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# TDAS PLUS
# Mini Smart Battery
# User's Manual


**June 2008**
**Rev. 2**

# Table of Contents

## DTS Support

TDAS systems are designed to be reliable and simple to operate. Should you need assistance, DTS has support engineers worldwide with extensive product knowledge and crash test experience to help via telephone, e-mail or on-site visits.

The best way to contact a DTS support engineer is to e-mail support@dtsweb.com. Your e-mail is immediately forwarded to all DTS support engineers worldwide and is typically the fastest way to get a response, particularly if you need assistance outside of normal business hours. For assistance by telephone, please go to http://www.dtsweb.com/support.html to find the phone number appropriate for your region of the world.

# Introducing the TDAS PLUS Mini Smart Battery

The crashworthy TDAS PLUS Mini Smart Battery functions as the primary power source for TDAS PRO, TDAS G5 and **iCrash**™ data acquisition products. Supplying power and integrating communication, control, event, and status signals, they are available in several configurations to meet a variety of user requirements around the world.

This manual discusses the features available with the TDAS PLUS Mini Smart Battery. To identify the specific hardware included with your system, please see your packing list.

## Overview of TDAS PLUS Mini Smart Battery

- Built and tested for 100+ G dynamic testing environments.
- DTS standard DC power input connector supporting an input range of 18-36 VDC.
- Provides 18-36 VDC output power for one TDAS or **iCrash**™ device.
- Provides 12 VDC/15 VDC output power for up to ten TDAS and **iCrash**™ devices including **iDummy**™ systems.
- Integrates power, communication, event, and status signals.
- Over- and undervoltage protection, overcurrent protection, power input polarity protection.
- Battery, power in, power out, and communication status LED indicators.
- Integral threaded mounting holes compatible with the TDAS G5 Vehicle Docking Station.

### TDAS PLUS Mini Smart Battery Control Panel

All connectors and LED indicators are accessible from the front panel.

- Power input and output connectors,
- Communication and control signals,
- Event input and output signals,
- System status and start record signals,
- Locking toggle switch for power control,
- Battery, power input, power output, and communication status LED indicators.

Please see Appendix A for connector information and pin assignments. A discussion of the LED indicators begins on page 12. A picture of the TDAS PLUS Mini Smart Battery control panel is shown below.


**TDAS PLUS Mini Smart Battery Control Panel**

**TDAS PLUS Mini Smart Battery Functional Overview**

| Switch Position | POWER IN Status | Battery Status | Comm Status | POWER OUT 18-36 VDC Status | POWER OUT 12/15 VDC Status |
|---|---|---|---|---|---|
| OFF | Sufficient input power connected (PWR IN LED is on) | Charging | Active | No output | No output |
| ON | Sufficient input power connected (PWR IN LED is on) | Charging | Active | Output power on (PWR OUT LED is on) | Output power on (15 VDC) (PWR OUT LED is on) |
| OFF | No input power connected | No change | Inactive | No output | No output |
| ON | No input power connected | Discharging if external load is drawing power | Active | Output power on (PWR OUT LED is on) | Output power on (12 VDC) (PWR OUT LED is on) |

Unit is shutdown.

### *Locking Toggle Switch*

When the toggle switch is in the ON position, communication and all internal control system electronics, including output power, are energized and the unit is fully functional. (This is the normal operating mode.) When the switch is in the OFF position, output power is disabled and:

1. Internal control system electronics and communication are active (input power is connected) or
2. The unit is in a shutdown state (input power is disconnected).

Note: You must pull out on the switch before moving--*do not force*.

### *POWER IN and POWER OUT Connectors*

The DTS standard power input and output connectors allow the connection of external power to and from the TDAS PLUS Mini Smart Battery. Ten 12/15 VDC outputs are also available via individual LEMO connectors. (A discussion of the PWR IN and PWR OUT LED indicators begins on page 12.)

***CONTROL Connector***

The CONTROL connector contains start record input, status output and event input signals. An external start record signal received by this connector will be transmitted to the COM connector. An internal status signal transmitted to this connector will be forwarded externally. All external contact-closure and/or logic-compatible event signals received by this connector will be transmitted to the COM connector.

***COM Connector***

Industry-standard Ethernet 10BaseT communications, event input, start record output, status output, and battery voltage signals are supported via this connector. Battery status is available via TDAS Control software or any web browser. This connector is compatible with all TDAS COM connectors. When used in a chain, this unit will be the last device in the communication path.

