Honeywell

TMS 9250 Product User Manual

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About This Document

Release Information

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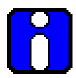
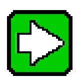
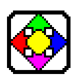
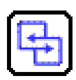
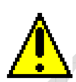
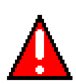
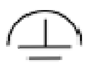
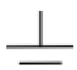
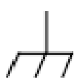
TMS 9250 Product User Manual		V 1.0	May 2011

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 bookset.
	**REFERENCE - INTERNAL:** Identifies an additional source of information within the bookset.
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. **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.
	**WARNING, Risk of electrical shock**: Potential shock hazard where HAZARDOUS LIVE voltages greater than 30 Vrms, 42.4 Vpeak, or 60 VDC may be accessible.

Symbol	Definition
	**ESD HAZARD:** 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.

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1. TMS 9250 Torque Measurement System

1.1 Important safety

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.

⚠	**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.
⚠	**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 other power supply with this system is prohibited and may result in electrical shock or fire hazards. • The CCM is intended only for connection to the SPM with cables provided by the manufacturer. • Refer to the Appendix-E for connecting cables to the SPM. • This equipment provides only low voltage double insulated signal I/O for connection to other equipment.

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 enhance 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

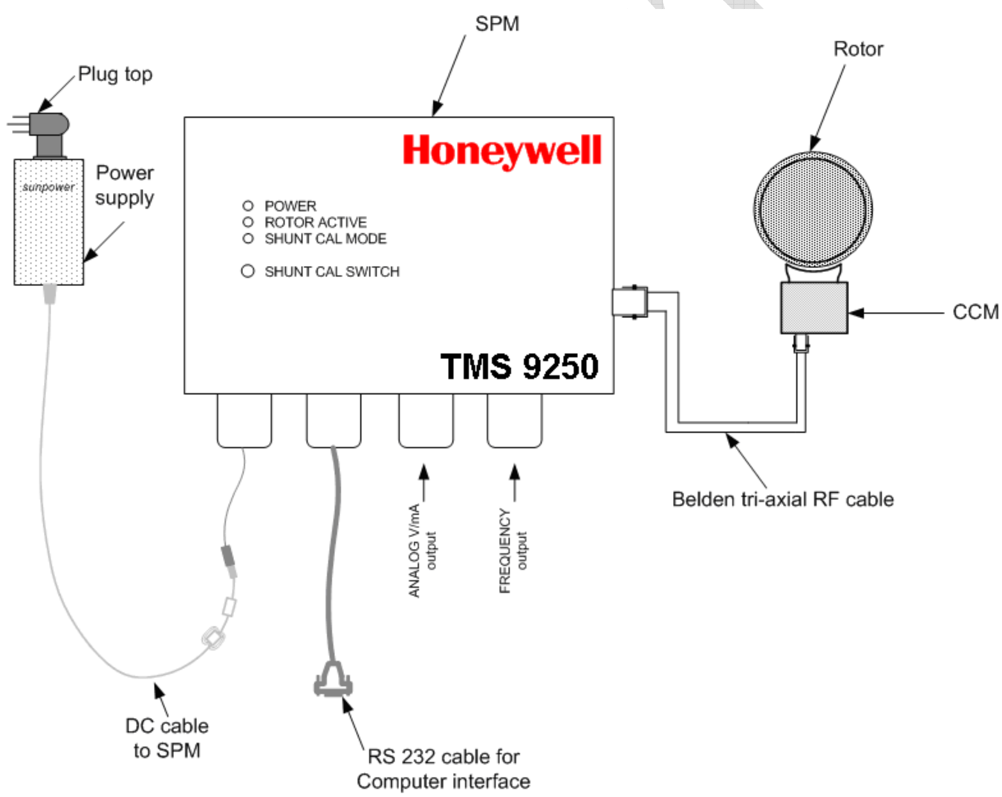
- Place the power supply of the system in a place where you can easily unplug the power cords.

1.2 Certification information

Certification	FCC ID: **XJLTMS9250FCC** 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
EMC	Product is meeting EMC/EMI requirement as per following standard • Class-B FCC § 15.225(a) • Class B FCC § 15.225(d) • Class B FCC § 15.207 • Class-B EN 301 489-1 • Class B EN 300 330 -1
Saftey	Product is meeting saftey requirement as per following standard • EN 60950 • EN 61010

1.3 In The Box

- Plug top
- Power supply
- SPM
- Rotor
- CCM
- RF cable
- RS-232 cable
- Alignment Tool



1.4 Intended Use

Torque Sensor

Lebow Torque Sensors are designed structures that perform in a predictable and repeatable manner when a torque is applied. This torque 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 on the structure.

