i300 MEMS INERTIAL MEASUREMENT UNIT.

Installation and Environmental Manual

Honeywell

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All technology that leaves the United States is subject to export regulations. This manual contains technology that has an Export Commodity Classification of ECCN 7E994 with associated country chart control code of AT1. This technology generally will not require a license to be exported or re-exported. However, if you plan to export this item to an embargoed or sanctioned country, to a party of concern, or in support of a prohibited end-use, you may be required to obtain a license.

PRODUCT OVERVIEW

The HGuide i300 is a high performance Micro-Electro-Mechanical System (MEMS) based Inertial Measurement Unit (IMU) designed to meet the needs of applications across various markets including agriculture, AUVs, industrial equipment, robotics, survey/mapping, stabilized platforms, transportation, UAVs, and UGVs. With industry standard communication interfaces and a wide input voltage range the HGuide i300 is easily integrated into a variety of architectures. The extremely small size, lightweight, and low power make the HGuide i300 ideal for many applications.

The HGuide i300 includes MEMS gyroscopes and accelerometers. In addition, the HGuide i300 employs an internal environmental isolation system to attenuate unwanted inputs commonly encountered in real world applications. The internal isolation and other proprietary design features ensure the HGuide i300 is rugged enough to meet the needs of the most demanding users.

The HGuide i300 is both hardware and software compatible with the HG4930 IMU. It is also software compatible with the HG1120 IMU with their message descriptions contained in those device manuals.

The HGuide i300 is not ITAR controlled. Its Export Control Classification Number (ECCN) is 7A994.

For more information, email hguide.sales@honey well.com or contact us on our website aerospace.honeywell.com/I300

PIN OUTS/POWER
SIGNAL LIST

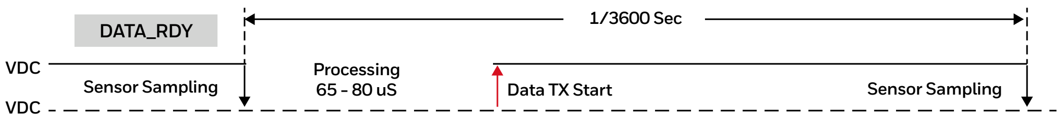
Typical power draw is 500 mW. The i300 will work with most PC USB ports; however, Honeywell recommends a non-PC power supply for permanent installations.

This device has been designed to meet stringent EMI and EMC requirements, and as such, the user should shield the I/O cabling and provide chassis ground connection to the IMU housing.

i300 14 PIN CONNECTOR			
Pin#	Signal Name	Input/Output & Signal type	Signal Function
1	Ground	NA	NA
2	Power	NA	+4.75 to 36 VDC
3	No Connection		
4	COM2 TX	Output, +5 Volt TTL	Asynchronous Board Level Signal. Adequate Protection Must Be Provided.
5	COM2 RX	Input - +3.3 to 5.5 VDC	
6	RESET	Input - +3.3 to 5.5 VDC	Device reset input discrete. CMOS Compatible. Device will remain in reset while at logic 0.
7	Reserved	No Connect	No Connect
8	DATA_RDY	Output - 5 Volt BiCMOS	Data Ready on Rising Edge to 5 VDC. Rise and Fall Time < 50 Nanoseconds.
9	COM1_TX_H	Output RS-422	Asynchronous High
10	COM1_TX_L		Asynchronous Low
11	CAN_H	Bi-directional ISO 11898-2 No Termination Resistor	Asynchronous High
12	CAN_L		Asynchronous Low
13	COM1_RX_H	Input RS-422	Asynchronous High
14	COM1_RX_L		Asynchronous Low

Use SAMTECH part numbers FLE-112- 01-G-DV or CLP-112- 02-F-D or equivalent. Honeywell evaluation boards available for purchase with connectors. Asynchronous Communications are 8 Bits, One Start Bit, One Stop Bit.

DATA READY
SIGNAL DESCRIPTION



This devices samples and processes sensor data at 3600 Hz. Data is transmitted at message specific frame rates between 100 Hz and 1800 Hz. Data transmission will continue across additional 3600 Hz frames with length dependent upon customer selected bit rate. The "Data TX Start" (shown in the diagram) will not occur at 3600 Hz but rather at the message specific frame rates.

