

DUNE SiPM Signal Processor(SSP)

ECO/FCO Verification & initial checkout procedure

Version 0.1 draft 1 Last Revision 20170412 JTA

Module Serial Number: _____ Testing Date: _____ By: _____

Scope of Procedure

Predecessor : Specification Document: Quality Assurance and Control for the ProtoDUNE-SP Photon Detector Readout Electronics.

Successor Procedure : DUNE SSP POST-ASSEMBLY Manual Test Procedure.

The sequence of tests described herein is to be performed on any newly manufactured SSP module. Modules with no repair issue sent to ANL solely for firmware upgrade are not subject to re-testing at this level and may proceed directly to the POST-ASSEMBLY Manual Test procedure.

In every step of this procedure, if a measurement FAILS, immediately stop testing, de-power all circuits, and alert supervising engineer.

Initial Checkout after Assembly

The module is assumed to be outside its box, with the external DC power and bias power cords removed. The board shall be in a completely **unpowered** condition. The bottom power supply shield should be mounted to the board but the top power supply shield should be removed.

- ___ PASS ___ FAIL 1. Verify that the PCB assembly is complete.
- ___ DONE a. Verify that the main board's serial number has been marked in the space below the Argonne logo on the component side of the PC board. Record at the top of this sheet.
- ___ DONE b. Verify that the bottom EMI shield has been mounted to the circuit board by 12 screws at 1/8th inch spacing from the board, all screws binding to standoffs on the component side of the board.
- ___ DONE c. Verify that ***none*** of the resistors associated with any chassis mount standoff position are installed. See Figure 1.