The strain gages are connected in a 4 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.

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 linearizing.

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.

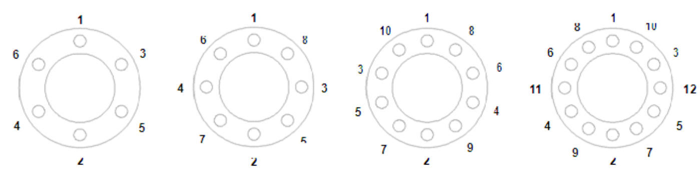
Usage scenario of TMS 9250

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

Refer to the cleaning instructions provided in the Appendix D.

1.5 Installation and Setup

To create DSN using EBIDataSource:

Step	Action
Bolting Information	Tighten all bolts, in incremental steps, to the bolt manufacturers rated torque specification. Use the respective sequence illustration shown below depending on the number of bolts the sensor requires. This bolting sequence applies to both bolt circles of the torque sensor. 
Torque Sensor	The TMS 9250 series torque sensors may be operated horizontally, vertically, or 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 industrial couplings. 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.

Step	Action
Caliper Coupling Module	The caliper coupling module must be firmly mounted to a non-rotating support structure. It must be aligned with the epoxy glass annular printed circuit board antenna so that the air gap between the 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 +/- 4.5mm (+/- 3/16”) and for run-out (radial) are +/- 1.0mm (+/- 1/16”). 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 tool kit returning 100% result. 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 mustuse tri-axial cable only of length 14.6 meters (47’11’’ feet) supplied with the product.

Step	Action
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. Request appropriate certified drawing from Lebow before making fixtures. 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.
Electrical connection	As mentioned in table below. Refer to Appendix E for SPM IO box connections
Powering of device	After all the connection are completed then system shall be power and allowed for 30-45min warm-up time for stable output

Connector	Function
J1	DC Power 12 V
J2	Primary RS485 port
J3	Secondary RS485 port
J4	Current loop output
J5	Voltage output
J6	Frequency output
J7	Primary RS232 port **NOTE - THIS IS THE DEFAULT COMMUNICATIONS PORT**
J8	Secondary RS232 port
J9	Factory use only
J10	Factory use only
J11	
J12	
J13	Expansion port
J14	Memory expansion port
JP1	Primary RS232/RS485 default select
JP2	Secondary RS232/RS485 default select
JP3	
JP4	

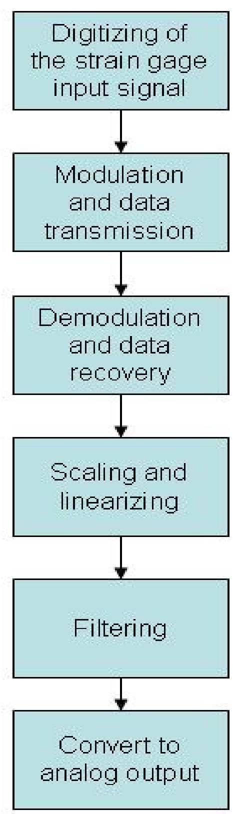
2. Modes of Operation

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 linearizing 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 output) using the output scaling parameters that are independent from the input calibration.

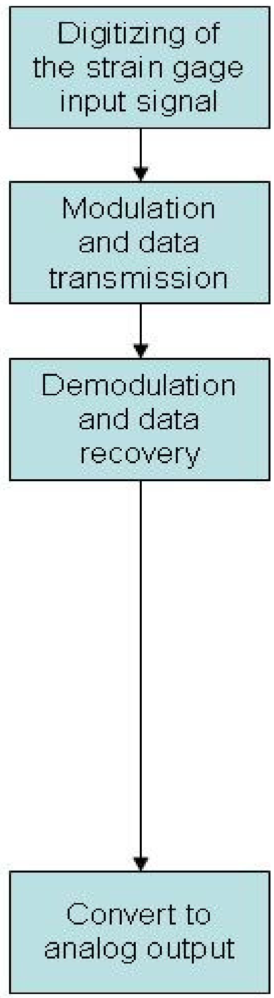
The rate at which the microprocessor can perform the separate linearizing and scaling calculations is the limiting factor in determining the available bandwidth of the TMS 9250.

