



# SAVER™ 9X30

## User's Guide



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## SAVER™ 9X30

The SAVER™ 9X30 is Lansmont's most powerful environmental recorder. The added performance and capability of this compact, self-powered data recorder has never been matched. This assures the best resolution for those tasked with defining, characterizing, and clearly understanding their respective transport, distribution, and in-use environments.

This instrument provides users with the ability to capture up to nine dynamic channels of data (3 internal and 6 external), while also recording temperature, humidity and atmospheric pressure. The 9X30 continuously measures up to thirty days of shock (impact/drop), vibration, temperature, humidity, and atmospheric pressure conditions. It also works seamlessly with various Lansmont supplied GPS hardware options.

SAVER™ 9X30 applications:

- Define product's in-use environmental characteristics.
- Capture time history and frequency data to replicate in a laboratory.
- Verify existing and create new test standards based on actual measurements.
- Define a packaged product's transportation hazards and characteristics.
- Improve package performance.
- Maximize risk management procedures.
- Define "normal" and "abnormal" shipping conditions.
- Audit transit environments to identify carrier handling practices.
- Assess transport liability.

## SaverXware

SaverXware is the companion software package for the 9X30 and is built on the latest Microsoft® .NET platform. It is used for programming the instrument, transferring information between the instrument and host computer, and analyzing and exporting all recorded data. This software package includes user features such as:

- **Event Classification**  
Automatically categorize each event as *shock*, *drop*, *vibration* or *general* and concentrate the summary events into a pertinent subset.
- **Event Processing**  
Process and provide a full analysis for all recorded shock, drop, and vibration events.
- **Simultaneous Trip Analysis**  
Create an event database to concurrently analyze multiple instruments and trips.
- **Enhanced Summary Selection**  
Build event selection criteria to quickly search the database and find desired information.

- **Customized Printing and Reporting**  
Organize results in formats ranging from automated summary overviews to detailed event-by-event printing.
- **GPS Mapping Software Capability**  
Associate GPS coordinates with each dynamic event using maps that display track and intensity. SaverXware will import and display GPS data worldwide. (Requires GPS option.)

## Operational Instructions

### Battery Installation

The 9X30 has one battery cover plate located on the back side of the instrument. (Figure 1.) It is secured with six 4-40 x 5/8" socket head cap screws that require a 3/32" allen driver for removal. Once the plate is removed, there will be two batteries (9V lithium or alkaline) that can be removed and replaced.



Figure 1. Battery Plate.

Always use the *Battery Replacement Utility* in SaverXware prior to removing batteries. If the *Battery Replacement Utility* is grayed out and not selectable when the instrument is attached, the batteries are completely exhausted. In this case, replace the batteries first and then run the *Battery Replacement Utility*.

## Overlay Interface

### Run/Stop Button

The Run/Stop button is the blue square located on the top of the instrument. (Figure 2.) Pressing the Run/Stop button toggles the unit between run and stop. When the instrument is in Run Mode, it is monitoring all channels and recording event data. When the instrument is in Stop Mode, it can communicate with a computer for setup and data viewing, but is not measuring or recording.



Figure 2. Overlay Interface.

### LED Indicators

There are 4 LED indicators located on the top of the instrument that illuminate to show the instrument status for *Stop*, *Run*, *Alarm*, & *USB*. (Figure 2.)

- Stop  
The yellow Stop LED illuminates for 2 seconds when the unit enters Stop Mode.
- Run  
The green Run LED double-blinks for 60 seconds when the unit is switched from Stop to Run. This settling time allows any transient conditions caused from channel configuration to settle out before data collection begins. Once the settling is complete, the Run LED will turn on solid for 2 seconds to indicate that the unit has started monitoring channels and collecting data. The Run LED will blink whenever a new event is recorded. If an alarm condition occurs, the Alarm LED will blink instead.

There is a “heartbeat” option the user can set up so that the Run LED blinks once every 5 seconds during Run Mode to provide a visual indication that it is functioning. If this option is not selected, the Run LED will blink only when an event is recorded.

- Alarm  
The red Alarm LED flashes instead of the Run LED when any user configurable alarm condition occurs. Once an alarm condition has occurred, the Alarm LED will continue to blink in place of the Run LED until the unit is switched back to Stop Mode.
- USB  
The green USB LED illuminates when the USB cable connects the instrument to the computer. (Communication with Computer, page 8.)

### External Dynamic Channels

The 9X30 has six external channels for dynamic measurement of acceleration. (Figure 3.) The 10-32 type connectors for these channels are located on the front side of the unit and are labeled CH 4 through CH 9. Channels 1 through 3 are the internal tri-axial accelerometer.



