Inertial Science, Inc.

3533 Old Conejo Road Suite #104 Newbury Park, CA 91320
Phone (805) 499-3191 Fax (805) 498-4882 E-mail: info@inertialscience.com

SHIP TO: JPL – Central Receiving
ADDRESS: 4800 Oak Grove Drive
M/S 241-104
Pasadena, CA 91109
ATTN: Daniel Gaines (818) 393-5346

Purchase Order No.	Shipper No.	Via	Date
1263199	JP8160401	Fedex	August 16, 2004

QTY	DESCRIPTION		
1	ISIS-IMU Rev. E Inertial Measurement Unit S/N: 109 (Model: JP05)		

* Country of Origin: Newbury Park, CA U.S.A

* Export of this item is controlled by US State Department under International Traffic in Arms Regulation (ITAR), Category VIII(e). Please contact Office of Defense Trade Control (ODTC PM/MC, Room 200, SA-6 • US Department of State • Washington DC 20522-0602) before any attempt to export this item out of US.

SHIPPER

Inertial Science, Inc.

3533 Old Conejo Rd. Ste 104
Newbury Park, CA 91320
USA
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info@inertialscience.com

Certificate of Conformance

Customer: JPL
4800 Oak Grove Drive
Pasadena, CA 91109

P.O. #: 1263199
P.O. Date: 6/22/04
Specification #: ISIS-IMU Rev: E
ATP #: ISIS-CAL Rev: E

Item #	Qty.	Description	Definitions	
1	1	ISIS-IMU	**Serial #:**	109
		Inertial Measurement Unit	**Configuration List #:**	JP-05
			Test Data Date:	8/16/2004
			Log Book #:	JP-05-00
Remarks (Deviation/Waivers, etc.):				

It is hereby certified that the above quantity shipped against the subject purchase order is in conformance with the requirements and specifications per terms and conditions of purchase order.

Young Jin Kang
Test Engineer

8-17-04
Date

IsisImu Acceptance Test

Model: JP05 Serial No.: 109

	Parameter	Specification / Test data	unit	Remarks
Sensor Gyro	Operating Range	90	d/s	
	Random Noise	0.02	d/s	rms
	Short Term Drift	7.2	d/h	rms, , In-Run Bias stability
	Bias stability	36.0	d/h	1σ,On-to-On Repeatability
	Scale factor stability	2000	ppm	rms
	Non linearity	2000	ppm	1σ
	Random walk	0.0028	d/s/sqrt(Hz)	rms
	Bandwidth	50	Hz	
	G - Sensitivity	1.0	d/h/g	rms
	Axis misalignment	1.0	mRad	rms
Accel	Operating Range	2	G	
	Random Noise	0.25	mg	rms
	Short Term Drift	3.0	mg/h	rms, In-Run Bias stability
	Bias stability	0.5	mg	1σ, On-to-On Repeatability
	Scale factor stability	2000	ppm	rms
	Non linearity	3000	ppm	1σ
	Random walk	35	ug/sqrt(Hz)	rms
	Bandwidth	50	Hz	
	Axis alignment	< 1	mRad	rms
Physical	Dimensions	2.8 x 3.0 x2.3	inch	W x L x H
	weight	0.8	Lb	
	Input voltage	12 (-/+2)	Vdc	
	Power	5.4	watt	0.45 A @ 12Vdc
	Vibration	4	grms	20 to 2000 Hz
	Shock	30	g	11 mS
	Operating Temp Range	" –20 to +60 "	deg C	
Serial Link	Signal format	RS232C		
	Data Bit	8	bit	
	Stop Bit	1	bit	
	Parity	N		
	Protocol	Async.		
	Baud	115.2	Kbaud	
	Rate	100	frame/sec	

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Test conditions : at ambient Temperature 25 degC, 1 hour after power on

Signature by: Young Jin Kang Date: August 17, 2004

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ISIS-IMU pin assignment

Connector: 26 pin high density d-type male connector

ISIS-IMU SN: 109 (Model: JP05)

