

TRIAXYS™ OEM Motion Sensor

USER'S MANUAL

Manufactured by:



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Model Identification by Serial Numbers

The TRIAXYS™ OEM Motion Sensor is identified by a unique Serial Number. Always provide the TRIAXYS™ Serial Numbers in any correspondence with Axys Environmental Systems.

This manual is supplied for use with the TRIAXYS™ OEM Motion Sensor,

Item	Location	Serial Number/Version
TRIAXYS™ OEM Motion Sensor	On the back lip of the lid of the Module.	
GpuC EPROM in TRIAXYS OEM Motion Sensor	Shown in the output Header Message on Start-up	

Revision History

Rev	Date	Change	By
01	Oct. 9, 2001	-Added Header info – to include s/w ver, sample interval and date/time -Modified sample output format to include 16 bit sample counter -removed serial number and interval from sample output string.	RP

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1.0 INTRODUCTION

The TRIAXYS™ OEM Motion Sensor is a multipurpose sensor for the monitoring of complex dynamic motions. Some typical applications range from, structure motion monitoring of offshore installations, ship motion recording and monitoring in the marine environment. The compact unit measures 6 degrees of freedom: 3 accelerations and 3 rates, along with magnetic orientation. All components used in the system are precision solid state sensors with no moving parts. This package is the heart of the TRIAXYS™ Directional Wave Buoy, which has been proven in use around the world in the harshest of marine climates.

1.1 System Description, Features and Specifications

The TRIAXYS™ OEM Motion Sensor samples and outputs the motion data through a serial communications port.

Table 1. TRIAXYS™ OEM Motion Sensor System Specifications

Item	Specification
Height/Length/Depth	35cm x 35cm x 20cm (13" x 13" x 6"), external bolt holes for attachment.
Weight	6 Kg (14 lb)
Enclosure Material	Stainless Steel/Aluminium
Sensors/Processor	
Accelerometers	3 (x,y,z) Axis Flexure suspension servo Range ± 2.0 g range Noise < 0.001 g RMS Resolution < 1 micro g
Rate	3 (x,y,z) Axis Piezoelectric vibrating gyroscope Range $\pm 80^\circ/\text{s}$ Axis Misalignment < 0.05% of full scale Resolution < 0.004 $^\circ/\text{s}$
Compass	Microprocessor controlled fluxgate Accuracy $\pm 0.5^\circ$ Resolution 0.1 $^\circ$
A/D and sampling frequency	8 channel 14 bit at 4Hz
Power Requirements	11.5 to 13.5 VDC, ~ 0.15 amps
Microprocessor	Axys gPvc
Communication Protocol	Serial RS232- 9600 baud, 8 bit, No Parity, 1 Stop bit

1.2 TRIAXYS™ OEM Motion Sensor Configuration

The Stainless Steel or Aluminium NEMA 4 TRIAXYS™ OEM Motion Sensor enclosure contains the Motion Sensors (accelerometers, rate sensors and compass) and the signal-processing unit. The processing unit samples, conditions the data and controls all the sampling systems in the TRIAXYS™ OEM sensor. The unit is set up to output data on powering at settings preset at the factory.

