

# ***Titan***

# ***Mini-Recorder***

## *CAI User Manual*



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## 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 CAI Mini-Recorder  
User Manual v1.2  
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## Introduction

The Titan CAI Mini-Recorder is a fully integrated data acquisition system that features a 16-channel interface with on-board signal conditioning, programmable gain and filtering, A/D conversion, and built-in data storage via an SD memory card data recorder. The Mini-Recorder can be powered by the supplied USB ‘Y’ cable when connected to a PC, or by applying power to the front panel auxiliary power connector when recording remotely.

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

## Furnished Accessories

The Titan CAI Mini-Recorder is typically shipped with the following items:

1. Titan CAI Mini-Recorder
2. SD Memory Card
3. Breakout Cables (DB9 to multiple BNC)

A Titan Power Adapter or a mating connector for the Mini-Recorder Auxiliary Power Connector may also be included.

## 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

### Electrostatic Discharge

Electrostatic 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

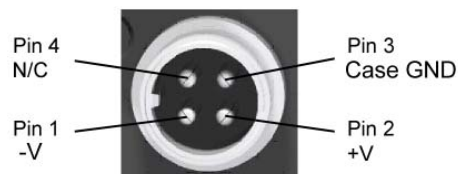
### Front Panel

The Titan CAI front panel incorporates an SD Memory card slot, a CONTROL toggle switch to initiate remote recording and select calibration modes, connections for USB, GPS, and Auxiliary Power.



### Auxiliary Power Connector

The Auxiliary Power Connector is used to power the Titan CAI in remote applications. The connector pinout is shown below. The voltage applied to Pin 2 is the operating voltage of the CAI (the operating voltage depends on the model).



**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!

**NOTE:** The mating connector for 4-pin Auxiliary Power input is available from the following sources:

Mars Labs - P/N MLCON10227

Description: 4-Pin Female CB and HAM Radio Microphone Plug

Radio Shack - P/N 274-001

Description: 4-Pin Female CB and HAM Radio Microphone Plug

Westlake Electrical Supply - P/N T609B

Description: 4-Pin Inline Female Mobile Connector

## SD Card Slot

The Titan CAI accepts Ultra II, Extreme III, or Class 10 SD cards. Make sure to have an SD memory card inserted prior to initiating recording or configuring tests in the Titan Control Software (TCS) application. In order to create a test header file on the SD card, you must configure a test in TCS prior to recording. This is done by creating a new test in TCS, connecting to the CAI, configuring the sensors, and initiating a Scan. For more information, consult the TCS User Manual.

**NOTE:** *If you are using memory cards other than the one supplied, those cards must be formatted prior to use. See page 13 for the procedure on formatting memory cards.*

## CONTROL Switch

The CONTROL switch is a multi-function toggle switch that is used to initiate manual recording and select calibration modes. LEDs to the left and right of the switch indicate the current status of the CONTROL modes.

**Stop Mode** – The red STOP LED indicates that the CAI is not in record (REC) mode. It remains illuminated when scanning, but goes off when recording begins.

**Record (REC) Mode** – The green REC LED is illuminated when the CAI is recording. To enter record mode manually, move the toggle switch to the ‘REC’ position and release. To exit record mode, move the toggle switch to the ‘REC’ position a second time and release.

**Calibration (CAL) Modes** – The CAI offers three calibration modes: ‘CAL-’, ‘CAL+’ and ‘CAL 0’. ‘CAL-’ is indicated by a red LED, ‘CAL+’ is indicated by a green LED, and ‘CAL 0’ is indicated by both red and green LEDs. When any of these LEDs are lit, the CAI is in CAL mode. To engage CAL mode, move the toggle switch to the ‘CAL’ position and release. Successively toggling the switch will cycle through the three CAL modes as follows:

CAL- → CAL+ → CAL 0 → CAL OFF



## USB Port

A USB Type B port that provides communication between the CAI and the Titan Control Software (TCS). The port also supplies power to the device.

