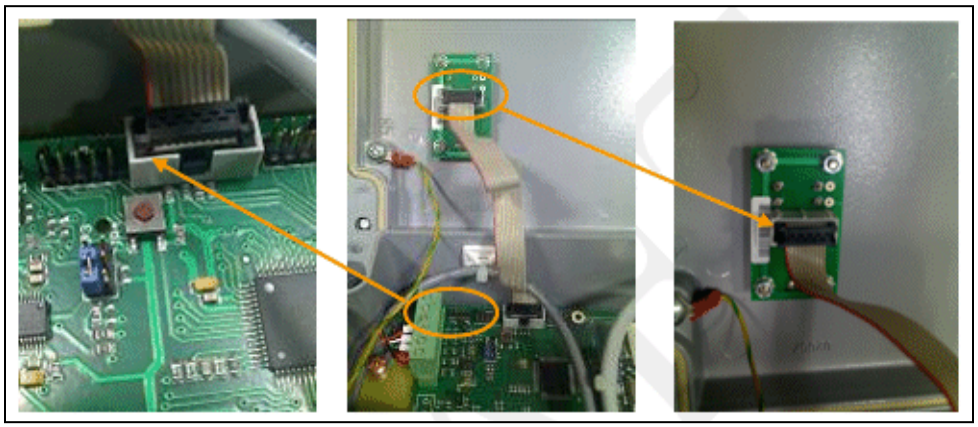


Figure 11: Left Digital Board, Middle Connection from LID to Digital Board, Right SPM LID

4.3 SHUNT Calibration Not Operating

- Check that the “Power LED” and “Rotor Active” light is showing green, prior to using the SHUNT CALibration function.
- Check that the RF cable is in good condition and is of the correct length (look for damage to the outer sheath that may indicate that the cable has been crushed at some time).
- Check that the caliper coupling module has been correctly positioned in close proximity to the rotating antenna. Use the positioning alignment tool supplied with the system to confirm the position. Move the caliper coupling module to try and achieve coupling and SHUNT CAL functionality in an alternative position.
- Check that there are no metal parts (flanges, covers, etc), within 2 inches (51 mm) of the caliper coupling surfaces.
- Check that the power supply is actually 12 VDC when the caliper coupling module is in the appropriate position.
- Make sure “scon” SHUNT CAL on command is not given in software Toolkit which will make SHUNT CAL on always. Type “scoff” command in the Toolkit window to switch off SHUNT CAL. Refer to the TMS Toolkit User Manual for more information.

4.4 No Communication

- Check all wiring.
- If using the RS232 port, check the Rx pin of the host computer is connected to the Tx pin of the TMS 9250 and vice versa.
- Check that the RS232 interface cable being used is of high quality or try a shorter length of cable (RS232 is sensitive to cable length and grounding issues, especially when used with laptop computers where grounding is uncertain).

© 2012 – Honeywell International Inc. All rights reserved

- Check that the correct serial port is selected in the software or TMS Toolkit. When using Windows, the serial port in use can be found by using the CONTROL PANEL, SYSTEM, HARDWARE, DEVICE MANAGER, COM ports functions.
- On older desktop computers, the COM1 port is already in use for the mouse, so a different COM port should be selected.
- If using a USB to Serial adapter, Windows assigns the COM port designations dynamically so they may change whenever the system is rebooted.
- The serial port settings are automatically modified by TMS Toolkit so there is no need to change any of the settings in Windows.
- The baud rate setting in TMS Toolkit should always be 38400 because that is the default baud rate of the TMS 9250.
- The “TMS ID” should be left blank because TMS Toolkit will search the connected port for any TMS device and will commence the communication automatically if present.
- Refer to the TMS Toolkit User Manual for more information.

© 2012 – Honeywell International Inc. All rights reserved

This page is intentionally left blank.

5. Product Specifications

Product Feature	Product Specification
Power Supply Adapter	Input 90~264 VAC 47~63 Hz 20 W Output 12 VDC 1.66 A
Signal Processing Module	12 V, 1 A
Protection	Short Circuit and over voltage protection
Warm-Up Time	30-45 minutes
Pollution Degree	3
Analog Output Signals	4-20 mA (zero torque = 12 mA) ± 10 VDC (zero torque = 0 V) 10 kHz ± 5 kHz (zero torque = 10 kHz) 60 kHz ± 20 kHz (zero torque = 60 kHz)
Output Drives Capability	Current: 4-20 mA: 400 Ω max including cable resistance Voltage: +/- 10 VDC: 2 k Ω min Frequency 10 kHz ± 5 kHz and 60 kHz ± 20 kHz: 4 V p-p for 100 k Ω and 2.3 V p-p for min load of 1 kΩ
Digital Resolution	Normal mode 16-bit (0.01 %FS)
RF carrier frequency	13.56 MHz
Accuracy	System 0.050% FS typical Note: 4-20 mA Current output drifts with input power supply change around the nominal 12 V
Temperature Range	Operating, Sensor and CCM Only -40 ˚ to 85 ˚C (-40 ˚ to 185 ˚F) Operating, SPM and Power Supply 0 ˚ to 40 ˚C (32 ˚ to 104 ˚F) Compensated -10 ˚ to +50 ˚C (14 ˚ to 122 ˚F) Storage temperature: The product can be stored for an indefinite period in a dry place at room temperature
Frequency Response	Input sampling rate 17,656 samples/sec Anti-aliasing filter fixed 4.1 kHz Telemetry update rate 8.828 kHz Fast mode data throughput rate 8.828 kHz Normal mode data throughput rate 1.104 kHz Group delay (typical, normal mode) 2.5 ms Group delay (typical, fast mode) 1.2 ms
Digital Filtering	IIR mode: Recursive algorithm with selectable filter levels and filter steps