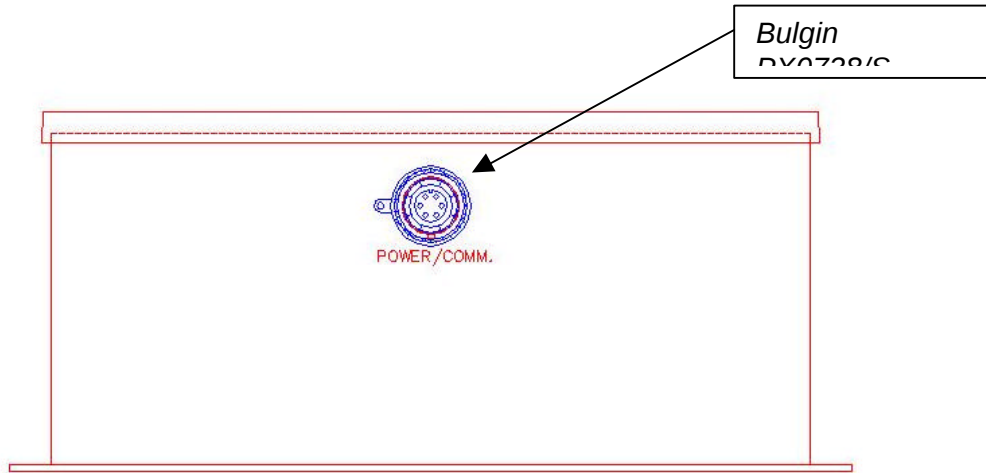


Figure 1. Side View of TRIAXYS™ OEM Motion Sensor

1.2 TRIAXYS™ OEM Motion Sensor Electrical Connection

The electrical connection to the Motion Sensor is via a Bulgin PX0738/S connector shown in the drawing above. The sensor requires one cable, with a minimum five conductors, ground, +12V, and 3 for the RS232, terminated with the appropriate mating Bulgin PX0738/P connector. Table 2. defines the pin out of the connector.

Table 2. TRIAXYS™ OEM Motion Sensor Connector Description

Connector	Description
6 pin male Bulgin	Power and Communications Pin 1: not used Pin 2: Pin 2: Power Control (enable High) Can be used with a PC's DTR RS232 output Pin 3: RS232 Data/Comms in to Sensor Pin 4: RS232 Data/Comms out from Sensor Pin 5: Power Ground

	Pin 6: +12V (11-14V)
--	----------------------

When the sensor is connected to an appropriate power supply, the data will be automatically output on the serial communications lines identified in Table 2. This data can be logged using any data logger and viewed and/or logged with any terminal emulation program (eg. Hyperterminal, ProCom, Mirror, etc.) set to the correct communications settings.

2.0 TRIAXYS™ OEM Motion Sensor Data Output

If the serial connections are set correctly on the receiving computer, when the sensor is started up, the following header information is shown:

```
Reset; SRAM OK
@ eprom_cs checksum: E214 for 65535 bytes AutoCAL
TAS00000 0.25 sec V3.24
01-11-01 20:07:55
```

Followed by the NEMA 0183 data string below:

```
$TSRDO,00001,133.6,-0.0423,-0.0213,-0.9800,+0.99,+0.06,+0.70,*69
$TSRDO,00002,135.4,-0.0296,-0.0079,-0.9933,+1.19,-0.08,+0.41,*6A
$TSRDO,00003,135.2,-0.0301,-0.0074,-0.9931,+1.13,-0.04,+0.37,*6A
.
.
.
```

Where the data is formatted as follows:

\$TSRDO,S,C,Ax,Ay,Az,Rx,Ry,Rz,*hh

Where:	TS	= TRIAXYS Sensor
	RDO	= Raw Data Output
	S	= Sample number (from 1 to 65536)
	C	= Compass (Direction Magnetic)
	Ax	= X acceleration (g)
	Ay	= Y acceleration (g)
	Az	= Z acceleration (g)
	Rx	= X rate (deg/s)
	Ry	= Y rate (deg/s)
	Rz	= Z rate (deg/s)
	hh	= checksum (between \$ and *)

The following table gives a guideline for the expected output of the sensor module in a known orientation and still environment. The operator can check the functionality of the unit by lifting the unit in known motions and monitoring the given output. All units

have been calibrated on an Axys ISO certified apparatus prior to being shipped and meet all performance criteria.

Table 3. Acceptable Ranges for Motion Sensors at Rest in a Still, Level, and Upright Position

Sensor	Range	Check Procedure
Compass Heading	0 to 360	Check against hand held compass
Accelerometer X	Near 0 $\pm$ 0.04	
Accelerometer Y	Near 0 $\pm$ 0.04	
Accelerometer Z	Near -1 $\pm$ 0.04	
Rate Gyro X	Near 0 $\pm$ 3 °/sec	
Rate Gyro Y	Near 0 $\pm$ 3 °/sec	
Rate Gyro Z	Near 0 $\pm$ 3 °/sec	
System Current*	Approx. 0.15 amps	Motion Sensors only powered

NOTE:

- 1 On initial powering of the instrument, the accelerometers require two minutes stabilization prior to acceptable readings being output. This is of importance when the unit is being switched off between sampling events.
- 2 Some computers will not be able to display the data at the faster rates, so not every line will be displayed.
- 3 It is important to use an appropriate data logger that is capable of logging data at the faster sample rates.
- 4 The checksum value shown in the example data may not be correct

3.0 INSTALLATION PROCEDURES

The TRIAXYS™ OEM Motion Sensor is very easy to install. Please note the following for optimum results.

