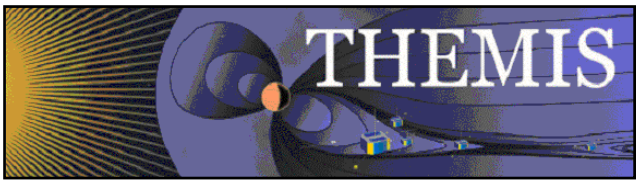

THEMIS
Boom Electronics Board (BEB)
Interface with IDPU

thm_sys_104E_BEB-to-IDPU_ICD.doc
Macrh 28, 2005

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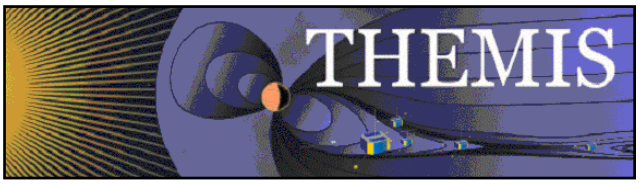

Document Revision Record

Rev.	Date	Description of Change	Approved By
A	8/21/03	Preliminary Draft	-
B	11/04/03	Updated for release	
C	11/10/03	Changed braid grounding resistor	
D	3/18/05	Added pin numbers, RTD signals	
E	3/28/05	Updated floating supply, DAC, and preamp signal descriptions	

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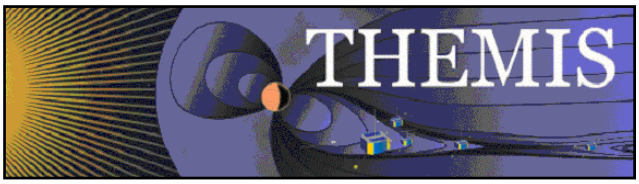
Identifier	Description



1. Scope

The Boom Electronics Board (BEB) is housed in the IDPU chassis. It provides a number of functions related to the Electric Fields measurement on each THEMIS spacecraft (S/C). One BEB will be used in each S/C. This document primarily describes the electrical interfaces with other subsystems in the S/C, and in particular with other subsystems in the IDPU.

2. BEB Specifications

2.1. Preamplifier Signal Characteristics

The BEB circuitry shall not significantly load, nor otherwise distort the input from the sphere preamplifier, i.e. signal "VSPHEREn". The electrical characteristics for this signal are as described in Table 1.

Table 1: Preamp Signal Characteristics

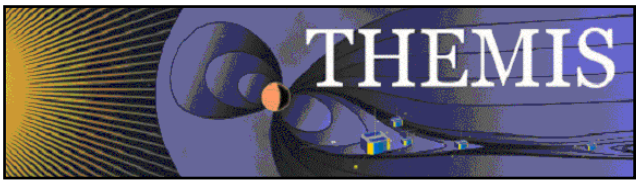
DC voltage level:	± 60Vdc w.r.t. AGND
AC voltage level:	15 Vpp
AC frequency band:	DC – 500kHz

2.2. Floating Ground Driver

The BEB shall provide the reference source for each floating ground used by the EFI preamps. Table 2 provides the specification for this driver.

Table 2: Floating Ground Driver Specifications

Input:	Preamp signal (VSPHERE)
Input filter:	300 Hz (3dB)
Output voltage level:	± 60Vdc w.r.t. AGND
Output:	References floating ground supply (± 10Vdc)



2.3. Bias, Usher, Guard Specifications

The sphere, usher and guard structures are part of the EFI sensor and each is separately biased with a programmable voltage potential. Programming is accomplished via FSW. The characteristics for each of these programmable voltage outputs are specified in Table 3. Control of each of these voltages is done via a digital-to-analog converter (DAC), whose specification is consequently described.