© 2012 – Honeywell International Inc. All rights reserved

This page is intentionally left blank.

6. Appendices

The following section describes about different appendices related to the TMS 9250 Torque Measurement System.

Appendix A – Principle of Telemetry.

Appendix B – Supplement for TMS 9250 SPM Remote SHUNT CAL Option.

Appendix C – Supplement for TMS 9250 SPM Digital Filter Settings.

Appendix D – Supplement for Conversion Table.

Appendix E – Supplement for Power Supply Positioning, Product Grounding, & Cleaning Instructions.

Appendix F - Setting up the Cables for the Signal Processing Module (SPM).

Appendix G – Manual Supplement for TMS 9250 SPM SQUAREWAVE output Option

6.1 APPENDIX A

Principle of Telemetry

The digital telemetry system consists of a receiver-transmitter module, a caliper-style coupling module, and a signal processing module.

The receiver-transmitter module is an integral part of the torque sensor and is connected to the strain gauges and to the epoxy glass annular printed circuit board that contains the rotating antenna system. Within the receiver-transmitter module, the sensor signals are amplified, digitized, and are then used to modulate the radio frequency carrier wave that is detected by the antenna after being transmitted across the air gap by the caliper coupling module. That same carrier wave is rectified to provide power to drive the strain gauges and the electronic components in the module, which is managed by a miniature microprocessor.

The caliper coupling module connects to the signal processing module via a Tri-axial cable. The detector circuitry in the signal processing module recovers the digital measurement data from the torque sensor and passes it to the second microprocessor for scaling and linear zing.

The third microprocessor provides the drive to the two analog outputs, as well as the standard digital interfaces and the optional digital interface modules. Extensive facilities are provided in software for setup and configuration of the complete system.

6.2 APPENDIX B

Manual Supplement for TMS 9250 SPM Remote SHUNT CAL Option

This supplement provides information on the operation and specifications of the TMS 9250 SPM with the Remote SHUNT CAL Option.

Overview

The TMS 9250 SPM with Remote SHUNT CAL option allows the user to remotely activate and deactivate the SHUNT CAL mode via an external switch and cable.

Setup

The Remote SHUNT CAL option is installed and tested at the factory. A six-pin circular connector is mounted to the front panel of the SPM box as a connection point for the remote SHUNT CAL switch. A mating connector is provided so the user can attach a cable between the SPM and the customer supplied switch.

© 2012 – Honeywell International Inc. All rights reserved

Step	Action
a	Connect a two-conductor cable between the remote switch and the mating connector. Solder one conductor to pin A of the mating connector and the other conductor to pin B. Attach the strain relief to the connector.
b	Attach the mating connector to the six pin connector on the SPM
c	After setting up the sensor and caliper module, power on the SPM and verify the Power LED and the Rotor Active LED is lit on the top of the SPM. Turn on the remote SHUNT CAL switch and verify the SHUNT CAL Mode LED is lit on the top of the SPM. Turn off the remote SHUNT CAL switch and verify the SHUNT CAL Mode LED turns off.
d	Setup of the Remote SHUNT CAL Option is complete.

6.3 APPENDIX C

Digital Filter Setting Supplement

This supplement is intended for the purpose of describing the function and operation of the digital filtering algorithms that are included in the TMS 9250 v.1.38 firmware and above. It should be used in conjunction with the TMS 9250 TMS Toolkit User Manual supplied with a TMS 9250 Torque Measuring System.

Filter Operation General Description

The digital filter algorithm in the v1.38 firmware and above version of the TMS 9250 is a recursive filter that behaves like an “RC” circuit. It has two user settings, the first being a “level” set by the parameter **FiltLevel**, and the second being a filter “weight”, set by the parameter **FiltSteps.**

The “level” works as a threshold, above which the filter is reset to allow a fast response to an event that exceeded the threshold. This is useful in the case when well-damped steady state data is required, but when significant fast transients and disturbances should not be filtered out.