The Data Ready has two primary purposes. The falling edge can be used to provide a time mark to a data recording system which will provide time of validity for recorded IMU data. This is often GPS time. Secondly – some customers need to know when Honeywell data transmission starts so that the data can be immediately processed or manage a data bus.

DATA AND BAUD SELECTION

USE THE HGUIDE DATA READER TO SELECT MESSAGES AND BAUD RATES											
Allowed Messages	Message Information				Data Rates (Hz)**		Available KBaud Rates				
	Control	Mag	Nav	Device	Control	Nav	115.2	230.4	460.8	921.6	1000
CAN	X	X	X	ALL	600	100		X	X	X	X
0x01	X			HG4930	600	NA			X	X	X
0x01 & 0x02 Interleaved	X		X	HG4930	600	100			X	X	X
0x04	X			HG1120	1800	NA			X	X	X
0x04 & 0x05 Interleaved	X		X	HG1120	1800	300			X	X	X
0x0C	X			HG1120	600	NA			X	X	X
0x0C & 0x0D Interleaved	X		X	HG1120	600	100				X	X
0xA1	X			i300	600	NA			X	X	X
					1200				X	X	X
					1800				X	X	X
0x0C & 0x0D Interleaved	X		X	i300	600	100			X	X	X
					1200	200				X	X
					1800	300				Default	X
0xA3			X	i300	NA	100	X		X	X	X
						200	X		X	X	X
						300			X	X	X
0xAC	X	X		i300	600	NA			X	X	X
					1200				X	X	X
					1800					X	X
0xAC & 0xAD Interleaved	X	X	X	i300	600	100			X	X	X
					1200	200				X	X
					1800	300				X	X
0xAE		X	X	i300	NA	100	X		X	X	X
						200	X		X	X	X
						300	X		X	X	X

For Legacy HG1120 and HG4930 messages, consult their respective manuals for message definitions.

Use the HGuide data reader to configure messages and baud rates.

INTERLEAVE TABLE

INTERLEAVE TABLE. TRANSMISSION SEQUENCE IS AT THE CONTROL RATE												
Allowed Messages	Message Information				Data Rates (Hz)		Interleave Transmission Sequence @Control Rate					
	Control	Mag	Nav	Device	Control	Nav	1	2	3	4	5	6
CAN	X	X	X	ALL	600	100	C1 C2 M1 I1 I2 I3	C1 C2 M1	C1 C2 M1	C1 C2 M1	C1 C2 M1	C1 C2 M1
0x01 & 0x02 Interleaved	X		X	HG4930	600	100	0x02	0x01	0x01	0x01	0x01	0x01
0x04 & 0x05 Interleaved	X		X	HG1120	1800	300	0x05	0x04	0x04	0x04	0x04	0x04
0x0C & 0x0D Interleaved	X		X	HG1120	600	100	0x0D	0x0C	0x0C	0x0C	0x0C	0x0C
0xA1 & 0xA2 Interleaved	X		X	i300	600	100	0xA2	0xA1	0xA1	0xA1	0xA1	0xA1
					1200	200						
					1800	300						
0xAC & 0xAD Interleaved	X	X	X	i300	600	100	0xAD	0xAC	0xAC	0xAC	0xAC	0xAC
					1200	200						
					1800	300						

USING HONEYWELL DATA

Controlling (Messages 0xA1 or 0xAC)
Honeywell provides high bandwidth (400 Hz information) at 1800 Hz. General "rule of thumb" is that sensor control bandwidth should be 5 times the structure being controlled – allowing control of an 80 Hz device. If you are controlling lower frequency platforms (like a car) – filter the 1800 Hz data to the desired bandwidth.

Navigation (Messages 0xA3 & 0xAE)
Navigating requires that single integration of angular rates to attitude and the double integration of acceleration into position. This navigation format provides data relative to the prior frame and often referred to as Delta Velocity / Theta or Incremental Velocity / Angles. The data is directly integrable in that the data is not "per second" but rather per the length of the navigation frame (100 Hz, 200 Hz or 300 Hz).