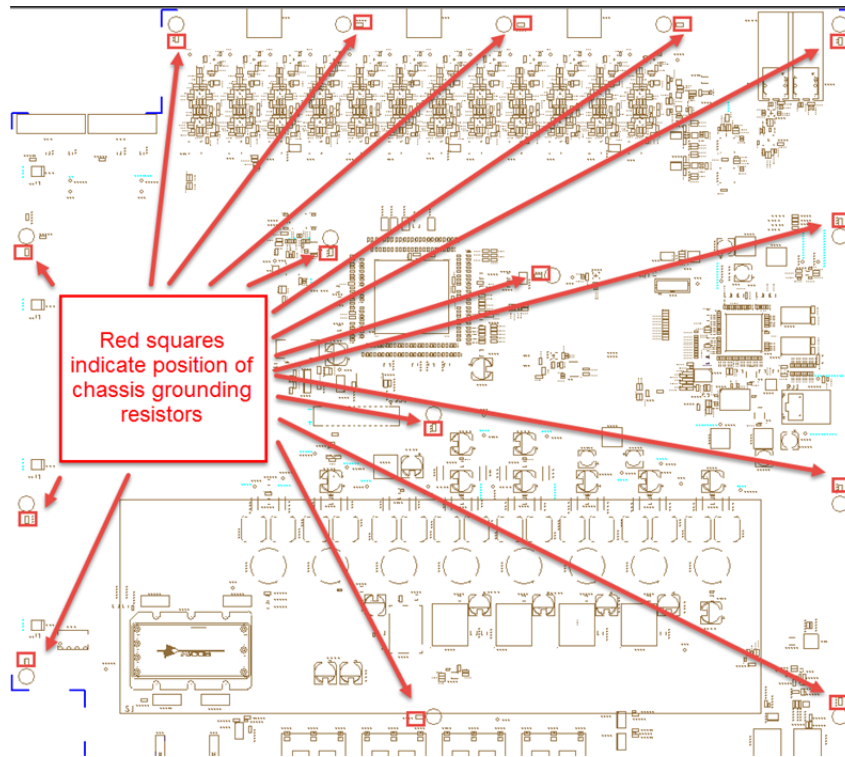


Figure 1 - positions of chassis grounding resistors adjacent to standoffs

___ DONE d. Verify the heat sinks have been installed on U9, UZ1, and the -V_A linear regulator U158. See Figure 2.

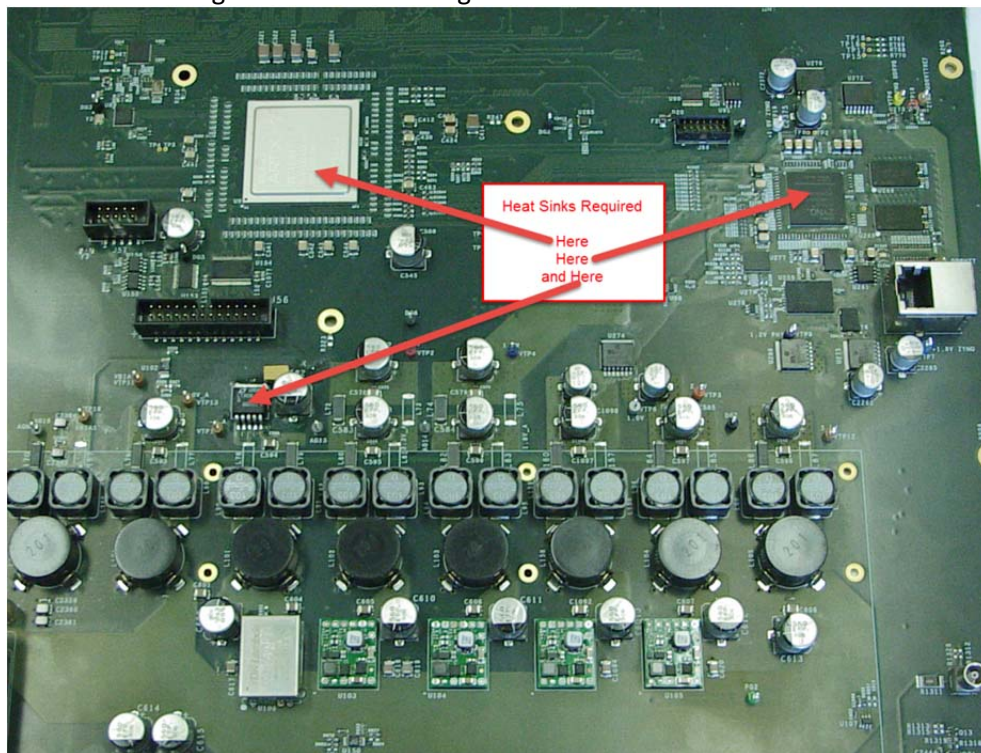


Figure 2 - locations of required heat sinks

- ___ DONE e. Verify that components **L167, L77, L78, L81, L73, L83, L75, L157, L85 and L87** are all ***not installed***. This ensures that all power supplies are disconnected. See Figure 3.