Table 3: Bias, Usher, Guard Specification

Reference Input:	Preamp signal (VSPHERE)
Ref. Input filter:	300 Hz (3dB)
Output voltage level:	Vref ± 40Vdc w.r.t. AGND, where FS DAC = Vref ± 40Vdc
DAC resolution:	12-bits (BIAS res. requirement=1nA; BIAS res. specification=0.65nA)
DAC accuracy:	Opposing booms matched to 0.1%
DAC step response:	< 25 ms (for information only)

2.4. Braid Bias Specification

The braid on the spin plane booms shall be connected to a programmable voltage, or upon command from FSW, switched to a connection to AGND via a resistor. The Braid programmable voltage shall meet the specifications in Table 4.

Table 4: Braid Specification

Outputs: (switchable)	Programmable voltage, or AGND via 1MΩ & 332kΩ resistor
Reference Input:	Preamp signal VSPHERE1, or
(switchable)	Preamp signal VSPHERE3, or AGND via 10MΩ resistor
Ref. Input filter:	300 Hz (3dB)
Output voltage level:	Vref ± 40Vdc w.r.t. AGND, where FS DAC = Vref ± 40Vdc
DAC resolution:	12-bit

2.5. ACTEST Output Specification

Table 5: ACTEST Specification

Output voltage:	0 – 5V square wave
Output frequency:	128 Hz
Output characteristics:	Capacitively coupled, ref. AGND

3. Interface Connector Definition

The following figure shows the electrical interface connectors. The signals on each connector will be described.

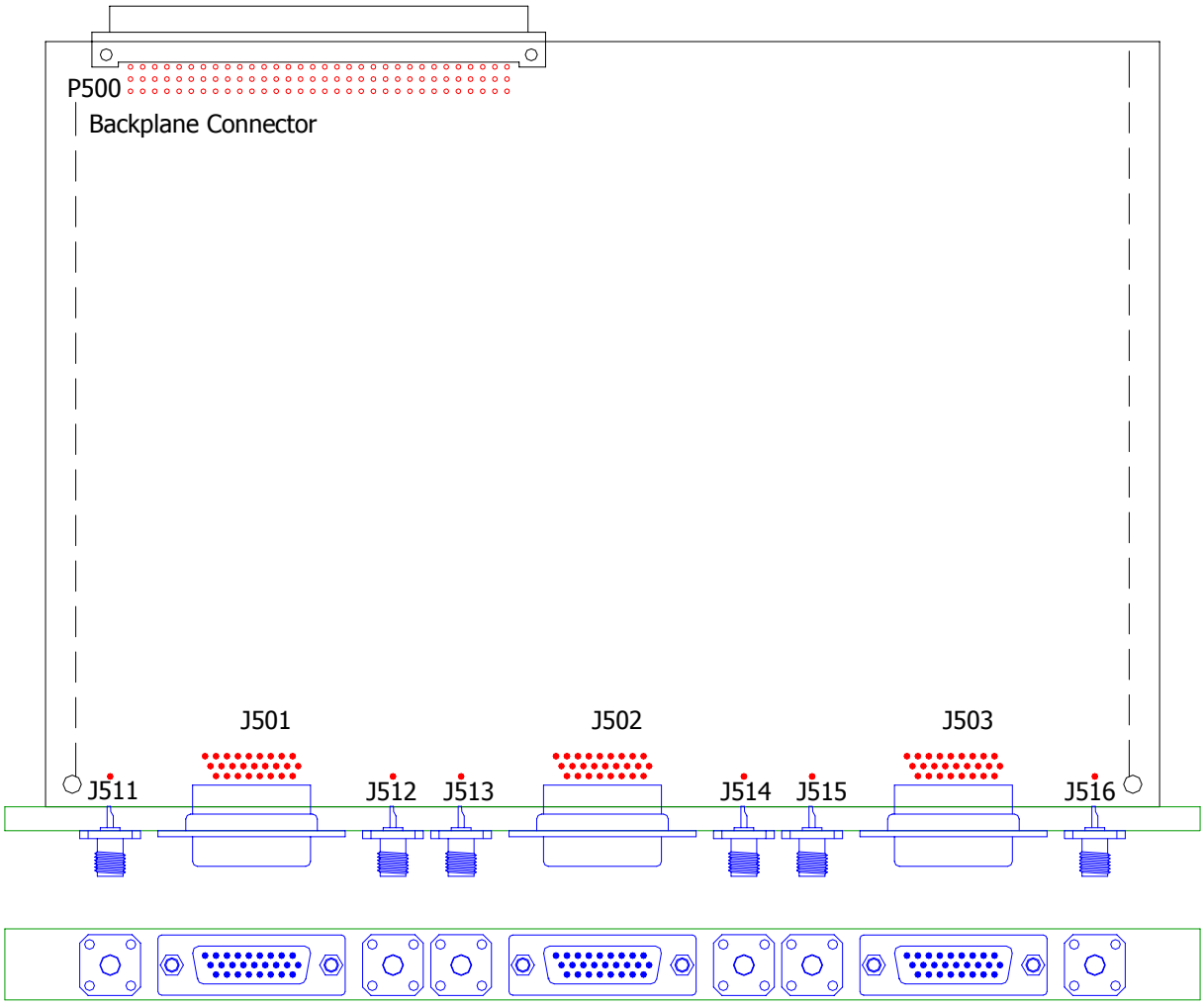
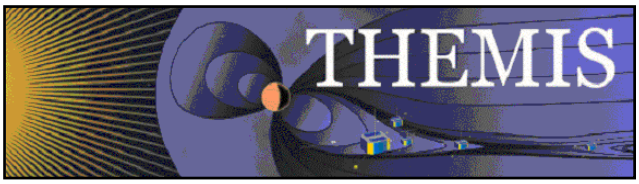