Interleaved (Multiple Messages & CAN)
Get both Control and Navigation data by selecting a message which sends out data on multiple frame rates. This is the default data for the i300 because it demonstrates all sensor types. If you are one of the few who need this – study carefully the right columns on the Interleave table. For the rest – use the Honeywell HGuide Data Reader to send out just Control or Navigation data.

ASYNCHRONOUS MESSAGE EXAMPLE

ASYNCHRONOUS MESSAGE					
Message Detail Template 0xAD Control, Mag, Status & Delta Data Apply the LSB, Byte, and Units information to all other message ID's					
Position	Parameter	Description	Bytes	LSB Weight	Units/LSB
1	Address	0x0E	1	NA	
2	Message ID	0xAD	1	NA	
3	Control	Angular Rate X	2	2^{-11}	rad/sec
4		Angular Rate Y	2		
5		Angular Rate Z	2		
6		Linear Acceleration X	2	$0.3048*2^{-5}$	m/sec^2
7		Linear Acceleration Y	2		
8		Linear Acceleration Z	2		
9	Mag	Mag Field X	2	0.438404	Milli-Gauss
10		Mag Field Y	2		
11		Mag Field Z	2		
12	Status	Status Word 1	2	See Table	See Table
13		Status Word 2	2	NA	Reserved
14	Navigation	Delta Angle X	4	2^{-33}	radians or equivalently, radians/second/Hz
15		Delta Angle Y	4		
16		Delta Angle Z	4		
17		Delta Velocity X	4	2^{-27}	m/sec or equivalently, $m/sec^2/Hz$
18		Delta Velocity Y	4		
19		Delta Velocity Z	4		
20	Checksum	Checksum	2	NA	Total of 50 Bytes

0xAD Control, Mag, Status & Delta Data.
Apply the LSB, Byte, and Units information to all other message ID's.
LS byte first and LS 16-bit word first.

STATUS AND CHECKSUM DESCRIPTIONS

i300 STATUS WORD – USED IN ALL i300 MESSAGES		
Bit	Definition	Values
0–3	4-bit Counter	0-15
4–7	Control Data Output	0 (No Active Output)
		1 (600 Hz)
		2 (1200 Hz)
		3 (1800 Hz)
8–11	Navigation Data Output	0 (No Active Output)
		1 (100 Hz)
		2 (200 Hz)
		3 (300 Hz)
12–15	BIT (Gyro/Accel/Mag/Summary)	0xAC

The Checksum is the sum of all message data (positions 1 … 19 of example message), taken as 16 bit words, and summed without regard for rollover.

This pseudo code illustrates the checksum algorithm:

```
u16sum = 0;
for (i=0; i<9; i++) // (20-2)/2=9
{ u16sum += u16_msg_array[i]; }
Checksum = u16_msg_array[9];
if (Checksum != u16sum) {checksum error}
```

The HGuide Data Reader with its associated software development tools provide real time examples of checksum calculations.

ASYNCHRONOUS MESSAGES ABBREVIATED

0XA1 CONTROL DATA

Position	Parameter Description	Bytes
1	IMU Address - 0x0E	1
2	Message ID - 0xA1	1
3-8	Control Data	12
9-10	Status	4
11	Checksum	2
	Total Bytes	20

0XAC CONTROL & MAG DATA

Position	Parameter Description	Bytes
1	IMU Address - 0x0E	1
2	Message ID - 0xAC	1
3-8	Control Data	12
9-11	Mag Data	6
12-13	Status	4
14	Checksum	2
	Total Bytes	26

0XAC CONTROL & MAG DATA

Position	Parameter Description	Bytes
1	IMU Address - 0x0E	1
2	Message ID - 0xAc	1
3-8	Control Data	12
9-10	Status	4
11-16	Navigation Data	24
17	Checksum	2
	Total Bytes	44

0XAD CONTROL, NAVIGATION & MAG DATA

Position	Parameter Description	Bytes
1	IMU Address - 0x0E	1
2	Message ID - 0xAD	1
3-8	Control Data	12
9-11	Mag Data	6
12-13	Status Word	4
14-19	Navigation Data	24
20	Checksum	2
	Total Bytes	50