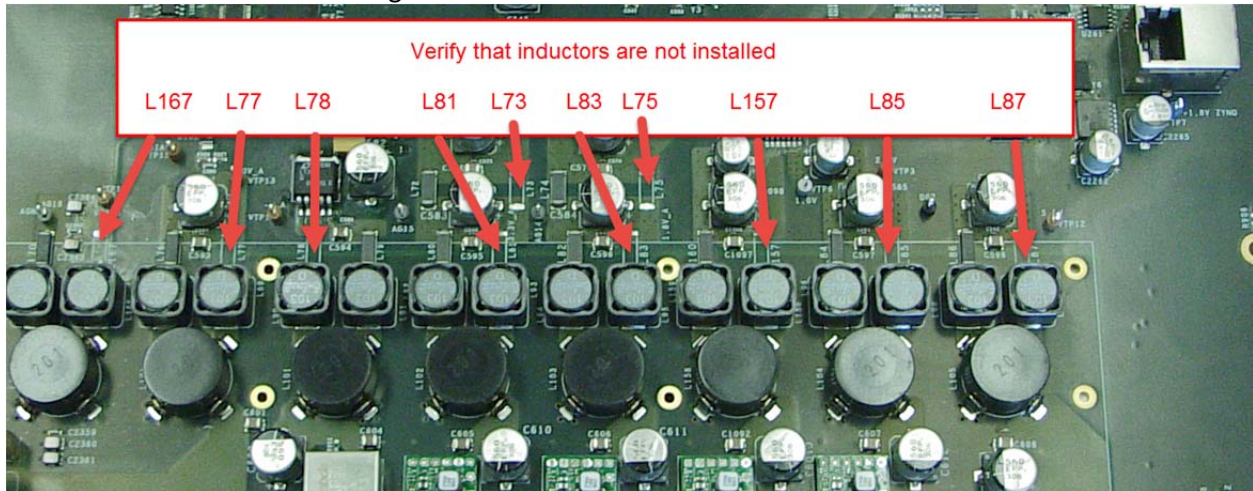


Figure 3 - Inductor components that should NOT be installed prior to initial testing.

- ___ DONE f. Verify that all **ASSEMBLY ERROR** notices have been addressed on the board. Assembly Error notices are found at

https://svn.inside.anl.gov/repos/hep_elecdesign/ProtoDune_SSP/Documentation/PC17001_Assembly_Errors

- ___ DONE g. Verify that all **ENGINEERING CHANGE ORDER** notices have been addressed on the board. Engineering Change Order notices are found at

https://svn.inside.anl.gov/repos/hep_elecdesign/ProtoDune_SSP/Documentation/PC17001_Engineering_Change_Orders

- ___ DONE h. Verify that all **FABRICATION CHANGE ORDER** notices have been addressed on the board. Fabrication Change Order notices are found at

https://svn.inside.anl.gov/repos/hep_elecdesign/ProtoDune_SSP/Documentation/PC17001_Fabrication_Change_Orders

- ___ PASS ___ FAIL 2. Verify correct isolation of different power supply test points relative to their respective ground on an **unpowered** board. Measure across the points specified in the table below. All DGx (DGND) test points have **black** rings. All AGx (AGND) test points have **gray** rings. All PGx (PWRGND) test points have **green** rings. The power supply test points are all various colors. Wait 10 seconds or until the meter reading stabilizes before recording the measurement. The pass criteria based on measurements using a Fluke 8842A.

Power Supply	Meter Scale	Black Lead	Red Lead	Criteria to pass	Measured value
BULK INPUT	20 Meg	PG3	VTP10 (brown)	Open	
BIAS INPUT	20 Meg	PG4	VTP11 (brown)	Open	
+5V pre-filter	2k ohms	PWRGND	VTP14 (brown)	Greater than 700 ohms Less than 1K ohms	
VBIAS	2M ohms	AGND	VTP16 (brown)	Greater than 100K ohm	
+5.0V_A	2k ohms	AGND	VTP13 (brown)	Greater than 700 ohms Less than 1K ohms	
-V_A	2k ohms	AGND	VTP1 (brown)	Greater than 600 ohms Less than 1K ohms	
-V_A (bulk)	2k ohms	AGND	Tab of U274	Greater than 900 ohms Less than 1.4K ohms	
+3.3V	2k ohms	DGND	VTP2 (red)	Greater than 400 ohms Less than 700 ohms	
+1.8V	2k ohms	DGND	VTP4 (blue)	Greater than 400 ohms Less than 700 ohms	
+3.3V_A	2k ohms	AGND	Pad of L81 or L73	Greater than 600 ohms Less than 1K ohms	
+1.8V_A	2k ohms	AGND	Pad of L83 or L75	Greater than 400 ohms Less than 700 ohms	
+1.0V	2k ohms	DGND	VTP6 (white)	Greater than 50 ohms Less than 200 ohms	
+2.5V	2k ohms	DGND	VTP3 (orange)	Greater than 400 ohms Less than 700 ohms	
+5.0V	2k ohms	DGND	VTP12 (brown)	Greater than 500 ohms Less than 1K ohms	
1.2V PHY	2k ohms	DGND	VTP9 (purple)	Greater than 400 ohms Less than 700 ohms	
1.8V ZYNQ	2k ohms	DGND	VTP7 (blue)	Greater than 400 ohms Less than 700 ohms	
DDRVT	2k ohms	DGND	VTP17 (brown)	Greater than 300 ohms Less than 500 ohms	
ZYNQ DDRVTREF	2k ohms	DGND	VTP18 (brown)	Greater than 350 ohms Less than 550 ohms	
ZYNQ DDRVQ	2k ohms	DGND	VTP8 (yellow)	Greater than 250 ohms Less than 450 ohms	