Fig. 1: Boom Electronics Board Interface Connectors

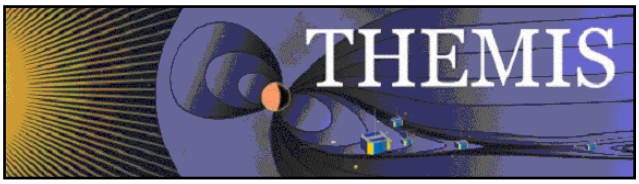


3.1. Back Plane Connector Definition:

Designation: P500
Type: DIN 96 pin, right angle
Part number: IAW with Back plane specification

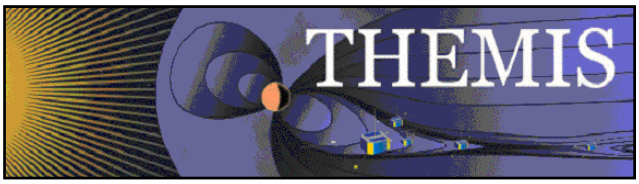
3.1.1. J500 Back Plane Signal Definition:

#	Pin	Signal	I/O	From/To	Description
1	B26 B27	AGND	Input	LVPS	Analog ground. Isolated from S/C Ground. Isolated from Chassis Ground.
2	A27	EFI_P10VA	Input	LVPS	DC power service at nominal +10.0V, 50 mA maximum. Voltage regulated to within ±5%.
3	C27	EFI_M10VA	Input	LVPS	DC power service at nominal -10.0V, 50 mA maximum. Voltage regulated to within ±5%.
4	A26	EFI_P100VA	Input	LVPS	DC power service at nominal +100V, 5 mA maximum. Voltage regulated to within ±5%.
5	C26	EFI_M100VA	Input	LVPS	DC power service at nominal -100V, 5 mA maximum. Voltage regulated to within ±5%.
6	C9 A1 B1 C1	EFI_DGND	Input	LVPS	Digital ground. Isolated from S/C Ground. Isolated from Chassis Ground. Isolated from Analog Ground.
7	A9	EFI_VP5D	Input	LVPS	DC Power service at nominal +5.0V, 10 mA maximum. Voltage regulated to range of 4.8 to 5.3V. Referenced to EFI_DGND. Turn on sequence for EFI_VP5D and EFI_VP2.5D shall conform to the requirements of FPGA (Actel RT54SX72S).
8	B9	EFI_VP2.5D	Input	S/C	DC Power service at nominal +2.5V, 50 mA maximum. Voltage regulated to within ±1%. Referenced to EFI_DGND.
9	A14	FV1_P10VA	Input	LVPS	Floating DC power service to EFI Boom 1. Nominal rating shall be +10.0V at 10 mA max. Voltage regulated to within ±5%. Referenced to floating ground FV1_GND.
10	C14	FV1_M10VA	Input	LVPS	Floating DC power service to EFI boom 1. Nominal rating shall be -10.0V at 10 mA max. Voltage regulated to within ±5%. Referenced to floating ground FV1_GND.
11	B14	FV1_GND	Output	LVPS	Floating analog ground #1 (Boom 1). Isolated from S/C ground, AGND, and from chassis ground. Ref. Para. 2.2.
12	A15	FV2_P10VA	Input	LVPS	Floating DC power service to EFI Boom 2. Referenced to FV2_GND, same spec. as FV1_P10VA.
13	C15	FV2_M10VA	Input	LVPS	Floating DC power service to EFI Boom 2. Referenced to FV2_GND, same spec. as FV1_M10VA.



