Specifications for Electronic Assembly

SiPM (Silicon Photo-Multiplier) Signal Processor (SSP) Design #PC17001A

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Document Revision 1.1

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1. GENERAL INFORMATION

The SiPM Signal Processor, or SSP, is a 12-channel waveform sampling module with digital signal processing firmware, timing/trigger interfaces and Ethernet port mounted in a 1U high standard rack-mount box. Two prototypes of the SSP, design #PC17001, have been manufactured by Argonne National Lab for use at the ProtoDUNE setup at CERN. The Deep Underground Neutrino Experiment (DUNE), a collaboration between Argonne, Fermilab, CERN and many university groups, has requested an additional number of modules after testing the prototypes. Figure 1 shows a fully assembled PC17001 SSP module in rear, top and front views.

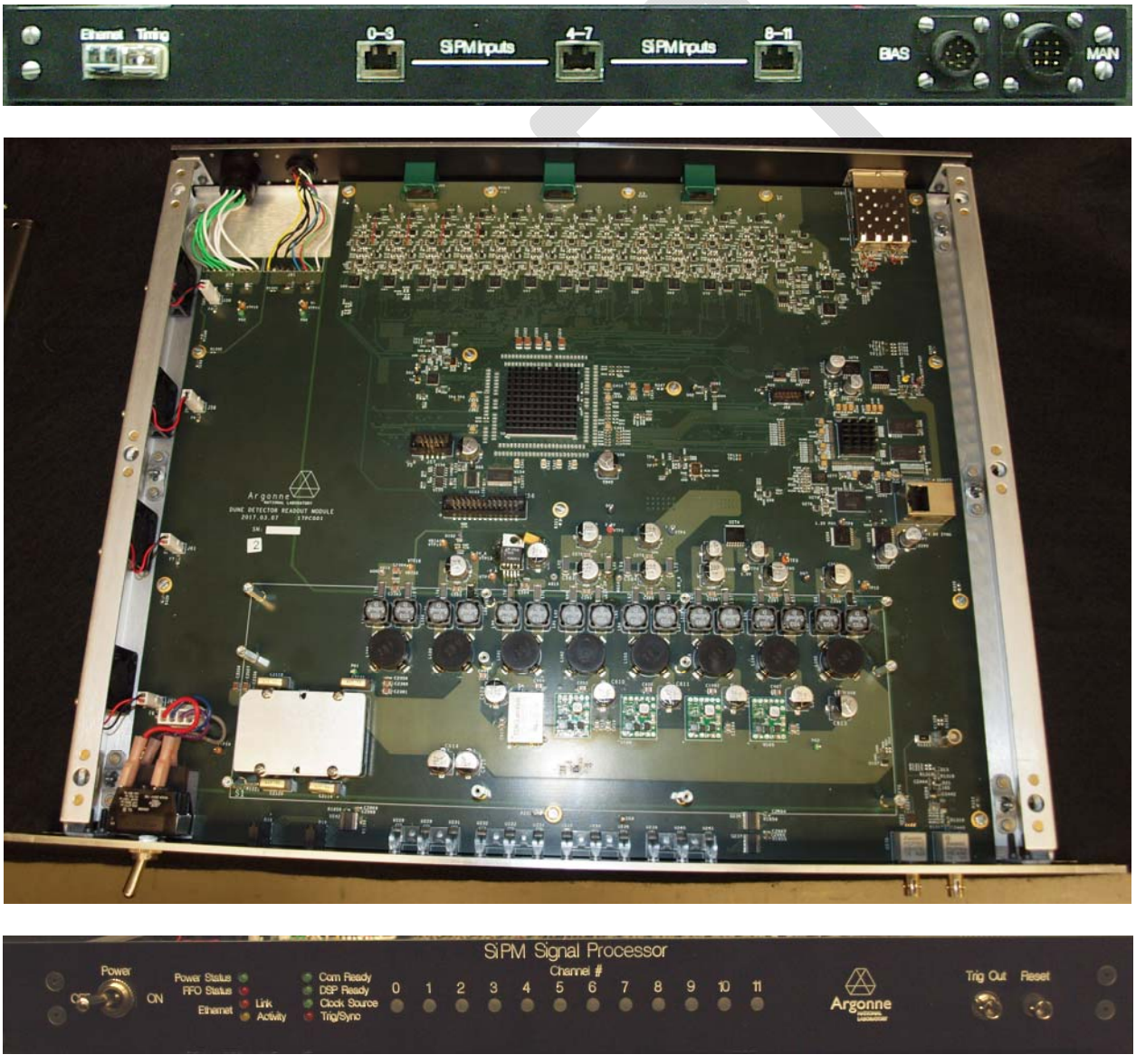

Figure 1 : Fully assembled prototype SSP

The Revision A version of the the SSP has the same overall architecture as the prototypes, with a few small changes to parts values and trace connectivity. For instance, the panel-mounted power switch of the prototype is replaced by a PC-mount switch in the PC17001A.

1.1.1 Supplementary information provided with this document

Gerber files for the Revision A board, plus the Bill of Materials for the Revision A board, are provided as supplementary information.

1.1 Schedule requirements

Delivery of all fully assembled modules to Argonne National Laboratory within 6 business days (5 for assembly process, one for shipping) after receipt of all bare PCB boards, parts kit and documentation is required.

1.2 Requested Response from Vendor

A labor-only quotation for the assembly of five modules in accordance with the specifications of this document is requested. Argonne National Laboratory shall provide all parts and bare printed circuit boards.

1.3 Oveview of Assembly

Standard IR reflow assembly of the surface mount parts followed by assembly of the through-hole & press-fit components is required, followed by cleaning of the board. All parts and bare PC boards will be supplied by Argonne.

