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TDAS PRO LAB Hardware User's Manual



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Introducing the TDAS PRO LAB

Each TDAS PRO LAB module is a highly advanced data recorder that is also easy to use.

Congratulations on choosing a TDAS PRO LAB data recorder for your data collection project! We are proud of our product and we want you to be completely satisfied with your purchase. The TDAS PRO LAB is the latest evolution of our original TDAS product that has won praise for value and reliability. The following information will introduce you to the inner workings of the TDAS PRO LAB.

Technical Overview

Each 8-channel module functions as a complete, standalone data recorder with integral microprocessor, adaptive signal conditioning, excitation sources, A/D circuitry, and data memory.

TDAS PRO LAB hardware is a standard 19-inch, rack-mounted system commonly used for stationary laboratory data collection. Each 8-channel module functions as a complete data recorder with integral microprocessor control, adaptive signal conditioning, excitation sources, A/D circuitry and data memory.

TDAS PRO LAB functions are set-up using an IBM-compatible computer. Once the computer initializes the system, it can be disconnected and the module will collect data with no additional support. After the test, data stored in each module is downloaded to the PC hard drive in binary format. Once on the hard drive, the binary data files are then unpacked for viewing and post-processing.

There are no potentiometers to adjust because hardware settings are performed completely under software control. Every time a data collection task is initiated, the software runs a thorough calibration check on each measurement channel. Appropriate gains are set, sensor offsets are zeroed and anti-aliasing filters are set.

Sensor inputs are through connectors located on the front of each TDAS PRO LAB module. See *Chapter 5—Configuration/Specifications* for your specific connectors and pin assignments.