The “weight” of the filter is set by increasing the number of filter steps, which in turn increases the time constant of the RC filter, increasing the damping effect. The settings of any of the TMS 9250 parameters can be changed at any time via the RS232 communications link. Changing parameters while the system is running will take effect immediately, and in the case of filter setting changes, will become effective as soon as the filter flushes through. The TMS Toolkit software, supplied with the TMS 9250 system, simplifies the task of changing settings, although any character-based communications software could be used instead (e.g. HyperTerminal).

Filter Operation Detailed Description

Consider the input signal as being Vi and the output signal being Vo.

- In a steady state situation, Vo will equal Vi.
- When Vi changes, the extent of the change is compared with the threshold, which is set as a proportion of the full scale sensitivity, by the parameter **FiltLevel**.
- If the change exceeds the threshold, then the new input value is passed immediately to the output, thereby resetting the filter.
- If the change does not exceed the threshold, then the output value Vo is updated by a fractional amount of the new value Vi until the output value equals the input value

© 2012 – Honeywell International Inc. All rights reserved

again. The number of steps set by FiltSteps determines the number of fractional steps that are taken to increment the output value, according to the following series :

1 / 2, 1 / 3, 1 / 4, 1 / 5 ….etc.

- The output characteristic is therefore exponential and behaves in a predictable manner.
- To determine the settling time of the filter (the time taken to reach the Vo = Vi condition), it is necessary to know both the filter update rate and the number of fractional steps. The filter update rate is fixed at 1104 Hz in the version v1.38 software and above.
- The cut-off point (in Hz) is given by the following expression

  Frequency (-3dB) =update rate / number of steps / 6.3.
- Table 1 below provides a quick reference to determine the filter characteristic Note that this filter operates only when the change in the input is below the threshold set by **FiltLevel**.

Filter Settling Time

The time required for the output to settle following a step change in input level is given by the following table.

Table 1: Filter Settling Time

% of Final Value	Time to Settle
63 %	Filter Update Period * FiltSteps
99 %	Filter Update Period * FiltSteps * **5**
99.9 %	Filter Update Period * FiltSteps * **7**

Where the Filter Update Period is the period in seconds (1/f), fixed at 0.000906s for software v1.38

AND

Where the change in input signal magnitude is **below** the threshold set by **FiltLevel.**

© 2012 – Honeywell International Inc. All rights reserved

Example

The following is an example of typical filter settings as applicable to a standard production TMS 9250 torque measuring system.

- Consider a sensor with a 1000 Nm full scale torque measuring range.
- Consider a test running at steady state torque of 550 Nm.
- Consider **FiltLevel** set at 1000. The unit of measure for **FiltLevel** approximates to 0.01%FS (where FS is the full scale of the sensor), therefore a **FiltLevel** of 1000 sets a threshold of change of 10% of FS which in this example is 100 Nm, above which the filter is reset and the output value becomes equal to the input value again. Note that the threshold is with respect to the current value, and not with respect to zero torque. Therefore, if the torque is fluctuating within a band of less than 100 Nm, the filter performance will be determined by FiltSteps alone.
- In the case where torsional vibrations and spikes may be present in the input signal, then the threshold set by **FiltLevel** should be raised so that the filter is not being reset by events which are not of interest. A safe value to use when setting up is 5000, which corresponds to 50% of FS, then reduce the threshold later if required.
- Now consider an input change of 0.1 Nm, which is below the threshold and therefore subjected to filtering. The difference between the input and the output is 0.1 Nm so this is the change that will be used by the filter comparator.
- If the **FiltSteps** parameter is set to 10, then the output of the TMS 9250 will be incremented towards the input in 10 steps, as follows:

  1 / 2(0.1 Nm), 1 / 3(0.1 Nm), 1 / 4(0.1 Nm), 1 / 5(0.1 Nm), . . 1 / 9(0.1 Nm), 1 / 10(0.1 Nm)
- The filter update rate being 1104 Hz gives an update period of 1/1104=0.000906 seconds, therefore the filter will settle to 63% of its final value in 0.00906 seconds (being 0.000906 * **FiltSteps**).
- Using the formula described in Table 1, it can be seen that the filter will settle to within 99.9% of its final value in 0.063 seconds (being 0.000906 * **FiltSteps** * 7)

Table 2: Quick look up table

Desired Settling Time to 99.9% of Final Value (seconds)	**Equivalent to Cut-Off Frequency of (Hz)**	**FiltSteps setting required**
6.3 s	0.18 Hz	1000
3.2 s	0.35 Hz	500
1.3 s	0.88 Hz	200
0.63 s	1.75 Hz	100
0.32 s	3.50 Hz	50
0.13 s	8.76 Hz	20
0.063 s	17.5 Hz	10
0.032 s	35.0 Hz	5
0.013 s	87.6 Hz	2
0.006 s	175 Hz	1

© 2012 – Honeywell International Inc. All rights reserved

Note:

The setting of **FiltLevel** is of great importance when adjusting the filter settings. Unexpected torsional spikes and vibration noise can cause the frequent resetting of the filter. If in doubt, increase FiltLevel (range 1 through 100000).