The board utilizes surface mount components on both sides, plus both through-hole and press-fit components that are loaded from the component, or top, side. Full (100%) post-assembly automated optical inspection and full (100%) X-ray inspection of all ball-grid and thermal-pad components is required.

2. ASSEMBLY SPECIFICATIONS

2.1 General Specifications – boards and parts

Board dimensions	17” x 12” x 0.063” (approximate)
# of layers	12 with multiple internal solid planes
Build quantity	5 boards
Technology	Majority SMT and some thru-hole. IR reflow soldering.
Ball grids?	Yes
SMT both sides?	Yes
Power pad parts?	Yes
SMT pitch	Smallest passive is 0402; 0.025” gull-wing ICs; ball grid pitch as low as 0.75mm.
Component baking?	Yes. Bake all ball-grid parts prior to assembly.
Post-baking storage	Dry air or nitrogen, less than 15% relative humidity.
Part packaging	All components supplied by customer, in reels wherever possible.
Thru-hole parts	Connectors, headers, power switch.
Thru-hole both sides?	No. All thru-hole parts applied from top side of board.
Press-fit parts?	Only non-electrical (light pipes)
Hole masking?	Not required.
ROHS compliance	A lead-free build is presumed, but not absolutely required.
Solder/flux chemisty requirements	A lead-free process is presumed, and all parts are, where possible, lead-free. Only flux of type ROL0 or ROL1, as defined in ANSI/J-STD-004B, may be used Boards shall be fully cleaned consistent with ANSI/J-STD-001F, Section 8.3.6.1, Class C-21, prior to delivery. Conformance to IPC-TM-650, section 2.3.27.1, is required. See section 2.5 of this document, below, for further requirements.
Inspection method	All boards to be 100% automated optical inspected for component value and orientation, proper solder joints, lack of shorts or solder bridges, flux residue and other imperfections. 100% X-ray inspection of all ball-grid and thermal-pad parts required, with delivery of all X-ray test results to Argonne with the assembled products required.
Allowable warp/weft	Finished assemblies shall exhibit warp and weft of no greater than allowed for a Class 2 assembly as defined in ANSI/J-STD-001D and IPC-A-610E.
Return of unused components	All unused components to be returned to Argonne National Laboratory with the completed assembly.

2.2 Applicable Standards

This board is a **Class 2 Assembly**, as per ANSI/J-STD-001D, IPC-A-610E and ANSI/J-STD004B. These standards shall serve as the basis for evaluating the quality of the assembly.

2.3 Allowed Exemptions from Standards

None.

2.4 Additional Assembly Notes

The parts kit contains plastic light pipes that are not soldered, but are mechanically assembled on top of surface mount LEDs after the LEDs have been soldered to the board. These light pipes press into holes provided for them.

The assembly documentation specifies the installation and mounting of magnetic shields into the chassis to reduce radiated noise. For the prototype only, these shields shall be manufactured and installed by Argonne staff.

Power for the module is provided through two plastic chassis-mount power connectors. Assembly of the internal wire harnesses between the chassis-mount power connectors and the PC board shall be performed by Argonne staff. The plastic chassis-mount power connectors shall not be supplied as part of the parts kit.

2.5 Assembly requirements in excess of standards

The PC17001A design implements charge amplification electronics that are extremely sensitive to leakage currents caused by any flux residue left upon the board after assembly. We therefore request that the boards be cleaned with a chemical process (e.g. Novec from 3M or Axarel 2200 from Vantage Specialties), not just plain water, to ensure maximum removal of any post-assembly residues.

3. COMPONENT PROCUREMENT AND REQUIRED VENDOR SERVICES

3.1 Items to be provided by Argonne

A. The bare printed circuit board(s).
B. All components required are provided. The components are packaged in tape-and-reel wherever possible, with a few components in tubes and trays. The connectors are packaged in bulk or in tubes.
C. Gerber photoplot files, to aid in the generation of solder paste screens.
D. BOM in Excel format.
E. XY placement coordinates for parts placement are available.

3.2 Items and services to be provided by the vendor

A. All stencils, screens, tooling fixtures, pick-and-place programming, etc. needed for assembly.
B. Assembly of the indicated quantity of boards.
C. Removal of all solder flux residues, and any other residues from the assembly process, in accordance with standards plus any more restrictive requirements as imposed by this document.
D. Soldering of the solderable connectors onto the boards, and press-fit insertion of press-fit components, including both connectors and light pipes. The vendor is responsible for procuring all specific press-fit tooling as specified by the manufacturer of the components.
E. Automated optical inspection of the assembled boards and rework of any components failing visual inspection.
F. X-ray inspection of all ball-grid and thermal-pad component soldering and rework of any such components with opens or shorts followed by re-inspection, plus full documentation of X-ray inspection results.
G. Electrical testing post-assembly of the boards is not required. The bare circuit boards were electically tested by the PC board vendor and functional testing will occur at Argonne.
H. Electrostatic bags for shipping completed boards.
I. Packaging of all completed boards into individual boxes/bags with sufficient material (e.g. bubble-wrap, packing peanuts, etc.) to provide protection against incidental damage during shipment. All boards are to be individually protected and no edge or surface of the board shall be allowed to directly contact the surface of the box used to ship any group of boards.
J. Delivery of the boards to Argonne. Vendor must provide appropriate packaging to ensure safe delivery, and shall provide tracking numbers to Argonne immediately upon consignment of material to the carrier. ***The cost of shipment shall be included in the offers.*** Shipment via UPS Ground or FEDEX Ground is adequate.

4. TECHNICAL CONTACT LIST

Contact via e-mail or telephone is preferred; the fax machine is in a remote location and only checked when something is expected.

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