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 penalty of using fastmode is that the scaling and linearizing 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 calculate the expected change in output value (by reference to the calibration data stored in the TMS 9250), or perform a physical system calibration or to use the SHUNT CAL feature.

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 Signal processing Modules (SPM) is de-activated.

2.2 Fast mode operation detailed description

Fast hmode operation

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.

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.

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 also given later.

Normal mode and FASTMODE data update rates

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 Note that the analog voltage output channel should be only channel is use for any data rate above 1104 results per second. Therefore OPTYPE should be set to 1. Note that 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 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 2000Nm 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 -10V when it is driven by a counts value of 0, and will generate an output of +10V when driven by a COUNTS value of 65535. Therefore each count generates 0.0003052V starting from a base of -10V.

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*0.0003052)-10V = -3.422V

#CALVALUE2=0.000000 #CALCNTS2=32700

Therefore at a load of 0 Nm, the analog Voltage will be (32700*0.0003052)-10V = -0.020V

#CALVALUE3=1998.500 #CALCNTS3=43842

Therefore at a load of +1998.500 Nm, the analog Voltage will be (43842*0.0003052)-10V = +3.381V

Example 2 - Using the SHUNT CALIBRATION 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	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)									

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 “staircasing” effect when the DAC is being updated at a relatively slow rate such as 1104Hz.

For users that do not require wide bandwidth, this staircasing 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 staircasing 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 staircasing is reduced as a result of the much faster update rate.

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 precalibrated 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 units 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

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. To provide for this eventuality, the shunt calibration value is factory-set to represent between 50% and 95% of full scale. This is achieved using high grade resistors that exhibit very low thermal sensitivity.

3.3 Storage and Recalibration

This torque measurement system may be stored for an indefinite period in a dry place at room temperature. Recalibration should follow normal instrumentation certification schedule.

4. Troubleshooting

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

4.1 “Power On” light is not showing

- Check that 12VDC 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.

4.2 “Rotor Active” light is 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.

4.3 Shunt calibra-tion does not operate

- Check that the “Rotor Active” light is showing, 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 guide that was 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 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 demand increase).

  Make sure "scon" shunt cal on command is not given in software tool kit. Which will make shunt cal on always. Type in scoff in the tool kit to switch off shunt cal. Refer to the TMS Tool kit User Manual for more information.

4.4 Cannot communicate.

- Check all wiring.
- If using the RS232 port, check that the Rx pin of the host computer is connected to the Tx pin of the TMS 9250 and vice versa.
- Check that the communications 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).
- 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 PC's, 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

5. Product Specifications

Product Feature	Product Specification
Power supply	• 90~264V AC 47~63 Hz
Protection	• Short Circuit and over voltage protection
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	• 4-20 mA 400 Ohms max including cable resistance • +/- 10 VDC 2 k Ohms min • Frequency 4 V p-p for 100 k Ohms 2.3 V p-p for min load of 1k Ohms
Digital resolution	• Normal mode 16-bit (0.01 %FS) • Hi-res mode 19-bit (0.001 %FS) RF carrier frequency 13.56 MHz
Accuracy	• System 0.050% FS typical* • *4-20mA Current output drifts with input power supply change around the nominal 12V
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) • 008-0738-00
Frequency response	• Input sampling rate 17,656 samples/sec • Anti-aliasing

	• filter fixed) 4.1kHz • Telemetry update rate 8.828 kHz • Fast mode data • throughput rate 8.828 kHz • Normal mode data • throughput rate 1.104 kHz • Analog output • bandwidth (max) 3 kHz @ -3 db • Group delay (typical, • normal mode) 2.5ms • Group delay (typical, • fast mode) 1.2ms
Digital filtering	• FIR mode 0.1 through 1000 Hz • IIR mode recursive algorithm

6. Appendices

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

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

Measurement System.

Appendix A – Supplement for TMS 9250 SPM Remote Shunt Cal Option.

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

Appendix C – Supplement for Conversion table.

Appendix D – Supplement for power supply positioning, product grounding and cleaning instructions.

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

6.1 APPENDIX A

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, P/N 064-LW37039.

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 (023-LW181-034) is provided so the user can attach a cable between the SPM and the customer supplied switch.

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.

Step	Action
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.

6.2 APPENDIX B

Manual Supplement for TMS 9250 SPM Digital Filter Settings

This supplement provides information on the operation and specifications of the TMS 9250 SPM with the Digital Filter Settings, as they relate to v1.38 software.