## Basic Care and Handling

The TDAS PLUS Mini Smart Battery is designed to operate reliably in 100+ G dynamic testing environments. Though resistant to many environmental conditions, care should be taken not to subject the unit to harsh chemicals, submerge it in water, or drop it onto any hard surface.

**WARNING:**

**Electronic equipment dropped from desk height onto a solid floor may experience as much as 10,000 Gs. Under these conditions, damage to the exterior and/or interior of the unit is likely.**

The lithium polymer battery contained within the enclosure requires no user maintenance. It is nonspillable and safe for transportation by truck, rail, ocean and air. Due to the chemical composition of the battery, it should not be allowed to fully discharge at any time. If you plan to store the unit, fully charge the battery and then place it in a location with ambient temperatures below 30°C, low relative humidity, and free from dust and direct sunlight. While in storage, the battery should be charged at least once every three months. Avoid storing the battery for longer than six months. The battery should be fully recharged before use after any time in storage.

When transporting the unit, treat it as you might a laptop computer and you should have no problems. We suggest that you always place the unit in the padded carrying case originally provided with your unit when it is not in use or if shipping is required.

TDAS PLUS equipment is not user-serviceable and should be returned to the factory for service or repair.

### Shock Rating

All crashworthy TDAS PLUS equipment is rated for and fully tested to 100+ Gs, 12 msec duration, in all axes and can be mounted directly on a vehicle, sled or other dynamic testing device. Mounting methods and mounting bolt selection should be carefully calculated so as to withstand expected shock loading and facilitate proper grounding. (Please see Appendix B for the unit's mechanical specifications.)

### Thermal Considerations

It is unlikely that the unit will overheat if common-sense measures are taken. Under normal conditions, the unit will get warm to the touch when a full load is applied continuously. The unit's internal fan and the application of a heat sink provided by bolting the unit to a structure of significant thermal mass will keep the temperature well within acceptable limits for any extended period in use at the maximum power output level. If high ambient temperatures, exposure to other heat sources or severely restricted airflow will cause case temperatures in excess of 50°C, the airflow created by a small fan will increase heat transfer by a factor of 3 to 5. Additionally, do not block or restrict air intake or exhaust (fan) to or from the unit and always shield the unit from exposure to direct sunlight. When in doubt, measure the case temperature of the unit and take whatever steps are necessary to improve heat transfer.

### Safety

The TDAS PLUS Mini Smart Battery contains an internal lithium polymer battery. Under normal operating conditions, contact with the battery will never occur. However, lithium polymer chemistry is volatile and users should be aware of first aid safety should contact occur. If at any time you should notice a sweet, bubble-gum-like scent, the integrity of the battery pack is compromised. Please take common-sense measures and observe safety precautions when exposed to a potentially harmful situation.

## Power Management

A good power source is of paramount importance. The TDAS PLUS Mini Smart Battery should be powered from a high-quality power source with output voltage and current ratings appropriate for the installation. (A discussion of the battery and power status LED indicators begins on page 12.)

### Maximum Input Power

The maximum input current is 25 A. A green PWR IN LED indicator means voltage input levels are within specifications. A blinking PWR IN LED means that input voltage is either too high or too low. If you have input power connected to the unit and the PWR IN LED is not on (the switch may be in either position), this can mean:

1. Input current is not sufficient,
2. Input polarity is not correct.

Additional troubleshooting can further isolate the problem.

## Maximum Output Power

The maximum output power available via the POWER OUT 18-36 VDC connector is 250 W.

All ten POWER OUT 12/15 VDC connectors provide nominal 15 V, 4.5 A output power up to a maximum of 15 A total. Each connector has a self-resetting fuse, so if one power output should shutdown, the other nine will not be affected, assuming power and current thresholds are not exceeded.

A green PWR OUT LED indicator means voltage output levels are within specifications. If you have sufficient input power connected to the unit (PWR IN LED indicator is green) and the switch is in the ON position but the PWR OUT LED is off, this can mean:

1. Current draw has been exceeded,
2. Output is shorted for one (or more) of the 11 POWER OUT connectors.

Additional troubleshooting can further isolate the problem.

## Power Consumption

The maximum power consumption for the TDAS PLUS Mini Smart Battery is 360 W.

