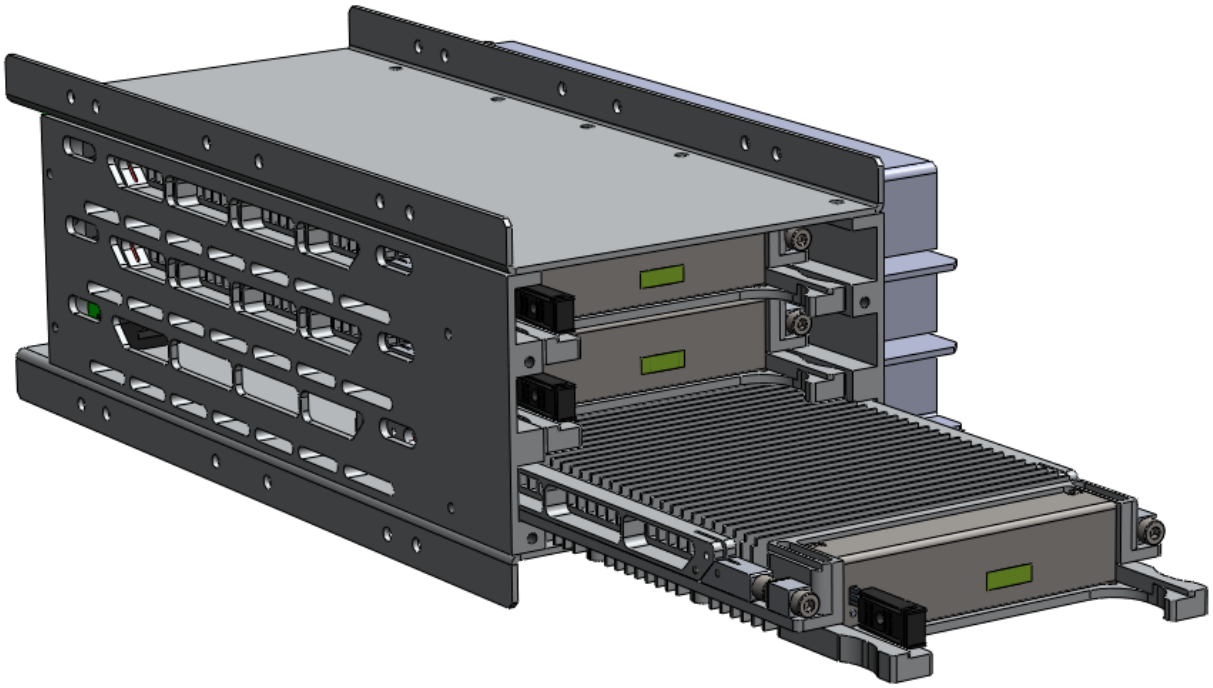
Hybrid Air/Conduction Cooled MicroTCA.2
Thermal Testing
Test Plan

Revision 1.1
November 07, 2011



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Revision History

Revision	Changes	Date
0.91	Release Candidate	9/09/11
1.0	Initial Release	9/13/11
1.1	Added 25W and 8W load tests	11/7/11

SCOPE

This test plan is intended to determine the thermal characteristics of representative MicroTCA.2 modules constructed following the mechanical design concepts shown in figures 1a and 1b of the draft specification. These thermal characteristics will be defined by measuring both air flow resistance and resulting temperature gradients of one or more powered Thermal Load Modules (TLM).

Goal

The goal of this test plan is to outline the testing sequences to be followed to determine the cooling capability of the Module concept proposed for adoption for the Hybrid MicroTCA.2 PICMG specification by empirically testing for the data values needed for tables 1 & 2. The TLM will be designed utilizing an AMC Single Module, Mid-Size thermal load Module inside of a MicroTCA.2 clam shell which incorporates cooling fins. See appendix A for the TLM design characteristics. Testing will be conducted using both low and high power output test Modules in an air-flow controlled test chamber. The intent is to conduct testing at room ambient temperature and at standard air defined in this plan.

Note: Analyses will be used to calculate the values which will be representative of the other AMC Single Module and Double Module variations, including altitude effects for each of the Module types.