Intended Use

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 version 1.38 firmware. It should be used in conjunction with the TMS 9250 User Manual and the TMS Toolkit User Manual, both of which are supplied with a TMS 9250 Torque Measuring System.

Filter Operation General Description

The digital filter algorithm in the v1.30 and later firmware versions of the TMS 9250 is basically 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 a 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 $\mathbf{V_i}$ and the output signal being $\mathbf{V_o}$

In a steady state situation, $\mathbf{V_o}$ will equal $\mathbf{V_i}$

When $\mathbf{V_i}$ 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 $\mathbf{V_o}$ is updated by a fractional amount of the new value $\mathbf{V_i}$ until the output value equals the input value 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 manne.

To determine the settling time of the filter (the time taken to reach the $\mathbf{V_o} = \mathbf{V_i}$ condition), it is necessary to know both the filter update rate and the number of fractional steps. The filter update rate is fixed at 1000 Hz in the firmware v1.30 and above, although other filter update rates can be made available upon request to the factory.

The cut-off point (in Hz) is given by the expression

Frequency (-3dB)=

(Update rate/number of steps)/6.3

The table below provides a quick reference to determine the filter characteristic

Note that this filter operates only when the cha Consider the input signal as being $\mathbf{V_i}$ and the output signal being $\mathbf{V_o}$

In a steady state situation, $\mathbf{V_o}$ will equal $\mathbf{V_i}$

When $\mathbf{V_i}$ 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 $\mathbf{V_o}$ is updated by a fractional amount of the new value $\mathbf{V_i}$ until the output value equals the input value 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

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The cut-off point (in Hz) is given by the expression

Frequency (-3dB)=(update rate/number of steps)/6.3

The table 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**.

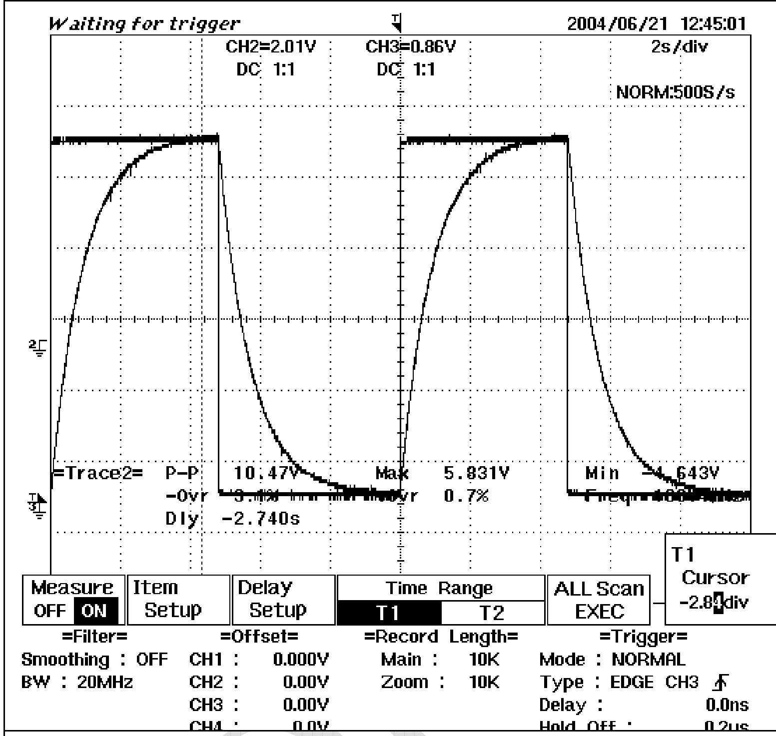
The time required for the output to settle following a step change in input level is given by the following table.

