

THEMIS Boom Electronics Board (BEB) Interface with IDPU

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TBDs

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 Input 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:	\pm 60Vdc w.r.t. AGND
AC voltage level:	12 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:	\pm 60Vdc w.r.t. AGND
Output:	References floating ground supply (± 10 Vdc)



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.

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:	1 nA (12-bit DAC = = 0.65nA res. On Bias)
DAC accuracy:	Opposing booms matched to 0.1%
DAC step response:	< 25 ms (for information only)

Table 3: Bias, Usher, Guard Specification

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 10Mohm resistor. The Braid programmable voltage shall meet the specifications in Table 4.

Table A. Dusid Outs differentiate

	Table 4: Braid Specification
Outputs: (switchable)	Programmable voltage, or AGND via $10M\Omega$ resistor
Reference Input:	Preamp signal VSPHERE1, or
(switchable)	Preamp signal VSPHERE3, or
	AGND via $10M\Omega$ resistor
Ref. Input filter:	300 Hz (3dB)
Output voltage level:	Vref \pm 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:	100 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 Part number: IAW with Back plane specification

3.1.1. J500 Back Plane Signal Definition:

#	Signal	I/O	From/To	Description
1	AGND	Input	LVPS	Analog ground. Isolated from S/C Ground. Isolated from Chassis Ground (TBR).
2	EFI_P10VA	Input	LVPS	DC power service at nominal ± 10.0 V, 100 (TBD)mA maximum. Voltage regulated to within $\pm 5\%$.
3	EFI_M10VA	Input	LVPS	DC power service at nominal -10.0V, 100(TBD)mA maximum. Voltage regulated to within $\pm 5\%$.
4	EFI_P100VA	Input	LVPS	DC power service at nominal \pm 100V, 10(TBD)mA maximum. Voltage regulated to within \pm 5%.
5	EFI_M100VA	Input	LVPS	DC power service at nominal -100V, 10(TBD)mA maximum. Voltage regulated to within $\pm 5\%$.
6	EFI_DGND	Input	LVPS	Digital ground. Isolated from S/C Ground. Isolated from Chassis Ground (TBR). Isolated from Analog Ground.
7	EFI_VP5D	Input	LVPS	DC Power service at nominal +5.0V, 250(TBD)mA maximum. Voltage regulated to range of 4.8 to 5.3V. Referenced to EFI_DGND.
8	EFI_VP2.5D	Input	S/C	DC Power service at nominal +2.5V, (TBD)mA maximum. Voltage regulated to range of to V. Referenced to EFI_DGND.
9	FV1_P10VA	Input	LVPS	Floating DC power service to EFI Boom 1. Nominal rating shall be $\pm 10.0V$ at 15(TBD) mA max. Voltage regulated to within $\pm 5\%$. Referenced to floating ground FV1_GND.
10	FV1_M10VA	Input	LVPS	Floating DC power service to EFI boom 1. Nominal rating shall be -10.0V at 15(TBD) mA max. Voltage regulated to within \pm 5%. Referenced to floating ground FV1_GND.
11	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	FV2_P10VA	Input	LVPS	Floating DC power service to EFI Boom 2. Referenced to FV2_GND, same spec. as FV1_P10VA.
13	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.:

	Signal	I/O	From/To	Description
14	FV2_GND	Output	LVPS	Floating analog ground #2 (Boom 2), same spec. as FV1_GND.
15	FV3_P10VA	Input	LVPS	Floating DC power service to EFI Boom 3. Referenced to FV3_GND, same spec. as FV1_P10VA.
16	FV3_M10VA	Input	LVPS	Floating DC power service to EFI Boom 3. Referenced to FV3_GND, same spec. as FV1_M10VA.
17	FV3_GND	Output	LVPS	Floating analog ground #3 (Boom 3), same spec. as FV1_GND.
18	FV4_P10VA	Input	LVPS	Floating DC power service to EFI Boom 4. Referenced to FV4_GND, same spec. as FV1_P10VA.
19	FV4_M10VA	Input	LVPS	Floating DC power service to EFI Boom 4. Referenced to FV4_GND, same spec. as FV1_M10VA.
20	FV4_GND	Output	LVPS	Floating analog ground #4 (Boom 4), same spec. as FV1_GND.
21	FV5_P10VA	Input	LVPS	Floating DC power service to EFI Boom 5. Referenced to FV5_GND, same spec. as FV1_P10VA.
22	FV5_M10VA	Input	LVPS	Floating DC power service to EFI Boom 5. Referenced to FV5_GND, same spec. as FV1_M10VA.
23	FV5_GND	Output	LVPS	Floating analog ground #5 (Boom 5), same spec. as FV1_GND.
24	FV6_P10VA	Input	LVPS	Floating DC power service to EFI Boom 6. Referenced to FV6_GND, same spec. as FV1_P10VA.
25	FV6_M10VA	Input	LVPS	Floating DC power service to EFI Boom 6. Referenced to FV6_GND, same spec. as FV1_M10VA.
26	FV6_GND	Output	LVPS	Floating analog ground #6 (Boom 6), same spec. as FV1_GND.
27	BEB_HSKP	Output	PCB	Analog housekeeping. Multiplexed output, commanded by FSW using CDI2.5 to +2.5V range. Referenced to AGND.
28	EFI_CMD	Input	DCB	Command data interface. Referenced to EFI_DGND.
29	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, switched simultaneously
1	EFI_VP5D, EFI_VP2.5D, EFI_P10VA, EFI_M10VA, EFI_P100VA, EFI_M100VA
2	FV1_P10VA, FV1_M10VA, FV2_P10VA, FV2_M10VA
3	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, right angle Similar to Positronics DD26F4F0 Part Number: TBD

3.2.1. J501 Boom Unit Signal Definition:

	Signal	I/O	From/To	Description	Ref¶
1	VSPHERE1	Input	PREAMP	EFI sensor signal #1. Requires shielded conductor (coax).	2.1
2	INNER_SHIELD1	Input	PREAMP	Shield for signal VSPHERE1. Tied to reference on BEB.	-
3	FVF1_P10VA	Output	PREAMP	DC power service output, derived from FV1_P10VA. Referenced to floating ground, FV1_GND.	-
4	FVF1_M10VA	Output	PREAMP	DC power service output, derived from FV1_M10VA. Referenced to floating ground, FV1_GND.	-
5	BIAS1	Output	PREAMP	Sphere bias potential	2.3
6	USHER1	Output	PREAMP	The "usher" structure potential.	2.3
7	GUARD1	Output	PREAMP	The "guard" structure potential.	2.3
8	BRAID1	Output	SPB	Boom wire braid connection.	2.4
9	ACTEST1	Output	PREAMP	Test signal output.	2.5
10	VSPHERE2	Input	PREAMP	EFI sensor signal #2. Requires shielded conductor (coax).	2.1
11	INNER_SHIELD2	Input	PREAMP	Shield for signal VSPHERE2. Tied to reference on BEB.	-
12	FVF2_P10VA	Output	PREAMP	DC power service output, derived from FV2_P10VA. Referenced to floating ground, FV2_GND.	-
13	FVF2_M10VA	Output	PREAMP	DC power service output, derived from FV2_M10VA. Referenced to floating ground, FV2_GND.	-
14	BIAS2	Output	PREAMP	Sphere bias potential.	2.3
15	USHER2	Output	PREAMP	The "usher" structure potential.	2.3
16	GUARD2	Output	PREAMP	The "guard" structure potential.	2.3
17	BRAID2	Output	SPB	Boom wire braid connection.	2.4
18	ACTEST2	Output	PREAMP	Test signal output.	2.5

3.2.2. J501 Wire Types Required:

Coax Conductors: RG316 (2 ea)

Discrete Conductors: 26 AWG (14 ea)



3.3. Boom Unit 3-4 Connector Definition:

Designation: J502 Type: D-subminiature, high density, 26-pin, female, panel mount, right angle Similar to Positronics DD26F4F0 Part number: TBD