**NOTE:** *The Titan CAI requires only a single USB connection for power when no sensors are driven. When sensor excitation is enabled, however, the USB connection alone may not be able to supply sufficient power to the device and to all connected sensors. To insure proper operation under these conditions, external power should be provided through the Auxiliary Power connector.*

## GPS Port (Auxiliary Digital Input)

A multi-function port that accepts either a GPS sensor (Garmin 18X-5Hz) or serial data from digital sensors. GPS sensor support is an optional feature on the Titan CAI.

## Rear Panel

The Titan CAI Mini-Recorder rear panel incorporates two LED status indicators, a communications (COMM) port and DB9 input connectors:



### Status Indicators

**P (Power)** – A green LED indicating that the CAI is ON.

**E (Error)** – A red LED indicating that a sensor output has meet or exceeded the range for the configured sensor channel as displayed on the TCS ‘Tags & Channels’ screen. If the input exceeds this amount, either positive or negative, the Error LED will be lit for as long as the input exceeds the maximum range. When the input signal falls back into the acceptable range the Error LED will go out. Note that the Error LED will be lit for *any* channel that exceeds the maximum range. If you are viewing signals in the Runtime screen in TCS, the signals will be clipped when they exceed the maximum allowable input.

### COMM (currently not implemented)

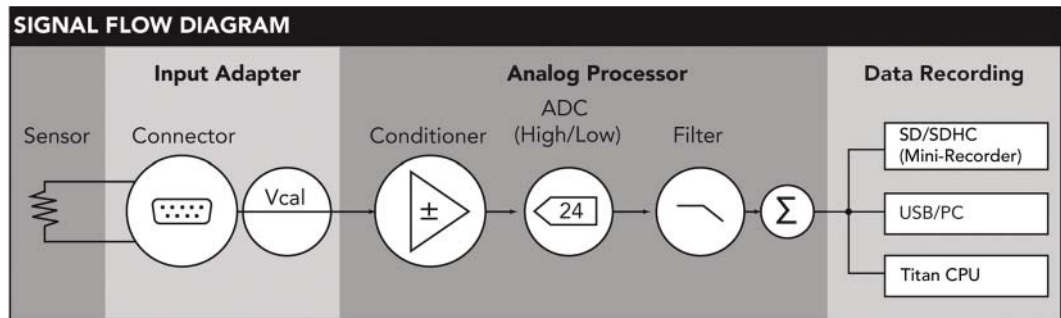
An RJ-45 port to interface the CAI with the Titan CPU Channel Multiplexer and other connectivity options. Integrated LEDs in the connector (RX & TX) indicate when the Mini-Recorder is receiving or transmitting data through this port.

### CH1-8 / CH9-16

Two DB9 female connectors provide analog input (see pinout diagram, page 14).

## Signal Flow

The diagram below shows the signal flow of the Titan CAI Mini-Recorder for a single input channel. The Titan ICP Mini-Recorder supports up to 16 channels at 2400 samples per second (Low Speed operation), or up to 60,000 samples per second (High Speed operation).



The Titan CAI features on-board signal conditioning, programmable gain and filtering, and A/D conversion. Each channel features sensor Balance\* and Calibration loopback functions (VCal ) 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), to a Titan CPU Channel Multiplexer, or internally to an SD memory card.

\* Balance is a function that removes channel offsets. It is configured and controlled via TCS. For more on the Balance function, consult the TCS User Manual.

## Calibration Modes

Calibration for the Titan CAI Mini-Recorder can either be activated from the panel switch or under control from TCS.

### **CAL+ and CAL-**

Calibration modes CAL+ and CAL- places a fixed voltage into the input (if the calibration type for the channel is set to 'VCal'). The input is switched over to the CAL voltage (either positive or negative), and Balance values (if any) are removed.

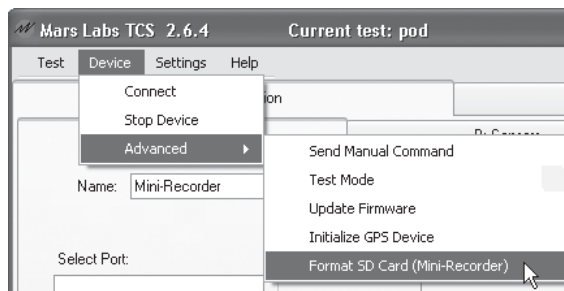
### **CAL0**

CAL0 mode activates a common mode short on the input of all channels, providing an indication of the system offset. Like the CAL+ and CAL- modes, the balance value for VCal sensors is removed.

