

Titan POD

*B-Series
User Manual*



29 C Street • Laurel, Maryland • 20707

Proprietary Notice

This information is furnished for installation, operation, test and maintenance purposes. The information is proprietary in nature and should be treated accordingly. The data shall not be released or used, duplicated or disclosed, in whole or in part, for manufacture or procurement without the written permission of **Mars Labs**.

Copyright

This Technical Manual is copyright © 2011. All rights reserved. Brief excerpts may be made from this manual for technical purposes, as long as they are referenced.

Although this manual is believed to be correct at the time of publication, **Mars Labs**, its employees, or agents involved in the preparation and publication of this manual do not accept any form of liability for its contents or any consequences arising from its use. People using the information contained in this manual should apply, and rely upon, their own skill and judgement to a particular issue which they are considering.

Warning

Only a qualified technician or representative of Mars Labs should attempt to service the components of this system. There are no user-serviceable parts inside.

For safety and protection of the equipment, power must be turned off prior to connecting or disconnecting cables and sensors.

**Titan Pod
B-Series
User Manual v1.2
MNL 1011
May 2011**

Table of Contents

Introduction

Furnished Accessories	4
Support	4
General Guidelines and Warnings	5
Guidelines for Wiring Sensors	6

Operation

Front Panel	7
Rear Panel	9
Signal Flow	10
Input Adapter Description	11

Interface

Analog Input Connector (DB9)	12
GPS Port	12
COMM Port	13

Sensor Connection Examples

Full Bridge Sensor	14
Half Bridge Sensor	15
Quarter Bridge Sensor	16
Voltage Sensor	17
ICP Sensor	18
String Pot Sensor	19
RVIT Sensor	20
Frequency Sensor	21
Thermocouple Sensor	22

Theory and Operation of Thermocouples

23

Per-Channel Excitation

25

Features & Specifications

Key Features	28
Specifications	28
Input Connections/Supported Sensors	29
Titan Nomenclature	30

Connecting to the Titan DAO

32

Special Considerations using a DAO with Thermocouples

35

Updating the Firmware

36

Troubleshooting

40

Warranty & Repair

42

Notes & Errata

43

Introduction

The Titan Pod is a fully integrated data acquisition system that features a 16-channel interface with on-board signal conditioning, programmable gain, excitation and filtering, and A/D conversion. The Pod can be powered by the supplied USB 'Y' cable when connected to a PC, or through the front panel auxiliary power connector. A remote recording jack permits cabled remote control of the recording function.

This manual is intended to provide an overview of the Titan Pod, with complete feature descriptions, specifications, setup procedures and operational information. It contains important safety information as well.

Furnished Accessories

The Titan Pod is shipped with the following items:

1. Titan Pod
2. USB 'Y' Cable
3. CD-ROM Installation Disc

Depending on the model, the Pod may also be shipped with an external Power Supply or a connector that mates to the Auxiliary Power Connector on the Pod front panel.

The CD-ROM Installation Disc contains the Titan Control Software (TCS) installation files, related support files, and PDF images of the Pod User Manual and TCS User Manual.

Documentation supplied with the shipment includes:

1. Calibration Certificate
2. Calibration Data Sheet
3. Titan Pod User Manual (hardcopy)
4. Titan Control Software (TCS) User Manual (hardcopy)

Support

Support for this product is available by contacting the factory during regular business hours (9am – 6pm EST) at 301-470-3278. Additional information can be found on our web site: <http://www.marslabs.com>

General Guidelines and Warnings

Electro-Static Discharge

Electro-Static Discharge (ESD) occurs when a static charge builds up on either yourself or the Titan hardware, and then you touch the Titan hardware. The static spark can be so small that you don't feel it, however, it can flaw a semiconductor. These flaws may generate an immediate failure, or, in most cases, cause a slight reduction in performance which will continue to degrade, eventually leading to failure of the hardware. When you feel a static shock, you are experiencing a minimum of 3,000 volts of electricity.

Even though the input connectors have protection to prevent ESD damage, it is good practice to always ground yourself and the Titan hardware while connecting and removing sensors.



Always use approved ESD handling procedures to prevent ESD damage.

Grounding Titans

In general, grounding the Titan hardware to the test vehicle or test structure will usually reduce noise pickup.

All of the analog inputs of the Titan hardware have a return path to ground. However, it is very important that each sensor have only one return path to avoid ground loops. When testing a vehicle, often the vehicle chassis and Titan can have very large ground imbalances of one or two volts. In such situations, ground the sensors to Titan and use differential inputs across the sensor. A totally floating input (like a 9-Volt battery) must have one side grounded at the point where used, either grounded to Titan or connected to the vehicle chassis ground via a resistor (e.g. 10K ohm).

If there is a possibility that a floating sensor may be occasionally grounded, install a 10K ohm resistor from the minus input to Titan ground. When the sensor is floating, the 10K ohm resistance will reference it to Titan ground, and when it is grounded, the resistor will allow the direct minus input wire to reference the remote chassis ground.



Specific Warnings

1. When using a power adapter with the Titan, always connect the adapter to the Titan before applying power. Never hot plug a Titan device under any circumstances - hot plugging may damage the device!
2. Under no conditions should the 12V and 5V lines on the Titan hardware be shorted together or connected directly to ground.

Guidelines for Wiring Sensors

Observe the following guidelines when wiring and connecting sensors to the Titan hardware:

1. Observe polarity of sensor wires
2. Strain relieve all connections
3. Secure cables with wire ties and bundle cables where possible.
4. Secure DB9 connectors by fastening to the Titan chassis
5. For Thermocouples, apply heat shrink to exposed wires
6. Double check all connections prior to connecting the cables to the Titan.
7. Use only heavy gauge CAT-6 cables with locking tabs when connecting to the Titan CPU.
8. When routing cables, be aware of sharp edges and pinch points where cables can bind, or be cut, introducing shorts in the wiring

Operation

A description of the Titan Pod panel controls and operation follows.

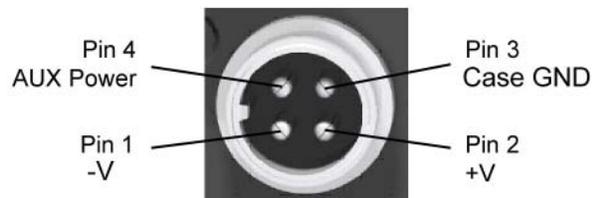
Front Panel

The Titan Pod front panel includes interfaces for computer and GPS (optional) connections, and an Auxiliary Power Connector as shown.



Auxiliary Power Connector

The Auxiliary Power Connector is used to power the Titan Pod in remote applications or whenever sensor excitation voltages greater than 2.048V are desired. The connector pinout is shown below. The voltage applied to Pin 2 (V+) is the operating voltage of the Pod (the operating voltage depends on the model). The voltage applied to Pin 4 appears as the Auxiliary Voltage on the Analog Input Connectors. See page 14 for more information.



WARNING: When using a power adapter with a Titan device, always connect the adapter to the device before applying power. Never hot plug a device under any circumstances - hot plugging may damage the device!

USB Port

A standard USB port that provides a communication link between the Titan Pod and the Titan Control Software (TCS). The port also supplies power to the device through the USB 'Y' cable (Pods require two USB ports for sufficient power). The voltage input range is 4.0 to 5.5 volts.

GPS Port

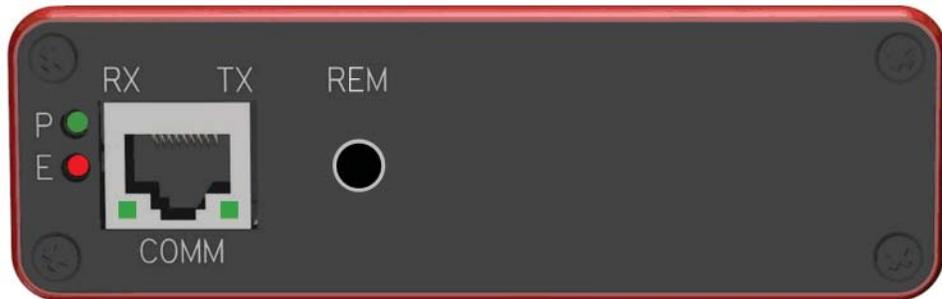
A multi-function serial port that accepts a GPS (a Garmin 18X-5Hz) and/or auxiliary serial data input such as CANBus (Titan high speed devices only).

GPS sensor support is an optional feature on the Titan Pod.

NOTE: Low Speed devices do not currently support auxiliary serial data

Rear Panel

The Titan Pod rear panel incorporates two LED status indicators, a communications (COMM) port and a remote (REM) jack:



Status Indicators

P (Power) – A green LED indicating that the Titan Mini-Recorder is ON.

E (Error) – A red LED indicating that a channel has gone full scale.