3.3.1. J502 Boom Unit Signal Definition:

	Signal	I/O	From/To	Description	Ref¶
1	VSPHERE3	Input	PREAMP	EFI sensor signal #3. Requires shielded conductor (coax).	2.1
2	INNER_SHIELD3	Input	PREAMP	Shield for signal VSPHERE1. Tied to reference on BEB.	-
3	FVF3_P10VA	Output	PREAMP	DC power service output, derived from FV1_P10VA. Referenced to floating ground, FV1_GND.	-
4	FVF3_M10VA	Output	PREAMP	DC power service output, derived from FV1_M10VA. Referenced to floating ground, FV1_GND.	-
5	BIAS3	Output	PREAMP	Sphere bias potential	2.3
6	USHER3	Output	PREAMP	The "usher" structure potential.	2.3
7	GUARD3	Output	PREAMP	The "guard" structure potential.	2.3
8	BRAID3	Output	SPB	Boom wire braid connection.	2.4
9	ACTEST3	Output	PREAMP	Test signal output.	2.5
10	VSPHERE4	Input	PREAMP	EFI sensor signal #4. Requires shielded conductor (coax).	2.1
11	INNER_SHIELD4	Input	PREAMP	Shield for signal VSPHERE2. Tied to reference on BEB.	-
12	FVF4_P10VA	Output	PREAMP	DC power service output, derived from FV2_P10VA. Referenced to floating ground, FV2_GND.	-
13	FVF4_M10VA	Output	PREAMP	DC power service output, derived from FV2_M10VA. Referenced to floating ground, FV2_GND.	-
14	BIAS4	Output	PREAMP	Sphere bias potential.	2.3
15	USHER4	Output	PREAMP	The "usher" structure potential.	2.3
16	GUARD4	Output	PREAMP	The "guard" structure potential.	2.3
17	BRAID4	Output	SPB	Boom wire braid connection.	2.4
18	ACTEST4	Output	PREAMP	Test signal output.	2.5

3.3.2. J502 Wire Types Required:

Coax Conductors: RG316 (2 ea)

Discrete Conductors: 26 AWG (14 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: TBD

3.4.1. J502 Boom Unit Signal Definition:

	Signal	I/O	From/To	Description	Ref¶
1	VSPHERE5	Input	PREAMP	EFI sensor signal #5. Requires shielded conductor (coax).	2.1
2	INNER_SHIELD5	Input	PREAMP	Shield for signal VSPHERE1. Tied to reference on BEB.	-
3	FVF5_P10VA	Output	PREAMP	DC power service output, derived from FV1_P10VA. Referenced to floating ground, FV1_GND.	-
4	FVF5_M10VA	Output	PREAMP	DC power service output, derived from FV1_M10VA. Referenced to floating ground, FV1_GND.	-
5	BIAS5	Output	PREAMP	Sphere bias potential	2.3
6	USHER5	Output	PREAMP	The "usher" structure potential.	2.3
7	GUARD5	Output	PREAMP	The "guard" structure potential.	2.3
8	BRAID5	Output	SPB	Boom wire braid connection.	2.4
9	ACTEST5	Output	PREAMP	Test signal output.	2.5
10	VSPHERE6	Input	PREAMP	EFI sensor signal #6. Requires shielded conductor (coax).	2.1
11	INNER_SHIELD6	Input	PREAMP	Shield for signal VSPHERE2. Tied to reference on BEB.	-
12	FVF6_P10VA	Output	PREAMP	DC power service output, derived from FV2_P10VA. Referenced to floating ground, FV2_GND.	-
13	FVF6_M10VA	Output	PREAMP	DC power service output, derived from FV2_M10VA. Referenced to floating ground, FV2_GND.	-
14	BIAS6	Output	PREAMP	Sphere bias potential.	2.3
15	USHER6	Output	PREAMP	The "usher" structure potential.	2.3
16	GUARD6	Output	PREAMP	The "guard" structure potential.	2.3
17	BRAID6	Output	SPB	Boom wire braid connection.	2.4
18	ACTEST6	Output	PREAMP	Test signal output.	2.5

3.4.2. J502 Wire Types Required:

Coax Conductors: RG316 (2 ea)

Discrete Conductors: 26 AWG (14 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

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 shielded conductor (coax).	2.1
J512	V2	Output	DFB	EFI sensor signal #2, connects to VSPHERE2. Requires shielded conductor (coax).	2.1
J513	V3	Output	DFB	EFI sensor signal #3, connects to VSPHERE3. Requires shielded conductor (coax).	2.1
J514	V4	Output	DFB	EFI sensor signal #4, connects to VSPHERE4. Requires shielded conductor (coax).	2.1
J515	V5	Output	DFB	EFI sensor signal #5, connects to VSPHERE5. Requires shielded conductor (coax).	2.1
J516	V6	Output	DFB	EFI sensor signal #6, connects to VSPHERE6. Requires shielded conductor (coax).	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)