TDAS BLOCK DIAGRAM

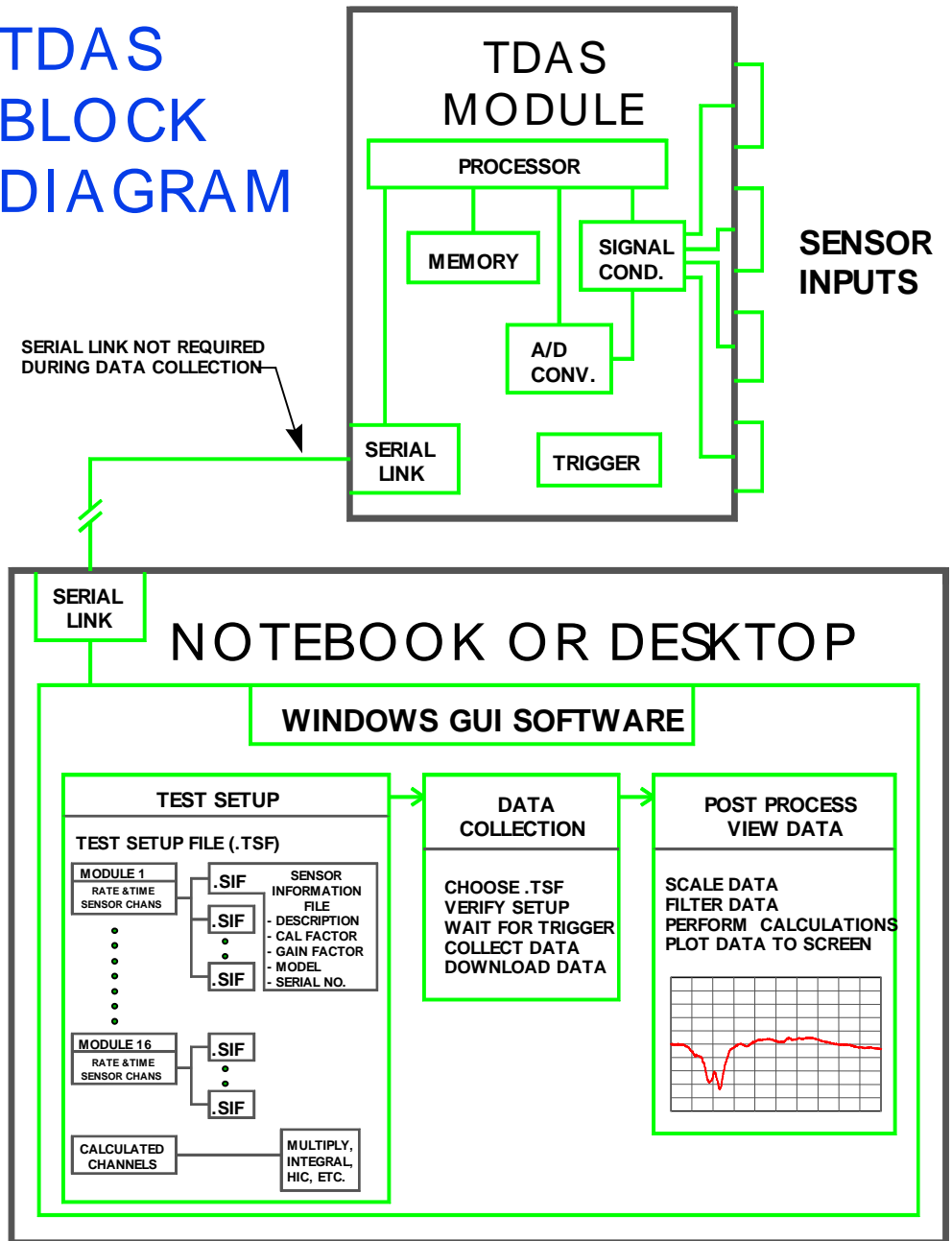


Figure 1: TDAS Block Diagram

Each TDAS PRO LAB module contains the following subassemblies:

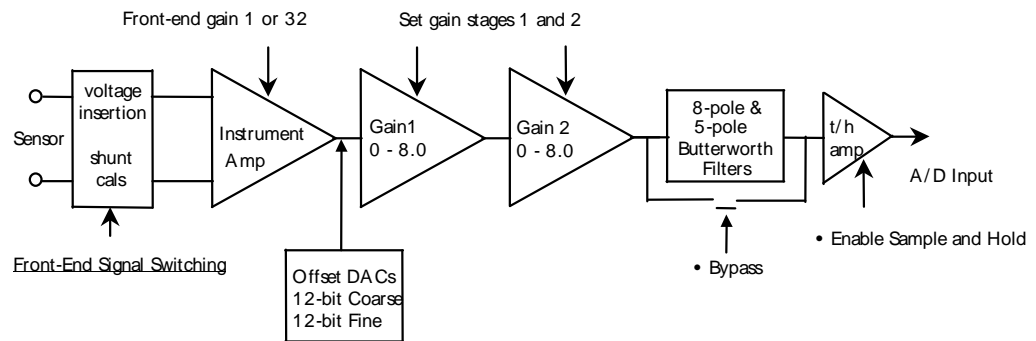
Each TDAS PRO LAB module is a completely autonomous data collection system.

A System Board that contains eight channels of adaptive signal conditioning, voltage insertion calibration functions, filtering, A/D, and triggering circuitry. Hardware anti-aliasing filters are set under software control based on user-selected data sampling rates.

A Processor Board that is very similar to most PCs in that it has a microprocessor, program storage, RAM, and communication links. The internal processor uses digital I/O channels to control all module functions.

An Auxiliary Board that contains power control circuitry, battery charging/status circuitry, software-programmable isolated excitation sources, and shunt calibration circuitry. Power inputs are diode protected and fused by self-resetting fuses.

Each measurement channel consists of the elements depicted below. (See *Chapter 5—Configuration/Specifications* for additional information.)



TDAS PRO LAB Rack Systems

Up to six 8-channel modules can be installed in the available 19" rack. Several racks may be daisy-chained to form systems with large channel counts.

The rack unit distributes communication signals, operating power, power-up control, trigger signal, and slot programming codes. The rack also contains a 1000 V, isolated, time zero trigger buffer, power status indicator and provisions for using RS232 communication protocols. Note that Ethernet (10Base-T) communications are optional. This requires additional hardware installed at the factory and therefore must be specified at the time your order is placed. Please see your packing slip for the communication cable(s) supplied with your system to determine what communication options you have.

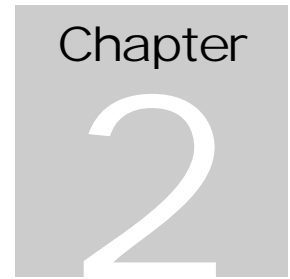
Basic Care and Handling

The TDAS PRO LAB is a high-precision measurement instrument designed to operate in a laboratory-testing environment. This system was *not* designed to tolerate shock, vibration, spilled liquids, etc.

WARNING:

TDAS PRO LAB is not a crashworthy system. Do not subject the system to any adverse shock loads or extreme environmental conditions.

When transporting the unit, treat it as you might a laptop computer and you should have no problems.