Figure 3. External Dynamic Channels.

The external channels are designed for use with piezoelectric accelerometers that have sensitivities of 0.3 pC/g to 30 pC/g. A 1.0 pC/g sensitivity means there will be an electric charge output of 1 pC for every 1 g of acceleration applied to the accelerometer. The instrument converts the electric charge into a digital representation of acceleration and stores this information in its memory.

While the 9X30 can use accelerometers with a wide range of pC/g sensitivities, not every value can be used for every full-scale range. (Table 1.) Larger sensitivities are better for use with low acceleration levels but can overdrive the inputs at high acceleration levels. Conversely, smaller sensitivities work with high acceleration levels, but are not as good for low accelerations. The 9X30 allows the best accelerometer and full-scale range combination to be selected for each application. SaverXware will not allow an accelerometer and full-scale range combination where the inputs will be overdriven.

Table 1. Full-Scale Range and Accelerometer Combinations.

Full Scale Range (g)	Acceptable Sensitivities (pC/g)
5	2.0 to 30.0
10	2.0 to 30.0
20	2.0 to 30.0
50	1.0 to 12.0
100	0.5 to 6.0
200	0.3 to 3.4

Each external channel can be independently configured with its own low-pass filter cutoff frequency and acceleration range. Every channel has its own analog-to-digital converter for the simultaneous sampling of multiple signals when doing phase shift comparisons. Channels can also be switched independently from charge mode input to voltage mode for monitoring sensors other than piezoelectric accelerometers. When in voltage mode, the input range is  $\pm 5.0$  volts and the input impedance is 20,000 Ohms. A low output impedance source, < 200 Ohms, is recommended when using the voltage input mode.

To enter pC/g conversion factors for external accelerometers in SaverXware:

- Click on the *Setup* menu.
- Click on the *Setup Details* submenu to open the *Advanced Instrument Setup* screen. (Figure 4.) At the bottom of this screen is the *Channel Information* table where you can enter values in the *Ext Sensitivity* column.

**Advanced Instrument Setup - SAVER 9X30**

**Memory Storage Partitions**

**Signal Triggered Data**

Record Time: 500 msec  
Samples / Sec: 1000  
Sample Size: 500

Signal PreTrigger: 20 %

Data Retention Mode: Max Overwrite  
Memory Allocation: 45000 events

**Timer Triggered Data**

Record Time: 100 msec  
Samples / Sec: 500  
Sample Size: 50

Wakeup Interval: 18 Minutes  
Time to Fill: 30.8 days

Data Retention Mode: Max Overwrite  
Memory Allocation: 2464 events

Disable PushButton On/Off (Requires Computer to Stop Acquisition)

**LED Alarm**

Temperature Alarm  
122 °F  
-40 °F

Humidity Alarm  
80 % RH  
10 % RH

Acceleration Alarm  
100.0 G's

LED Heartbeat

**Cell Phone Alarm**

SMS Alarm Alerts  
Target Phone Number: 1 831 261 3048

**GPS Tracking**

GPS Enable

Print Cancel OK

**Channel Information** Copy Channel Setting Paste Channel

CH	Active In Signal Partition	Active In Timer Partition	Channel Description	Full Scale	Trigger	Trigger Level	Filter	Ext Sensitivity	Input Source
1	<input type="checkbox"/>	<input type="checkbox"/>	Channel 1	200.0 G	<input type="checkbox"/>	10.00 G	500 Hz	---	Channel Off
2	<input type="checkbox"/>	<input type="checkbox"/>	Channel 2	200.0 G	<input type="checkbox"/>	10.00 G	500 Hz	---	Channel Off
3	<input type="checkbox"/>	<input type="checkbox"/>	Channel 3	200.0 G	<input type="checkbox"/>	10.00 G	500 Hz	---	Channel Off
4	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Channel 4	50.0 G	<input checked="" type="checkbox"/>	10.00 G	500 Hz	7.000 pc/g	Charge Amp
5	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Channel 5	50.0 G	<input type="checkbox"/>	10.00 G	500 Hz	7.000 pc/g	Charge Amp
6	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Channel 6	50.0 G	<input type="checkbox"/>	10.00 G	500 Hz	7.000 pc/g	Charge Amp
7	<input type="checkbox"/>	<input type="checkbox"/>	Channel 7	200.0 G	<input type="checkbox"/>	10.00 G	500 Hz	3.000 pc/g	Channel Off
8	<input type="checkbox"/>	<input type="checkbox"/>	Channel 8	200.0 G	<input type="checkbox"/>	10.00 G	500 Hz	3.000 pc/g	Channel Off
9	<input type="checkbox"/>	<input type="checkbox"/>	Channel 9	200.0 G	<input type="checkbox"/>	10.00 G	500 Hz	3.000 pc/g	Channel Off

Figure 4. Advanced Instrument Setup Screen Capture.