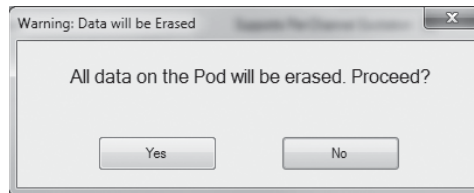
## Formatting Memory Cards

New SD memory cards must be formatted for the CAI Mini-Recorder prior to use. New memory cards should always be formatted *in the CAI Mini-Recorder* using the following procedure:

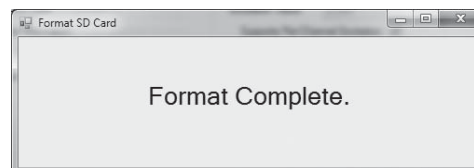
1. If a memory card is inserted, eject the card and power cycle the CAI.
2. In TCS, connect [F1] to the CAI.
3. Insert the SD memory card.
4. In TCS, select ‘Format SD Card (Mini-Recorder)’ from the Device menu:



5. A warning message will be displayed:



6. Click ‘YES’ to proceed and the card will be formatted. When finished, a ‘Format Complete’ message will be displayed:



7. Close the message window and disconnect in TCS, or proceed with test configurations.

### NOTES:

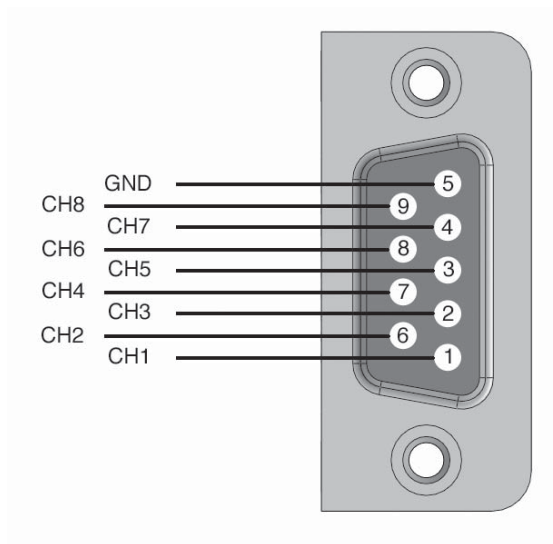
1. Memory cards up to 32GB (Ultra II, Extreme III, or Class 10) supported.
2. The maximum file size that a Pod can handle is 2GB. If your anticipated acquisition approaches or exceeds this amount, enable File Partitioning under “Recording Options” in TCS and adjust the partition size to ‘1000M’ (1GB). File Partitioning breaks up large test files into small chunks; when the chunk size limit is reached, the file is closed out and stored, and a new file is opened. For more on File Partitioning, refer to the TCS User Manual.

# Interface

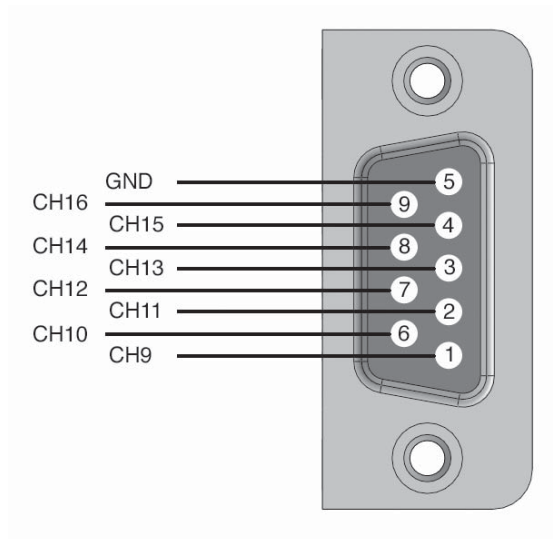
Pinouts for the analog input connector, communications (COMM) port and GPS port are shown below.

## Analog Input Connector:

Titan CAI Mini-Recorder provides up to 16 analog inputs on DB9F connectors. The connector pinouts are shown below.