Filter Settling Time

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

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

Sample Charts

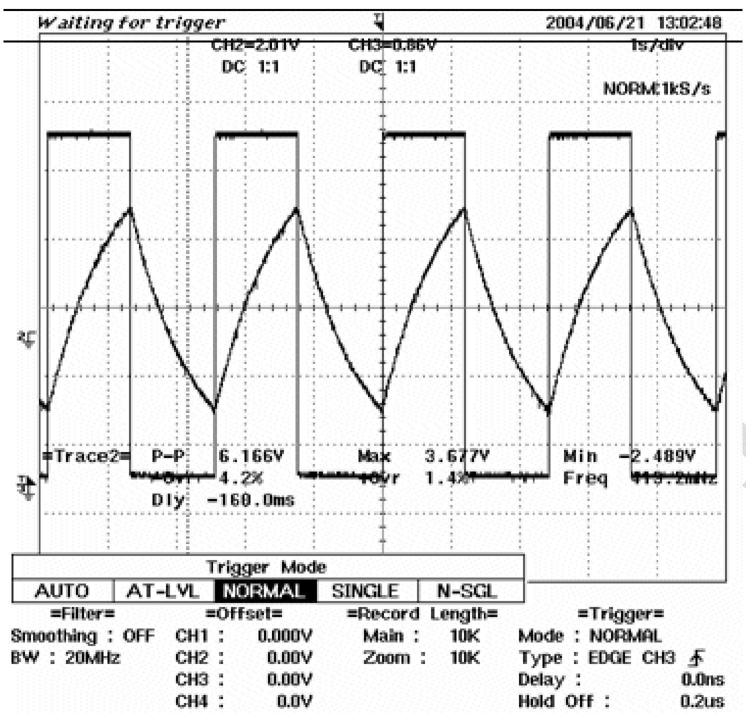


INPUT : Square Wave, 0.1 Hz
OUPUT : Analog Voltage
FiltLevel=10000

FiltSteps=1000

Settling time to 99% is given by

5 * 0.001 * 1000 = 5 seconds



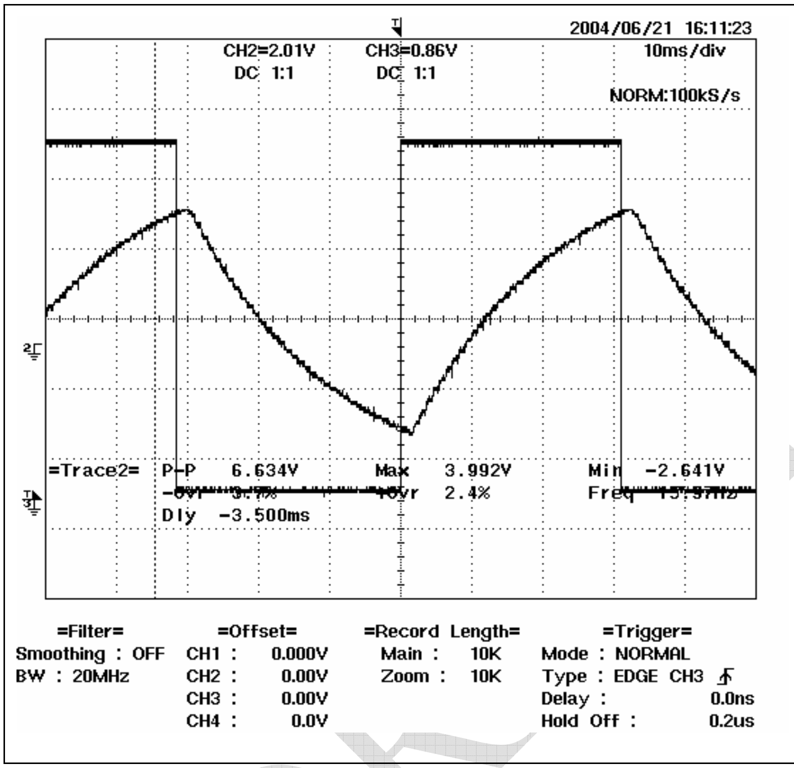
INPUT : Square Wave, 0.4 Hz
OUPUT : Analog Voltage
FiltLevel=10000