When FiltLevel=1, the filter is bypassed and the torque value is delivered to the output processor at a rate of 2207 Hz, thereby providing a 3dB cut-off of 350 Hz

When **FiltLevel=1** and **FastMode=1**, the scaling and linearizing algorithms are bypassed and the raw ADC count value is delivered to the output processor at a rate of 8828 Hz, thereby providing a 3 dB cutoff of 1400 Hz. It should be noted that **FastMode** is a volatile setting and will be reset to 0 whenever the power is recycled or when a reset is performed.

To calculate the setting of **FiltSteps** required for a particular 3dB cut-off frequency, use:

FiltSteps = Update rate in Hz / (Desired cut-off Frequency * 6.3)

To calculate the 3dB cut-off frequency for a particular setting of FiltSteps, use:

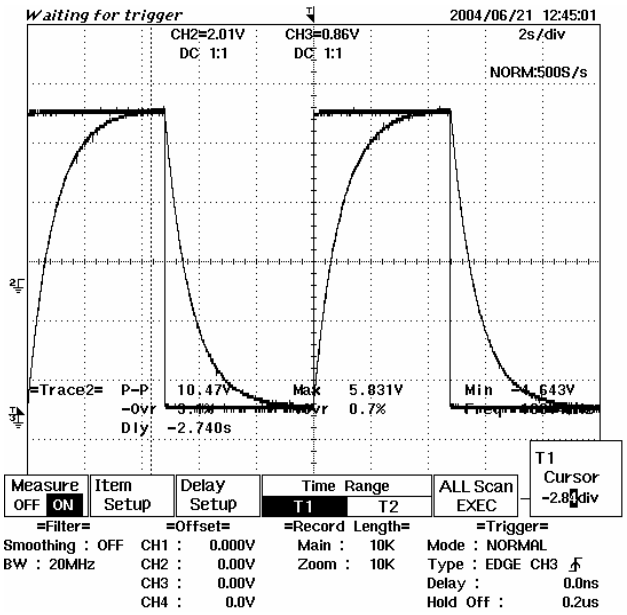
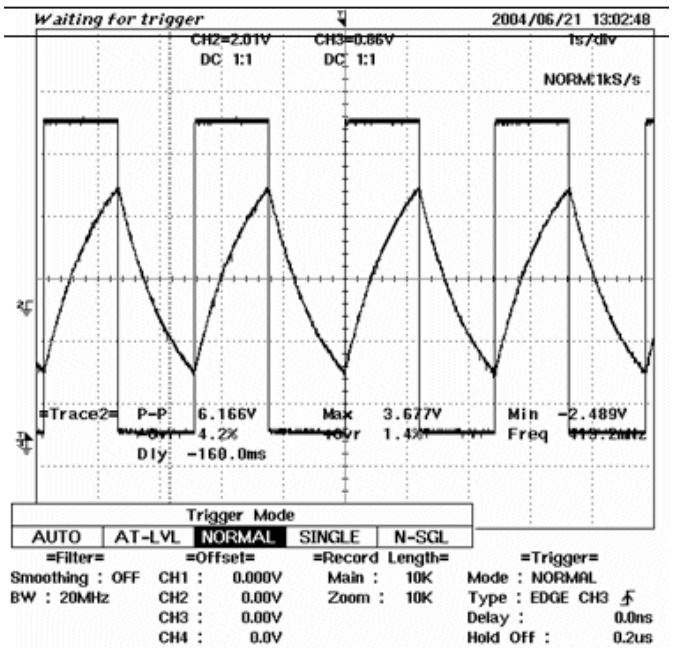
Frequency = Update rate in Hz / FiltSteps / 6.3

Note:

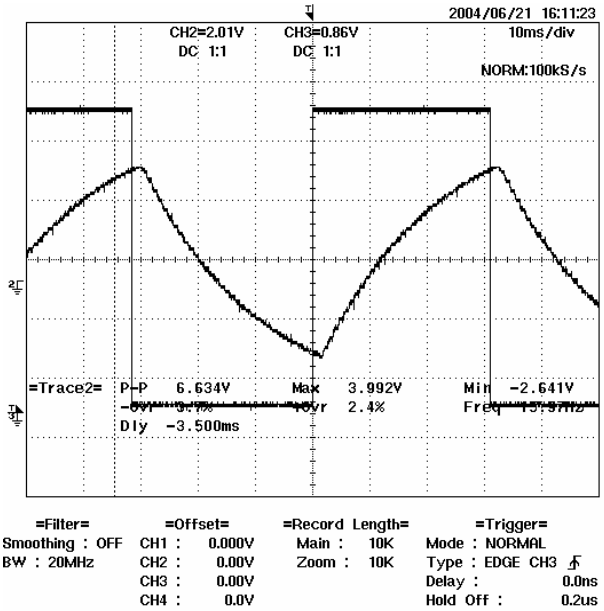
The 3 dB point is also known as the half power point and occurs when the amplitude of the output is equal to 71% of the input.