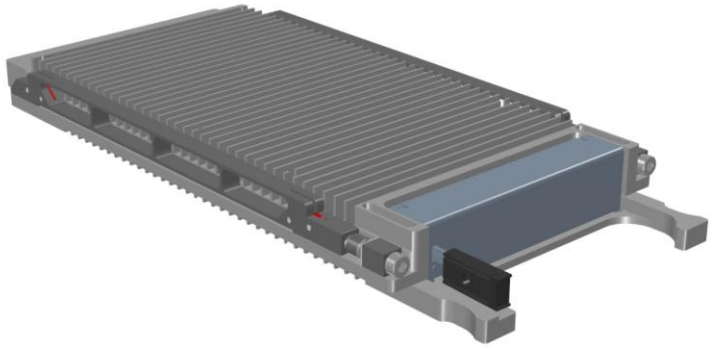


Figure 1a, High Power MicroTCA.2 Module

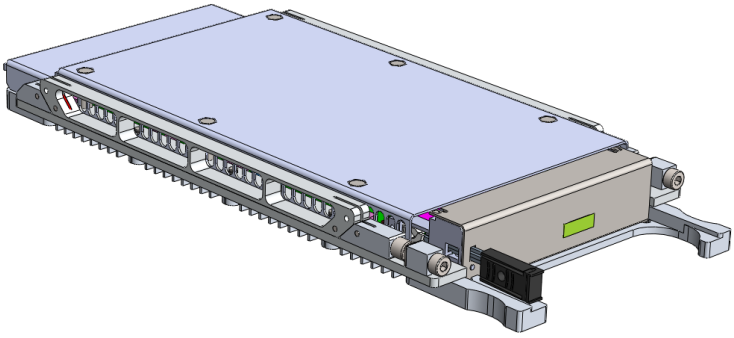


Figure 1b, Low Power MicroTCA.2 Module

APPLICABLE DOCUMENTS

Unless otherwise specified, the following documents of issue in effect at the time of testing form a part of this report to the extent as specified herein. The requirements of sub-tier specifications and/or standards apply only when specifically referenced in this test plan.

Test Specifications:

The following specifications used in this test plan are from direct or derived requirements to support the testing and generation of the MicroTCA.2 specification. Also see appendix D for thermal references:

- VITA 47, latest revision
- MicroTCA.1 R1.0

TEST SAMPLES AND PREPARATION

The following test samples for module testing shall be utilized:

Module Testing:

- Qty 4 (3 + 1 spare) MicroTCA.2 Single Module, Mid-size High Power Thermal Load Modules (HP-TLM) compliant with AMC.0 Revision 2:
    - See Appendix A to this Test Plan for the definition of the board characteristics required for module testing.
- Qty 1 MicroTCA.2 AMC Characterization Module (MACM)
    - Blank AMC air baffle module (Single Module, Mid-size) inside a low power MicroTCA.2 clam shell

Test Chassis:

- Qty 1, 3 slot thermal test chassis with thermally conductive side walls and 3 slot backplane
- Qty 1, 3 slot thermal test chassis with thermally non-conductive side walls and 3 slot backplane

  Note: 3 slot backplane to support MicroTCA.0 physical requirements for 3 single, mid-size AMCs, +12VDC payload and +3.3VDC management power, no fabric or IPMI support, see appendix B for Backplane details.

The test samples shall be certified by the manufacturer as being fabricated and assembled utilizing normal production techniques common for this type of product and inspected in accordance with the quality criteria as established for the product involved.

All test sample modules shall be coded and identified by the test sponsor to maintain continuity throughout the test sequences.

Test Location & Schedule

Tests to be performed November 8 -11, 2011 at the test facility below:

Degree Controls, Inc.
18 Meadowbrook Drive
Milford, NH 03055
USA
Tel: (603) 672-8900 or (877) 334-7332

Thermal Test and Analysis Data (Tests to be run at 50W, 25W &b 8W)

Analysis to be performed to fill in data for table 1 and 2

Table 1 Low Power MicroTCA.2 Module

Module Type	Module Heat Dissipation (W)	Pressure Drop (Inch/H2O)	Reference Impedance (EFI)	Airflow (CFM)	Temp. Rise (°C)	Module Inlet Air
SM/CS	<=5					Standard Air (SL)
SM/MS	5 - 10					
DM/CS	10 - 15					
DM/MS	15 - 20					