Customer Order #: 1263199

Pin #	Description	Remarks	Note
1	Rate x analog output	n/a	
2	Rate y analog output	n/a	
3	Rate z analog output	n/a	
4	Accel x analog output	n/a	
5	Accel y analog output	n/a	
6	Accel z analog output	n/a	
7	Gnd	Analog Output Return	
8	Gnd	Analog Output Return	
9	Gnd	Analog Output Return	
10	External /RESET	Active low	TTL input
11	1 PPS	Ext Sync Clock interface	Future Use
12	ISP Tx	RS-232,Program download	Factory Use
13	ISP Rx	RS-232,Program download	Factory Use
14	RS-422 TX (-)	No Connection	
15	RS-422 RX (-)	No Connection	
16	RS-232 TX	Transmit sensor data	Serial Port Com1 Pin 2
17	RS-232 RX	Receive command	Serial Port Com1 Pin 3
18	Gnd	Common	Serial Port Com1 Pin 5
19	+12V Power Input	+12Vdc	0. 45A @+12Vdc
20			
21	Gnd	Case ground	
22			
23	Power Gnd	12V Return	
24			
25	TOV	Time Of Valid	TTL output
26	PRGM	Programming command	Factory Use

ISIS-IMU RS-232 data format

Baud rate : 115.2 KB
Frame rate : 100 frame/sec
Protocol : 1 start bit (0), 8 data bit (LSB first), 1 stop bit (1), no parity
ISIS-IMU SN : 109 (model JP05)

Byte #	Description	Remarks	
1	7E(hex)	Header	
2	slow data	1Hz average data	See next page
3	delta angle X Low	LSB = 90/(30000*100) deg/ bit	2's complement
4	delta angle X High		
5	delta angle Y Low	LSB = 90/(30000*100) deg/ bit	2's complement
6	delta angle Y High		
7	delta angle Z Low	LSB = 90/(30000*100) deg/ bit	2's complement
8	delta angle Z High		
9	delta velocity X Low	LSB = 9.8*2/(30000*100) m/s/ bit	2's complement
10	delta velocity X High		
11	delta velocity Y Low	LSB = 9.8*2/(30000*100) m/s/ bit	2's complement
12	delta velocity Y High		
13	delta velocity Z Low	LSB = 9.8*2/(30000*100) m/s/ bit	2's complement
14	delta velocity Z High		
15	counter	1 upcount/frame (0 ~ 99)	See next page
16	check sum	Exclusive-Or Byte 1 – 15	

Table : Decoding Slow data (Byte 2) vs. Counter (Byte 17)

Counter (byte 15)	Description (byte 2)
7, 6, 5, 4	Rate X 1 Hz Average data (msb = 7)
11, 10, 9, 8	Rate Y 1 Hz Average data (msb = 11)
15, 14, 13, 12	Rate Z 1 Hz Average data (msb = 15)
19, 18, 17, 16	Accel X 1 Hz Average data (msb = 19)
23, 22, 21, 20	Accel Y 1 Hz Average data (msb = 23)
27, 26, 25, 24	Accel Z 1 Hz Average data (msb = 27)
31, 30, 29, 28	Temp (gyro X) 1 Hz Average data (msb = 31)
35, 34, 33, 32	Temp (gyro Y) 1 Hz Average data (msb = 35)
39, 38, 37, 36	Temp (gyro Z) 1 Hz Average data (msb = 39)
43, 42, 41, 40	Temp (accel X) 1 Hz Average data (msb = 43)
47, 46, 45, 44	Temp (accel Y) 1 Hz Average data (msb = 47)
51, 50, 49, 48	Temp (accel Z) 1 Hz Average data (msb = 51)
52 ~ 79	Reserved
80	Constant 1 Low byte
81	Constant 1 High byte
82	Constant 2 Low byte
83	Constant 2 High byte
84	Constant 3 Low byte
85	Constant 3 High byte
86	Constant 4 Low byte
87	Constant 4 High byte
88	Constant 5 Low byte
89	Constant 5 High byte
90	Constant 6 Low byte
91	Constant 6 High byte
92	Constant 7 Low byte
93	Constant 7 High byte
94	Constant 8 Low byte
95	Constant 8 High byte
96	Address Low byte of Constant 1
97	Address High byte of Constant 1
98	Reserved
99	Reserved

Average data 1Hz is calculated and output from ISISIMU as follow:

Decoding Slow data (Byte 2) vs. Counter (Byte 15)

Ex. Rate x 1 sec Average data (RXavg) calcuration

RXavg = (7)x256 + (6) + (5)/256 + (4)/65536
if RXavg > 32767 then RXavg = RXavg - 65536