Getting Started

Getting started with the TDAS PRO LAB is easy. Follow these simple steps and you will be collecting data before you know it!

This section will assist you in using your TDAS PRO LAB system for the first time. After unpacking the system, you will attach an external power supply, connect the communication cable, and perform a preliminary system test.

Unpacking the System

Open the box and unpack the system. Please check for the items specified on the packing list for your system. If you are missing any items, please contact us immediately so that we may correct any shortages.

Connecting the Cables

Plug the AC power cord into any power outlet that supplies 100-240 V, 50-60 Hz. The ground pin on the plug must connect to a suitable facility ground.

Connecting Communication and Trigger Cables

TDAS PRO LAB contains a robust RS232C serial communication driver and may be connected to the standard serial port on virtually any IBM-compatible personal computer. You can use any available communications port from COM1 to COM4.

1. Attach one end of the serial cable to the TDAS PRO LAB rack connector (see Figure 2).
2. Attach the other end of the serial cable to the communications port on your computer.

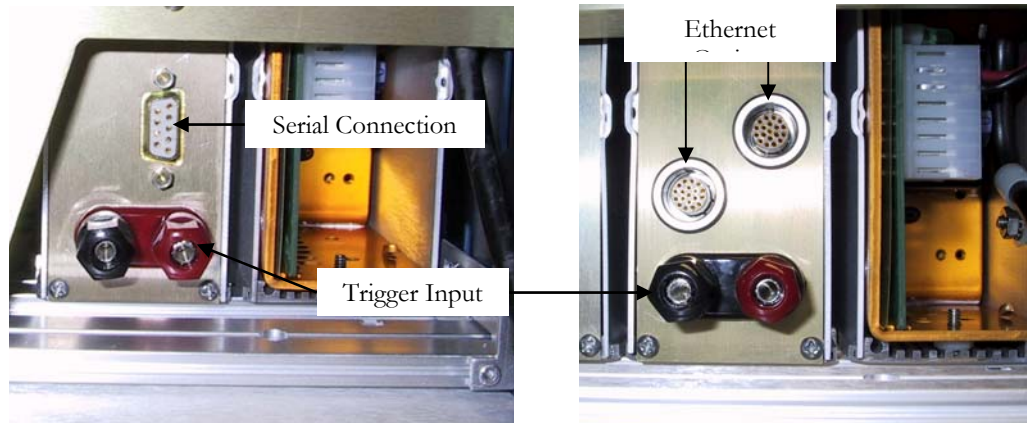


Figure 2: TDAS PRO LAB Rear View (RS232 and Ethernet option)

- A standard, off-the-shelf, serial (RS232) cable is needed to communicate with the TDAS PRO LAB rack system. Note that the cable should not be any longer than 25 feet. Ethernet communications are optional and use either 19-pin LEMO connector. RS232 communications are also possible through either LEMO connector. Please see your packing slip for the communication cable(s) supplied with your system to determine what communication options you have.
- A contact-closure trigger switch can be connected to the binding-post banana jack input located on the rear panel.
- Please contact DTS if you have questions regarding these functions.

Switching On Power

The power switch for the TDAS PRO LAB is located on the second panel from the left and next to the power indicator LED. To switch the power on, toggle the switch to the up position. The POWER indicator LEDs on the module(s) and the rack will begin to blink green.

When power is turned off, the POWER indicator on each module will stop flashing. If you turn off the power, then decided to turn it back on, you must wait *at least* 10 seconds after the module POWER indicators stop flashing to ensure a proper re-initialization of the modules.

Attaching Sensors

The TDAS PRO LAB system supports a wide variety of common sensors.

The TDAS PRO LAB hardware works in concert with the software in such a way that one need only wire a sensor to the input connector and enter some basic sensor calibration information into a Sensor Information File (.SIF).

Sensor Connector Options

Each module can record up to eight channels of data simultaneously. There are a variety of sensor input connector and pin assignment options available for your TDAS PRO LAB module. Several options are available. Please see the documentation provided with your system to determine your pin assignments.

Wiring Sensor Cables

A wide variety of four-wire, bridge-type transducers are accommodated by the adaptive electronics within the TDAS PRO LAB. The system automatically accommodates bridge transducers with varying offsets and unequal arms. The auto-zero circuit is capable of balancing most bridges beyond their full-scale ranges.

Half-bridge, three-wire sensors (such as potentiometers) can be accommodated by connecting the sensor excitation leads to +/- excitation, and the signal lead to - signal. Use “half-bridge” in the software set-up.