J500 Back Plane Signal Definition, con't.:

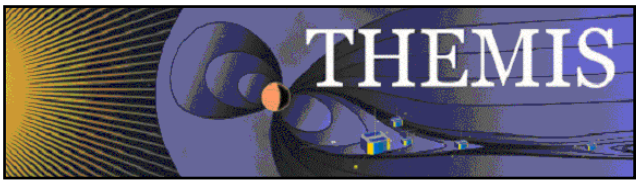
#	Pin	Signal	I/O	From/To	Description
14	B15	FV2_GND	Output	LVPS	Floating analog ground #2 (Boom 2), same spec. as FV1_GND.
15	A16	FV3_P10VA	Input	LVPS	Floating DC power service to EFI Boom 3. Referenced to FV3_GND, same spec. as FV1_P10VA.
16	C16	FV3_M10VA	Input	LVPS	Floating DC power service to EFI Boom 3. Referenced to FV3_GND, same spec. as FV1_M10VA.
17	B16	FV3_GND	Output	LVPS	Floating analog ground #3 (Boom 3), same spec. as FV1_GND.
18	A17	FV4_P10VA	Input	LVPS	Floating DC power service to EFI Boom 4. Referenced to FV4_GND, same spec. as FV1_P10VA.
19	C17	FV4_M10VA	Input	LVPS	Floating DC power service to EFI Boom 4. Referenced to FV4_GND, same spec. as FV1_M10VA.
20	B17	FV4_GND	Output	LVPS	Floating analog ground #4 (Boom 4), same spec. as FV1_GND.
21	A18	FV5_P10VA	Input	LVPS	Floating DC power service to EFI Boom 5. Referenced to FV5_GND, same spec. as FV1_P10VA.
22	C18	FV5_M10VA	Input	LVPS	Floating DC power service to EFI Boom 5. Referenced to FV5_GND, same spec. as FV1_M10VA.
23	B18	FV5_GND	Output	LVPS	Floating analog ground #5 (Boom 5), same spec. as FV1_GND.
24	A19	FV6_P10VA	Input	LVPS	Floating DC power service to EFI Boom 6. Referenced to FV6_GND, same spec. as FV1_P10VA.
25	C19	FV6_M10VA	Input	LVPS	Floating DC power service to EFI Boom 6. Referenced to FV6_GND, same spec. as FV1_M10VA.
26	B19	FV6_GND	Output	LVPS	Floating analog ground #6 (Boom 6), same spec. as FV1_GND.
27	B11	BEB_HSKP	Output	PCB	Analog housekeeping. Multiplexed output, commanded by FSW using CDI. –2.5 to +2.5V range. Referenced to AGND.
28	B2	EFI_CMD	Input	DCB	Command data interface. Referenced to EFI_DGND.
29	A2	EFI_CLK	Input	DCB	Command data interface. Referenced to EFI_DGND.