0XA3 NAVIGATION DATA

Position	Parameter Description	Bytes
1	IMU Address - 0x0E	1
2	Message ID - 0xA3	1
3-8	Navigation Data	24
9-10	Status	4
11	Checksum	2
	Total Bytes	32

0XAE NAVIGATION & MAG DATA

Position	Parameter Description	Bytes
1	IMU Address - 0x0E	1
2	Message ID - 0xAE	1
3-8	Navigation Data	24
9-11	Mag Data	6
12-13	Status	4
14	Checksum	2
	Total Bytes	38

See 0xAD Combined Control & Inertial for detailed contents.

CAN MESSAGES ABBREVIATED

C1 CONTROL DATA		
#	Parameter	Bytes
NA	Arbitration ID	NA
1	Angular Rate X	2
2	Angular Rate Y	2
3	Angular Rate Z	2
4	Status Word	2

C2 CONTROL DATA		
#	Parameter	Bytes
NA	Arbitration ID	NA
1	Linear Acceleration X	2
2	Linear Acceleration Y	2
3	Linear Acceleration Z	2
4	Reserved	2

C3 MAGNETIC DATA		
#	Parameter	Bytes
NA	Arbitration ID	NA
1	Mag X	2
2	Mag Y	2
3	Mag Z	2

I1 NAVIGATION DATA		
#	Parameter	Bytes
NA	Arbitration ID	NA
1	Delta Angle X	4
2	Delta Velocity X	4

I2 NAVIGATION DATA		
#	Parameter	Bytes
NA	Arbitration ID	NA
1	Delta Angle Y	4
2	Delta Velocity Y	4

I3 NAVIGATION DATA		
#	Parameter	Bytes
NA	Arbitration ID	NA
1	Delta Angle Z	4
2	Delta Velocity Z	4

See 0xAD Combined Control & Inertial for LSB weights and units.

CAN ID'S

CAN ID TABLE			
(0xC, 0xD, 0xA1, 0xA2)			
Message	Packet	CAN-11	CAN-29
0xC	C1	0x121	0x04924921
0xC	C2	0x122	0x04924922
0xC	C3	0x126	0x04924926
0xD	I1	0x123	0x04924923
0xD	I2	0x124	0x04924924
0xD	I3	0x125	0x04924925
0xA1	C1	0x141	0x04924941
0xA1	C2	0x142	0x04924942
0xA1	C3	0x146	0x04924946
0xA2	I1	0x143	0x04924943
0xA2	I2	0x144	0x04924944
0xA2	I3	0x145	0x04924945

CAN ID TABLE			
(0x01,0x02,0xAC,0xAD)			
0x01	C1	0x131	0x04924931
0x01	C2	0x132	0x04924932
0x02	I1	0x133	0x04924933
0x02	I2	0x134	0x04924934
0x02	I3	0x135	0x04924935
0xAC	C1	0x151	0x04924951
0xAC	C1	0x152	0x04924952
0xAC	C3	0x156	0x04924956
0xAD	I1	0x153	0x04924953
0xAD	I2	0x154	0x04924954
0xAD	I3	0x155	0x04924955

Use CAN ID's to design DBC Files.

HGUIDE DATA READER/ INTEGRATION

The Honeywell HGUIDE DATA READER is a web deployed software integration tool which can configure the i300 for message types and baud rate. The software tool also provides real time and "Off Device" integration support.

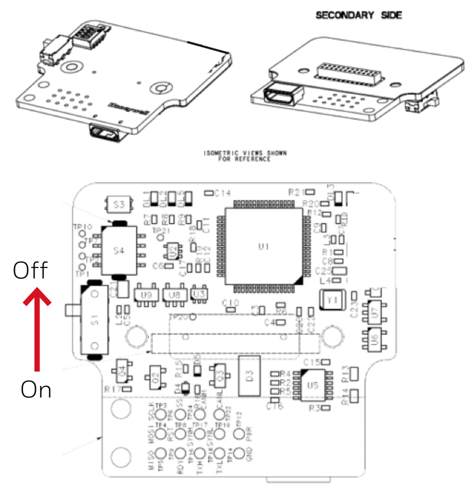
The software integration tool will display and record data, generates supporting message documentation, and includes an example Windows executable which will parse and log data. The program will also export data to CSV format for easy plotting.