## Internal Battery

The TDAS PLUS Mini Smart Battery contains a 6.6 AHr lithium polymer battery. It charges whenever sufficient external power is connected to the power input connector. (Please see Appendix A for connector information and pin assignments.) A green PWR IN LED indicator means voltage input levels are within specifications. A discussion of this LED indicator begins on page 12.

### *Charging the Internal Battery*

The TDAS PLUS Mini Smart Battery is typically supplied with a bench-top power supply for efficient and safe charging. The unit will charge whenever sufficient external power is connected (the switch may be in either position). The maximum charge time is ~1 hour from complete discharge to full capacity.

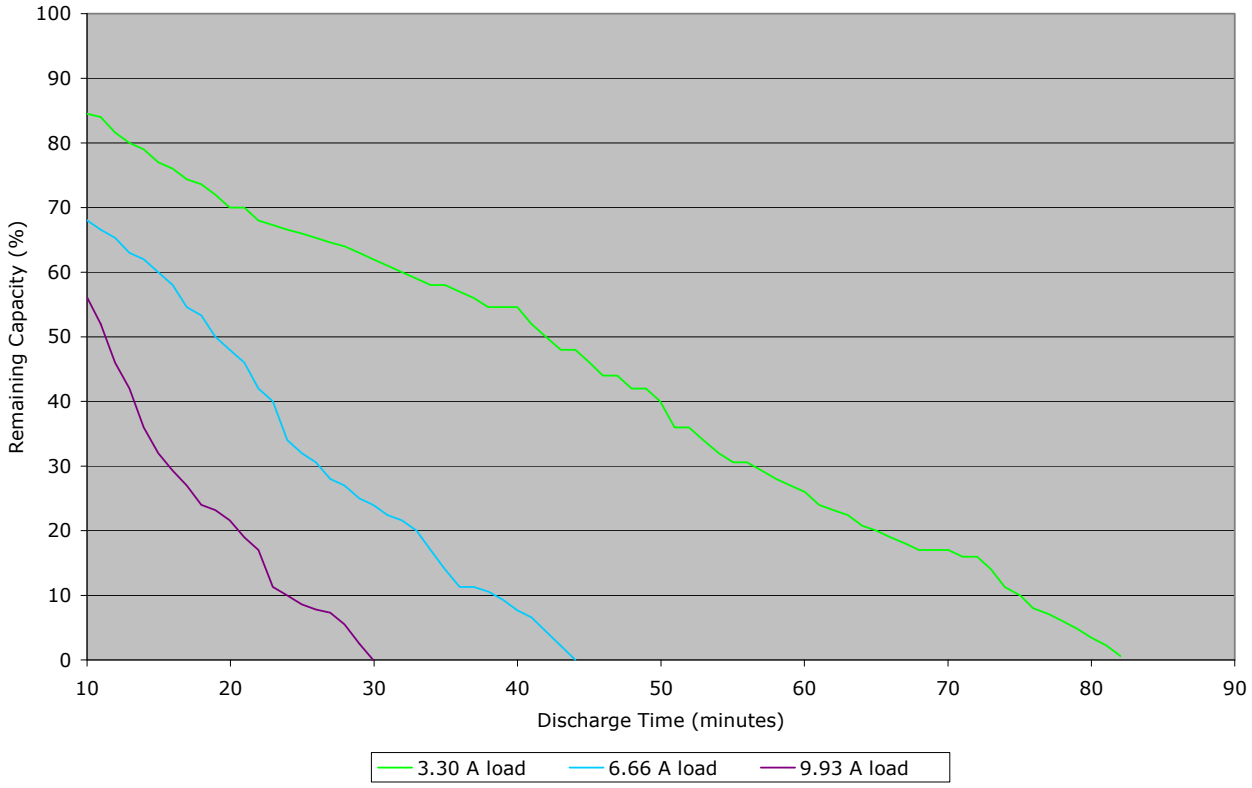
### *Battery Capacity and Discharge Rates*

The actual useful capacity will depend upon the current draw of the connected equipment and whether or not the battery was fully charged before testing.

A system fault (system armed) or warning (system not armed) will occur when:

1. The battery goes below the minimum power reserve threshold (in minutes) as set by the user,
2. The EMPTY LED indicator begins to flash.

Discharge rates are shown in the graph below.




**WARNING:**

**Do not perform any critical tests when the EMPTY LED indicator is blinking (battery critical).**

### *Battery Life Cycle*

The useful battery life is ~300 full discharge/recharge cycles. Partial discharge/ recharge cycles do not impact the useful battery life as much as full discharge/ recharge cycles. The internal battery is not user-serviceable; the TDAS PLUS Mini Smart Battery should be returned to the factory for service or repair.