- ✓ The TRIAXYS™ OEM Motion Sensor is oriented North when the front side (with electrical connector) points North. The compass, which is mounted inside the Motion Sensor, sets this orientation.
- ✓ The TRIAXYS™ OEM Motion Sensor enclosure has external bolt holes (10" x 14.75" spacing) drilled on the four corners for attachment.
- ✓ The TRIAXYS™ OEM Motion Sensor should be attached via the four feet. It is recommended that M6 flat washers and M6 Nylock nuts (SS 316) are used to attach the Motion Sensor. It is also recommended that some rubber pads are used underneath the feet to provide a degree of protection against severe shock. The bolts should be tightened until the rubber pads are slightly compressed.

4.0 REFERENCES

References to the software used in the TRIAXYS™ OEM Motion Sensor include:

- Benoit, M., P. Frigaard and H.A. Schaffer (1997) "Analysing Multidirectional Motion Spectra: A Tentative Classification of Available Methods". IAHR Seminar on Multidirectional Motions, 27th IAHR Congress, San Francisco, pp. 131-158.
- Darras, M. (1987) "IAHR List of Sea State Parameters: A Presentation". IAHR Seminar on Motion Analysis and Generation in Laboratory Basins, Lausanne, pp. 11-73.
- Hawkes, P.J., J.A. Ewing, C.M. Harford, G. Klopman, C.T. Stansberg, M. Benoit, M.J. Briggs, P. Frigaard, T. Hiraishi, M. Miles, J. Santas, H.A. Schaffer (1997) "Comparative Analysis of Multidirectional Motion Basin Data". IAHR Seminar on Multidirectional Motions, 27th IAHR Congress, San Francisco, pp. 25-88.
- Miles, M.D. (1986) "Measurement of Six Degrees of Freedom Model Motions using Strapdown Accelerometers". 21st American Towing Tank Conference, Washington, D.C., pp. 369-375.
- Miles, M.D. and E.R. Funke (1989) "The GEDAP Software Package for Hydraulics Laboratory Data Analysis". IAHR Workshop on Instrumentation for Hydraulics Laboratories, Burlington, Canada, pp. 325-339.
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- Nwogu, Okey (1989) "Maximum Entropy Estimation of Directional Motion Spectra from an Array of Motion Probes". Applied Ocean Research, 1989, Vol. 11, No. 4, pp. 176-182.
- Nwogu, O.U., E.P.D. Mansard, M.D. Miles, M. Isaacson (1987) "Estimation of Directional Motion Spectra by the Maximum Entropy Method". IAHR Seminar on Motion Analysis and Generation in Laboratory Basins, Lausanne, pp. 363-376.

Appendix A

Warranty and Service

WARRANTY

LIMITED WARRANTY

AXYS TECHNOLOGIES INC ("AXYS") warrants that the Equipment shall conform to Specifications and shall remain free from defects in materials and workmanship for a period of twelve (12) months from the date of delivery (the "Warranty Period"); provided, however, that the Equipment is applied, installed, operated and used substantially in accordance with the Specifications.

AXYS shall, at AXYS' expense, replace or repair any Equipment within such warranty period, provided:

AXYS receives written notice of any non-conformance or defect within the Warranty Period;
after AXYS' authorisation, the Equipment is returned to AXYS' factory of origin or to an Authorised AXYS Distributor with all freight charges prepaid; and
AXYS determines the Equipment to have a non-conformance or defect covered under this warranty.
Any replacement Equipment shall be warranted for a further period that expires on the later occurrence of three (3) months from the date of shipment or the expiration of the original warranty period.

LIMITATION OF LIABILITY

AXYS does not grant any further representations or warranties on the Equipment than as expressly set forth above and expressly disclaims all other warranties, express or implied, including any warranties that the Equipment shall be merchantable, suitable or fit for any purpose other than expressly stated. Notwithstanding any other term of this Agreement, in no event shall AXYS be liable to the Customer, its officers, employees, agents or contractors for any lost or anticipated profits, for any incidental, consequential, exemplary or special damages whether or not AXYS was advised of such claim, or for damages and loss due to personal injury. In any event, AXYS' liability shall not exceed the purchase price of the Equipment.

WARRANTY OF AUTHORITY

AXYS represents and warrants that it has full and complete power and authority, corporate, legal and otherwise, to enter into and do all things required to be performed or done under this Agreement; that no litigation or other proceeding is pending or threatened against it, and that no order or judgement or ruling has been made which might adversely affect AXYS' right to enter into and do all things required to be done under this Agreement.