Single-ended voltage inputs that are referenced to common may be accommodated by connecting the voltage source common to TDAS PRO LAB common and -sig, and the signal to the +Sig input.

When 5 V excitation is chosen, the negative excitation terminal is internally connected to system common and may be used to reference single-ended input signals.

Calibration Techniques

TDAS PRO LAB hardware supports both voltage insertion and true shunt calibration methodologies.

Voltage Insertion

As the name implies, a precise calibration voltage source is temporarily connected to the sensor input amplifier. Voltage insertion calibrations are generally the best choice when the signal source has an actively driven output as is the case with many of the latest 0-5 V active output accelerometers and angular rate sensors.

Voltage insertion may also be the best choice for passive sensors that have a bridge resistance that varies significantly with temperature, or from sensor to sensor. Some silicon-based, piezo-resistive sensors fall into this category.

Shunt Calibration

Shunt calibration is the temporary application of an external resistance across one leg of a bridge transducer. Shunt calibration is appropriate primarily for sensors that exhibit a predictable bridge resistance such as is the case with strain gage load cells, accelerometers, etc.

The TDAS PRO LAB system allows you to apply shunt resistance from within the TDAS PRO LAB module and/or you can install an external shunt resistor between the -Sig and +Sig pins on the sensor interface connector. Please see *Chapter 5—Configuration/Specifications* for information regarding the internal shunt calibration resistors supplied with your system.

Maintaining Your System

The TDAS PRO LAB has no mechanical adjustments and will provide years of trouble-free service.

From the ground up, TDAS PRO LAB data recorders have been developed to operate reliably in a laboratory testing environment. Each unit is hand-assembled by skilled technicians and there are no potentiometers to go out of adjustment.

General Care

The TDAS PRO LAB system does not require any special care or maintenance except for periodic calibration. Please remember though that all electronic instrumentation should be kept in a clean, dry environment and be treated gently. TDAS PRO LAB was not designed to withstand severe shocks (such as drops onto a hard floor), spilled liquids, or other environments that are commonly detrimental to electronic measurement equipment.

TDAS Hardware Calibration

TDAS PRO LAB modules are supplied fully-calibrated using NIST-traceable test equipment. Each TDAS PRO LAB module is delivered with an embedded Module Information File (MIF) that contains calibration values for excitation sources, internal references, diagnostic circuits, etc.

DTS recommends a standard recalibration interval of six months in accordance with TDAS PRO LAB calibration protocols. DTS calibration tests include verification of all internal amplitude and time base references, frequency sweeps on each measurement channel and verification of the performance of excitation sources and ancillary circuitry. All TDAS products are delivered with updated MIF files and data plots showing the end-to-end response of each measurement channel against SAE J211 performance windows.

Configuration/Specifications

Our goal is that you understand our products well enough to trust us with your test data.

If you have questions regarding the performance of TDAS products that are not addressed in the specifications that follow, please contact DTS and ask to speak with a Technical Support.

The following information identifies the configuration of your TDAS PRO LAB system. If you have any questions regarding the following configuration information or specifications, please contact us.

1. Our standard internal shunt resistors are 0.1%, 25 ppm with the following values:

1	2	3	4	5	6	7
10.0k	20.0k	40.2k	80.6k	162k	324k	649k

Several options are available. Please see the documentation provided with your system to determine your specifications.

2. Our standard ½ bridge completion resistors are 1k at 0.1%, 25 ppm.
3. Each TDAS PRO LAB channel has a fixed 8-pole Butterworth filter and an adjustable 5-pole Butterworth filter. The fixed filter –3 dB point has been specified to optimize performance on sampling rates up to 20k samples/sec/channel. (Standard is 4.3 kHz. Several options are available. Please see the documentation provided with your system to determine your specifications.) Software automatically chooses the best combination of fixed and variable filter usage for a selected sampling rate.
4. Although the sampling rate is software adjustable to fine increments, DTS purposely limits the choices. This allows DTS to perform 100% Quality Assurance checks at all sampling rates prior to shipment of your TDAS PRO LAB. Our standard sampling rates (per channel) are as follows:

250, 500, 1k, 2k, 5k, 8k, 10k, 12.5k, 20k, 25k, 38k, 40k, 50k, 60k, 75k, 100k, 150k, and 300k

For convenience, a one-page summary of your system's Hardware Configuration Specifications, including pin assignments, is included as a separate attachment.