COMM

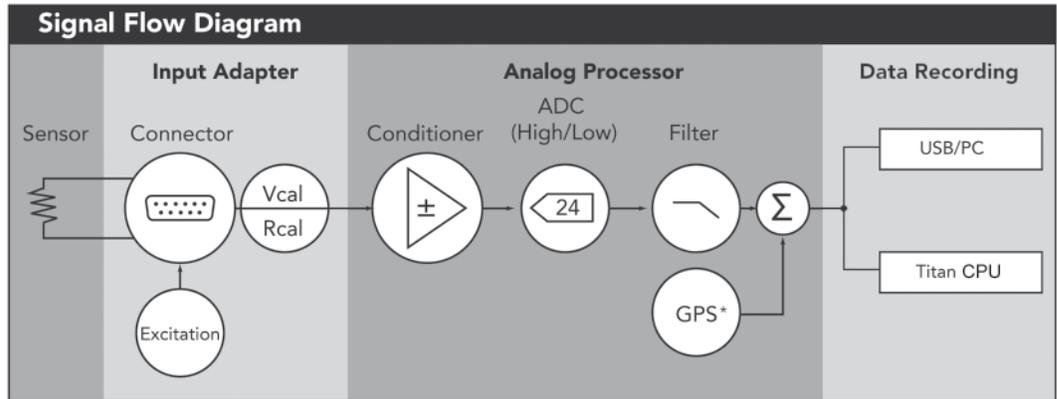
An RJ-45 port used to interface the Mini-Recorder with the Titan CPU Channel Multiplexer and other expansion options. LED's integrated into the COMM port connector indicate when the Pod is transmitting or receiving data.

REM

An 1/8" TRS connection for remote operation - currently not implemented.

Signal Flow

The diagram below shows the signal flow of the Titan Pod for a single input channel. The Titan Pod supports up to 16 channels at 1200 samples per second (low speed operation), or 10,000 samples per second (high speed operation).



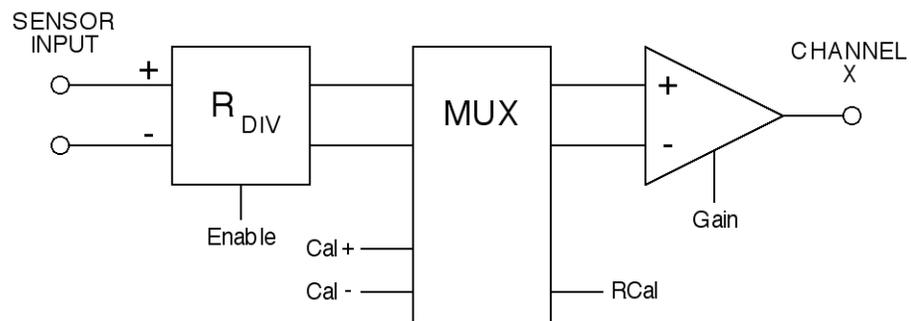
The Titan Pod features on-board signal conditioning, programmable gain and filtering, and A/D conversion. Each channel features Programmable Excitation, sensor Balance* and input Rcal and Vcal loopback functions to facilitate ease of setup and ensure data integrity. All channels have individual input amplifiers to achieve high accuracy, high inter-channel isolation, and low temperature drifts. Data recording options include recording directly to a PC (via USB) or to a Titan CPU Channel Multiplexer.

* Balance is a function that removes channel offsets. It is controlled and configured through the Titan Control Software (TCS). For more on the Balance function, consult the TCS User Manual (see “Advanced Settings - Tags and Channels”).

Input Adapter - Description

The Input Adapter consists of the physical and electrical components that provide the interface to sensors. The physical connection is dependent upon the version of the Titan product purchased. The physical connection can be 16 DB9 connectors (Titan model 'BMS'), 16 BNC connectors (Titan model 'BI'), or a combination of DB9 and BNC connectors (Titan model 'BIV'). Titan Thermocouple devices (Titan model 'TC') feature 16 mini thermocouple (mini-TC) jacks.

Electrically, each Titan input channel features a resistive divider network, a multiplexer that enables the resistive calibration (RCal) and voltage calibration (VCal) loopback functions, and a differential amplifier with programmable gain, as shown in the diagram below. Per-channel programmable excitation (not shown) is also provided for Titan BDF, BMS, and BIV devices. Excitation, gain selection, signal attenuation, and calibration functions are controlled by the Titan Control Software (TCS).



Each Titan channel provides a floating differential input that accommodates a maximum range of 0-4.096V. To provide for larger input signals, as well as signals that are bi-directional, a resistive divider network can be enabled that will attenuate the input voltage by a factor of 16, and internally bias the input to +2.048V (the midpoint of the input range). With the divider network enabled, the Titan device can accept a maximum input of +/- 32.767V.

Without the input dividers enabled, the sensor input is not referenced to the device and should be wired accordingly depending on the application. To provide for an input range of +/- 2.048V without the resistive divider, the input must be offset by +2.048V.

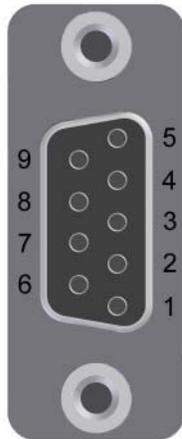
Interface

Titan Pods offer several connection options for interfacing with sensors. Connector types include D-sub (DB9), BNC, and mini-thermocouple (mini-TC) jacks. A complete list of the input connectors and types of sensors supported can be found on page 29.

Pinout definitions for D-sub connectors appears below. Pinouts for the GPS port and communication (COMM) port follows.

Analog Input Connector (DB9F):

A DB9F connector is the standard analog input connector type on BMS, BSG and BIV model Titan devices.

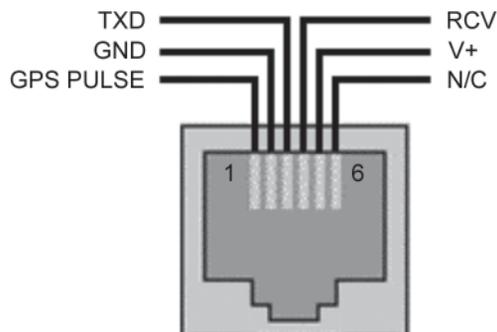


Pin Number	Function
1	Ground
2	Quarter Bridge (QB) Completion Resistor
3	Current source
4	ICP Capacitor
5	Auxiliary Voltage *
6	Half Bridge Bias
7	- Input
8	+ Input
9	Programmable Excitation

* The Auxiliary Voltage is the voltage that is applied to pin 4 of the Auxiliary Power Connector.

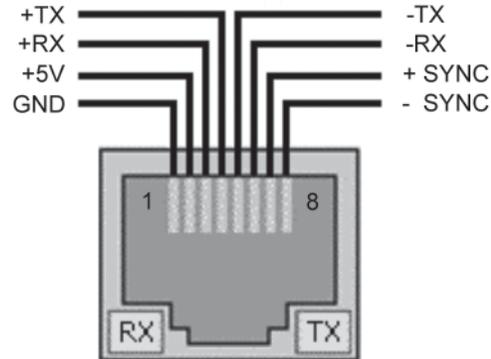
GPS Port:

The pinout of the GPS port appears below. The labels identify the signal lines coming *from* the GPS device.

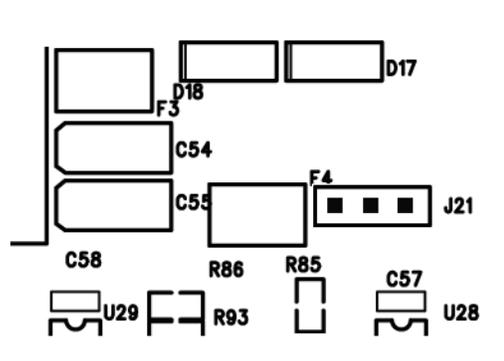


COMM Port:

The pinout of the COMM port appears below.



NOTE: The voltage that appears on pin 2 of the COMM port is supplied externally by the Titan CPU. The Titan CPU is configured at the factory to supply either 5V or 12V on this pin. The Pod **must** be configured to match this voltage in order to operate properly when connected to the CPU. A jumper located on the Pod Top Board (J21 - located near the board edge) is used to select either 5V or 12V operation through the COMM port:



For 5V operation, the jumper should be placed between pins 1 & 2 of J21:



For 12V operation, the jumper should be placed between pins 2 & 3 of J21:

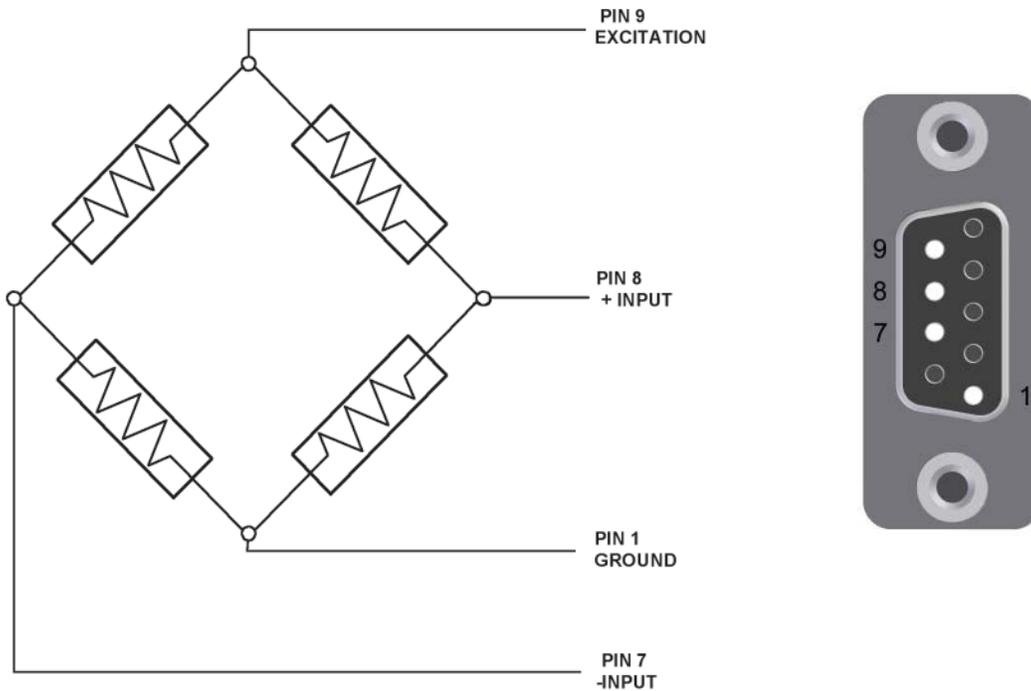


WARNING: A 12V Titan CPU should never be connected to a Pod configured for 5V operation through the COMM port - doing so will subject the Pod to an overvoltage condition that could damage the device!

Sensor Connection Examples

The following diagrams illustrate common sensor connections using Titan Pods that feature DB9 connectors.

Full Bridge Sensor



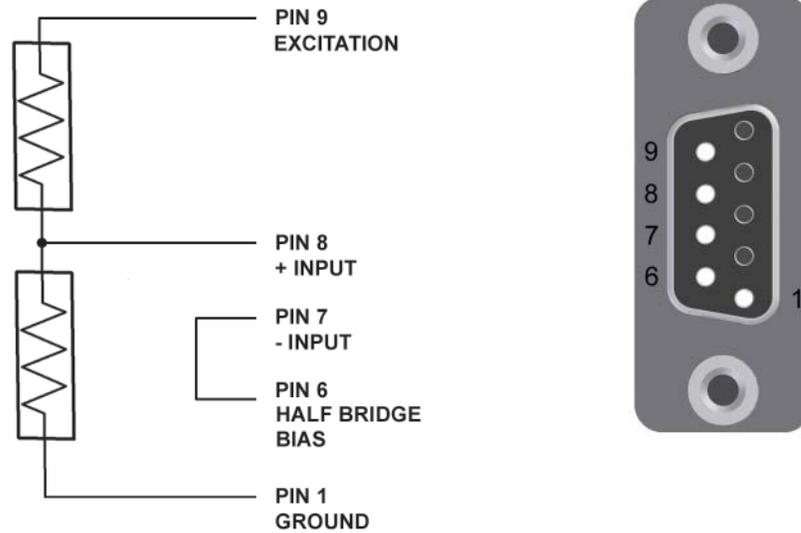
<i>Pin Number</i>	<i>Function</i>
1	Ground
2	Quarter Bridge (QB) Completion Resistor
3	Current source
4	ICP Capacitor
5	Auxiliary Voltage
6	Half Bridge Bias
7	- Input
8	+ Input
9	Programmable Excitation

NOTE: For Full Bridge configurations, the input dividers are set to OFF



See Guidelines for Wiring Sensors, page 6

Half Bridge Sensor



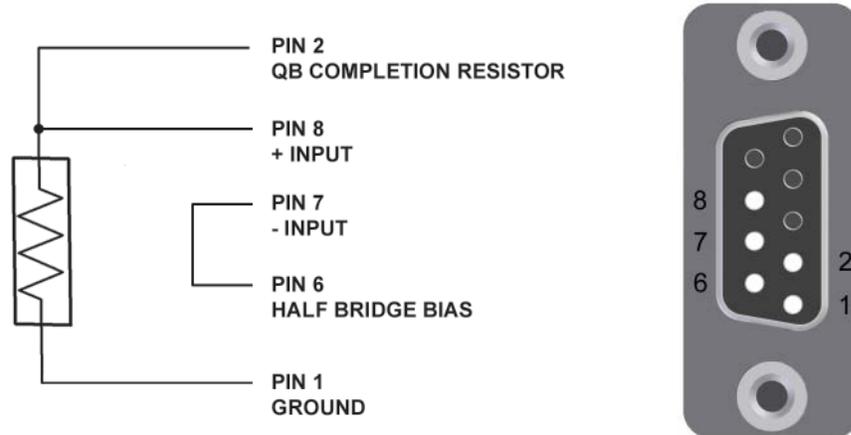
<i>Pin Number</i>	<i>Function</i>
1	Ground
2	Quarter Bridge (QB) Completion Resistor
3	Current source
4	ICP Capacitor
5	Auxiliary Voltage
6	Half Bridge Bias
7	- Input
8	+ Input
9	Programmable Excitation

NOTE: For Half Bridge configurations, the input dividers are set to OFF



See Guidelines for Wiring Sensors, page 6

Quarter Bridge Sensor



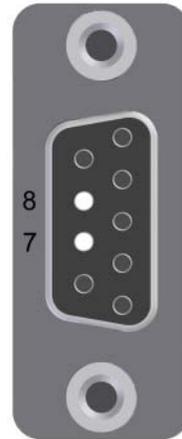
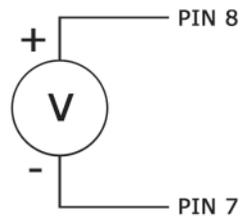
<i>Pin Number</i>	<i>Function</i>
1	Ground
2	Quarter Bridge (QB) Completion Resistor
3	Current source
4	ICP Capacitor
5	Auxiliary Voltage
6	Half Bridge Bias
7	- Input
8	+ Input
9	Programmable Excitation

NOTE: For Quarter Bridge configurations, the input dividers are set to OFF



See Guidelines for Wiring Sensors, page 6

Voltage Sensor



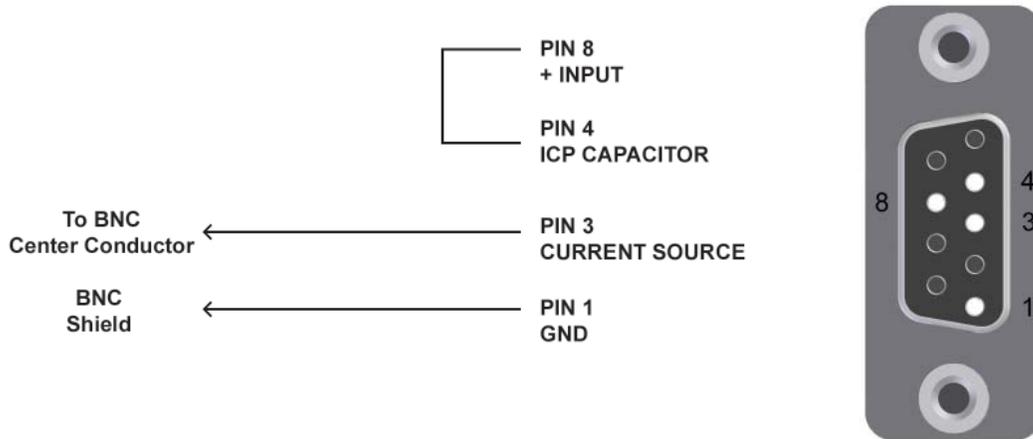
<i>Pin Number</i>	<i>Function</i>
1	Ground
2	Quarter Bridge (QB) Completion Resistor
3	Current source
4	ICP Capacitor
5	Auxiliary Voltage
6	Half Bridge Bias
7	- Input
8	+ Input
9	Programmable Excitation

NOTE: For Voltage Sensor configurations, the input dividers must be ON.