3.1.2. Power switching methodology:

Power services to the BEB shall be switched under control of FSW, in accordance with the following table.

Switch No.	Independent services, floaters ***must*** be turned on before EFI_BOARDS
7	EFI_VP5D, EFI_VP2.5D, EFI_P10VA, EFI_M10VA, EFI_P100VA, EFI_M100VA
6	FV1_P10VA, FV1_M10VA, FV2_P10VA, FV2_M10VA
5	FV3_P10VA, FV3_M10VA, FV4_P10VA, FV4_M10VA
4	FV5_P10VA, FV5_M10VA, FV6_P10VA, FV6_M10VA



3.2. Boom Unit 1-2 Connector Definition:

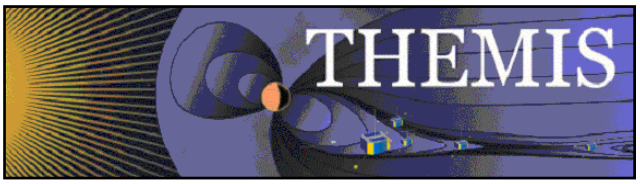
Designation: J501
Type: D-subminiature, high density, 26-pin, female**,** panel mount
Similar to Positronics DD26F4F0
Part Number: 311P407-2S-B-12

3.2.1. J501 Boom Unit Signal Definition:

#	Pin	Signal	I/O	From/To	Description	Ref ¶
1	9	VSPHERE1	Input	PREAMP	EFI sensor signal #1. Requires shielded conductor (coax).	2.1
2	18	INNER_SHIELD1	Input	PREAMP	Shield for signal VSPHERE1. Tied to FV1_GND on BEB.	-
3	8	FVF1_P10VA	Output	PREAMP	DC power service output, derived from IDPU_P5V. Referenced to floating ground, FV1_GND.	-
4	17	FVF1_M10VA	Output	PREAMP	DC power service output, derived from IDPU_P5V. Referenced to floating ground, FV1_GND.	-
5	15	BIAS1	Output	PREAMP	Sphere bias potential	2.3
6	6	USHER1	Output	PREAMP	The "usher" structure potential.	2.3
7	16	GUARD1	Output	PREAMP	The "guard" structure potential.	2.3
8	5	BRAID1	Output	SPB	Boom wire braid connection.	2.4
9	7	ACTEST1	Output	PREAMP	Test signal output.	2.5
10	10	VSPHERE2	Input	PREAMP	EFI sensor signal #2. Requires shielded conductor (coax).	2.1
11	1	INNER_SHIELD2	Input	PREAMP	Shield for signal VSPHERE2. Tied to FV2_GND on BEB.	-
12	11	FVF2_P10VA	Output	PREAMP	DC power service output, derived from IDPU_P5V. Referenced to floating ground, FV2_GND.	-
13	2	FVF2_M10VA	Output	PREAMP	DC power service output, derived from IDPU_P5V. Referenced to floating ground, FV2_GND.	-
14	4	BIAS2	Output	PREAMP	Sphere bias potential.	2.3
15	13	USHER2	Output	PREAMP	The "usher" structure potential.	2.3
16	3	GUARD2	Output	PREAMP	The "guard" structure potential.	2.3
17	14	BRAID2	Output	SPB	Boom wire braid connection.	2.4
18	12	ACTEST2	Output	PREAMP	Test signal output.	2.5
19	23, 22	AGND	Output	SPB	Analog ground. Isolated from S/C Ground. Isolated from Chassis Ground.	-

3.2.2. J501 Wire Types Required:

Coax Conductors: RG316 (2 ea); Discrete Conductors: 24 AWG (16 ea)



3.3. Boom Unit 3-4 Connector Definition:

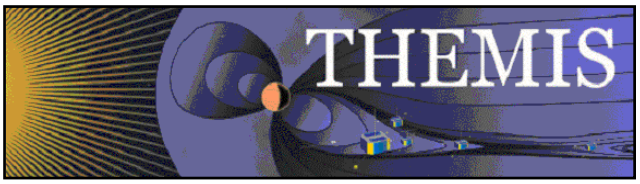
Designation: J502
Type: D-subminiature, high density, 26-pin, female, panel mount
Similar to Positronics DD26F4F0
Part number: 311P407-2S-B-12