## Communication with Computer

The 9X30 communicates with a computer via a USB cable that has a 7-pin ODU connector on one end and Type-A USB connector on the other. The ODU communications port is located on the side face of the instrument. (Figure 5.)



Figure 5. ODU to USB Connector

To connect the cable to the instrument, align the red dot on the cable ODU connector with the red dot at the three-o'clock position on the instrument port and insert it. Then, insert the cable USB connector into the computer USB port to establish communication between the instrument and the computer. (Figure 6.)

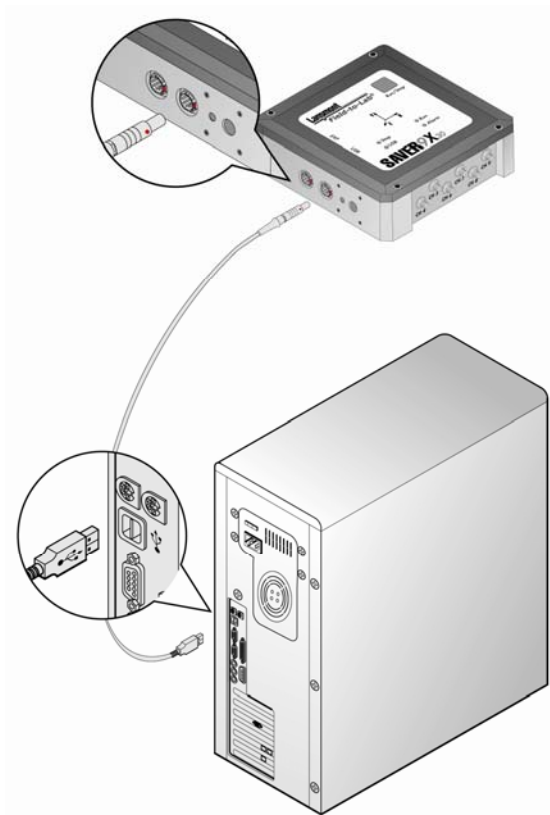


Figure 6. Connecting the 9X30 and Computer.

## Expansion Connector (EXP)

The expansion connector, located on the side panel, is a serial communications port that expands instrument capabilities. (Figure 7.) Slow speed peripheral devices designed to work with a 9X30 can be connected with this port. These devices provide functions that require access only once per event. Due to the low speed of the port, additional high-speed dynamic channels that require multiple accesses per event cannot be supported. At present, the only peripheral device available is a combination GPS and cell phone interface.

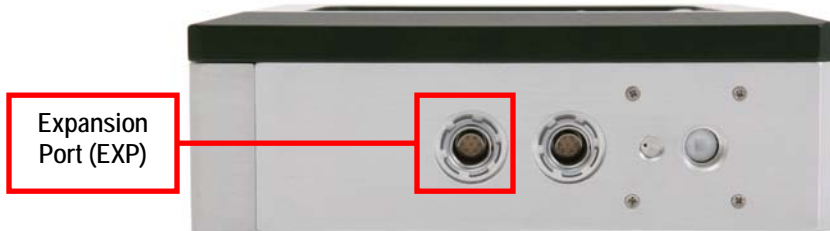


Figure 7. Expansion Connector

There are two identical expansion ports on the instrument. If the USB connector is not being used to communicate with a computer, a second peripheral device can be plugged into it. Both devices must have different functions. Note that only the ODU-to-USB connector can be used to communicate with a computer, but damage will not occur if a USB cable is inserted into the EXP connector.

## Internal Temperature and Relative Humidity Sensors

The instrument has built-in temperature and humidity sensors that accurately record these environmental parameters as part of a shock or vibration event. (Figure 8.) The sensors function over the entire operational temperature range of the instrument. It is possible to set range limits for both temperature and humidity so that the Alarm LED will flash if exceeded. It is necessary to leave clearance for air flow around the temperature and humidity sensors. Restricting air flow with packaging material will adversely affect measurement accuracy.