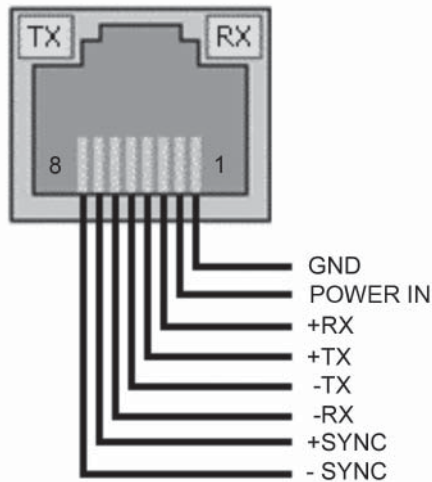
Channels 1 - 8



Channels 9 - 16

## COMM Port (currently not implemented):

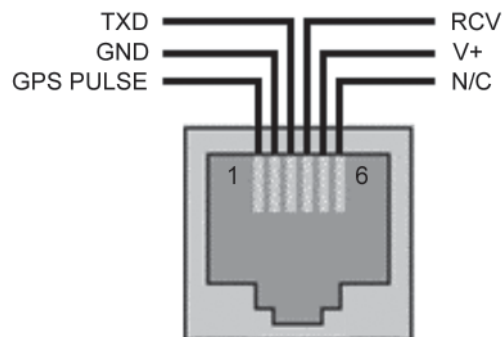
The pinout of the COMM port appears below. The POWER IN pin is internally configured at the factory for +5V, +12V or 0V. A label on the side nearest the COMM connector displays the POWER IN configuration.



**NOTE:** For information on configuring the COMM port for communication with TCS instead of using the USB port, refer to 'Running with RS-422' in the TCS User Manual

## GPS Port:

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



## Features and Specifications

### Key Features

- Supports multiple modes of operation:
  - Standalone recording up to 16 channels
  - Connected to a PC recording up to 16 channels
- 24 bit analog conversion
- ICP sensor support
- Compact size, light weight and low power make the device suitable for in-vehicle applications
- Slim form factor permits device stacking to create compact large channel-count systems
- Available in a top-mount 16 channel configuration or rear-mount dual DB9 (8 + 8 channel) configurations

### Specifications

Number of Channels	16 fault tolerant channels on BNC (-23 version) or DB9 (-53 version) connectors
Sample Rate	High Speed Operation: up to 60,00 samples per second per channel Low Speed Operation: up to 2400 samples per second per channel
Resolution	Utilizes 24-bit A/D conversion; 16-bit exported
Programmable Gain	From $\pm 1$ to $\pm 8$ ; $\pm 8V$ full scale input maximum
Programmable Filter	10 pole Linear Phase (High Speed operation) 8 pole Butterworth (Low Speed operation)
Calibration Modes	Voltage (VCal): Precision positive and negative calibration voltages
Analog Sensor Support	Techometer/Totalizer: Frequencies up to 7KHz ICP Sensors: 2.5mA current @ 20V compliance
Recorder	Records data to Secure Digital memory card. Supports SD cards up to 32 GB.
PC Operation	Remote recording and control via USB
Stand-alone operation	Via on-board switches
Power Requirements	11-32VDC, 3W for base unit
Dimensions	13.5cm x 10.6 cm x 3.7 cm (L x W x H)
Breakout Cables	DB9 to multiple BNC (included)



## 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.

**This section under development**

## Notes and Known Issues

This section offers additional operational information about the Titan CAI Mini-Recorder not covered elsewhere.

### Frequency Measurements

1. The Titan CAI supports a single frequency sensor on channel 8 only.
2. The frequency sensor input requires an input of 2Vpp or greater to function correctly. If there is a negative offset on the input signal, the signal may need to be boosted to register correctly.
3. With a timebase setting of 50,000, the lowest value that the frequency input can read is 800 mHz (0.8 Hz). Lower values will be rounded down to zero.

### DC Inputs

1. Channels configured for a DC input have an offset of -2.048V. To create a balanced signal, you must add an offset of 2.048V.

### Input Dividers

1. Unlike other Titan Input Modules, the CAI does not have input divider circuitry, therefore enabling input dividers in TCS will have no effect.

## 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](mailto:Support@MarsLabs.com)