See Guidelines for Wiring Sensors, page 6

ICP Sensor

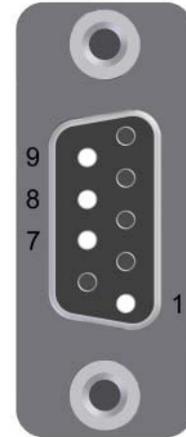
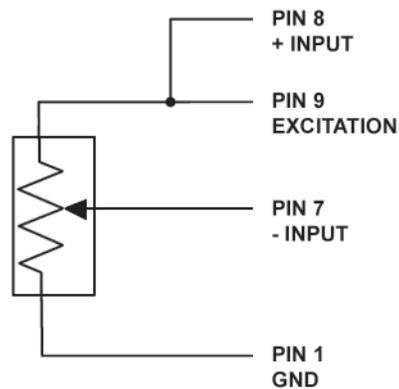


<i>Pin Number</i>	<i>Function</i>
1	Ground
2	Quarter Bridge (QB) Completion Resistor
3	Current source
4	ICP Capacitor
5	Auxiliary Voltage
6	Half Bridge Bias
7	- Input
8	+ Input
9	Programmable Excitation



See Guidelines for Wiring Sensors, page 6

String Pot Sensor (Cable Extension Transducer)



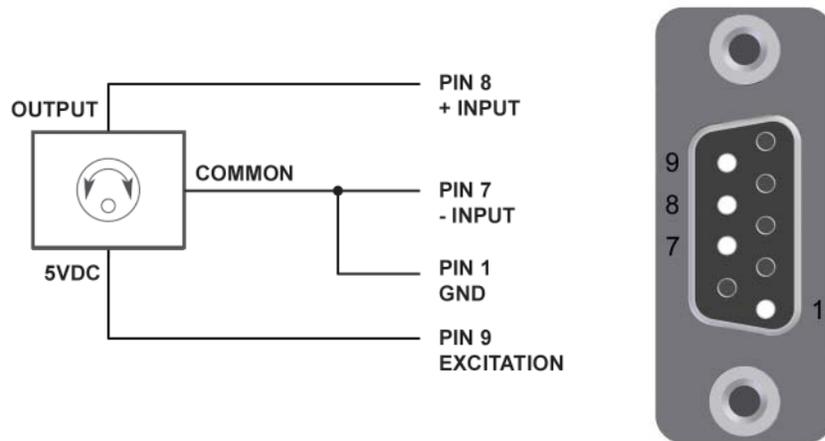
<i>Pin Number</i>	<i>Function</i>
1	Ground
2	Quarter Bridge (QB) Completion Resistor
3	Current source
4	ICP Capacitor
5	Auxiliary Voltage
6	Half Bridge Bias
7	- Input
8	+ Input
9	Programmable Excitation

NOTE: For String Pot Sensor configurations, the input dividers must be OFF



See Guidelines for Wiring Sensors, page 6

RVIT (Rotary Variable Inductive Transducer), 60 Degrees



Pin Number	Function
1	Ground
2	Quarter Bridge (QB) Completion Resistor
3	Current source
4	ICP Capacitor
5	Auxiliary Voltage
6	Half Bridge Bias
7	- Input
8	+ Input
9	Programmable Excitation

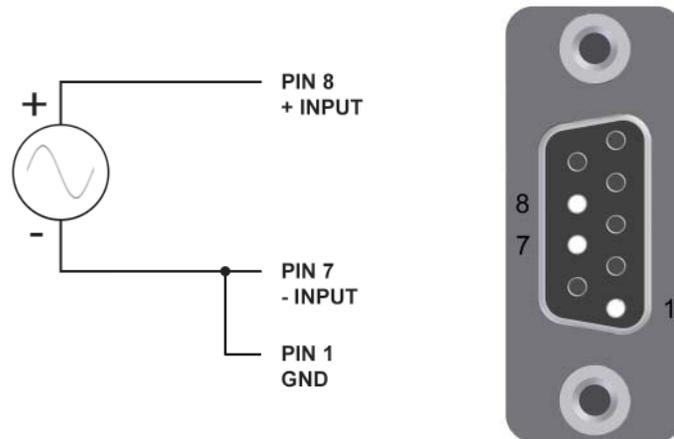
NOTES:

1. For RVIT configurations, the input dividers are set to ON.
2. The configuration shown above is for the Schaevitz Sensors Model RVIT-15-60. For other RVIT sensors, consult the manufacturer's data sheet



See Guidelines for Wiring Sensors, page 6

Frequency Sensor



Pin Number	Function
1	Ground
2	Quarter Bridge (QB) Completion Resistor
3	Current source
4	ICP Capacitor
5	Auxiliary Voltage
6	Half Bridge Bias
7	- Input
8	+ Input
9	Programmable Excitation

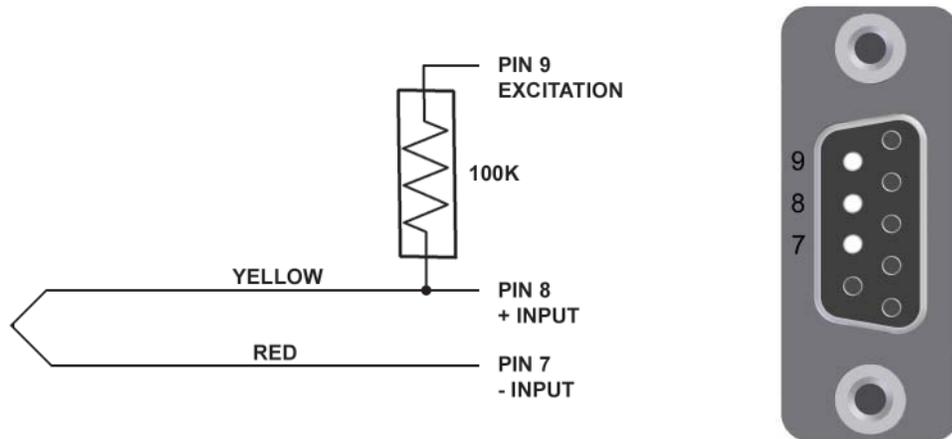
NOTES:

1. Frequency Sensors can only be configured on channel 1, 8 & 16; only one frequency sensor may be connected at a time.
2. Frequency sensor measurements are valid to approximately 7K Hz.



See Guidelines for Wiring Sensors, page 6

Thermocouple Sensor



Note: Colors shown are for a K type thermocouple

Pin Number	Function
1	Ground
2	Quarter Bridge (QB) Completion Resistor
3	Current source
4	ICP Capacitor
5	Auxiliary Voltage
6	Half bridge Completion
7	- Input
8	+ Input
9	Programmable Excitation

For more information on using Thermocouples with Titan Mini-Recorders, refer to the *Theory and Operation of Thermocouples* on the following page.



See *Guidelines for Wiring Sensors*, page 6

Theory and Operation of Thermocouples

This section will address the theory and operation of thermocouples in real-world applications.

A thermocouple consists of a junction between two different metals that produces a voltage related to temperature. All dissimilar metal junctions exhibit this phenomenon, called the “Seebeck effect”. One common thermocouple is the T-Type, which is shown below:



Figure 1. Thermocouple Junction

The voltage on the Copper and Constantan (Cu and C, respectively) leads is related to the temperature of the junction J1 by a polynomial in general, and linearly when the temperature range is small. Connection of those Cu and C leads directly to a copper volt-meter results in one additional junction between the Constantan of the Thermocouple and Copper lead of the Meter, as seen below at junction J2 (J3 is Cu-Cu, which results in zero voltage):

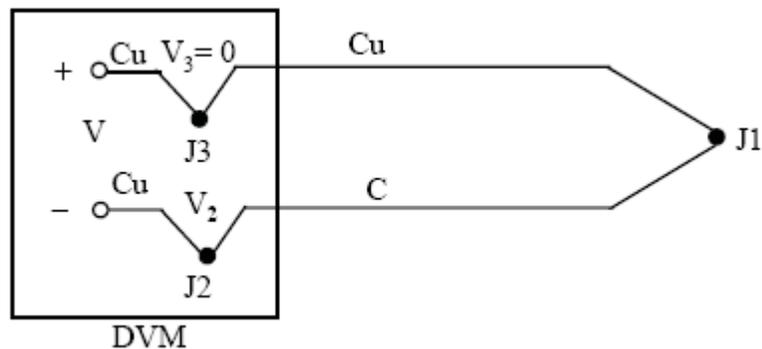


Figure 2. Thermocouple attached to a Digital Volt Meter

Compensation for this additional junction is accounted for within the Titan devices, the details of which are outside the context of this discussion.

The purpose of this discussion is to emphasize the sensitivity of the measurement to external effects. By extending the thermocouple with regular hookup wire, for instance, an additional junction is created between the thermocouple and the hookup wire. This will lead to an error in the

measurement unless some compensation for the junction is made. Additionally, by placing the junction J1 in an environment that may affect its output voltage such as in an electrolytic solution, the thermocouple may report misleading values. Finally, connection of the thermocouple to some conductive surface may or may not be of concern. Should that surface have any electrical path back to the Titan Thermocouple device such as a common ground, voltage readings from the thermocouple may be unreliable. **These concerns suggest that any and all electrical isolation (galvanic isolation) precautions should be taken when installing a thermocouple.** The material used to isolate the thermocouple should depend on the application. In most applications where temperatures are within -55 to 260 degrees C, non-conductive epoxy such as J-B Weld may be used. In more extreme temperatures, applications may call for specialty epoxy or cement. For example, if the temperature event under study is very fast the method of isolation must be very quick to change temperature. Omega Engineering sells thermally conductive cement called OmegaBond that is electrically isolating and suitable for such uses. Thin coats of this cement may be applied to thermocouples to isolate them electrically while allowing high thermal conductivity. This cement is suitable for high temperature applications. For more information on OmegaBond, go to:

http://www.omega.com/ppt/pptsc.asp?ref=OB_BOND_CHEM_SET&Nav=temf08

Thermocouples are available in several variants. *Titan Mini-Recorder* devices support **J**, **K**, and **T** type thermocouples (only one type of thermocouple may be used at a time). The table below displays the temperature ranges and related connection information for the three supported thermocouple types.