Table 2 High Power MicroTCA.2 Module

Module Type	Module Heat Dissipation (W)	Pressure Drop (Inch/H2O)	Reference Impedance (EFI)	Airflow (CFM)	Temp. Rise (°C)	Module Inlet Air
SM/MS	20 - 35					Standard Air (SL)
SM/FS	35 - 50					
DM/MS	50 -70					
DM/FS	70 - 80					

SM = Single Module
DM = Double Module
CS = Compact-Size
MS = Mid-Size
FS = Full-Size
EFI = English Flow Impedance
SL = Sea Level

TEST SELECTION

All tests shall be performed in accordance with the applicable sequences and procedures as defined below.

TEST SEQUENCES

Figure 2 MicroTCA.2 Module Test Flow shows the test sequences for the module assemblies that are to be tested. This sequence of testing is for thermal testing to show compliance of the module to the thermal requirements stated within this document.

Characterization Test Setup

1. MicroTCA.2 AMC Characterization Module (MACM) will be used for maximum airflow and minimum impedance testing. Design details to be recorded.

> These Modules have Side 1 and Side 2 Covers but no external fins and no components on the PCB other than the Hot swap Switch and LED holder .

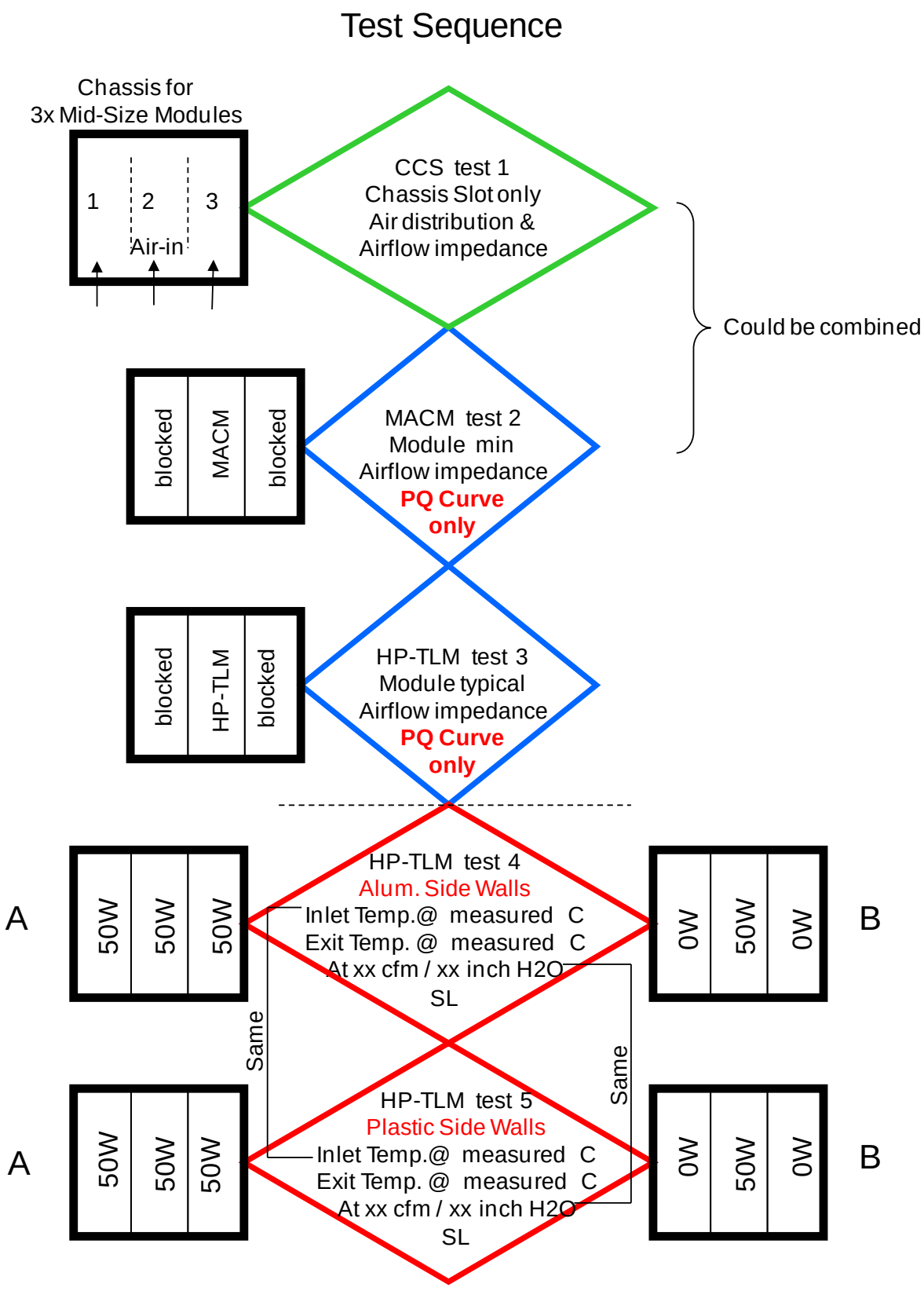
2. High Power Thermal Load Module (HP-TLM) will be used for minimum airflow and typical impedance (50W). Design details to be recorded.