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



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 overdamped response

6.3 APPENDIX C

Conversion Table

Imperial-Metric conversion			Metric-Imperial conversion		
Foot-pounds	inch-pounds	Nm	Nm	inch-pounds	foot-pounds
1	12	1.35575	1	8.85119	0.73760
2	24	2.7115	2	17.702	1.4752
3	36	4.0673	3	26.554	2.2128
4	48	5.4230	4	35.405	2.9504
5	60	6.7788	5	44.256	3.6880
6	72	8.1345	6	53.107	4.4256
7	84	9.4903	7	61.958	5.1632
8	96	10.846	8	70.810	5.9008
9	108	12.202	9	79.661	6.6384
10	120	13.558	10	88.512	7.3760
20	240	27.115	20	177.02	14.752
30	360	40.673	30	265.54	22.128
40	480	54.230	40	354.05	29.504
50	600	67.788	50	442.56	36.880
60	720	81.345	60	531.07	44.256
70	840	94.903	70	619.58	51.632
80	960	108.46	80	708.10	59.008
90	1080	122.02	90	796.61	66.384
100	1200	135.58	100	885.12	73.760
200	2400	271.15	200	1770.2	147.52
300	3600	406.73	300	2655.4	221.28
400	4800	542.30	400	3540.5	295.04
500	6000	677.88	500	4425.6	368.80
600	7200	813.45	600	5310.7	442.56
700	8400	949.03	700	6195.8	516.32
800	9600	1084.6	800	7081.0	590.08
900	10800	1220.2	900	7966.1	663.84
1000	12000	1355.8	1000	8851.2	737.60
2000	24000	2711.5	2000	17702	1475.2
3000	36000	4067.3	3000	26554	2212.8
4000	48000	5423.0	4000	35405	2950.4
5000	60000	6778.8	5000	44256	3688.0
6000	72000	8134.5	6000	53107	4425.6
7000	84000	9490.3	7000	61958	5163.2
8000	96000	10846	8000	70810	5900.8
9000	108000	12202	9000	79661	6638.4
10000	120000	13558	10000	88512	7376.0
20000	240000	27115	20000	177024	14752
30000	360000	40673	30000	265536	22128
40000	480000	54230	40000	354048	29504
50000	600000	67788	50000	442559	36880
60000	720000	81345	60000	531071	44256
70000	840000	94903	70000	619583	51632
80000	960000	108460	80000	708095	59008
90000	1080000	122018	90000	796607	66384

6.4 APPENDIX D

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

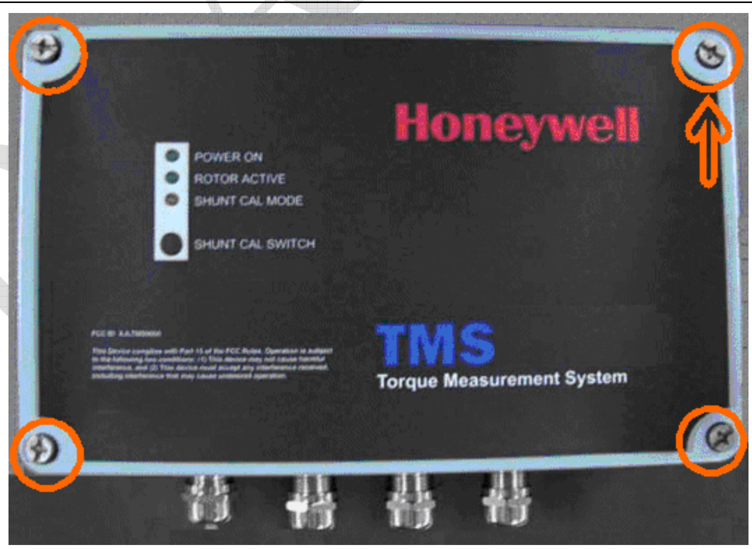
Step	Action
Positioning the power supply	Place the power supply of the system in a place where you can easily unplug the power cords.
Cleaning the system	
Step	**Action**
a	Disconnect the power supply from the system.
b	Clean the SPM, Shroud, CCM and Rotor with dry cloth.
	ATTENTION Do not use any chemicals to clean the system.
Product Grounding	• Shield of all the output signal shall be connected to SPM side (refer to step 4.c of Appendix-E) 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.