Figure 8. Temperature and Relative Humidity Sensor

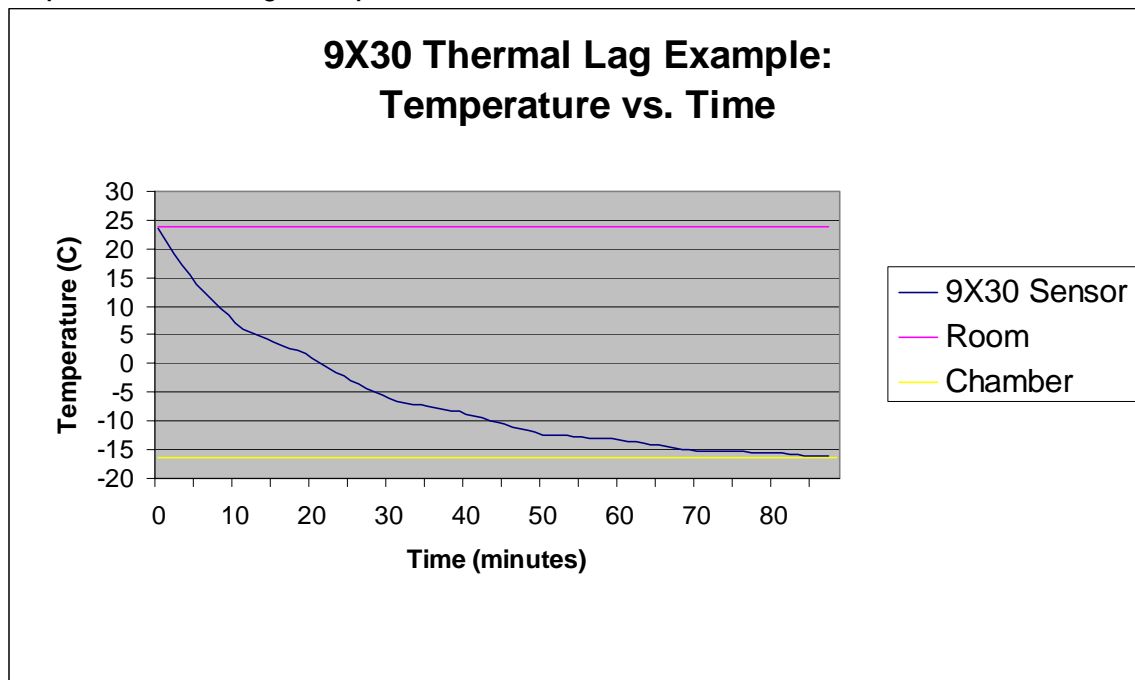
The sensors work well for normal temperature excursions; however, the mass of the instrument creates a thermal lag when abrupt changes of temperature occur. Thermal lag is the transfer of heat energy between a mass and its surroundings and is not instantaneous; therefore, the temperature change of the mass is slow.

Since temperature and humidity are related, humidity accuracy is also affected during the transfer of heat energy between the instrument and its surroundings. The effect of this thermal lag is only significant if there are abrupt changes in temperature. Normal changes that occur due to daily heating and cooling cycles have a negligible thermal lag.

### Thermal Lag Example

If a room temperature instrument is placed in a cold chamber, the instrument will not immediately become the same temperature as the air in the chamber because the heat energy stored in the mass of the instrument will not have fully dissipated yet. Until it does, the heat from the instrument will transfer to the air and affect the readings from the temperature sensor. Once the heat energy has had time to dissipate, the instrument will no longer affect the temperature sensor by heating the air around it. (Graph 1.)

Graph 1. Thermal Lag Example Data.



### Atmospheric Pressure Sensor

The 9X30 has a pressure sensor that records atmospheric pressure with every event. Variations in pressure due to altitude can burst packaging during air shipments and on truck shipments over high mountain passes. By including pressure measurements, the instrument provides information on the time of occurrence, magnitude, and duration of significant pressure changes. It is

necessary to leave clearance for air flow around the pressure sensor port. Restricting air flow with packaging material will adversely affect measurement accuracy.

Note: Pressure sensor available starting December 2006.

## Specifications

PHYSICAL	
Envelope Size:	4.99 x 4.90 x 1.69 in (127 x 124 x 43 mm).
Volume:	41.2 in <sup>3</sup> (675 cm <sup>3</sup> ).
Case Material:	6061-T6 aluminum.
Weight:	2.04 lbs (1 kg).
Mounting:	Four holes for #6 screws. Mounting bars recommended.
Environmental:	Weather-resistant.
Power:	Two lithium or alkaline 9V batteries.