> These Modules have Side 1 and Side 2 Covers with external fins and components on the PCB (Schroff Load Board).

3. Chassis Characterization Setup (CCS) to be attached to the wind tunnel.

- Wind tunnel type AMCA-210, see appendix C, figure C1
- Wind tunnel performance range
- Wind tunnel attachment concept/detail, see appendix C, figure C2 & C3
- Two types of dimensionally identical chassis's to be built
  - Type a: Alum. Side Walls
  - Type b: Plastic Side Walls
- Air leakage containment

Note: The same chassis is used for all tests (except for Test 5)



Repeat test 4 and 5 at 25W and 8W

Figure 2, MicroTCA.2 module Test Flow

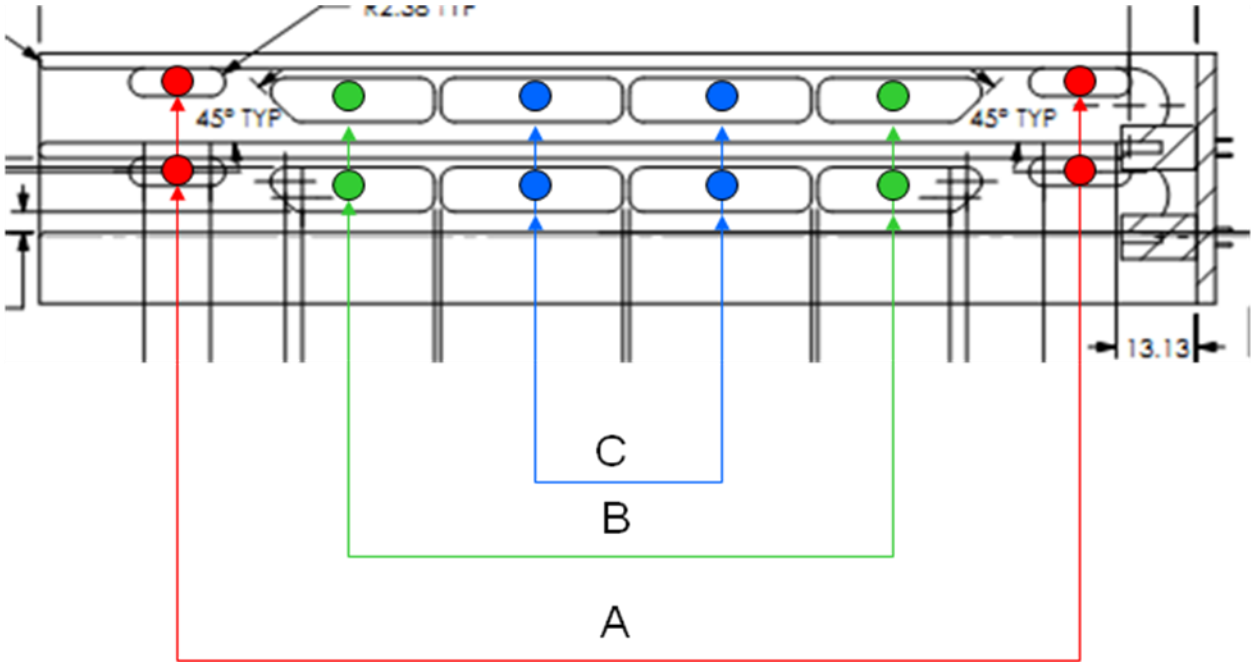
Test Goals

Test 1: **Calibrating the Chassis**

Balancing / Measuring the airflow distribution of the test Chassis:

Measurement is at Chassis internal air-in only

- Side to Side equal airflow in all three slots
- Front to Back equal airflow in all three slots
- All A size openings have equal airflow
- All B size openings have equal airflow
- All C size openings have equal airflow
- Record details



Test 2: Airflow impedance measurements - low impedance

- Measuring the MACM (un-powered) min airflow impedance
- PQ-curve to be established
- The MACM is to be placed into slot 2
- Slot 1 and 3 are solid blocked
- Record details

Test 3: Airflow impedance measurements - high impedance

- Measuring the HP-TLM (un-powered) typical airflow impedance
- PQ-Curve to be established
- The HP-TLM is to be placed into slot 2
- Slot 1 and 3 are solid blocked
- Record details

Test 4: Temperature measurements - aided by conduction cooling
(Metal side walls)

- Test 4a
  - Based on 3 - HP-TLM 50W Modules under power
  - Air intake temp. and air exit temp (ΔT) to be recorded

- Test 4b
  - Based on 1 - HP-TLM 50W Module under power
  - flanked both sides by one HP-TLM 0W Module
  - Air intake temp. and air exit temp (ΔT) to be recorded

Test 5: Temperature measurements - not aided by conduction cooling
(Plastic side walls)

- Test 5a
  - Based on 3 - HP-TLM 50W Modules under power
  - Air intake temp. and air exit temp (ΔT) to be recorded

- Test 5b
  - Based on 1x HP-TLM 50W Module under power
  - flanked both sides by one HP-TLM 0W Module
  - Air intake temp. and air exit temp (ΔT) is recorded

Tests 4 and 5 to be repeated at 25W and 8W

Summary of tests and analysis to be accomplished:

1. Test 2: Establish the PQ-curve based on min airflow impedance
2. Test 3: Establish the PQ-curve based on a typical airflow impedance
3. Test 4: Comparing the Temp rise between Test 4a and Test 4b @ 50W
4. Test 5: Comparing the Temp rise between Test 5a and Test 5b @ 50W
5. Comparing the Temp rise between Test 4a and Test 5a @ 50W
6. Comparing the Temp rise between Test 4b and Test 5b @ 50W
7. Repeat steps 3 thru 6 for 25W and 8W

Test Data

All test data is to be recorded in an engineering notebook, with the following info:

- Date, test location, tester names
- Test equipment used, with S/N and calibration dates as appropriate
- All data with relative temperatures, humidity, air flows and … etc.
- Pictures of all setups to be taken and recoded in electronic form with references to them in the notebook.
- All thermal couple recordings to be retained as part of the test data

Appendix A: Thermal load Module (TLM) & wind tunnel (Module profiler) Requirements