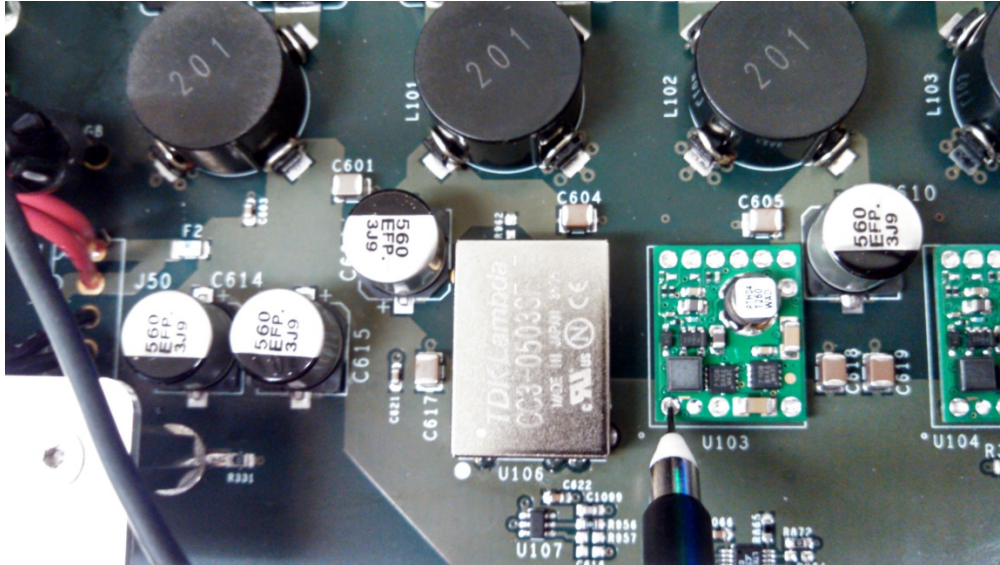
Confirmation of Section Completion

Module Serial Number: _____ **Testing Date:** _____ **By:** _____

Verification of Isolated Power Supply Operation

PASS FAIL 3. Check the total current draw and voltages of the incompletely assembled SSP (inductors still unfilled). Attach the SSP to a bench power supply set to deliver 20.0V at a maximum current of 1.0A. Using front panel switch turn SSP on.

- DONE a. Verify that all four fans are running.
- DONE b. Measure the switching frequency of U103 using an oscilloscope. Probe the lower left pin of the supply to obtain this measurement. Use PWRGND for the probe ground.



➔ Switching Frequency: _____ (Pass Range: 295kHz to 305kHz)

DONE c. Measure the total current flowing from the 20V power supply and record into table below.

Power Supply	Criteria to pass	Measured value
Total Current	Greater than 0.3A	.
	Less than 0.8A	

DONE d. Measure the voltages generated by the internal supplies of the SSP and record into table below. Each voltage measurement is made with the red lead of the voltmeter touching the lower pad (that is, pad closest to round coil) of the un-installed inductors shown in Figure 3.

Power Supply	Black Lead	Red Lead	Criteria to pass	Measured value
Output of main DC-DC converter	PWRGND	VTP14 (brown)	Greater than 5.00V	.
			Less than 5.15V	
+5.0V_A	AGND	L77 pad	Greater than 5.05V Less than 5.15V	.
-V_A regulator	AGND	L78 pad	Greater than 3.25V	

input			Less than	3.35V	.
+3.3V	AGND	L81 pad	Greater than	3.25V	
			Less than	3.35V	.
+1.8V	AGND	L83 pad	Greater than	1.75V	
			Less than	1.90V	.
+1.0V regulator input	DGND	L157 pad	Greater than	1.35V	
			Less than	1.45V	.
+2.5V	DGND	L85 pad	Greater than	2.45V	
			Less than	2.55V	.
+5.0V	DGND	L87 pad	Greater than	5.00V	
			Less than	5.15V	.