The Honeywell HGuide Data reader provides a software development kit (SDK) including C/C++ source code, header files, DLL, and essential functions. See "Bit Stream" window to produce the SDK.

An evaluation kit is also available for separate purchase. Connect the evaluation board to the IMU being careful to align the pins to the connector.

Connect a micro-USB cable. Make sure the switch is on. Verify that both green LEDs power on. Once data transmission starts orange LED should flash. Data can be monitored using any terminal program or the data reader program. The Windows Device Manager should show a new port.

If using the Honeywell Data reader, be sure to press the "scan/hunt" button on the introductory screen. The program will automatically do an initial search but will time out if device not connected.



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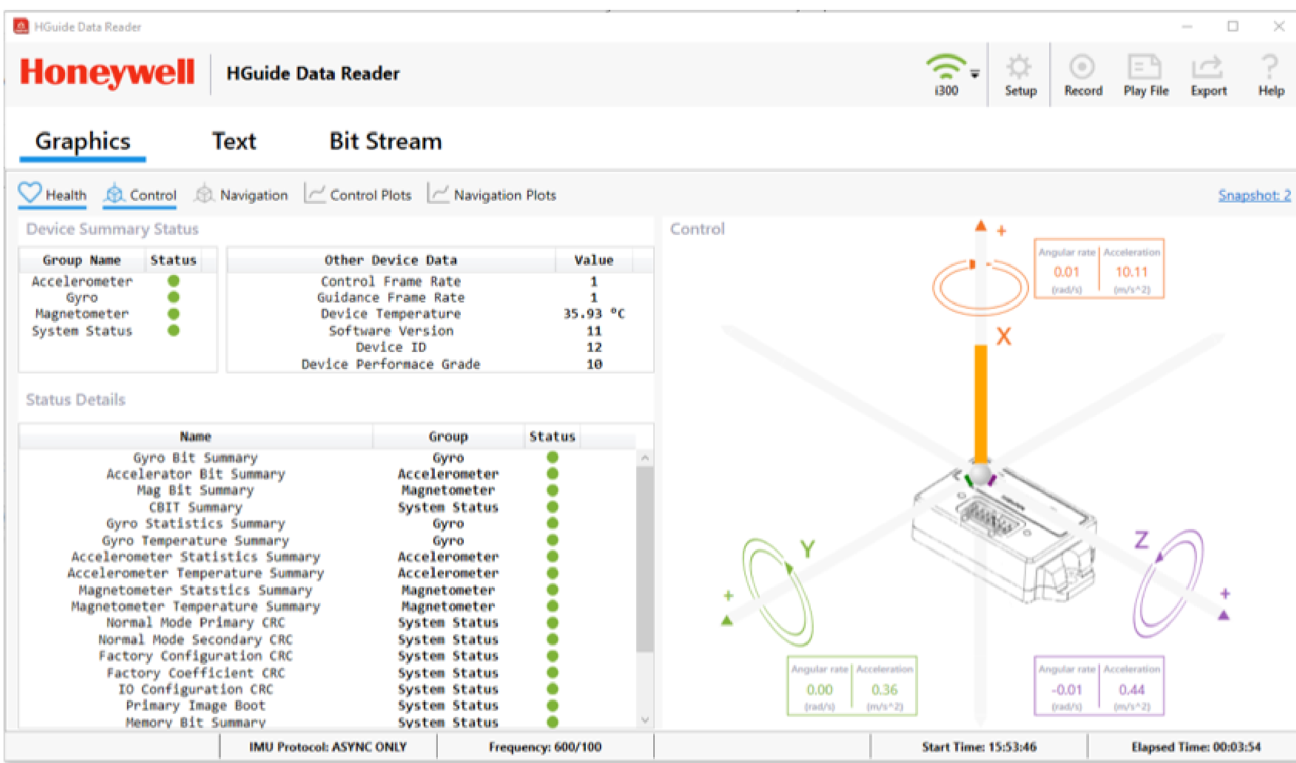