© 2012 – Honeywell International Inc. All rights reserved

Sample Charts

	INPUT : Square Wave, 0.1 Hz OUPUT : Analog Voltage **FiltLevel**=10000 **FiltSteps**=1000 Settling time to 99% is given by 5 * 0.001 * 1000 = 5 seconds
	INPUT : Square Wave, 0.4 Hz OUPUT : Analog Voltage **FiltLevel**=10000 **FiltSteps**=1000 Settling time to 99% is given by 5 * 0.001 * 1000 = 5 seconds Therefore overdamped response, only reaching 60% of full scale p-p value

© 2012 – Honeywell International Inc. All rights reserved



INPUT : Square Wave, 16 Hz
OUPUT : Analog Voltage
FiltLevel=10000

FiltSteps=38

Settling time to 63% is given by

0.001 * 38 = 0.038 seconds

Therefore over damped response

© 2012 – Honeywell International Inc. All rights reserved

6.4 APPENDIX D

Conversion Table

Imperial-Metric Conversion

Foot-pounds	inch-pounds	Nm
1	12	1.35575
2	24	2.7115
3	36	4.0673
4	48	5.4230
5	60	6.7788
6	72	8.1345
7	84	9.4903
8	96	10.846
9	108	12.202
10	120	13.558
20	240	27.115
30	360	40.673
40	480	54.230
50	600	67.788
60	720	81.345
70	840	94.903
80	960	108.46
90	1080	122.02
100	1200	135.58
200	2400	271.15
300	3600	406.73
400	4800	542.30
500	6000	677.88
600	7200	813.45
700	8400	949.03
800	9600	1084.6
900	10800	1220.2

© 2012 – Honeywell International Inc. All rights reserved

Imperial - Metric Conversion

Foot-pounds	inch-pounds	Nm
1000	12000	1355.8
2000	24000	2711.5
3000	36000	4067.3
4000	48000	5423.0
5000	60000	6778.8
6000	72000	8134.5
7000	84000	9490.3
8000	96000	10846
9000	108000	12202
10000	120000	13558
20000	240000	27115
30000	360000	40673
40000	480000	54230
50000	600000	67788
60000	720000	81345
70000	840000	94903
80000	960000	108460
90000	1080000	122018
100000	1200000	135575

© 2012 – Honeywell International Inc. All rights reserved

Metric-Imperial Conversion

Nm	inch-pounds	foot-pounds
1	8.85119	0.73760
2	17.702	1.4752
3	26.554	2.2128
4	35.405	2.9504
5	44.256	3.6880
6	53.107	4.4256
7	61.958	5.1632
8	70.810	5.9008
9	79.661	6.6384
10	88.512	7.3760
20	177.02	14.752
30	265.54	22.128
40	354.05	29.504
50	442.56	36.880
60	531.07	44.256
70	619.58	51.632
80	708.10	59.008
90	796.61	66.384
100	885.12	73.760
200	1770.2	147.52
300	2655.4	221.28
400	3540.5	295.04
500	4425.6	368.80
600	5310.7	442.56
700	6195.8	516.32
800	7081.0	590.08
900	7966.1	663.84

© 2012 – Honeywell International Inc. All rights reserved

Metric-Imperial Conversion

Nm	inch-pounds	foot-pounds
1000	8851.2	737.60
2000	17702	1475.2
3000	26554	2212.8
4000	35405	2950.4
5000	44256	3688.0
6000	53107	4425.6
7000	61958	5163.2
8000	70810	5900.8
9000	79661	6638.4
10000	88512	7376.0
20000	177024	14752
30000	265536	22128
40000	354048	29504
50000	442559	36880
60000	531071	44256
70000	619583	51632
80000	708095	59008
90000	796607	66384
100000	885119	73760

© 2012 – Honeywell International Inc. All rights reserved

6.5 APPENDIX E

Power Supply Positioning and Cleaning

This supplement provides information on positioning information on positioning the power supply and cleaning instructions.

Step	Action
Positioning the Power Supply	Place the power supply of the system in a place where you can easily unplug the power cords.
Cleaning the system	
Step	**Action**
Step1: Disconnect Power	Disconnect the power supply from the system. Wait for rotating parts to come to stand still
Step2: Clean Components	Clean the Power supply adapter, SPM, CCM and Rotor with dry cloth.
	**ATTENTION:** Do not use any chemicals to clean the system.
Product Grounding	
Step	**Action**
Product Grounding	• Shield of all the output signal shall be connected to SPM side (refer to step 4.c of APPENDIX F) and let floating on data acquisition side. • Third pin of power supply adapter must and shall be connected to earth. • CCM shall be left floating.