## Charging / Powering other TDAS Equipment via the TDAS PLUS Mini Smart Battery

The TDAS PLUS Mini Smart Battery can be used to charge/power TDAS PRO racks (including any modules), TDAS G5 Vehicle Docking Stations, and other TDAS equipment containing an internal battery. The length of time required to charge all equipment depends primarily on the discharge state of the batteries. Please see the discussion on "Equipment Interconnections" beginning on page 12 for information on how to connect the equipment together.

Attached TDAS equipment will charge only when there is sufficient input power connected to the TDAS PLUS Mini Smart Battery and its toggle switch is in the ON position. If input power is disconnected and the toggle switch is in the ON position,

any attached and powered TDAS equipment will use their internal battery reserves first until levels are low enough to begin drawing power from the TDAS PLUS Mini Smart Battery. When the TDAS PLUS Mini Smart Battery goes below the minimum power reserve threshold as set by the user, a system fault/warning will occur.

***Power Requirements of Other TDAS Equipment***

TDAS PRO and TDAS G5 equipment use extensive power management to minimize power consumption. The lowest power demand condition is during charging when power is off. Current demand is at its maximum when the systems are fully armed and powering full sensor loads. Power requirements for TDAS PLUS equipment vary greatly. Please see the user's manual for your specific equipment to determine its power requirements.

*Power off*: When connected to sufficient external power, TDAS PRO racks will draw up to 600 mA to charge its internal battery; TDAS PRO SIMs, TOMs and DIMs will each draw an additional 25 mA to charge their internal battery. The TDAS G5 Vehicle Docking Station will draw up to 600 mA for charging its internal battery.

*Power on*: To determine maximum power requirements, assume 1 amp per TDAS PRO module or rack. For each TDAS G5 DAS/Vehicle Docking Station system, assume 2 amps per system.

## Input Power Calculations

The TDAS PLUS Mini Smart Battery contains high-efficiency power conversion circuitry with a wide input range and well-regulated outputs. With an appropriate external power supply, the system supplies optimal power for TDAS systems without having to worry about variable voltage drops through the input power cable.

It is very important that you choose a power supply and cabling carefully to ensure there is sufficient input voltage at the power input connector of the TDAS PLUS Mini Smart Battery under all circumstances. Power cables have resistance that depends upon the conductor diameter and increases with length. For reference, the following table identifies the nominal wire resistance by gage. (Since current flows through two wires (+ and -), the value in the table should be doubled.)

| Gage | Resistance (per foot) | Resistance (per meter) |
|---|---|---|
| 12 | 0.00162 Ω | 0.00531 Ω |
| 14 | 0.00258 Ω | 0.00846 Ω |
| 16 | 0.00408 Ω | 0.01338 Ω |
| 18 | 0.00652 Ω | 0.02139 Ω |
| 20 | 0.01036 Ω | 0.03398 Ω |

A simple voltage measurement at the cable end that connects directly to the TDAS PLUS Mini Smart Battery will verify whether the unit is receiving sufficient input voltage.

# Equipment Interconnections

The TDAS PLUS Mini Smart Battery is typically supplied with a bench-top power supply. Please see your packing list for any cables that maybe provided with your system.

Connections should be made as follows:

1. Connect the TDAS PLUS Mini Smart Battery's power supply to the POWER IN connector. (A green PWR IN LED indicator means voltage input levels are within specifications and polarity is correct.) The unit will be ready immediately for use.
2. Connect the TDAS equipment of choice to the appropriate POWER OUT connector using the appropriate cable.
3. Continue in this manner until all equipment has been connected.

# Communication Features

The TDAS PLUS Mini Smart Battery supports the industry-standard Ethernet 10BaseT communication method. Communication is active immediately upon application of the power source (the switch may be in either position). See Appendix C for the network parameters of your equipment.

## LED Indicators

The TDAS PLUS Mini Smart Battery has a variety of LED indicators to provide battery status, power input/output status and communication information.

### *Battery Status*


These LED indicators are green, blinking (EMPTY LED only) or off. Each indicator corresponds to ~25% of the battery's capacity. The EMPTY LED will blink when the battery reaches 25% of full capacity and a system fault (system armed) or warning (system not armed) will occur.