DATA RECORDING	
A/D Resolution:	16 bits.
Instrument Noise Floor:	0.02 Grms typical at 500 Hz bandwidth.
Dynamic Range:	80 dB typical.
Sample Rates:	50 to 10,000 samples per second per channel.
Triggering:	Signal threshold and/or timer based recording.
Continuous Record Time:	Up to 30 days using lithium batteries. Up to 15 days using alkaline batteries.

MEMORY	
Memory Size:	128 MB.
Memory Type:	FLASH.
Data Retention:	Retains data even when batteries are exhausted.

COMMUNICATIONS	
Interface:	USB 1.1 and 2.0 compatible.
Data Rate:	400 KB per second typical.

TEMPERATURE	
Measurement Range:	-40 to +60°C (-40 to +140°F).
Measurement Accuracy:	±0.5°C from +5 to +40°C. ±1.5°C from -40 to +60°C.
Communication Temperature Range:	0 to +60°C.
Operating Temperature:	-40 to +60°C (-40 to +140°F) using lithium batteries. -20 to +54°C (-4 to +130°F) using alkaline batteries.

HUMIDITY	
Measurement Range:	5% to 95% RH, non-condensing.
Measurement Accuracy:	±2% from 10% to 90% RH at 25°C. ±3% from 5% to 95% RH at 25°C.

**ATMOSPHERIC PRESSURE**

Measurement Range:	10 to 1100 mbar.
Measurement Accuracy:	±4 mbar from 750 to 1100 mbar at 25°C.

**CONTROLS AND INDICATORS**

Controls:	Run / Stop button.
LED Indicators:	Green: Run. Red: Alarm condition. Yellow: Stop. Green: USB cable attached.

**INTERNAL CHANNELS**

Accelerometer Type:	Tri-axial piezoelectric.
Acceleration Ranges:	5, 10, 20, 50, 100, and 200 g full scale.
Channel Filter Type:	4-pole, low-pass.
Filter Frequencies:	10, 20, 25, 50, 100, 200, 250 and 500 Hz.
3 dB Frequency Response:	0.4 Hz to filter maximum.
Measurement Accuracy:	±5% with nominal variations in temperature and frequency.

**EXTERNAL CHANNELS**

Number of Channels:	6.	
Input Modes:	Charge (Acceleration). Voltage.	
Channel Filter Type:	4-pole, low-pass.	
Filter Frequencies:	10, 20, 25, 50, 100, 200, 250, 500, 1000, 2000, and 2500 Hz.	
Charge Mode	Accelerometer Type:	Piezoelectric.
	Input Sensitivity:	0.3 to 30.0 pC/g.
	Acceleration Ranges:	5, 10, 20, 50, 100, and 200 g full scale.
	3 dB Response:	0.4 Hz to filter maximum.
	Measurement Accuracy:	±5% with nominal variations in temperature and frequency.
Voltage Mode	Input Range:	±5 volts.
	Input Coupling:	AC or DC.
	3 dB AC Response:	0.4 Hz to filter maximum.
	3 dB DC Response:	DC to filter maximum.
	Measurement Accuracy:	±1% with nominal variations in temperature and frequency.

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## Accessories

### GPS-Cell Phone Interface

A combination Global Positioning System (GPS) and cell phone interface (Figure 9) is available as an external peripheral that attaches to the expansion connector (EXP) of the 9X30. GPS coordinates are stored in the instrument with every event and provide valuable information on the location that shipping events occur. The cell phone interface provides instant notification of serious events via text messaging to any cell phone. If cell phone service is not available when events occur, the events will be queued for transmission as soon as cell phone service is restored.

The GPS-Cell Phone Interface comes in a weather-tight enclosure. It is configured and has its data processed using SaverXware. No additional software package is needed. A connection to a GPS antenna mounted external to the vehicle is required. The GPS and cell phone interface should not be used on shipments by air or in other areas where cell phone use is restricted.



Figure 9. GPS-Cell Phone Interface.

## GPS Logger

A Global Positioning System (GPS) logger (Figure 10) is available for use that does not require direct connection with the 9X30. The GPS logger can be placed on the outside of a vehicle while the SAVER is inside monitoring the shipment. The GPS logger is supplied in a weather-tight enclosure with an external antenna. The antenna uses an SMA type threaded connector for added protection against vibration induced signal loss. The GPS logger comes with its own software package that must be used to configure the unit, retrieve data, and export the data to a file that can be imported by SaverXware. For those applications where a cable can be run from inside the vehicle to an external GPS antenna, the GPS and cell phone interface is recommended because it does not require the separate GPS software package.



Figure 10. GPS Logger.