© 2012 – Honeywell International Inc. All rights reserved

6.6 APPENDIX F

SPM cable connections

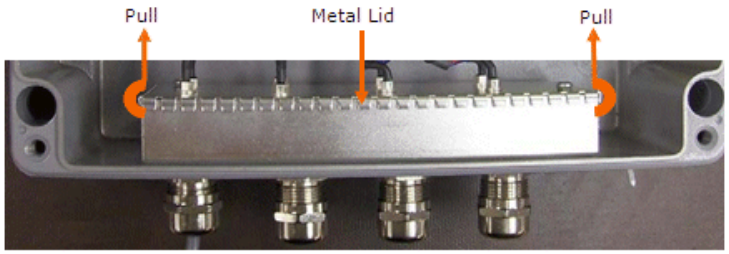
Setting up the cables involves the following steps.

	ATTENTION: The interface cables must be shielded type and connected to product end only.

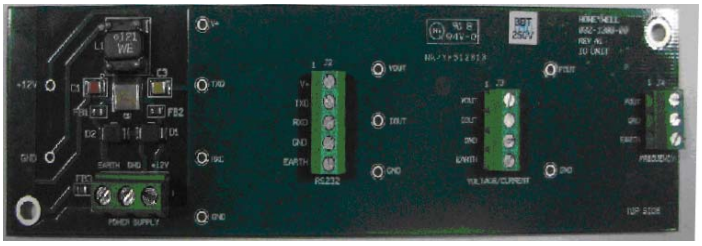
Step 1: Removing the Cover of the SPM Box	
Step	**Action**
Step 1a: Opening SPM	Keep the SPM on table with ESD plane, and wear the ESD strap. Open the cover of the SPM box by removing the screws.
	

© 2012 – Honeywell International Inc. All rights reserved

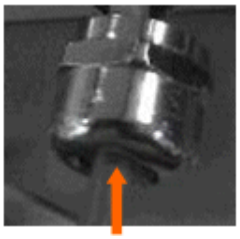
Step 1b: View SPM Base Unit	After removing the cover, you can see the base unit of the SPM in the following figure.
	

Step 2: Removing the Metal Lid in the SPM Box	
Step	**Action**
Step 2a: Remove Metal Lid	Hold the metal lid at the end and then remove as shown in the following figure.
	

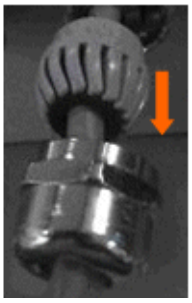
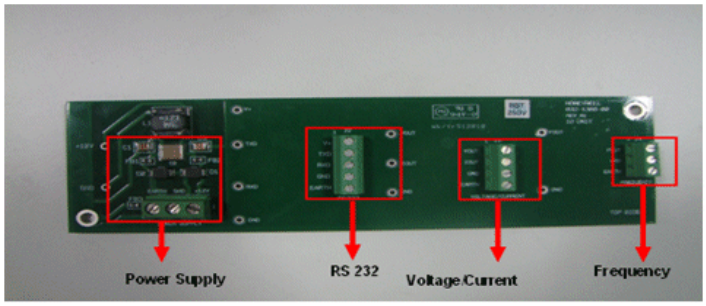
© 2012 – Honeywell International Inc. All rights reserved

Step2b: View Printed Circuit Board	After removing the metal lid, you can see the printed circuit board as shown in the following figure.
	
Step 3: Removing the Glands You must remove the glands before connecting the wires to the printed circuit board.	
Step 3a: Remove Screws	Turn the screws of the metal glands in the counter clockwise direction using the pliers and remove it as shown in the following figure
	

© 2012 – Honeywell International Inc. All rights reserved

Step 3b: Remove Plastic Cover	Remove the plastic cover as show in the following figure.
	
Step 4: Inserting the Cables You must insert the cables into connectors such as Analog Voltage/ Current, and Frequency.	
Step 4a:	Insert the cable into the metal gland as show in the following figure.
	

© 2012 – Honeywell International Inc. All rights reserved

Step 4b: Insert Cable Into Plastic Cover	Insert the cable into the plastic cover as show in the following figure.
	
Step 4c: Connect Wire	Insert the braid shield of cable into metal gland and make sure that clips are in contact with braid as in the following figure for proper grounding.
	
Step 5: Connecting the wires to the Printed Circuit Board (PCB)	
	After inserting the cables into glands, you must connect the wires to the respective connectors, inside the printed circuit board as shown in the figure below. Strip off about ¼" of insulation from the wires and tin the ends with solder. The exposed shield of cable is twisted sleeved with appropriate rubber or heat shrink tuning. Make sure 1/4" of the shield is exposed and connect to EARTH at the respective pins of the connectors.
	
	ATTENTION: RS 232 is the only cable supplied with the product.

© 2012 – Honeywell International Inc. All rights reserved

Step 5a: Connect Wires To Connectors

Loosen the screws of the connectors on the PCB and connect the respective wires to the connectors by referring to the below table.

