IM³ INTERFACE CONTROL DOCUMENT

IM³ ICD Change History Log

Revision	Description	Date	Author
IR	Initial Release	April 15, 2005	J. Dabhade
A	Added IMU Data Flag, Modified pinouts, Reduced Header bytes from 6 to 5, Added Inertial Message and description	Dec.21, 2005	M. Greene
A	Modified pinouts, Added Figure 1 and Modified Table 10. Modified: Table 1,4,5,10,11,13,14 and 15 Added: Table 2,6,7,12, Figure 2 and Section 3.1.1 Reworded: Section 3.1.3, 3.1.4 and 3.1.5 Added Heat Sink Requirement Section.	April 12, 2006 April 14, 2006	V. Trent S. Hallacy
B	- Allowed for Table of Content Field to produce a higher level of heading. - Overall: Reorganized and added Section numbers. - Included and updated Message Table (Table 1) to include the IM³ Command Message. - Replaced System Overview contents with SRS-IM3's System Architecture which included adding Figure 1 and 2. - Simplified Figure 3, Removed IM3 External Interface Section. - Changed External Connection to Connector and reworded that sections contents. Modified Figure 3. - Added Mechanical Interface Section. - Moved Heat Sink Requirements to a subsection of the Mechanical Interface section. - Renamed Section named "Communication" to "Serial Communication". - Renamed Section named "Power" to "Input Power". - Reworded Input Power Table Descriptions. - Moved Input Power Section to a place after Connector Section.	April 19, 2006	S. Hallacy M. Greene S. Hallacy

	- Added Master and Slave Mode to Serial Communication Section. Also, Added both SPI Master and Slave Mode to the IM3 Communication Mode Table and SPI Figure. - Added Serial Communication Section. - Added Master/Slave Mode Command to Command Message. - Moved CRC Polynomial Section. - Added GPS Input Message Section and INS Message Section. - Modified IMU Output Message Format and AHRS Output Message Format Tables. - Renamed Table named "IMU Mode Serial Data Message Status Word Format" to "IMU Status Word". Also, moved "IMU Status Word" Table to Section 3.4.1.3.		
C	Corrected Pin out to match mating connector CAR 197 – Corrected revision information Revised Table 1 to have correct part number format. - Removed IM3-M ARCHITECTURE figure and reworded system overview section. Corrected message formats and sizes	27SEP06 27SEP06 Sept 29, 2006 14AUG2007	M. Greene A. Henderson S. Hallacy K. Narayanan
D	Corrected message formats and sizes Removed bad cross-references in change history Corrected pin-out to match spec sheet.	28APR2011	K. Narayanan

Table of Contents

List of Tables

1 Introduction

1.1 Purpose

This Interface Control Document (ICD) defines the interfaces of the Inertial Measurement Cube, henceforth referred to as the IM^3.

1.2 Scope

This ICD specifies all system and system component interfaces for the IM^3. System interfaces include all external interfaces of the IM^3. This ICD defines the characteristics, protocol, and timing for all system and system component interfaces.

This document is intended for users of the IM^3, the developers of the IM^3 and verification engineers responsible for independent testing of the IM^3 and its components.

1.3 Document Precedence and Overview

This ICD establishes the basis for development and testing of the IM^3 communications with other units external to the IM^3 system.

1.4 System Overview

The IM3 contains strap-down solid state gyros, solid state accelerometers, analog interface circuitry and a digital signal processor (DSPic). Figure 1 shows the IM3 commercial configuration. This configuration contains three MEMS gyros interfaced to a 24-bit external Analog to Digital (A/D) converter and three dual axis MEMS Accelerometers interfaced to the Input Capture Ports of the DsPIC. Temperature sensors are included in the system to provide thermal data necessary for thermal compensation. The IM3 receives and sends data to the external world using the communication modules (UART) of the DSPic.