## Mounting Recommendations

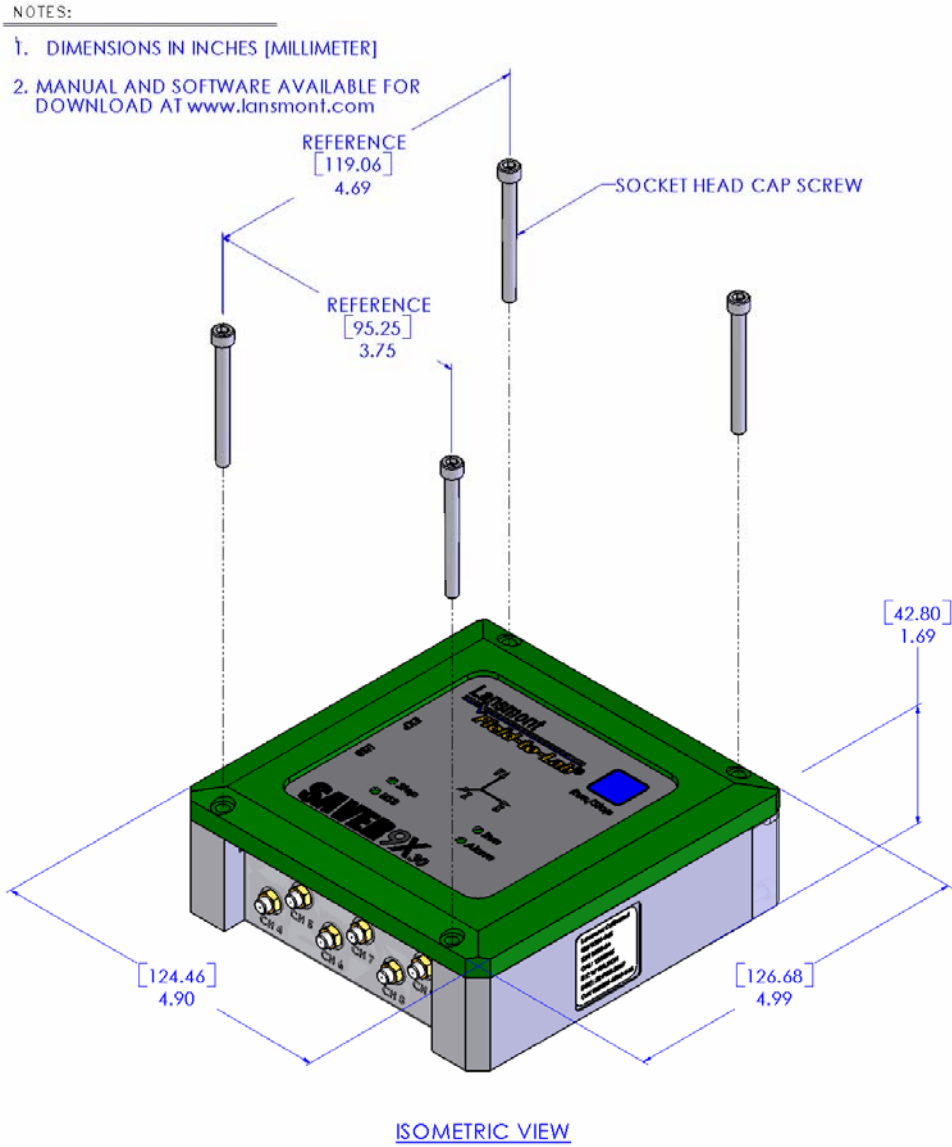
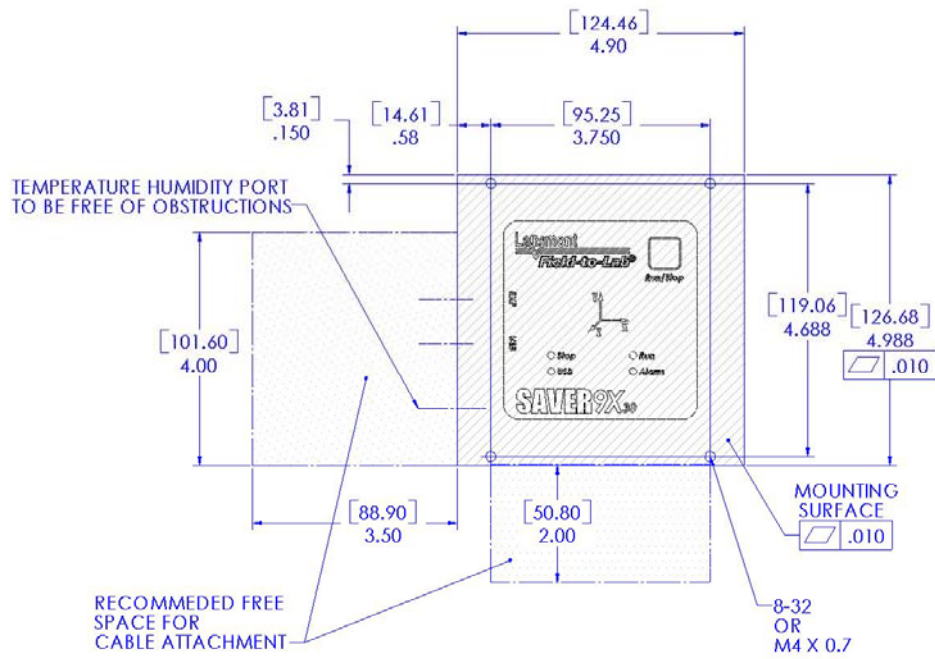