Connector Details		Pin Details	Description
J1	Power Supply	+12V	+12VDC
		GND	0VDC
		EARTH	Shield/Braid

ATTENTION:

By default, the power supply cable is connected.

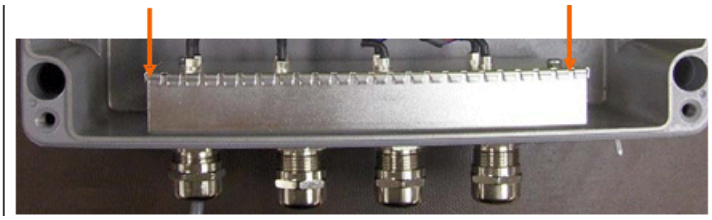
Connector Details		Pin Details	Description
J2	RS232	V+	No connection
		TXD	2
		RXD	3
		GND	5
		Earth	0

Connector Details		Pin Details	Description
J3	Analog Voltage / Current	Vout	Voltage / Current Output
		Iout	No Connection
		GND	Signal Ground (0V)
		EARTH	Shield/Braid

ATTENTION:

The output depends on OPTYPE value configured using TMS Toolkit for TMS 9250.

© 2012 – Honeywell International Inc. All rights reserved

<table>
<tr><td></td><td>
<table>
<tr><th colspan="2">Connector Details</th><th>Pin Details</th><th>Description</th></tr>
<tr><td rowspan="3">J4</td><td rowspan="3">Frequency</td><td>Fout</td><td>Frequency Output</td></tr>
<tr><td>GND</td><td>Signal Ground (0V)</td></tr>
<tr><td>EARTH</td><td>Shield/Braid</td></tr>
</table>
</td></tr>
<tr><td>Step 5b: Tighten Screws</td><td>After connecting the wires to respective connectors, tighten the screws.</td></tr>
<tr><td></td><td>ATTENTION:
The output depends on OPTYPE value configured using TMS Toolkit for TMS 9250. Refer to the TMS Toolkit User Manual for more information.</td></tr>
<tr><td colspan="2">Step 6: Closing the Metal Lid inside the SPM Box</td></tr>
<tr><td>Step 6a: Close Metal Lid</td><td>Hold the metal lid at the end and push the LID then close it as shown in the figure below.</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">Step 7: Closing the Glands</td></tr>
<tr><td></td><td>After closing the metal lid inside the SPM box, you must tighten the gland.</td></tr>
<tr><td>Step 7a: Reposition Plastic Cover</td><td>Put the plastic cover as shown in the figure below.</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Step 7b: Tighten Metal Gland</td><td>Put the metal gland and tighten in the clock wise as show in the figure.</td></tr>
</table>

© 2012 – Honeywell International Inc. All rights reserved

	
Step 8: Closing the Metal Cover of the SPM Box	
	After closing the glands, you must close the top cover of the SPM box.
Step 8a: Replace top Cover	Replace the top cover on the base of the SPM box.
Step 8b: Replace Screws	Insert the screws into the screw holes and tighten it.

6.7 APPENDIX G

Manual Supplement for TMS 9250 SPM SQUAREWAVE output Option

This supplement provides information on the operation and specifications of the TMS9250 SPM with the Square Wave Output Option

Overview

The Square Wave Output Option is a plug-in module for the SPM that converts the sine-wave analog frequency output of the SPM to a square wave that is compatible with most RS-422 and RS-485 type inputs to data acquisition systems and frequency/pulse counters. The frequency of the square wave is equal to the frequency of the standard sine wave output. The square wave output is available in three formats: positive phase (TTL level), differential (+/- 5 VDC), and negative phase (TTL level, 180 degrees out of phase compared to positive phase).