Rate X (d/s) = 90.0 (d/s) x 1.28 x RXavg / 30000.0

Ex. Accel x 1 sec Average data (AXavg) calcuration

AXavg = (19)x256 + (18) + (17)/256 +(16)/65536
if AXavg > 32767 then AXavg = AXavg - 65536

Accel X (m/s^2) = 9.8 x 2 (m/s^2) x 1.28 x AXavg / 30000.0

Ex. Gyro's Temperature 1 sec Average data (TGXavg) calcuration

TGXavg = (31) x 256 + (30) + (29)/256 +(28)/65536
if TGXavg > 32767 then TGXavg = TGXavg – 65536

Gyro X Temp in degC = (SF_Tgx x 1.28 x TGXavg) – Bias_Tgx

SF_Tgx = 1.0 / 128.3 (degC/bit)	Bias_Tgx = 26.6 (degC)
SF_Tgy = 1.0 / 138.0 (degC/bit)	Bias_Tgy = 27.0 (degC)
SF_Tgz = 1.0 / 126.7 (degC/bit)	Bias_Tgz = 27.4 (degC)
SF_Tax = 1.0 / 161.9 (degC/bit)	Bias_Tax = 14.9 (degC)
SF_Tay = 1.0 / 179.1 (degC/bit)	Bias_Tay = 9.7 (degC)
SF_Taz = 1.0 / 166.8 (degC/bit)	Bias_Taz = 13.4 (degC)

Decoding Byte 80 ~ 99

96	97	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
Address		**&H00**		**&H02**		**&H04**		**&H06**		**&H08**		**&H0A**		**&H0C**		**&H0E**	
&H300 (768)				B Rx				B Ry				B Rz				B Ax	
&H310 (784)				B Ay				B Az		S Rx		S Ry		S Rz		S Ax	
&H320 (800)		S Ay		S Az													
&H340 (816)																	
&H350 (832)		BD Ry		BD Rz		BD Ax		BD Ay		BD Az		SD Rx		SD Ry		SD Rz	
&H360 (848)		SD Ax		SD Ay		SD Az											
&H370 (880)																	

Note:

Low, High Byte (2's complement)
B = Bias
S = Scale Factor
BD = D/A Bias
BS = D/A Scale Factor

Ex. Address for Bias Rate Z = &H30A (778)

Tx Data Format (Host to IMU)