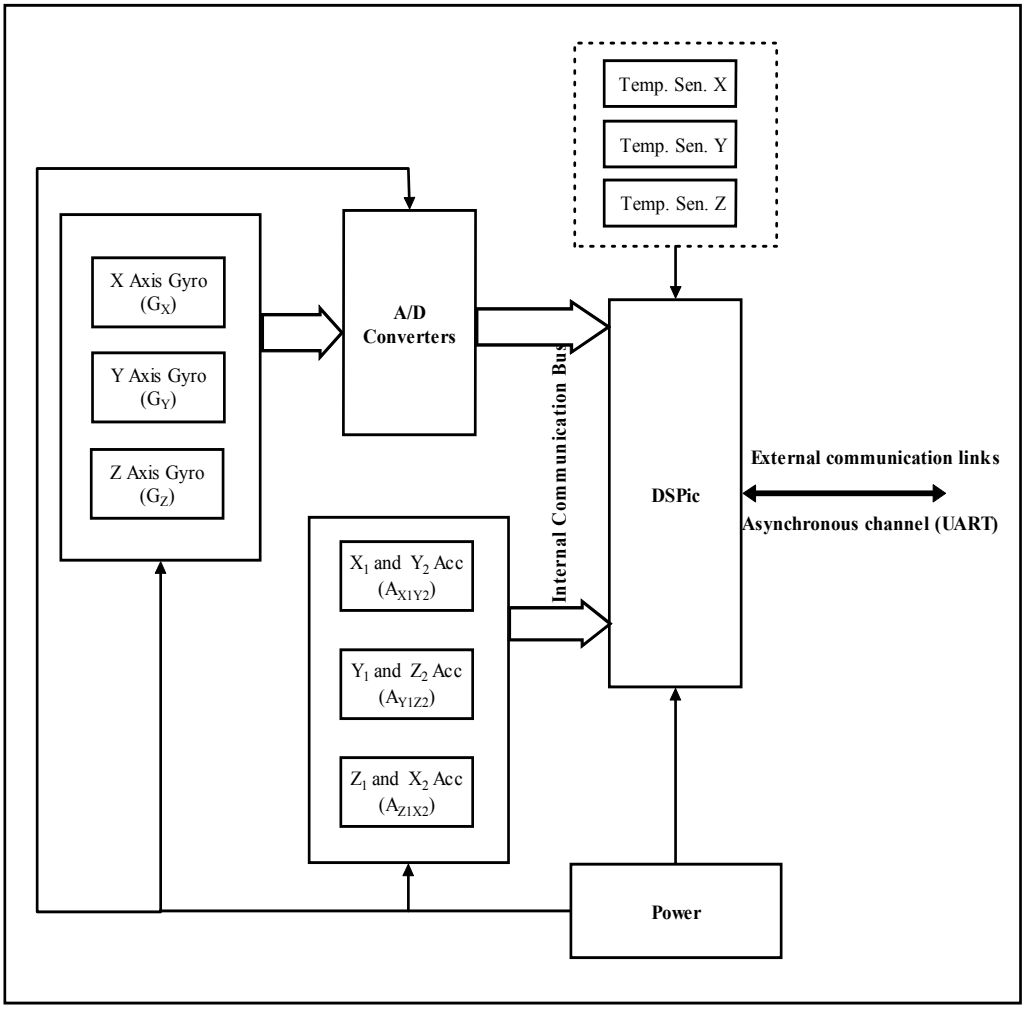


FIGURE 1: IM3-C ARCHITECTURE

2 References

This section lists all documents that provide supporting information to the contents of this ICD.

2.1 Regulatory Documents

None

2.2 Archangel Systems, Inc. Documents

This section lists all internal Archangel Systems, Inc. documents that provide supporting information to the contents of this ICD. The version of the documents, referenced within this list, connote the latest document released within ASI's CM control. In the event of conflict between the documents referenced herein and the contents of this document, the contents of this document shall be considered a superseding requirement.

Ref. ID	Title & Supplier	Part Number
IM3	IM3 Specifications	

3 Interfaces

3.1 Connector

The IM^3 Flexible Printed Circuit (FPC), Zero Insertion Force (ZIF) connector mates to a ZIF socket (Part #: 52610-1271, Manufacturer: Molex). The FPC pin out is listed in Table 1 and the pin locations are defined in Figure 2.

TABLE 1: FPC PIN OUT

Pin No.	Name	Signal Description	Notes
1	Data Valid	System operational fault indicator pin	
2	RESET*	Digital signal processor reset pin	
3	SPISS_ICSPC	SPI slave select line/Programmer Clock	RESERVED
4	GPIO_ICSPD	GPIO/Programmer Data	RESERVED
5	SPI_CLK	Synchronous serial communication clock pin (IM^3 master).	RESERVED
6	Digital Power Input	5V (Nominal)	
7	UART Rx	UART Data Input	Asynchronous serial communication receive pin (5 Volt Logic level UART interface). Active only in UART Data Output Mode.
8	UART Tx	UART Data Output	Asynchronous serial communication transmit pin (5 Volt Logic level). Active only in UART Data Output Mode.
9	SPI_Rx	SPI Data In	RESERVED
10	SPI_Tx	SPI Data Out	RESERVED
11	Analog Power Input	12V (Nominal)	
12	GND	System ground	