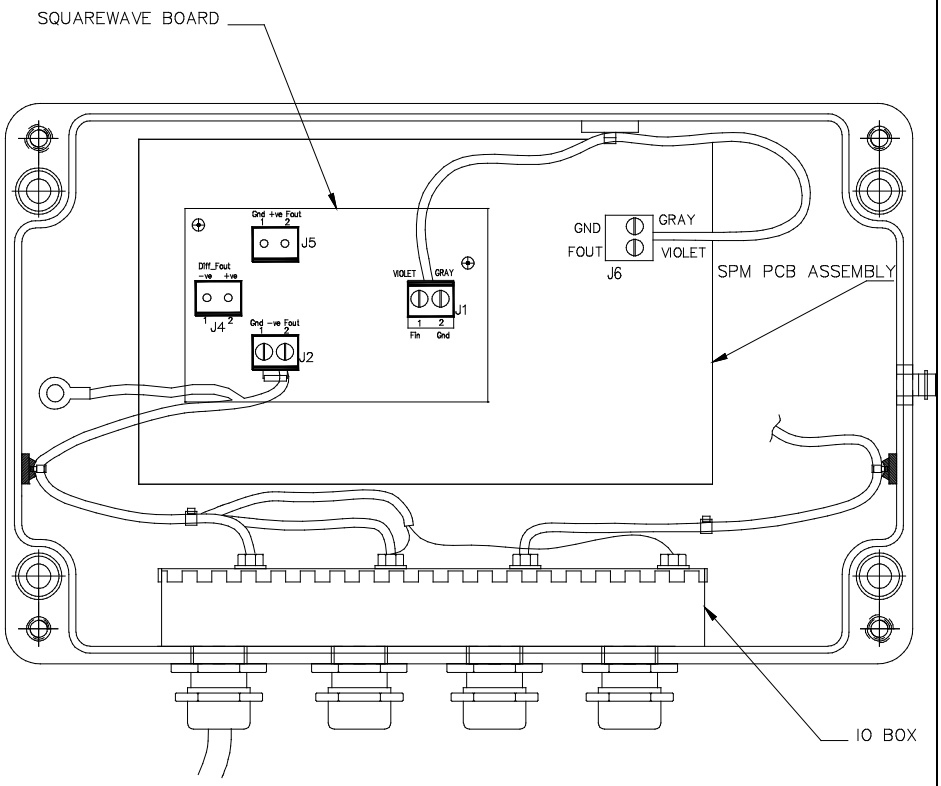
Setup

The Square Wave Output Option is installed and tested at the factory. Two core shielded cables shall be used where one end is inserted in to frequency gland and the other end of the cable is connected to customer supplied data acquisition system (DAQ) counter or other device. The output impedance of square wave card is 120 ohm. The following steps describe the process of connecting the SPM option board to the DAQ or counter.

Step	Action
1	Be sure the AC/DC power supply module is not connected to a power source.
2	Place the SPM on a flat workbench or table, preferably with an ESD-safe mat or cover to dissipate electrostatic voltages. Wear an ESD-safe grounded wrist strap while working inside the SPM box.
3	Carefully remove the four screws of the SPM cover and slowly lift the cover off the SPM. Take care not to damage the ribbon and ground wires connected to the inside of the cover.
4	The square wave option module is installed just to the right of J3 and J8 on the main circuit board. A 2-core cable connects J6 of the main board

© 2012 – Honeywell International Inc. All rights reserved

Step	Action
	(frequency output) and the J1 (frequency input) on the option board.
5	Determine the desired output type. On the option board, the negative phase output is J2, differential output is J4, and positive phase is J5 as shown in the figure below. Customers must pull the green connector and swap between J2, J4 and J5 for desired output.



ATTENTION

Do not interchange J1 with J2 or J4 or J5.

Refer to APPENDIX F for detail cable connections to SPM.

6	Route the cable from the DAQ system through the Frequency cable gland on SPM labeled “Frequency” to the desired length. Strip off about ¼” of insulation from the wires and tin the ends with solder. Connect one wire of core to V+ terminal of RS232 connector and another wire to FOUT terminal of the FREQUENCY connector present on the IO PCB. Refer to steps 2a and 2b of APPENDIX F for accessing to IO board connectors. The remaining exposed shield of cable is twisted sleeved with appropriate rubber or heat shrink tubing. Make sure 1/4" of the shield is exposed and connect to the EARTH pin of the FREQUENCY connector present on the IO PCB. Loosen the screws on the connector, slide the wires into the connector, and tighten the screws. Following table specifies output signal for square wave configuration.

IO board Pin	Output Designation
V+ on J2	Positive / Negative phase square wave output OR Positive phase differential output

© 2012 – Honeywell International Inc. All rights reserved

Step	Action			
		Fout on J4	Gnd OR Negative phase differential output	
7	Close the IO box lid firmly and tighten the frequency cable gland.			
8	Re-attach the SPM cover and tighten the cover screws.			
9	Continue with system installation as described in the TMS9250 user manual.			

WARRANTY/ REMEDY	Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship. Honeywell's standard product warranty applies unless agreed to otherwise by Honeywell in writing; please refer to your order acknowledgement or consult your local sales office for specific warranty details. If warranted goods are returned to Honeywell during the period of coverage, Honeywell will repair or replace, at its option, without charge those items it finds defective. **The foregoing is buyer's sole remedy and is in lieu of all other warranties, expressed or implied, including those of merchantability and fitness for a particular purpose. In no event shall Honeywell be liable for consequential, special, or indirect damages.** While we provide application assistance personally, through our literature and the Honeywell web site, it is up to the customer to determine the suitability of the product in the application. Specifications may change without notice. The information we supply is believed to be accurate and reliable as of this printing. However, we assume no responsibility for its use.
SALES AND SERVICE	Honeywell serves its customers through a worldwide network of sales offices, representatives and distributors. For application assistance, current specifications, pricing or name of the nearest Authorized Distributor, contact your local sales office or: **E-mail:** info.tm@honeywell.com **Internet:** http://measurementsensors.honeywell.com **Phone and Fax:** Tel: 614-850-5000 Fax: 614-850-1111

© 2012 – Honeywell International Inc. All rights reserved