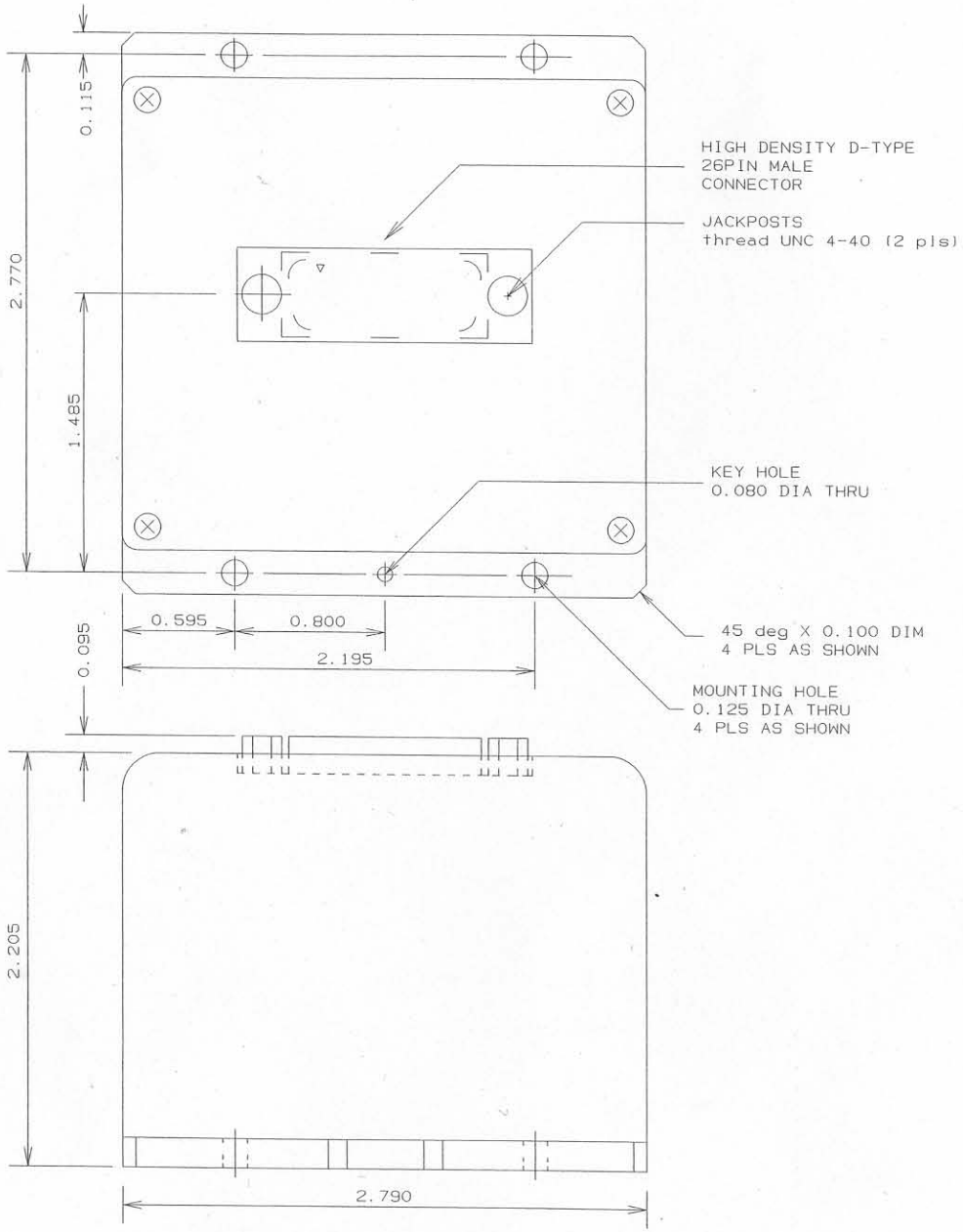
Byte	Description		
1	Header (&H7E)		
2	Command (L)	Constant	(Command=05, Constant=03)
3	Command (H)	Address Low Byte	
4	0	Address High Byte	
5	0	Constant Low Byte	
6	0	Constant High Byte	
7	0	0	(Reserved)
8	Check Sum EX-OR Byte 1 – 7		

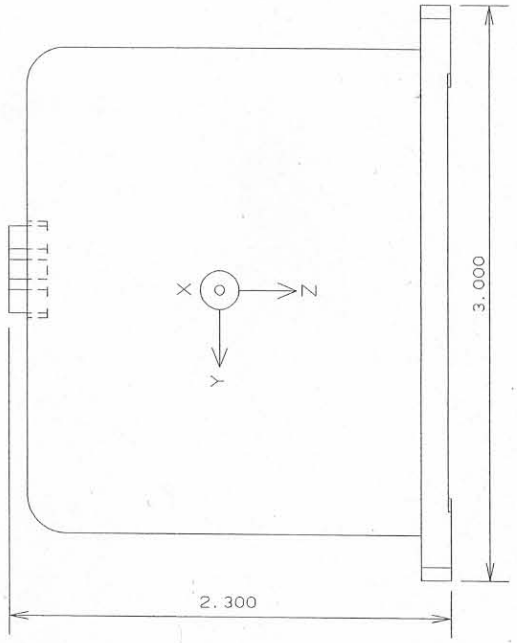
Rate Sensor Bias Calibration

Command Data Format (Host to IMU)

Byte	Description			
	Rate Sensor Bias update	**Rate Sensor Bias Save**	**Canceling Bias update**	**Reset to Factory Constant**[1]
1	Header (&h7E)	Header (&h7E)	Header (&h7E)	Header (&h7E)
2	**5**	**5**	**5**	**5**
3	**145** (&h91)	**147** (&h93)	**149** (&h95)	**255** (&hFF)
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	0	0	0	0
8	Check Sum (&hEA)	Check Sum (&hE8)	Check Sum (&hEE)	Check Sum (&h84)

[1] Warning: This will lose all the updated or saved data such as updated bias, etc. It will reset to Factory data.