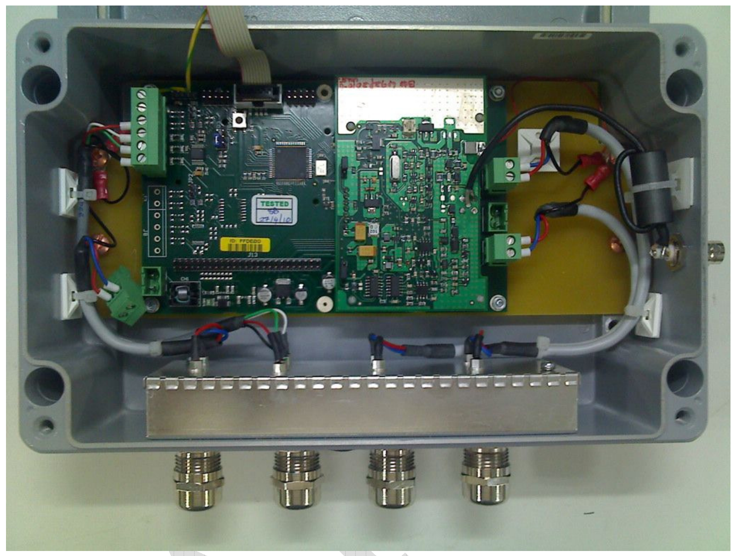
6.5 APPENDIX E

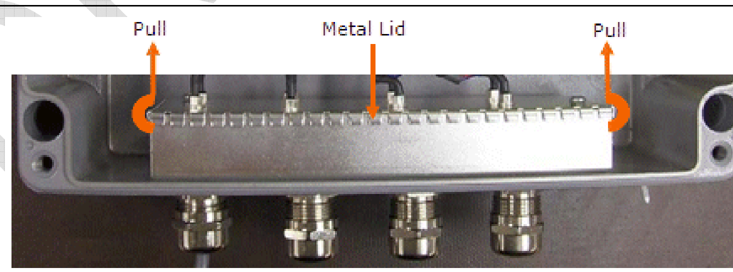
Setting up the Cables for the Signal Processing Module (SPM)

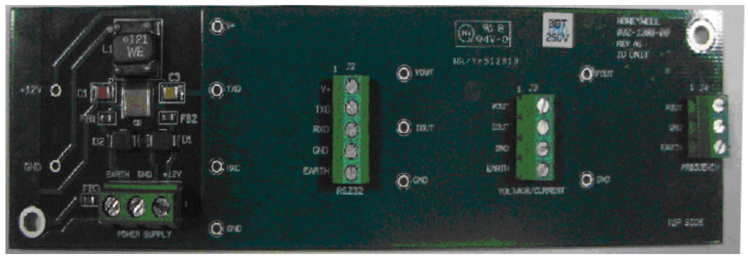
Setting up the cables involves the following steps.

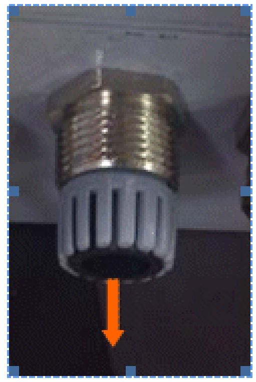
	ATTENTION The interface cables must be shielded type and connected to product end only.

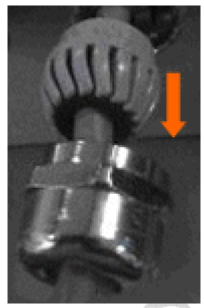
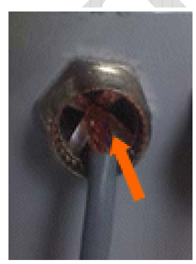
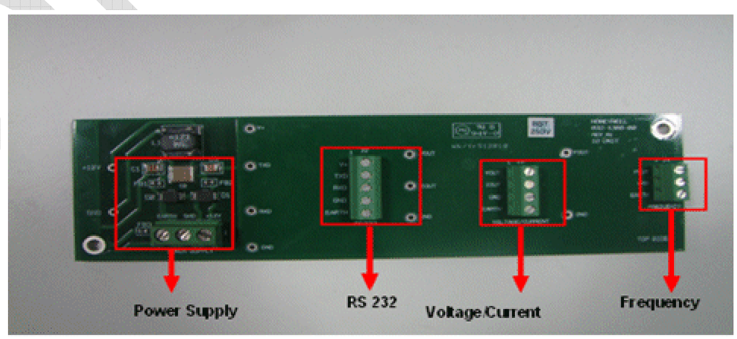
Step 1: Removing the Cover of the SPM Box	
Step	**Action**
a	Keep the SPM on table with ESD plane, and wear the ESD strap. Open the cover of the SPM box by removing the screws.
	
b	After removing the cover, you can see the base unit of the SPM in the following figure.

Step 2: Removing the Metal Lid in the SPM Box	
Step	**Action**
a	Hold the metal lid at the end and then remove as shown in the following figure.
	
b	After removing the metal lid, you can see the printed circuit board as shown in the following figure.

<table>
<tr><td></td><td></td></tr>
<tr><td colspan="2">Step 3: Removing the Glands
You must remove the glands before connecting the wires to the printed circuit board.</td></tr>
<tr><td>Step</td><td>Action</td></tr>
<tr><td>a</td><td>Turn the screws of the metal glands in the counter clockwise direction using the pliers and remove it as shown in the following figure</td></tr>
<tr><td></td><td></td></tr>
<tr><td>b</td><td>Remove the plastic cover as show in the following figure.</td></tr>
</table>

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

	
c	Connect the wire to the metal gland as show in the following figure.
	
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.
	
	ATTENTION RS 232 is the only cable supplied with the product.