Type	Temp Range (C)	Positive (+) Lead	Recommended TCS Gain
K	-180 to +1300	Yellow	32
J	-180 to +800	White	32
T	-250 to +400	Blue	32

In summary, when using thermocouples:

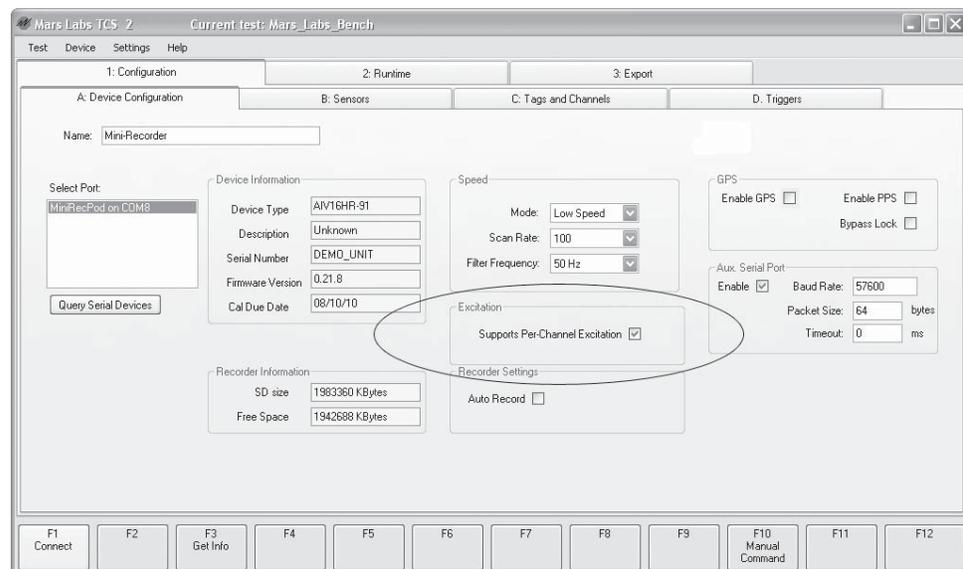
- 1) Electrically isolate thermocouples from the environment in which they are used
- 2) Minimize isolation mass around thermocouple when concerned with high-speed temperature events
- 3) Use the appropriate thermocouple for the application
- 4) Use appropriate thermocouple hookup or extension cabling for the type of thermocouple in use
- 5) Always observe the polarity of connections

Per-Channel Excitation

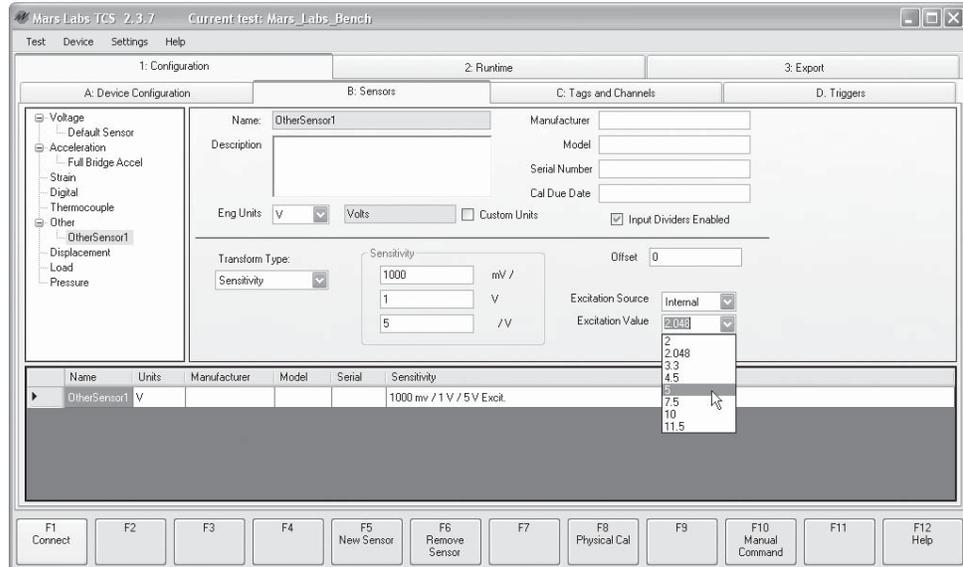
Titan B Series devices support a “per-channel excitation” feature that permits individual sensor excitation voltages to be specified for each channel. This feature is available for nine sensor types (Load, Strain, Displacement, Pressure, Full-Bridge Accelerometer, Solid State Accelerometer, Sensitivity, Polynomial and Voltage), and is programmable over a range of 2-11.5 volts. Per-channel excitation is configured through the Titan Control Software (TCS), version 2.3.7 and higher.

To configure per-channel excitation, follow these steps:

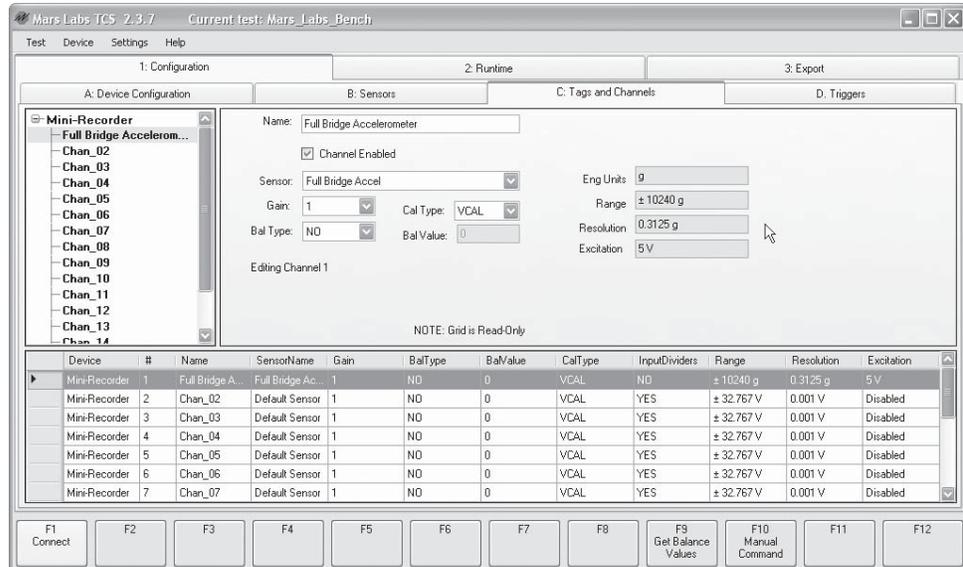
1. In TCS, on the Device Configuration page, check the “Supports Per-Channel Excitation” checkbox:



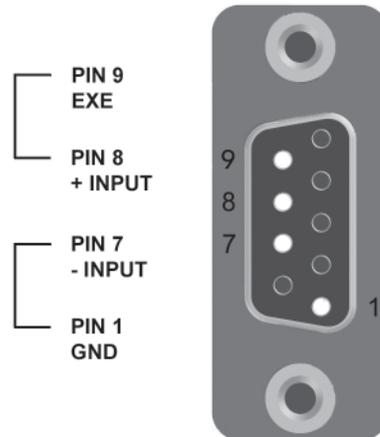
2. In the Sensors page, select the desired sensor type. Set the excitation source to 'Internal' and select the desired Excitation Value from the drop-down menu. For the purpose of this example, set Eng Units to "V", and enter the selected excitation voltage in the "/V" field in the Sensitivity pane:



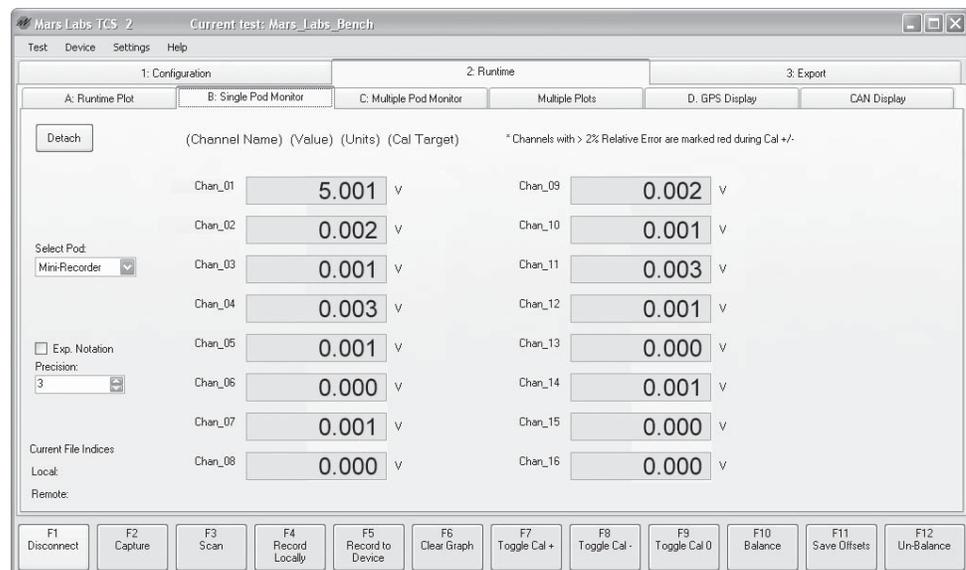
3. In the Tags & Channels page, select the sensor that was just configured on the Sensors page. TCS will automatically determine the range and resolution for the given sensor parameters:



4. On the Titan hardware, the Excitation voltage (EXE) appears on pin 9 of the DB9 connector. To configure a simple loopback circuit to monitor the excitation voltage in TCS, jumper the pins as shown:



5. With the loopback in place, the excitation voltage value can be viewed on the TCS Single Pod Monitor screen.



Features and Specifications

Key Features

- Supports multiple modes of operation:
 - Connected to a PC recording up to 16 channels
 - Connected to an 8-port Titan CPU for up to 128 channels
- High performance analog front-end with full Balance, $\pm V_{cal}$ and Rcal loopback features.
- Lightweight, portable unit suitable for in-vehicle applications.
- Sensor input connections via industry-standard D-sub connectors, BNC connectors (for ICP sensors), and mini-TC jacks (for thermocouples)
- Simplified user interface provides easy operation under difficult operating conditions.
- Sample rates up to 1200 Hz/channel (Low Speed) or 10,000 Hz/channel (High Speed)

Specifications

Number of Channels and Filters	16
Calibration resistor	$\pm 100K$ Ohms
Bridge Completion (BMS, BSG, & BIV devices only)	Bridge completion provided for 350 ohm Quarter bridge and Half bridge sensors
Excitation Value and Current (BMS, BSG & BIV devices only)	Precision per-channel programmable, 2 to 11.5 Volts at 25mA with per-channel overload protection
Input Connector	See table, page 29
Power Requirements	5 Volts DC @ 750mA
Programmable Gain	1/16, 1/8, 1/4, 1/2, 1, 2, 4, 8, 16, 32, 64, 128, 256, 512 Full scale input voltage up to $\pm 32V$
Programmable Filter	8 pole Butterworth for scan rates up to 1200 samples/sec 10 pole Linear Phase for scan rates > 1200 samples/sec
Sensors Supported	See table, page 29
PC Operation	Control via USB
CANBus	J1939 / ISO15765
GPS	Optional GPS support for the Garmin GPS 18X 5Hz; PPS support
Dimensions	17.4cm x 10.6 cm x 3.6 cm (L x W x H)

Input Connections/Supported Sensors

The table below shows the input connection and types of sensors supported by the Titan family of devices.

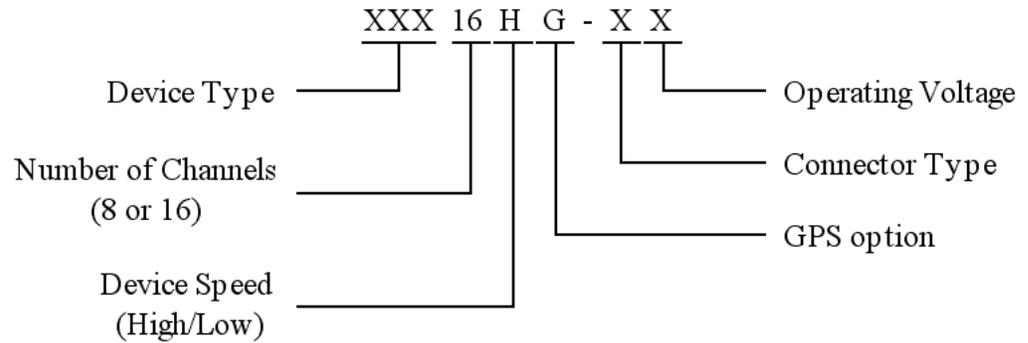
Titan Device Type	Input Connector	Sensors Supported					
		Strain Gauge		TC ¹	Differential Voltage $\pm 32V$	ICP	Tach ²
		FB	Bridge Comp.				
BSG	(16) DB9	16	Y	16	16	0	1
BMS	(16) DB9	16	Y	16	16	16	1
BIV	(15) BNC + (1) DB9	1	Y	1	1	15	1
BIV ³	(12) BNC + (4) DB9	4	Y	4	4	12	1
BI	(16) BNC	0	N/A	0	0	16	0
TC	(16) Mini TC	0	N/A	16	0	0	0

Notes:

1. All Titan devices support thermocouple types J, K & T.
2. Supports Tachometer frequencies up to 7KHz.
3. Alternate input connector option for Titan BIV device types.

Titan Nomenclature

The Titan family of input modules offer a wide range of configuration options. Titan device configurations are specified by the part number in the following format:



Titan Device Type:

- BMS - 'B' Series Multi-Sensor
- BSG - 'B' Series Strain Gauge
- BIV - 'B' Series ICP/Voltage
- BI - 'B' Series ICP
- TC - Thermocouple

Connector Type:

Input connector options are dependant on the Titan device type. Consult the factory for more information.

Operating Voltage:

- '1' - for 12 volt devices
- '2' - for 24 volt devices
- '3' - for wide input range devices (9 - 32V)

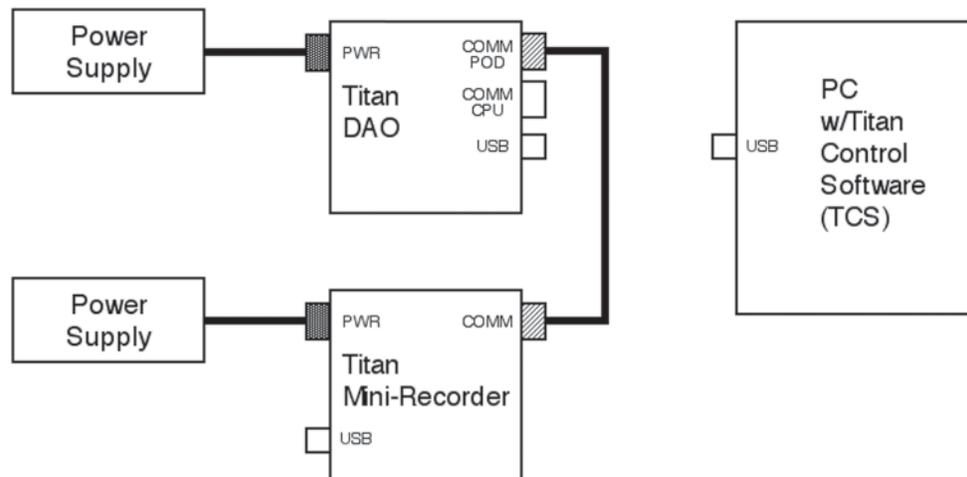
This page intentionally left blank

Connecting to the Titan Digital Analog Output (DAO) device

NOTE: The DAO operates exclusively in low speed mode, and therefore any Titan high speed device (Mini-Recorder or Pod) that will be connected to the DAO must also be set to low speed mode. To insure that the Titan device has the proper configuration prior to connecting to the DAO, first connect the device to TCS, select low speed mode (any scan rate will do), and begin scanning. Stop the scan, disconnect from TCS, power down the device, and then proceed as described below.

If you are using a Titan Pod or Mini-Recorder with a Titan DAO, follow the procedure below to connect and configure the devices.

1. Make the connections shown, but do not apply power



NOTE: The maximum recommended cable length between the Titan DAO and the Mini-Recorder is 300 feet.

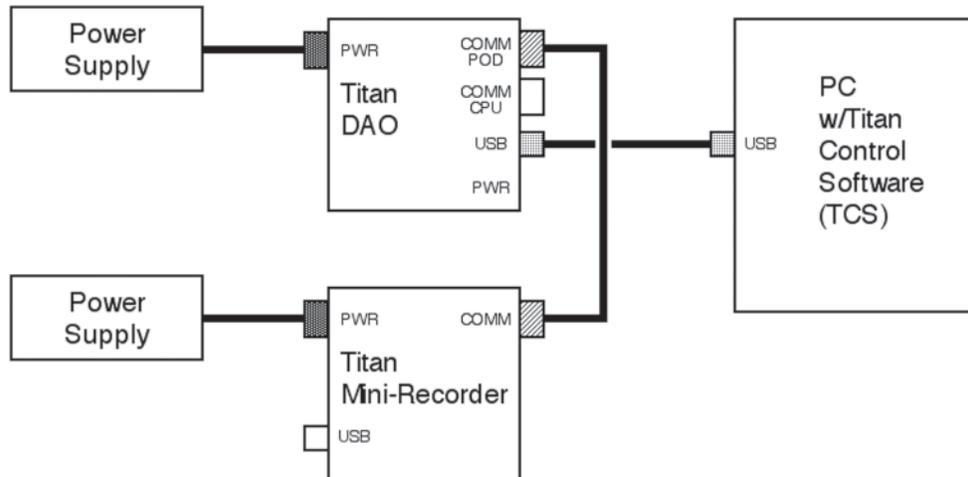
WARNING: When using a power adapter with any Titan device, always connect the adapter to the device before applying power. Never hot plug a device under any circumstances - hot plugging may damage the device!

2. Apply power to the Pod or Mini-Recorder first, and then apply power to the DAO. Allow the DAO to initialize (about 25 seconds). During initialization, the TX and RX LEDs on both DAO COMM ports will be illuminated. When the initialization process is finished, only the Power LED, the TX LED on the COMM CPU port and the RX LED on the COMM POD port will remain lit on the DAO.