Figure 11. Mounting Dimensions.



PLAN VIEW (MOUNTING SURFACE)

Figure 12. Mounting Guidelines.

## Mounting Plates

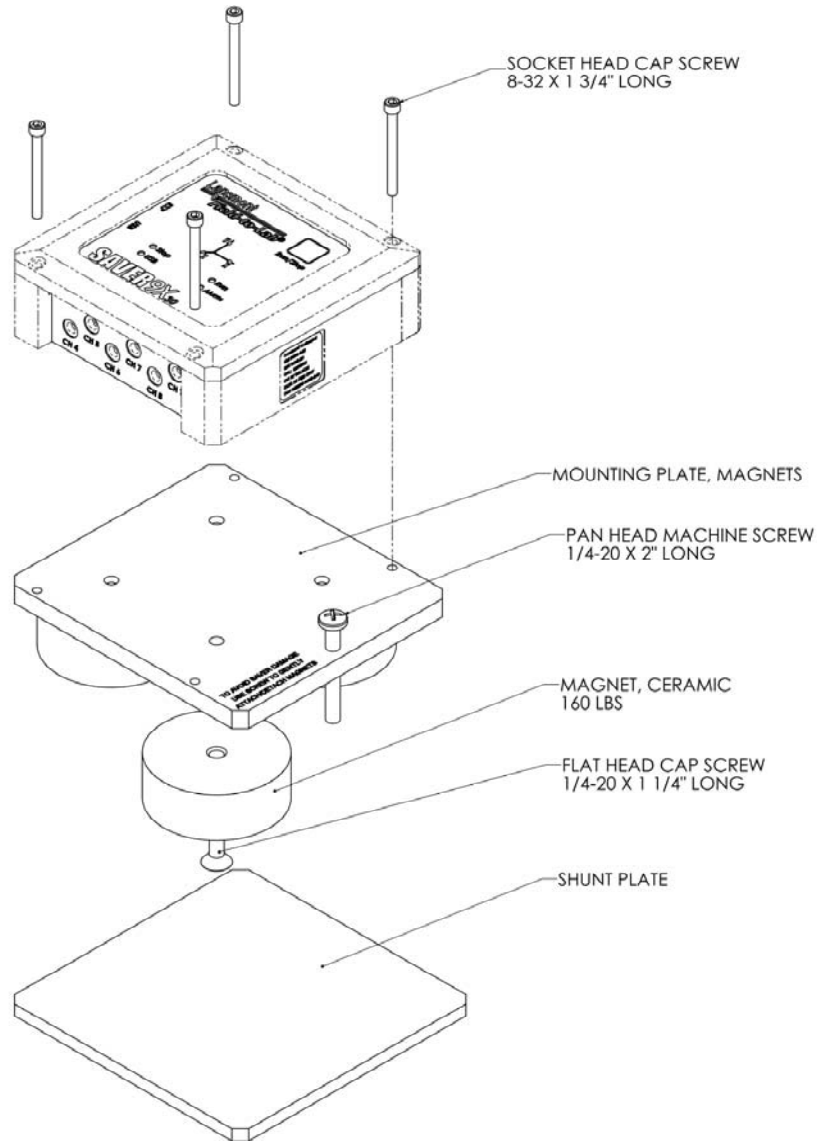


Figure 13. Magnet Mount.