3.3.1. J502 Boom Unit Signal Definition:

#	Pin	Signal	I/O	From/To	Description	Ref ¶
1	9	VSPHERE3	Input	PREAMP	EFI sensor signal #3. Requires shielded conductor (coax).	2.1
2	18	INNER_SHIELD3	Input	PREAMP	Shield for signal VSPHERE1. Tied to FV3_GND on BEB.	-
3	8	FVF3_P10VA	Output	PREAMP	DC power service output, derived from IDPU_P5V. Referenced to floating ground, FV3_GND.	-
4	17	FVF3_M10VA	Output	PREAMP	DC power service output, derived from IDPU_P5V. Referenced to floating ground, FV3_GND.	-
5	15	BIAS3	Output	PREAMP	Sphere bias potential	2.3
6	6	USHER3	Output	PREAMP	The "usher" structure potential.	2.3
7	16	GUARD3	Output	PREAMP	The "guard" structure potential.	2.3
8	5	BRAID3	Output	SPB	Boom wire braid connection.	2.4
9	7	ACTEST3	Output	PREAMP	Test signal output.	2.5
10	10	VSPHERE4	Input	PREAMP	EFI sensor signal #4. Requires shielded conductor (coax).	2.1
11	1	INNER_SHIELD4	Input	PREAMP	Shield for signal VSPHERE2. Tied to FV4_GND on BEB.	-
12	11	FVF4_P10VA	Output	PREAMP	DC power service output, derived from IDPU_P5V. Referenced to floating ground, FV4_GND.	-
13	2	FVF4_M10VA	Output	PREAMP	DC power service output, derived from IDPU_P5V. Referenced to floating ground, FV4_GND.	-
14	4	BIAS4	Output	PREAMP	Sphere bias potential.	2.3
15	13	USHER4	Output	PREAMP	The "usher" structure potential.	2.3
16	3	GUARD4	Output	PREAMP	The "guard" structure potential.	2.3
17	14	BRAID4	Output	SPB	Boom wire braid connection.	2.4
18	12	ACTEST4	Output	PREAMP	Test signal output.	2.5
19	23, 22	AGND	Output	SPB	Analog ground. Isolated from S/C Ground. Isolated from Chassis Ground.	-
20	19, 20	RTD	Input	PREAMP	RTD installed in preamp assembly	-

3.3.2. J502 Wire Types Required:

Coax Conductors: RG316 (2 ea); Discrete Conductors: 24 AWG (16 ea)



3.4. Boom Unit 5-6 Connector Definition:

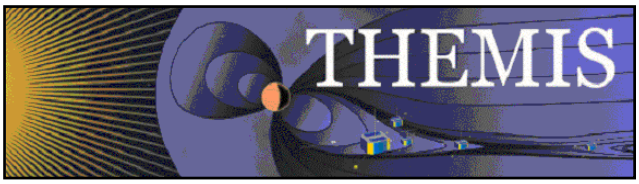
Designation: J503
Type: D-subminiature, high density, 26-pin, female, panel mount.
Similar to Positronics DD26F4F0
Part number: 311P407-2S-B-12