ENVIRONMENTAL/ COMPLIANCE

ENVIRONMENTAL AND COMPLIANCE INFORMATION			
Item	Operating	Non-Operating	Units
Temperature	-54 to +85 -40 to +85 (Full Performance)	-55 to +95	°C
Temperature Shock	±3 Operating ±0.8 Full Performance	-40 to + 85 in 15 Minutes Measure on Top of Device with Thermocouple	°C/minute
Random Vibration	5 g's RMS	12 g's RMS	NA
Shock	15 g bump half-sine, 6 ms duration, both polarities, each axis, per IEC 60068-2-27	40 g Shock at 11 msec duration per MIL-STD-810G Method 516.7 Procedure I 500 g's 0.5 mSec, Half Sine	NA
Static Acceleration	> 250 g's of static acceleration in all directions and recover within 25 milliseconds		NA
Altitude	0 to 12000, Mean Sea Level		Meters
Magnetic Field	±10	No Known Sensitivity	Gauss
Acoustic Rectification	147 dB, SPL, 20 - 8000 Hz	No Known Sensitivity	NA
Regulatory*	CE, ICED, FCC*		NA
Materials	RoHS Compliant and RoHS Process Compatible		NA
WEEE Compliance	Classified as electrical and electronic equipment. Must be sent to separate collection facilities for recovery and recycling.		

***Regulatory Tests were not Completed at Time of Publication.**

EMC TEST CONDITIONS

i300 COMPLIANT TO LISTED EMC TEST CONDITIONS		
Environment	Test Method Standard	Test Parameters
Radiated Emissions	ISO 13309:2010	30 MHz to 1000 MHz
	ISO 13766:2006	BB and NB Scans
	ISO 14982:1998	Ambient Baseline Before & After
Bulk Current Injection (BCI)	ISO 11452-4:2011	20 MHz to 400 MHz
		100 mA, 80% AM at 1kHz
Radiated Immunity	ISO 11452-2:2004	400 MHz to 2000 MHz
		100 V/m, 80% AM at 1kHz and PM
Conducted Transients	ISO 7637-2:2011	Pulses 1, 2a, 2b, 3a, 3b at Test Level IV
	ISO 7637-2:2004	Pulse 4 at Test Level IV

MOUNTING/ INSTALLATION

Do not place this device in an environment with Helium concentrations greater than the normal atmosphere. The helium will permeate the housing and affect sensors. The housing seal allows Helium to enter/leave so that helium does not accumulate. The IMU should not be subjected to contact with any fuels, lubricants, solvents, or their vapors.

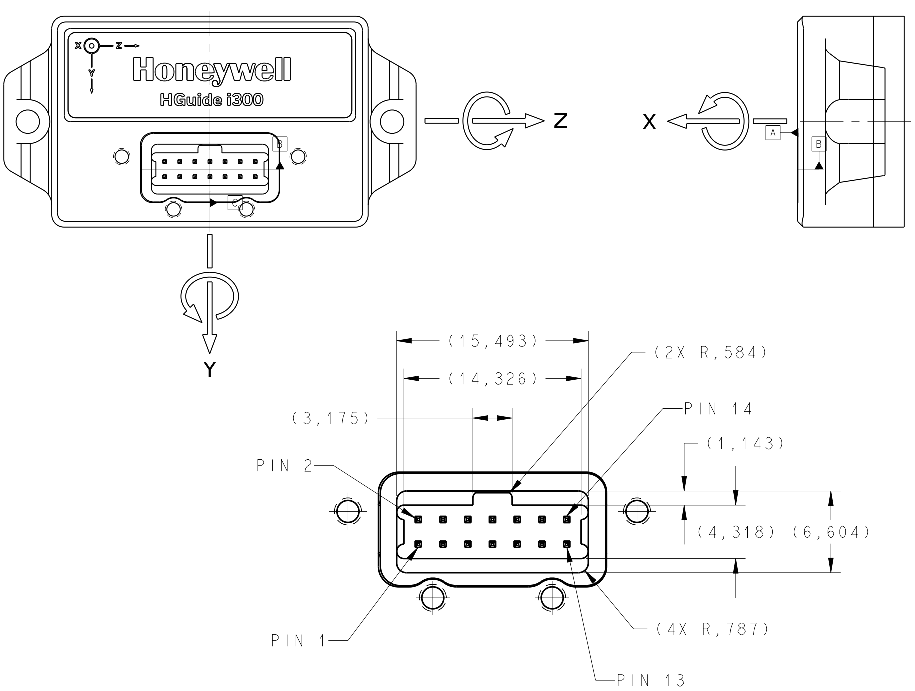
The accelerometer and gyro sensors are mounted in a normally aligned, right-handed axis configuration that is nominally aligned with the IMU axes as shown in the figure below. If the X axis is pointed up away from the Earth's surface, the accelerometer reading will be positive.