**WARNING:**

**Do not perform any critical tests when the EMPTY LED indicator is blinking (battery critical).**

### *Power In (PWR IN)*

This LED indicator is green, blinking or off. A green PWR IN LED indicator means voltage input levels are within specifications. A blinking PWR IN LED means that input voltage is either too high or too low. If you have input power connected to the unit and the PWR IN LED is not on (the switch may be in either position), this can mean:

1. Input current is not sufficient,
2. Input polarity is not correct.

Additional troubleshooting can further isolate the problem.

***Power Out (PWR OUT)***
This LED indicator is green or off. A green PWR OUT LED indicator means voltage output levels are within specifications. If you have sufficient input power connected to the unit (PWR IN LED indicator is green) and the switch is in the ON position but the PWR OUT LED is off, this can mean:

1. Current draw has been exceeded,
2. Output is shorted for one (or more) of the 11 POWER OUT connectors.

Additional troubleshooting can further isolate the problem.

***Communications (COM)***
This LED indicator is green, flashing or off. Once an Ethernet link is established, the LED indicator will turn green. It will flash intermittently when signals are being transmitted.

If the LED indicator remains off, an Ethernet link has not been established and the problem will need to be resolved before continuing. If the LED remains off when the TDAS equipment is connected and the locking toggle switch is in the ON position, check that the attached equipment is powered up and working properly.

## Grounding

In addition to providing reliable power conversion for TDAS systems, the TDAS PLUS Mini Smart Battery also provides a means for grounding the entire data acquisition system and the test vehicle. The enclosure of the TDAS PLUS Mini Smart Battery is connected to pin D of the 18-36 VDC POWER IN and POWER OUT connectors (Amphenol MS3474L14-4) and to the power output pins on the 12/15 VDC POWER OUT connectors. (Please see Appendix A for connector information and pin assignments.)

DTS strongly recommends that the test vehicle or sled be connected to earth ground. One easy way to do this is to attach a trailing ground cable to the TDAS PLUS Mini Smart Battery's POWER IN connector or to the enclosure of the unit.

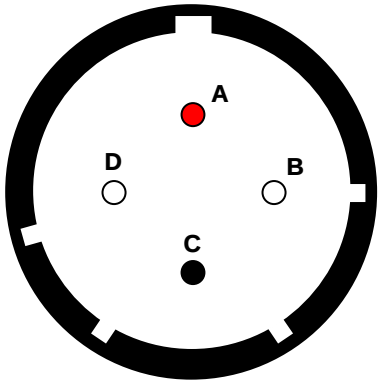
Additionally, it is very important that the enclosures of all TDAS equipment be grounded to each other and the test vehicle, sled carriage, or test fixture. This will minimize any risk of data noise due to high-current transients from sources such as vehicle battery shorts or air bag squib shorts. Bolting the units to the vehicle or mounting structure will ordinarily provide proper grounding. DTS recommends checking continuity between the enclosures of each unit and the test vehicle or sled to confirm resistance readings of <1 ohm.

If the installation does not permit bolting the TDAS PLUS Mini Smart Battery and connected TDAS systems to a common ground, DTS recommends connecting ground wires between the various enclosures.

Please contact DTS if you have any questions regarding proper methods to ground the system.

# Appendix A: Connector Information

**POWER IN (18-36 VDC) connector**
(Amphenol MS3474L14-4P)

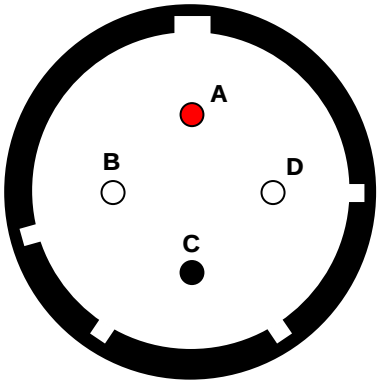



(panel view)

Suggested cable connector P/N:
MS3476L14-4S/97-3057-1008-1

| Pin | Function |
|---|---|
| A | +VDC input |
| B | N/C |
| C | -VDC input (power return) |
| D | Enclosure (case ground) |

**POWER OUT (18-36 VDC) connector**
(Amphenol MS3474L14-4S)

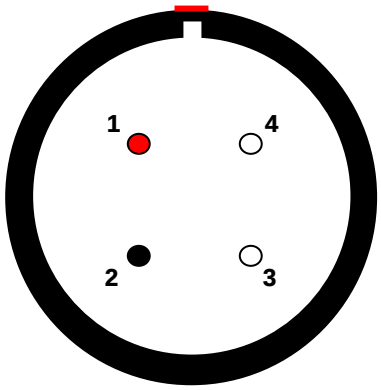



(panel view)