3.4.1. J503 Boom Unit Signal Definition:

	Pin	Signal	I/O	From/To	Description	Ref ¶
1	9	VSPHERE5	Input	PREAMP	EFI sensor signal #5. Requires shielded conductor (coax).	2.1
2	18	INNER_SHIELD5	Input	PREAMP	Shield for signal VSPHERE1. Tied to FV5_GND on BEB.	-
3	8	FVF5_P10VA	Output	PREAMP	DC power service output, derived from IDPU_P5V. Referenced to floating ground, FV5_GND.	-
4	17	FVF5_M10VA	Output	PREAMP	DC power service output, derived from IDPU_P5V. Referenced to floating ground, FV5_GND.	-
5	15	BIAS5	Output	PREAMP	Sphere bias potential	2.3
6	6	USHER5	Output	PREAMP	The "usher" structure potential.	2.3
7	16	GUARD5	Output	PREAMP	The "guard" structure potential.	2.3
8	5	BRAID5	Output	SPB	Boom wire braid connection.	2.4
9	7	ACTEST5	Output	PREAMP	Test signal output.	2.5
10	10	VSPHERE6	Input	PREAMP	EFI sensor signal #6. Requires shielded conductor (coax).	2.1
11	1	INNER_SHIELD6	Input	PREAMP	Shield for signal VSPHERE2. Tied to FV6_GND on BEB.	-
12	11	FVF6_P10VA	Output	PREAMP	DC power service output, derived from IDPU_P5V. Referenced to floating ground, FV6_GND.	-
13	2	FVF6_M10VA	Output	PREAMP	DC power service output, derived from IDPU_P5V. Referenced to floating ground, FV6_GND.	-
14	4	BIAS6	Output	PREAMP	Sphere bias potential.	2.3
15	13	USHER6	Output	PREAMP	The "usher" structure potential.	2.3
16	3	GUARD6	Output	PREAMP	The "guard" structure potential.	2.3
17	14	BRAID6	Output	SPB	Boom wire braid connection.	2.4
18	12	ACTEST6	Output	PREAMP	Test signal output.	2.5
19	23, 22	AGND	Output	SPB	Analog ground. Isolated from S/C Ground. Isolated from Chassis Ground.	-
20	25.26	RTD	Input	PREAMP	RTD installed in preamp assembly	-

3.4.2. J503 Wire Types Required:

Coax Conductors: RG316 (2 ea); Discrete Conductors: 24 AWG (16 ea)



3.5. DFB Connector Definition:

Designation: J511 – J516

Type: SMA coax receptacle, panel mount

Part number: 901-9244-2-SMA (Amphenol) M39012/60-3002

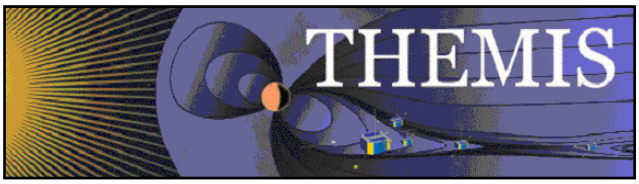
Note: SMA connectors are mounted to BEB/IDPU front panels. Jumpers (G-C1, G-C2, G-C3, G-C4) between the BEB front panel and AGND allow for the isolation or connection of AGND and chassis ground.

3.5.1. J511 – J516 DFB Interface Definition:

Conn	Signal	I/O	From/To	Description	Ref ¶
J511	V1	Output	DFB	EFI sensor signal #1, connects to VSPHERE1. Requires 24 AWG Bus wire.	2.1
J512	V2	Output	DFB	EFI sensor signal #2, connects to VSPHERE2. Requires 24 AWG Bus wire.	2.1
J513	V3	Output	DFB	EFI sensor signal #3, connects to VSPHERE3. Requires 24 AWG Bus wire.	2.1
J514	V4	Output	DFB	EFI sensor signal #4, connects to VSPHERE4. Requires 24 AWG Bus wire.	2.1
J515	V5	Output	DFB	EFI sensor signal #5, connects to VSPHERE5. Requires 24 AWG Bus wire.	2.1
J516	V6	Output	DFB	EFI sensor signal #6, connects to VSPHERE6. Requires 24 AWG Bus wire.	2.1

3.5.2. J511 – J516 Wire Type:

RG316 with SMA Coaxial plug, right angle.



3.5.2.1. Miscellaneous

Abbreviations:

BEB = Boom Electronics Board

DFB = Digital Fields Board

FSW = Flight Software

Notes

(1)
(2)
(3)
(4)
(5)
(6)