The i300 nominally weighs 35 grams. The packaging is compliant to IP68; however, do not intentionally submerse device under water.

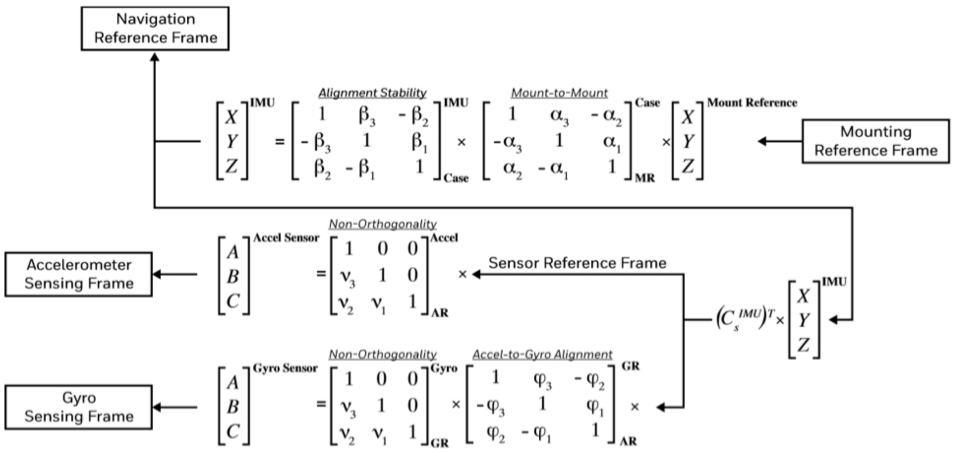
Recommended mating connectors are SAMTECH part numbers FLE-112- 01-G-DV or CLP-112- 02-F-D or equivalent.

The center of gravity and center of navigation are located at the approximate geometric center. A CAD compatible STP file is available from Honeywell upon request.

ATTENTION:
IMUs are precision instruments which measure angular rate and linear acceleration across a broad temperature range. Because of their precision, users often interpret real motion (both angular and linear) as sensor noise. This noise can often be coupled mechanically through the mounting plate. Installation on a thin structure is generally not desirable. Placement at anti-nodes will minimize angular rotation and maximize linear displacement. Placement at nodes will maximize angular rotation and minimize linear displacement.



ALIGNMENT AND ORTHOGONALITY



AR Accel/Sensor Reference Frame (Orthogonal)

GR Gyro Reference Frame (Orthogonal)

C_s^{IMU} Gyro Reference Frame (Orthogonal)

ALIGNMENT AND ORTHOGONALITY		
Parameter	Requirement	Units
Mount to Mount with Pins	7000	μrad max
Alignment Stability	1800	μrad 1σ
Accelerometer Non-orthogonality	600	μrad 1σ
Accelerometer to Gyro Alignment	1000	μrad 1σ
Gyro Non-Orthogonality	800	μrad 1σ

Alignment / Orthogonality Note

Honeywell navigation system equations implement alignment / orthogonality as shown. These equations are provided to customers for understanding of the parameters provided. Customers may optionally choose to implement these equations into their own navigation equations.

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