WEIGHT : 0.8 lb (360 g)

NOTE : METAL SUBSTRATE REQUIRED
FOR HEATSINK

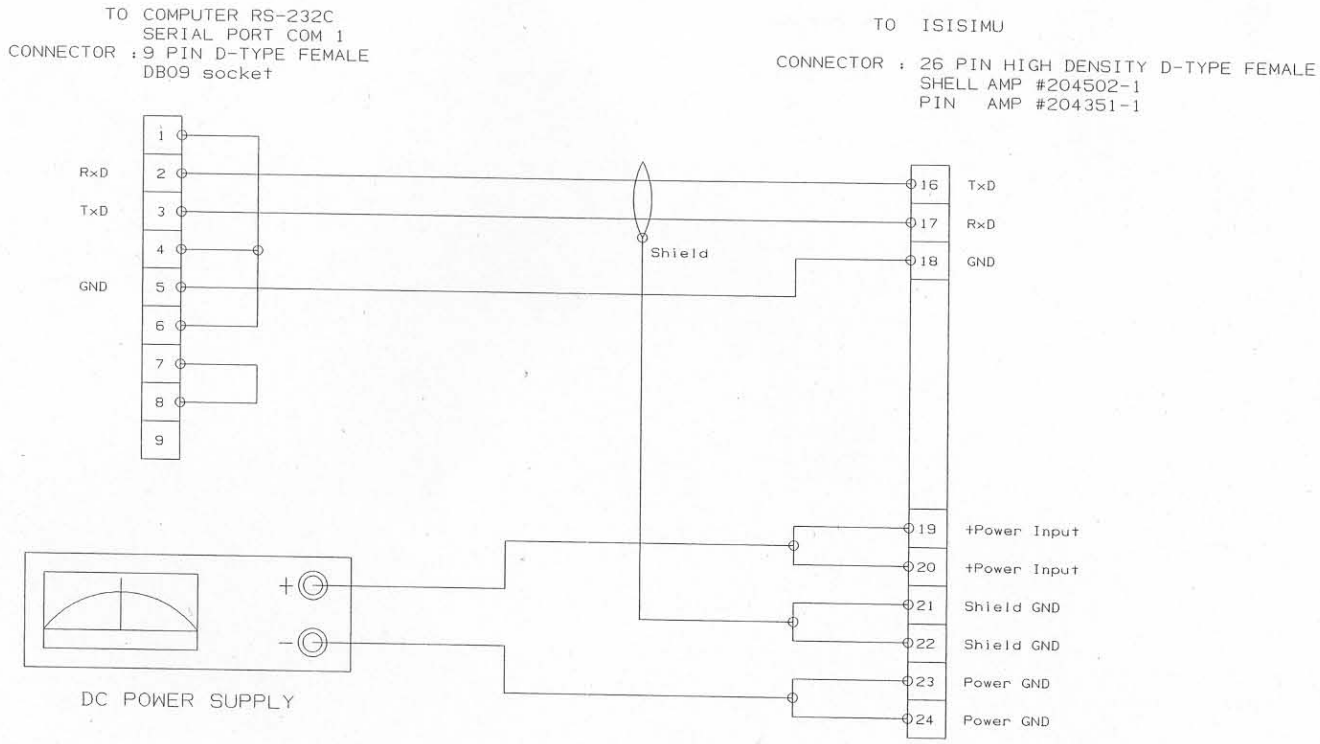
DIMENSIONS ARE IN INCHES

TOLERANCES :

.XX	.XXX	ANGLES
+/-.01	+/-.001	+/-.5 deg

UNLESS OTHERWISE SPECIFIED

INERTIAL SCIENCE INC			
TITLE ISISIMU OUTLINES & AXIS C:\DMEE\ISISIMU\RevE\IMUEOLD.LOC			
SIZE A	CODE	PLATFORM OUTLINE AND AXIS DEFINITION	REV E
DATE JUNE 01, 2002		SHEET 1 of 1	



COMPUTER RS-232C SERIAL PORT COM 1 & DC POWER SUPPLY TO ISISIMU CONNECTION DIAGRAM

INERTIAL SCIENCE INC			
TITLE C:\DMEE\ISISIMU\RevE ISISWIRE.LOC			
SIZE A	CODE UB01	Power & Data Cable Interface Drawing	REV
DATE Sep. 20, 2002		SHEET 1 of 1	