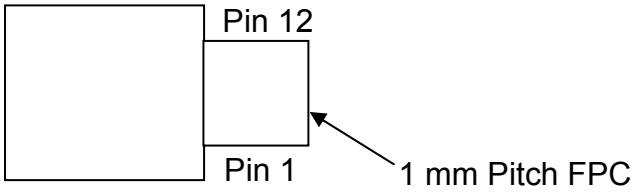


FIGURE 2: TOP VIEW OF IM^3

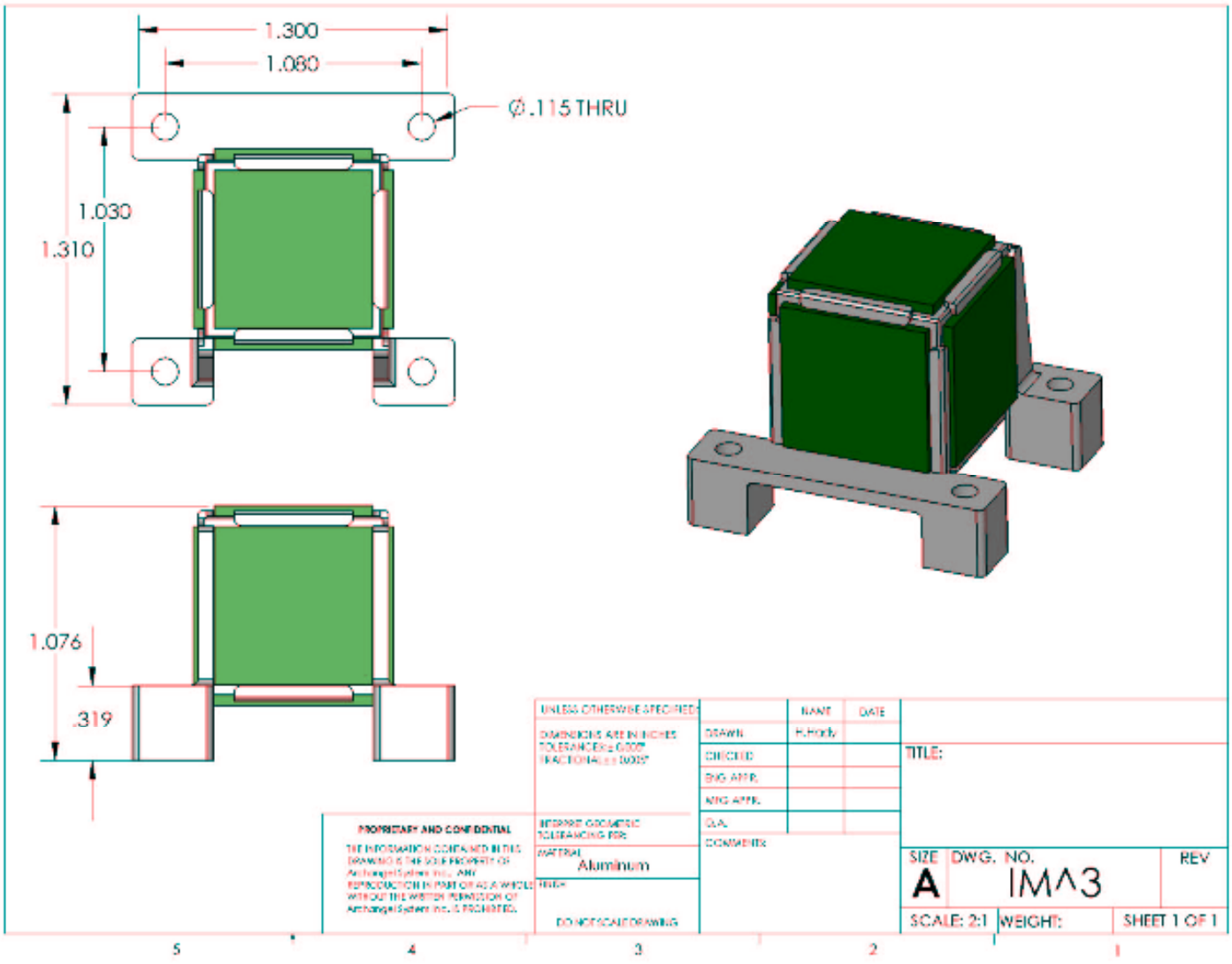
3.2 Input Power

The Input power source for the IM^3 is a DC power supply as specified in Table 2.