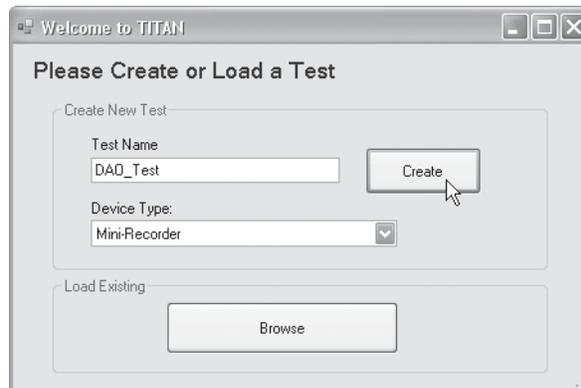


WARNING: During initialization, the DAO will output full scale values (0 to +5V or ± 10 Volts, depending on the DAO version). Do not connect to the DAO analog outputs until the initialization process has completed. Failure to observe this important step can result in damage to connected equipment!

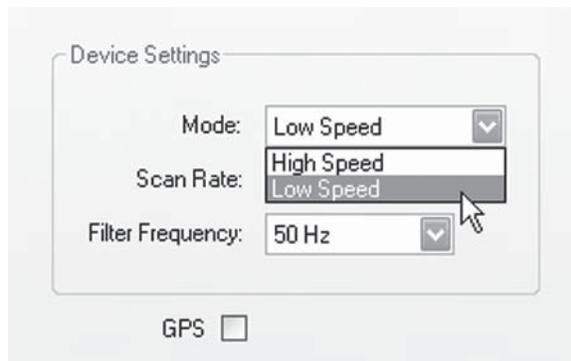
3. Connect the Titan DAO to the PC using a USB cable as shown, and then launch the Titan Control Software (TCS) application.



4. When TCS starts, you will be prompted to create a new test or load an existing test. To create a new test, enter a name in the Test Name field. In the 'Device Type' drop-down menu, select "Mini-Recorder", and then click the 'Create' button. If you wish to load an existing test, click the 'Browse' button. Note that existing tests must be of the 'Mini-Recorder' device type for use with the Titan DAO.

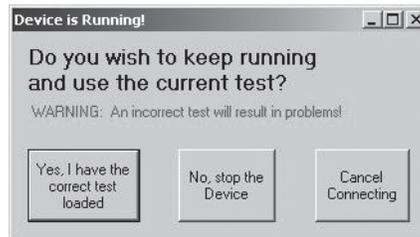


5. In the Device Configuration window, check the Device Settings field for low speed operation. You may need to select "Low Speed" from the 'Mode' drop-down menu:



NOTE: For proper operation when using a DAO with a High Speed Pod or Mini-Recorder, you must configure your test to use at least one channel between 1 - 8.

6. Finally, click on the 'Connect' button (F1). TCS will display a 'Device is Running' warning message:



If the test that is loaded into TCS is the same test that is currently running on the Mini-Recorder, i.e. the current configuration, click 'YES'; otherwise click 'NO' to stop the device.

For additional information on configuring TCS, consult the TCS User Manual.

NOTE: The DAO output will always mirror the input of the connected Titan Pod or Mini-Recorder proportionally over the full range of $\pm 10V$. For example, a full scale input to the Pod or Mini-Recorder will produce a full scale output on the DAO. Decreasing the input to the Pod or Mini-Recorder by 50% will result in a 50% decrease on the DAO output.

Special Considerations using a DAO with Thermocouples

When using a DAO with a Titan device that has a thermocouple connected to one or more channels, the DAO output for these channels represents the raw non-linear voltage response of the thermocouple sensor itself. The response from these channels will be different from the response observed in TCS, which will apply a pre-defined 8th order polynomial transform dependent on the type of thermocouple in use (J, K or T), resulting in a linear response.

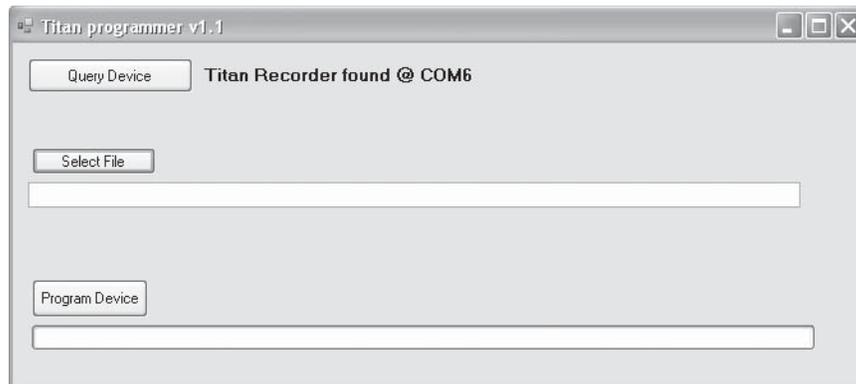
For information on thermocouple transforms, see 'Sensor Types - Thermocouple' in the TCS User Manual.

Updating the Firmware

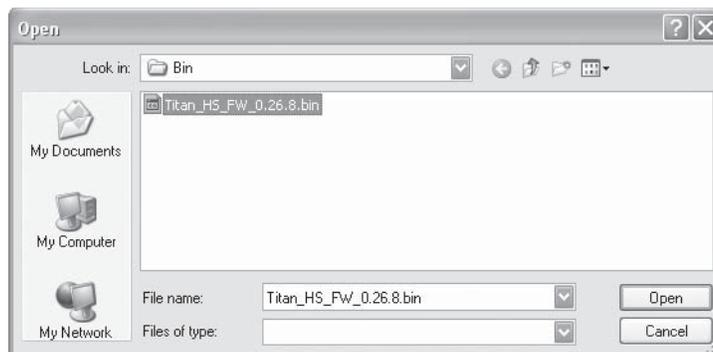
To update your Titan device with the latest firmware, follow the steps below.

NOTE: The Titan programmer runs under Windows XP only!

1. Download the Titan Programmer (Titan Programmer vX.X.exe) and the firmware update that is appropriate for your Titan device to the PC that will be used to perform the update.
2. Connect the Titan device to USB and apply power. The PC may prompt that new hardware has been detected. Proceed with the online instructions and install the Titan USB drivers.
3. Launch the Titan Programmer. The Programmer should locate the Titan device and report the COM port connection. If the Programmer doesn't report finding Titan hardware, click on the 'Query Device' button:

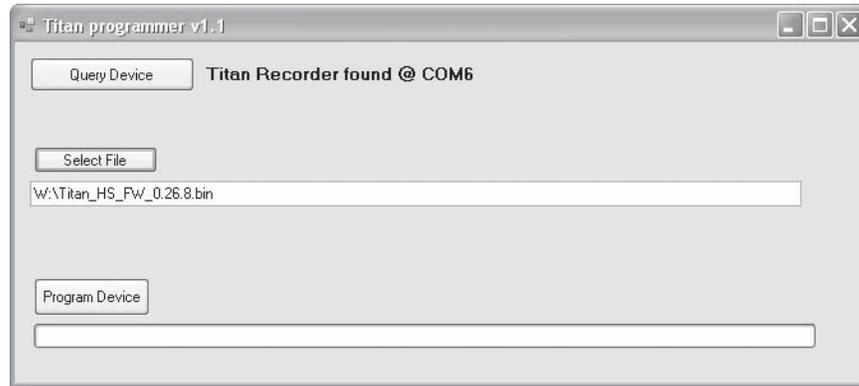


4. Click on the 'Select File' button. An 'Open' dialog window will appear. Navigate to the update file location, select the file, and click "Open":

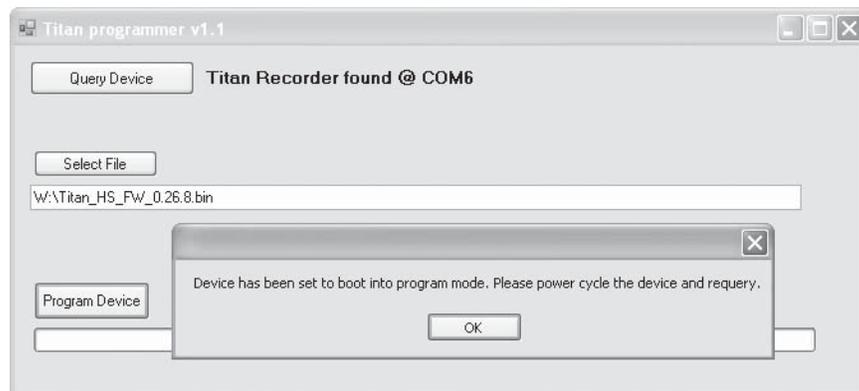


NOTE: In this window you will be limited to selecting .bin (binary) files only.