Suggested cable connector P/N:
MS3476L14-4P/97-3057-1008-1

| Pin | Function |
|---|---|
| A | +VDC output |
| B | N/C |
| C | -VDC output (power return) |
| D | Enclosure (case ground) |

**POWER OUT 12/15 VDC connectors**
(ECG.2B.304.CLL)



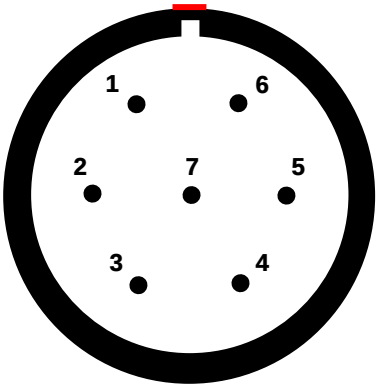

(panel view)

Suggested cable connector P/N:
FGG.2B.304.CLADxx

| Pin | Function |
|---|---|
| 1 | +VDC output |
| 2 | -VDC output |
| 3, 4 | Enclosure |

Note: All –VDC power input/outputs are connected to the enclosure.

**7-pin CONTROL connector**
(ECG.2B.307.CLL)



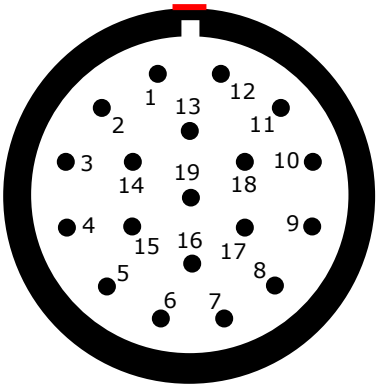

(panel view)

Suggested cable connector P/N:
FGG.2B.307.CLADxx

| Pin | Function |
|---|---|
| 1 | +Start record input, 0-5 V signal to pin 2 |
| 2 | -Start record input, return line for pin 1 |
| 3 | +Event input, 5-12 V applied with respect to pin 7 |
| 4 | Ground for status output |
| 5 | Status output, 0 V/+5 V with respect to pin 4 |
| 6 | +Event input, contact closure to pin 7 |
| 7 | -Event input, contact closure to pin 6 |

N/C = No connection

**19-pin COM connector**
(ECG.2B.319.CLL)




(panel view)

Suggested cable connector P/N:
FGG.2B.319.CLADxx

| Pin | Function |
|---|---|
| 1 | RS232 Rx |
| 2 | RS232 Tx |
| 3 | Shield (RS232 reference) |
| 4 | Start record output, optically coupled (referenced to pin 5) |
| 5 | Soft common |
| 6 | Status output, 5 V via 110 ohm (referenced to soft common) |
| 7 | +Rack status daisy-chain input |
| 8 | Ethernet Tx2- |
| 9 | Ethernet Tx2+ |
| 10 | Battery voltage via a 68K resistor in series |
| 11 | N/C |
| 12 | N/C |
| 13 | N/C |
| 14 | N/C |
| 15 | +Event, rack-to-rack |
| 16 | -Rack status daisy-chain input |
| 17 | Ethernet Rx2- |
| 18 | Ethernet Rx2+ |
| 19 | -Event, rack-to-rack |

## Suggested Connector Sources

DTS uses LEMO and Amphenol connectors on the TDAS PLUS Mini Smart Battery. If you need to purchase LEMO connectors, we suggest first going to LEMO directly (http://www.lemo.com). Their web site and worldwide sales team are very helpful. Should you have difficulty obtaining a specific part number, they can suggest connector variations or alternates and explain options that may be useful for your particular application. Another U.S. source is Alpine Electronics (www.alpine-electronics.com) in San Jose, California. They are a stocking distributor for LEMO and LEMO-compatible connectors.

There are many distributors for Amphenol and Amphenol-compatible connectors (Cannon, Array, etc.) including Allied, Arrow, Newark and TTI. Contact information for these distributors can be found at http://www.amphenol-industrial.com/index.asp?page=newcontact.asp.

# Appendix B: Mechanical Specifications

Weight: ~2.5 kilograms (~5.5 lbs)