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

Connector		Connector details	Description
J1	Power Supply	+12V	+12VDC
		GND	0VDC
		Earth	Earth

ATTENTION

By default, the power supply cable is connected.

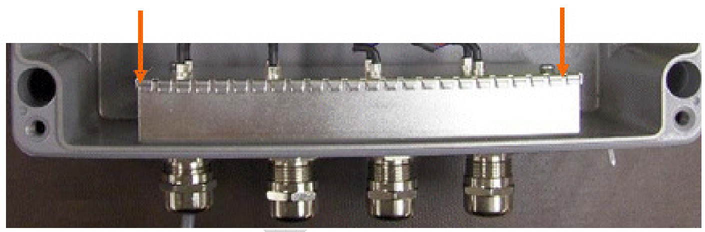
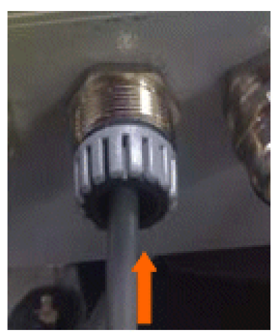
J2	RS232	V+	Not connected
		TXD	Transmit data
		RXD	Receive data
		GND	Signal ground (0V)
		EARTH	Signal EARTH of TMS 9250
J3	Analog Voltage/ Current	VOUT/IOUT	Voltage output or Current output
		GND	Signal ground (0V)
		EARTH	Signal EARTH of TMS 9250

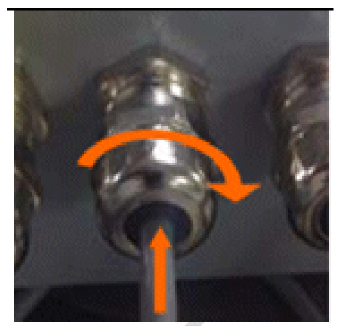
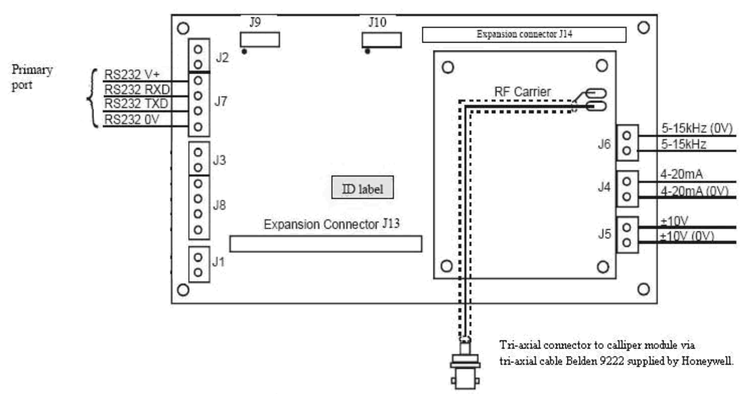
ATTENTION

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

J4	Frequency	FOUT	Frequency Output
		GND	Signal ground (0V)
		EARTH	Signal EARTH of TMS 9250

Step	Action
b	After connecting the wires to respective connectors, tighten the screws.

	ATTENTION The output depends on OPTYPE value configured using TMS tool kit for TMS 9250. Refer to the TMS Toolkit User Manual for more information.
Step 6: Closing the Metal Lid inside the SPM Box	
a	Hold the metal lid at the end and push the LID then close it as shown in the figure.
	
Step 7: Closing the Glands	
	After closing the metal lid inside the SPM box, you must tighten the glands.
Step	**Action**
a	Put the plastic cover as show in the figure.
	
b	Put the metal gland and tighten in the clock wise as show in the figure.

	
Step 8: Closing the Metal Cover of the SPM Box	
	After closing the glands, you must close the metal cover of the SPM box.
Step	**Action**
a	Replace the cover on the base of the SPM box.
b	Insert the screws into the screw holes and tighten it.
Electrical Connections	The signal-processing module features two-part plug and socket connectors and the connection details are shown in figure 2. All cable connections should pass through the cable glands, and shield to be connected to metal glands,as described in the Appendix-E.
	

Note

Make sure J4/J5 are not swapped with J6

Connector and Jumper Functions

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
J11	
J12	
J13	Expansion port
JP1	Primary RS232/RS485 default select

WARNING

MISUSE OF DOCUMENTATION

• The information presented in this product sheet is for reference only. Do not use this document as product installation guide.

• 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.

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 death or serious injury.

WARRANTY/

Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship. Honeywell's standard

REMEDY	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.
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