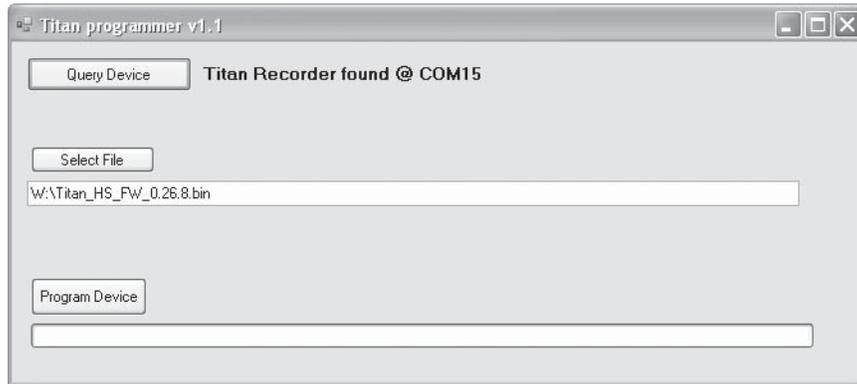
5. The selected firmware will appear in the name field below the 'Select File' button:



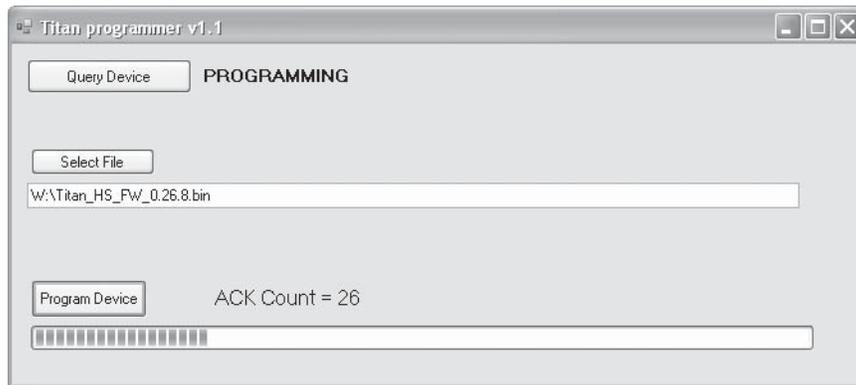
6. Click on the 'Program Device' button. The Programmer will check the connected Titan device and issue an error message if the selected firmware is incompatible with the device. If the firmware is compatible, the Programmer will place the Titan device into program mode and issue a status message as shown. Power cycle the Titan device, allowing the LED indicators to extinguish *completely* before restoring power. Click 'OK' to dismiss the status message.



7. After power-cycling, re-query the Titan device by clicking on the ‘Query Device’ button. The Programmer will report finding the Titan device on a different COM port:

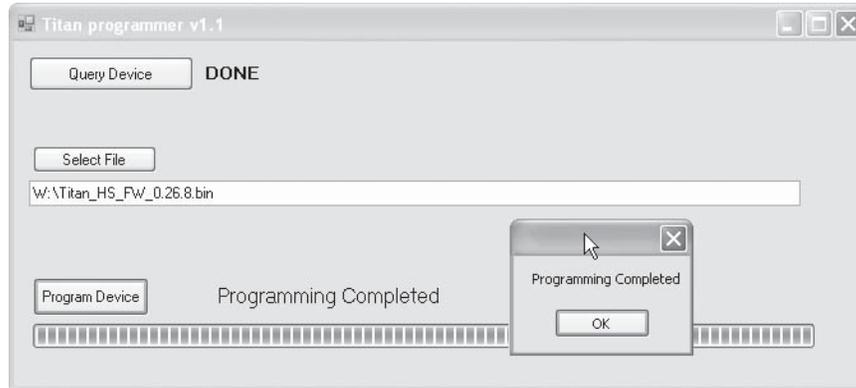


8. Click the ‘Program Device’ button; after a brief pause, programming will begin. A series of status messages will appear as the programming operation proceeds:

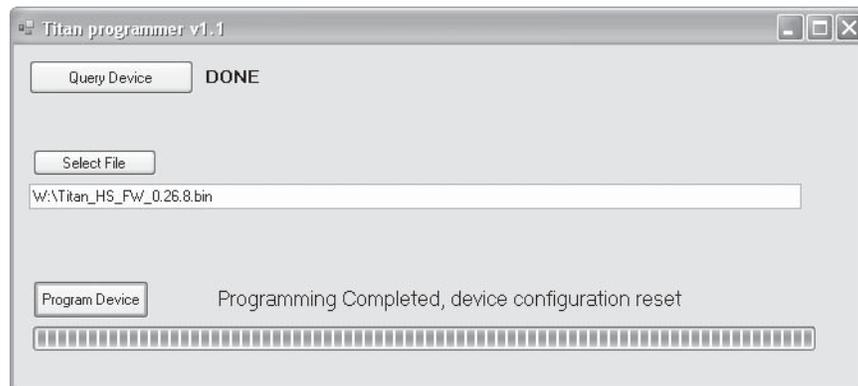


Warning: Do not remove power while the device is being programmed!

9. When programming is finished, a 'Programming Complete' message window will appear:



10. Click 'OK' to dismiss the status message. The Programmer will then reset the Titan device to its initial configuration. Quit the Programmer and power-cycle the Titan device. The firmware update is complete and the device is ready for use.



Troubleshooting

If you are having difficulties configuring, connecting or using your Titan device, refer to the troubleshooting section below. This section addresses common issues with the operation of Titan devices. If your specific issue is not addressed, please contact the factory for additional assistance.

Issue: No power

After connecting the Titan device via USB, the Power LED does not illuminate (no power).

Solution

Titan devices use a special ‘Y’ cable to provide power from two USB ports. Both USB cable connections must be in place - a single connection does not supply sufficient power. If both USB connectors are plugged in and the Titan device still isn’t powered, try connecting to another USB port pair on the host PC. If the problem persists, try applying power to the Titan device through the Auxiliary Power Connector. If the Titan device still isn’t working, contact the factory for additional support.

Issue: Windows holds port open

If you fail to disconnect in TCS before physically disconnecting or powering down the Titan device, Windows holds that port open. When you reconnect, the port appears twice in the *Select Port* field in TCS.

Solution

Click ‘Disconnect’ in TCS. Physically disconnect the Titan device. In TCS, click ‘Query Serial Devices’. This will clear the *Select Port* field and unlock the COM port.

Issue: Windows won’t recognize the Titan device when using a DAO

If you are using a Titan DAO with a new installation of TCS, Windows does not recognize the hardware.

Solution

This can happen if the Titan device drivers are not installed. Remove the DAO temporarily from the configuration and plug the Titan device directly into USB. The Windows ‘Hardware Install’ wizard will recognize that new hardware is connected and begin the driver installation process. Allow this process to complete before reconnecting the DAO.

Issue: No output from sensors

One or more of the connected sensors does not output data.

Solution

If the sensor requires power and the Titan device is powered from USB, no power is available to run the sensors. For this configuration, you must apply power through the Auxiliary Power Connector.

Warranty

Mars Labs warrants all their manufactured equipment to be free from defects in material and workmanship. **Mars Labs** liability under this warranty is limited to servicing or adjusting any equipment returned to the factory for that purpose, and to replace any defective parts thereof. The warranty remains effective for 365 days following delivery to the original purchaser. During this time, equipment will only receive repair when the original purchaser prepays all return transportation charges, and **Mars Labs** finds to its satisfaction that the equipment is indeed defective.

If the fault has been caused by misuse or abnormal conditions of operation, normal service charges will prevail. In this case, an estimate will be submitted before work is started. **Mars Labs** must authorize any warranty returns.

Mars Labs reserves the right to make changes in the design of its instruments without incurring any obligation to make the same changes on equipment previously purchased.

This warranty will be void if unauthorized alterations or modifications are found which impede the repair or testing of the equipment.

Receipt of Equipment

The equipment should be tested as soon as it is received. If the equipment is damaged in any way, a claim should be obtained by the claim agent, and this report should be forwarded to **Mars Labs**.

Mars Labs will then advise the customer of the disposition to be made of the equipment and arrange for repair or replacement. When referring to this equipment for any reason, the model number, serial number and purchase order number should be included.

Malfunction

If the unit fails to operate, or any fault develops, **Mars Labs** should be notified, giving full details of the difficulty, including model number and serial number. Upon receipt of this information, **Mars Labs** will provide service data and shipping instructions.

This warranty is expressly in lieu of all other obligations or liabilities on the part of **Mars Labs**, which neither assumes nor authorizes any person to assume for it any other liability in connection with the sale of its equipment. Contact:

Mars Labs
29 C Street
Laurel, MD
20707
(301) 470-3278
email: Support@MarsLabs.com

Notes & Errata

Additional operational information about the Titan Pod not covered elsewhere:

Known Issues:

General:

1. The Pod will stop running if scanning with USB enumerated but not connected/opened in either TCS or a terminal emulator.

High Speed Issues:

1. When operating at the 10K Hz scan rate while connected via USB, the Pod will support a maximum of 12 channels. If full 16-channel operation with a USB connection is desired, select the 8192 or lesser scan rate.

GPS Issues:

1. GPS does not operate correctly at the 10K Hz scan rate.
2. GPS output does not currently include northing and easting data.

Calibration:

1. Calibration values are off by a factor of 2 for a gain of 256, and off by a factor of 4 for a gain of 512.



29 C Street • Laurel, Maryland • 20707