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Connection of Power Supply Inductors

Upon successful completion of the previous sections the inductors that isolate the power supplies from the rest of the circuit board may be installed. Disconnect the board from all power sources prior to installing components. Refer to Figure 3 for positions of components.

- DONE A. Install L167.
- DONE B. Install L77.
- DONE C. Install L78.
- DONE D. Install L81.
- DONE E. Install L73.
- DONE F. Install L83.
- DONE G. Install L75.
- DONE H. Install L157.
- DONE I. Install L85.
- DONE J. Install L87.

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Verification of Fully Assembled Board Power Supply Operation

Reconnect the SSP module to the bench power supply. Set the bench power supply to 20V with a current limit of 1 Amp. Turn on power supply and turn SSP on.

___ PASS ___ FAIL 4. Check the total current draw of the fully assembled SSP (inductors installed).

___ DONE a. Measure the total current flowing from the 20V power supply and record into table below.

Power Supply	Criteria to pass	Measured value
Total Current	Greater than 0.8A	.
	Less than 1.2A	

___ PASS ___ FAIL 5. Measure the voltages generated by the internal supplies of the SSP.

___ DONE a. Record measured voltages into table below. Each voltage measurement is made with the red lead of the voltmeter connected to one of the color-coded voltage test points and the black lead of the voltmeter connected to one of the green (PWRGND), black (DGND) or gray (AGND) ground points.

Power Supply	Black Lead	Red Lead	Criteria to pass	Measured value
main DC-DC converter	PWRGND	VTP14 (brown)	Greater than 5.00V	.
			Less than 5.15V	
+5.0V_A	AGND	VTP13 (brown)	Greater than 5.05V	.
			Less than 5.15V	
-V_A	AGND	VTP1 (brown)	Greater than 3.25V	.
			Less than 3.35V	
+3.3V	AGND	VTP2 (red)	Greater than 3.25V	.
			Less than 3.35V	
+1.8V	AGND	VTP4 (blue)	Greater than 1.75V	.
			Less than 1.90V	
+1.0V	DGND	VTP6 (white)	Greater than 0.98V	.
			Less than 1.03V	
+2.5V	DGND	VTP3 (orange)	Greater than 2.45V	.
			Less than 2.55V	
+5.0V	DGND	VTP12 (brown)	Greater than 5.00V	.
			Less than 5.15V	
1.2V PHY	DGND	VTP9 (purple)	Greater than 1.1V	.
			Less than 1.3V	
1.8V ZYNQ	DGND	VTP7 (blue)	Greater than 1.75V	.
			Less than 1.85V	
DDRVTT	DGND	VTP17 (brown)	Greater than 0.62V	.
			Less than 0.65V	
ZYNQ DDRVTTREF	DGND	VTP18 (brown)	Greater than 0.62V	.
			Less than 0.65V	
ZYNQ DDRVQ	DGND	VTP8 (yellow)	Greater than 1.32V	.
			Less than 1.36V	

___ PASS ___ FAIL 6. Check bias voltage input.

- ___ DONE a. Set up second power supply to deliver 1.0V at a maximum current of 0.25A.
- ___ DONE b. Connect + output of second power supply to BIAS V+ (VTP11, brown).
- ___ DONE c. Connect – output of second power supply to PWRGND at test point PG4 (adjacent to VTP11).
- ___ DONE d. Enable second power supply and measure voltages. Record into table below.

Power Supply	Black Lead	Red Lead	Criteria to pass	Measured value
VBIAS regulator input	AGND	VTP16 (brown)	Greater than 0.95V Less than 1.05V	.
VBIAS regulator output	AGND	VTP15 (brown)	Greater than 0V Less than 50mV	.

Confirmation of Section Completion

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