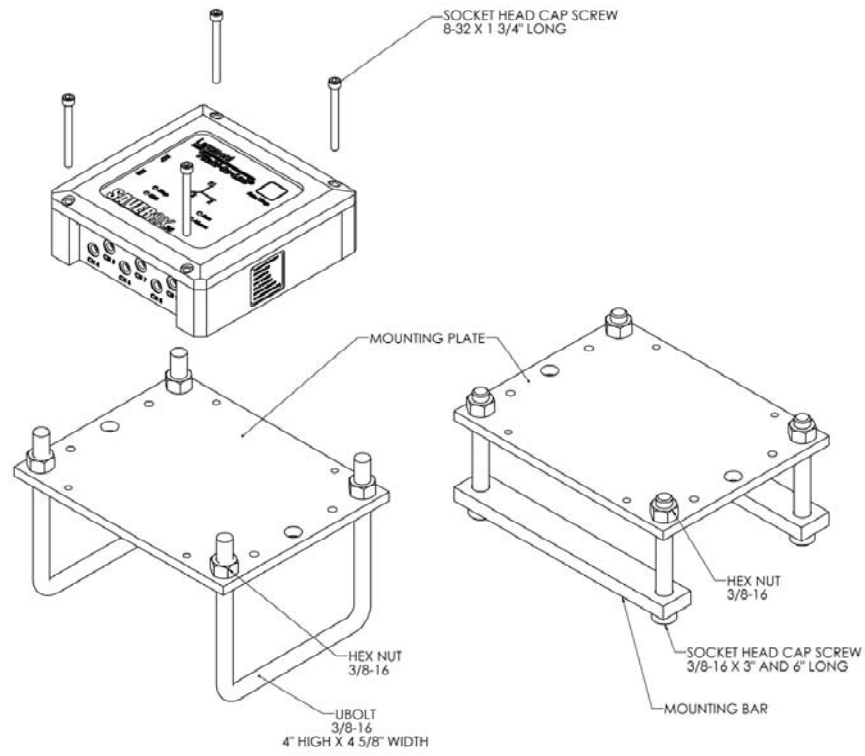


Figure 14. Assembly Kit Mount.

## Certification Statements

### FCC Part 15 Declaration

The Lansmont Corporation Model SAVER 9X30, a class B computing device, has been verified to comply with Part 15 of the FCC rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

### DO-160 Environmental Qualification Form

NOMENCLATURE: Shock and Vibration Recorder

TYPE/MODEL/PART NO: SAVER 9X30

TSO NUMBER: None

MANUFACTURER'S SPECIFICATION AND/OR OTHER APPLICABLE SPECIFICATION: None

MANUFACTURER: Lansmont Corporation

ADDRESS: 17 Mandeville Court, Monterey, CA 93940, USA

REVISION AND CHANGE NUMBER OF DO-160: Revision E

DATE TESTED: September 18, 2006

CONDITIONS	SECTION	DESCRIPTION OF TESTS CONDUCTED
Radio Frequency Susceptibility	20.0	Equipment tested for radiated RF susceptibility to Category T
Radio Frequency Emissions	21.0	Equipment tested for radiated RF emissions to Category M

#### REMARKS:

1. Equipment was tested at National Technical Systems, Plano, TX.
2. Equipment operated normally during the Section 20.0, Category T testing.
3. Equipment RF emissions measured below the limits set for Section 21.0, Category M.

## CE Marking

### Declaration of Conformity

We, Lansmont Corporation of Monterey, CA, following the provisions of Council Directive 89/336/EEC (May 3, 1989) on Electromagnetic Compatibility, declare under our sole responsibility that the following product,

- SAVER Model 9X30,

if installed according to the manufacturers instructions, is in conformity with the following European harmonized and published standards at date of this declaration:

- EN 61000-4-3; 2006
- EN 55022, Class B
- EN 61000-4-2; 2001

Dated October 3, 2006.

Signature \_\_\_\_\_

Name PETER BROWN

Title CHIEF OPERATIONAL OFFICER

Lansmont Corporation  
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USA  
Telephone: 831-655-6600

## Important Notes

**WARNING**

**THE SAVER MUST NOT BE DROPPED ON A HARD SURFACE WITHOUT CUSHIONING MATERIAL OR OTHER PROTECTION. THE SAVER IS INTENDED TO BE SECURED INSIDE A PACKAGE OR ATTACHED TO A PRODUCT, PACKAGE, OR VEHICLE, AND WILL ACCURATELY MEASURE SHOCK IF THE INPUT ACCELERATION LEVELS DO NOT EXCEED 200G. BEWARE THAT EVEN A LOW DROP OF AN UNPROTECTED SAVER ONTO A HARD SURFACE CAN RESULT IN ACCELERATIONS OF SEVERAL THOUSAND G, POTENTIALLY CAUSING INACCURACY, MALFUNCTION, OR DAMAGE.**