TABLE 2: IM^3 POWER SPECIFICATIONS

Input	Description
Digital Input Power	4.75 to 5.5 VDC, 5 VDC Nominal during normal operation
Digital Input Current	200 mA
Analog Input Power	10 to 16 VDC, 12 VDC Nominal
Analog Input Current	50 mA

3.3 Mechanical Interface



3.3.1 Heat Sink Requirements

To obtain the best measurement results, the IM^3 should be mounted on a thermally conductive material.

3.4 Serial Communications

The IM^3 communicates with external system components in Asynchronous serial mode.

TABLE 3: IM3 COMMUNICATION MODES

Communication Mode Type	Description
Asynchronous Serial	The IM3 transmits Data messages (See Section 3.4.1) on UART_Tx (See Table 1) at 100 Hz data rate. The default setting for this communication mode is 460800 Baud, 8 bits, 1 stop bits and no parity.

3.4.1 Serial Communication Messages

The IM^3 can output and input a variety of messages.

3.4.1.1 CRC Polynomial

All serial communication data sent to or received by the IM3 require error checking through the use of a 32-bit CRC (Cyclic Redundancy Check). This 32-bit CRC is based upon the CCITT polynomial, and has a CRC Polynomial Key equal to 0x04C11DB7. The CRC is calculated using bytes 6 (Message ID Byte) through the last data byte.

3.4.1.2 Input Data Messages

TBD

3.4.1.3 Output Data Messages

The IM^3 can output two types of Message Formats: IMU and AHRS. The messages output by the IM^3 are determined by the IM^3 dash number as specified in the IM3 Specification.

3.4.1.3.1 IMU (Inertial Measurement Unit) Output Data Message

The message format is given in Table 4.

TABLE 4: IMU OUTPUT MESSAGE FORMAT

Byte	Value	Format	Units	Notes
0-5	0xFF	N/A	N/A	
6	Message ID = 0xAA	N/A	N/A	
7-10	Status Byte 1 to 4	N/A	N/A	
11	Reserved	N/A	N/A	
12-15	Delta Body Roll Angle	32-bit float	Degrees	LS Byte first
16-19	Delta Body Pitch Angle	32-bit float	Degrees	LS Byte first
20-23	Delta Body Yaw Angle	32-bit float	Degrees	LS Byte first
24-27	Delta Body Longitudinal Velocity	32-bit float	m/sec	LS Byte first
28-31	Delta Body Lateral Velocity	32-bit float	m/sec	LS Byte first
32-35	Delta Body Normal Velocity	32-bit float	m/sec	LS Byte first
36-65	Reserved			
66-69	CRC			MS Byte first

TABLE 5: IMU STATUS WORD

Status Byte	Bit Field	Bit Designation	Value	NOTES
1	0	Gyro X Status		Sensor Self-Test Status Pass = 1, Fail = 0
	1	Gyro Y Status		
	2	Gyro Z Status		
	3	Acc X1 Status		
	4	Acc Y1 Status		
	5	Acc Z1 Status		
	6	Acc X2 Status		
	7	Acc Y2 Status		
2	0	Acc Z2 Status		
	1	Temp X Status		
	2	Temp Y Status		
	3	Temp Z Status		
	4	Alignment	Aligning = 1, Done = 0	Alignment lasts for 45 seconds after power up.
	5-7	Reserved	N/A	
3-4	0-7	Reserved	N/A	

3.4.1.3.2 AHRS (Attitude Heading Reference System) Output Message

The complete message format is given in Table 6.

TABLE 6: AHRS OUTPUT MESSAGE FORMAT

Byte	Value	Format	Units	Notes
0-5	0xFF			
6	Message ID = 0x55	N/A	N/A	
7-10	Inertial Roll Angle	32 bit float	Degrees	LSB First
11-14	Inertial Pitch Angle	32 bit float	Degrees	LSB First
15-18	Inertial Yaw Angle	32 bit float	Degrees	LSB First
19-22	Inertial Roll Rate	32 bit float	Degrees/sec	LSB First
23-26	Inertial Pitch Rate	32 bit float	Degrees/sec	LSB First
27-30	Inertial Yaw Rate	32 bit float	Degrees/sec	LSB First
31-65	Reserved	N/A	N/A	N/A
66-69	CRC			MS Byte first