Specifications

Analog Inputs

Type:	Differential, software programmed
Common Mode Range:	± 6.25 V
Protection:	± 50 V
Impedance:	50 M Ω typical
Gain Range:	0.8 to 2000
Overall Bandwidth:	D.C. to 25 kHz
Noise Spectral Density:	0.06 $\mu\text{V}/\sqrt{\text{Hz}}$ RTI Typical, 0-4,000 Hz
Signal to Noise Ratio:	80 dB typical
Crosstalk:	<0.05% under all circumstances
Accuracy:	0.2% - automatically calibrated each use by internal 16-bit DAC
Auto Offset Method:	Dual 12-bit DACs per channel
Auto Offset Range:	Gain 0.8 to 31: ± 5.0 V, Gain ≥ 32 : ± 150 mV
Auto Offset Accuracy:	Typically <0.1% of A/D full scale
Bridge Completion:	Software selected per channel
Anti-Alias Filters:	Two per channel
Fixed Low Pass:	8-pole Butterworth, customer specified knee point (4.3 kHz standard)
Adjustable Low Pass:	5-pole Butterworth, set under software control from 50 to 3,000 Hz
SAE J211:	System response meets SAE J211 requirements

Digital Inputs

Method:	Sensor inputs may be used as event inputs with filters bypassed
Propagation Delay:	0.02 msec
Excitation Method:	Individually galvanically/optically isolated and software selected
Voltage levels:	Off, 5, 10 V standard; Off, 2, 10 V optional
Accuracy:	0.25% basic, each channel calibrated and software compensated
Rated Current:	50 mA per channel, individually current limited
Short Circuit Recovery:	<1 msec in all modes

Calibration

Method: Individually software-controlled voltage insertion and multiple shunt calibrations

Voltage insertion

Type: 16-bit DAC

Accuracy: Better than 0.1% 100 ppm/°C, NIST traceable and software compensated

Shunt Calibration

Number: 7 internal and 1 external

Values: Customer specified, 0.1% 25 ppm

Switching Resistance: $<2 \Omega$

Analog-to-Digital Conversion

Method: Successive approximation with simultaneous sampling of all channels (up to 25k samples per second per channel)

Resolution: Standard 16-bit

Maximum Sampling Rate: 304k samples/sec/module (38k on each of 8 channels, 100k on each of 3 channels, etc.)

Minimum Sampling Rate: 1 sample/sec/channel

Relative Accuracy: ± 4 LSB (0.006%)

Storage Technique: Circular memory buffer. Any portion of the memory may be allocated to pre-trigger data.

Memory Capacity/Type: 2 options; 4 MB SRAM, 250k samples/channel –or– 16 MB SRAM, 1 MB samples/channel

Triggering Systems

Each Module: Conditioned contact closure input with T=0 received LED indicator

Rack System: Standard contact closure input, galvanically and optically isolated to 1 kV. 5-12 V optically coupled inputs available.

Level Triggering: Available from any channel within each module

Sensor ID

Method: Serial data read from signal terminal or digital I/O line in sensor connector

Types Supported: Dallas, Endevco, DTS, and others as specified

PC Interface

Module (standalone): RS232 @ 115.2 kHz

Rack System, Standard: RS232 @ 115.2 kHz (up to 460k with PC plug-in card)

Power Requirements and Features

External Voltage: 110/240 VAC
 Maximum Power: Depends largely upon connected sensors. Up to 900 mA per 8-channel module with 350 Ω bridges and 10 V excitation on all channels (\approx 7.0 A maximum for 64 channels).
 Protection: Self-resetting fuses plus reverse current and transient over-voltage protection
 Post-test Power Reduction: Drops to \approx 350 mA per 8-channel module

Environmental

Operating Temperature: 0-50°C

Physical

Module Size: 5.4 x 4.8 x 1.35 in (13.7 x 12.2 x 3.4 cm, 73 cm³ per channel)
 Module Weight: ~1.5 lb (~0.7 kg; 87.5 g per channel)
 Standard 19 inch 3U Rack
 48 Channel Rack Size: 5.25 x 19.0 x 9.0 in (13.34 x 48.26 x 22.86 cm)
 48 Channel Rack Weight: ~16.5 lb (~7.5 kg) – includes modules

Control Software

Method: Intuitive, Graphic User Interface
 Operating Systems: Windows® 95, 98, NT
 Other Recommendations: Pentium 100 MHz or faster, 64 MB RAM, 1024 x 768 resolution