WARRANTY OF INFRINGEMENT AND INDEMNIFICATION

AXYS represents and warrants that it owns and/or has legal right to the hardware and software design, all applicable patents and other intellectual and proprietary property, including without limitation all patents, incorporated into, or to be used in connection with the Equipment. AXYS further represents, and warrants that the design, manufacture and sale of the Equipment, and the patents, patent applications and other rights used in connection with the Equipment, do not and will not infringe upon the patents, patent rights, copyrights, trade secrets or other property interests of third parties. All royalties or other charges for any patent, trademark or copyright to be used in connection with the Equipment and/or Services shall be considered as included in the purchase order price.

Notwithstanding any other provision contained in this Agreement, AXYS shall defend, indemnify and hold the Customer, its affiliates, directors, officers, agents, representatives and employees harmless against any and all suits, proceedings, actions, claims, demands, damages, losses, expenses or liabilities, in which it is claimed, asserted or alleged, whether or not rightfully, that the Equipment, Services, process, material or any part thereof, furnished by AXYS to the Customer, constitutes an infringement of patent, patent application, copyright, trade secret or other property interest of a third party, and AXYS shall pay all damages, expenses (including reasonable attorneys' fees) and costs awarded against or incurred by the Customer or any third party to which the Customer is responsible in connection therewith. In case the Equipment, process or material or any part thereof is held in such suit action or proceeding to constitute infringement and/or its use is enjoined or restricted, in addition to any other rights and remedies the Customer may have hereunder or at law or equity, AXYS shall, at its own expense, either procure for the Customer an irrevocable, royalty-free, fully paid up license to continue using the Equipment, process or material, or with the Customer's prior written approval, replace the same with substantially equal but non-infringing Equipment or modify the Equipment so it becomes non-infringing, provided that no such replacement or modification shall in any way amend or relieve AXYS or its warranties and guarantees set forth in this Agreement.

The Customer shall give prompt notice to AXYS of any claim, suit or proceeding involving the Customer in which such infringement is alleged or asserted.

SERVICE

WARRANTY SERVICE

To obtain service under the warranty during the warranty period:

write, fax, e-mail or call Axys Environmental Systems to describe precisely and completely the nature of the problem;

carry out any minor adjustments or service as instructed by Axys technical personnel;

if proper operation is still not achieved, obtain an RMA (Return to Manufacturer Authorisation) number from Axys and return the instrument, freight prepaid, to the factory or to an authorised Service Centre. The instrument will not be accepted by Axys without an RMA. The instrument will be repaired and returned free of charge in accordance with the terms of the warranty.

NON-WARRANTY SERVICE

Proceed as for Warranty Service described above. If Axys personnel can provide assistance by phone, letter, fax, or e-mail they will be pleased to do so at no charge.

As with Warranty Service, if the return of the instrument is necessary, an RMA number must be obtained from Axys prior to shipping. The instrument must be returned to the Company freight prepaid. Once the instrument is received at the factory, a firm estimate of the repair cost will be provided.

MODEL UPGRADES

Enhancements to the product will be made from time to time. Whenever possible, earlier models of the product may be upgraded at a reasonable cost to provide the user with the new additional features and to extend the useful life of the product. All registered owners will be contacted when new design enhancements are implemented

Return Material Authorization (RMA) Form

PLEASE FILL FORM OUT COMPLETELY
FAX COMPLETED FORM TO +1 (250) 655-5856
PLEASE ALLOW 24 HOURS BEFORE CONTACTING
SHIPPING/RECEIVING +1 (250) 655-5871

DATE: ____
RMA#:_____
ISSUED BY: ____

CUSTOMER / RETURN SHIPPING INFORMATION

CONTACT NAME	
COMPANY NAME / DIVISION / BRANCH / ASSOCIATION	
STREET ADDRESS	
CITY / PROVINCE / COUNTRY	POSTAL CODE
TELEPHONE	BETWEEN THE HOURS OF
E-MAIL	FAX

PRODUCT DESCRIPTION PART NO. SERIAL # QTY# INVOICE#

(Continue list in Notes section if needed)

NOTES

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SHIPPING INSTRUCTIONS

Address each carton to: *Axys Environmental Systems*
 2045 Mills Road, Sidney, BC, Canada, V8L 3S8

- ☐ Clearly mark each carton with: **"CANADIAN MADE GOODS BEING RETURNED FOR REPAIR" "RMA No. _____ Carton # _____ of _____."**
- ☐ RMA shipments must be prepaid by customer
- ☐ Enclose a copy of this RMA Form in each carton