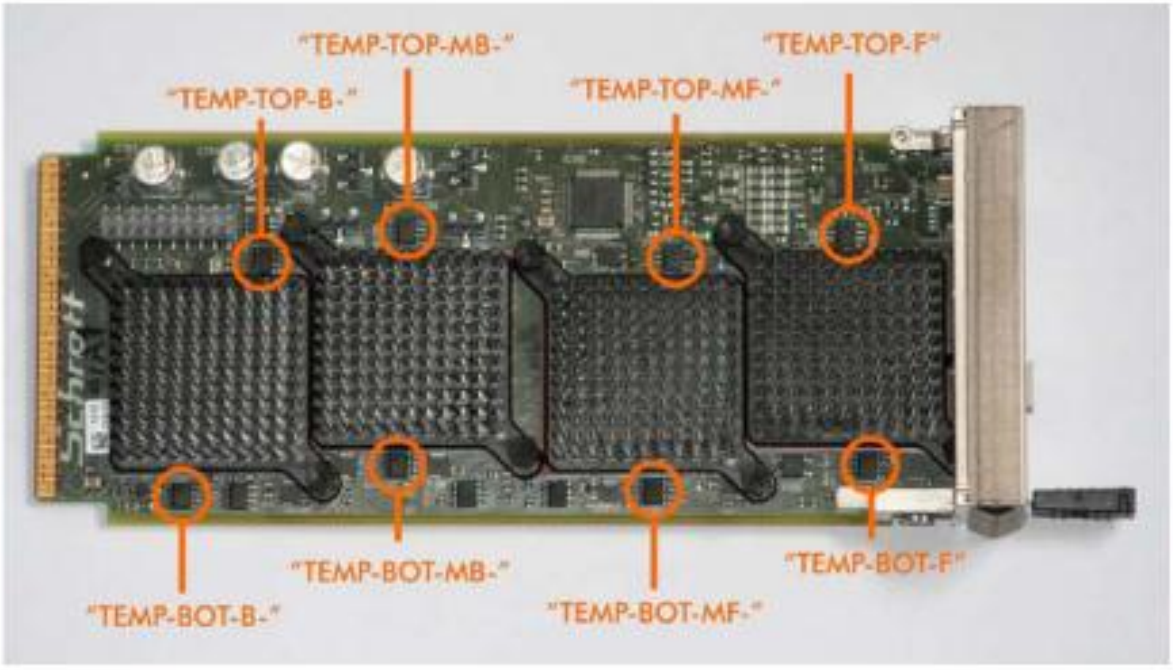


Figure A1, Schroff Thermal Load AMC Component side View

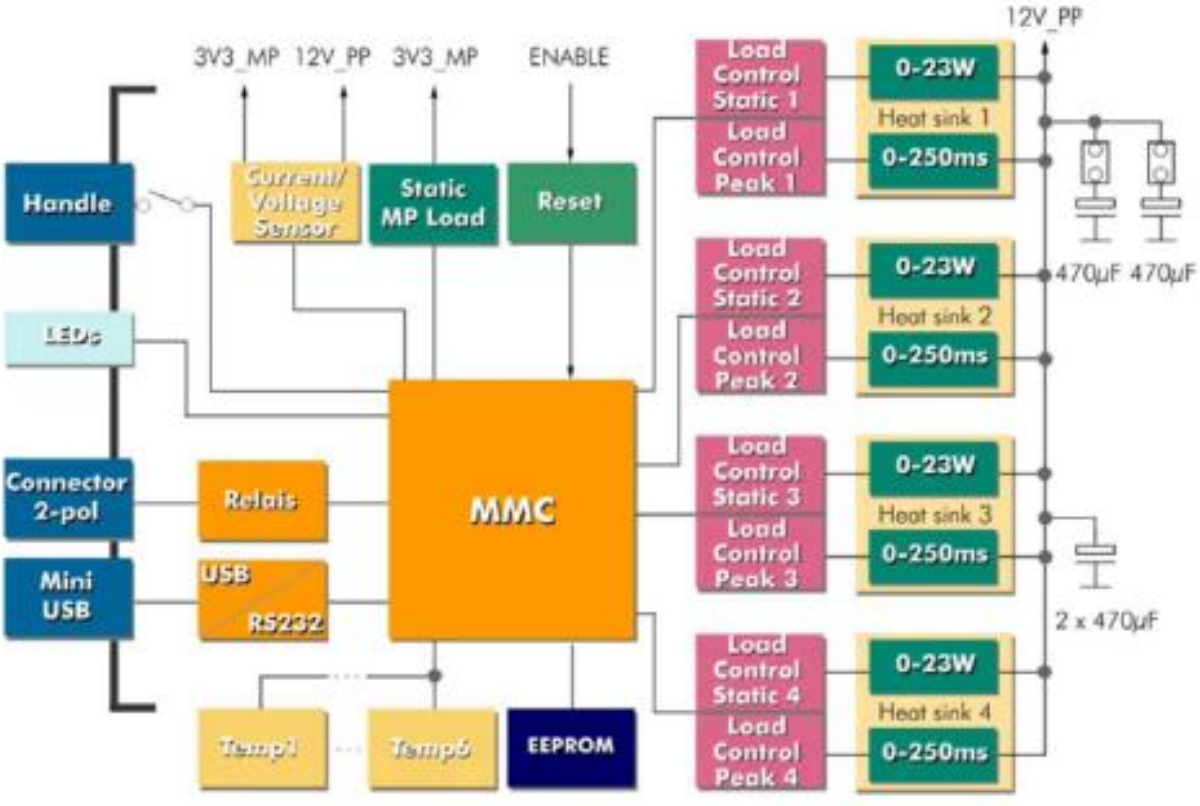
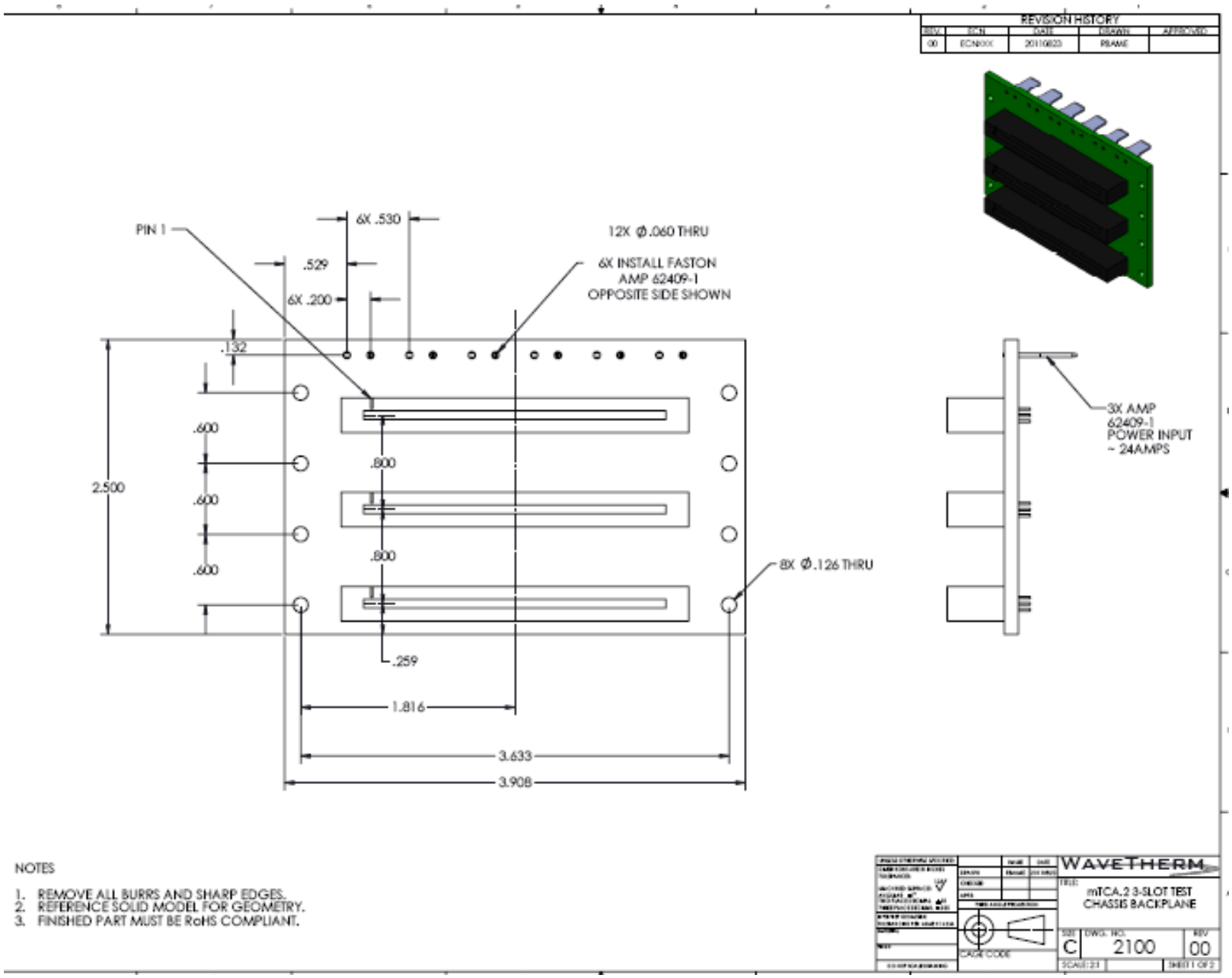


Figure A2, Schroff Thermal Load AMC Functional View

Appendix B: Backplane Details



Appendix C: Thermal Test Setup

Figure C1, AMCA210-99 2000CFM Tunnel (Airflow Measurement Systems)

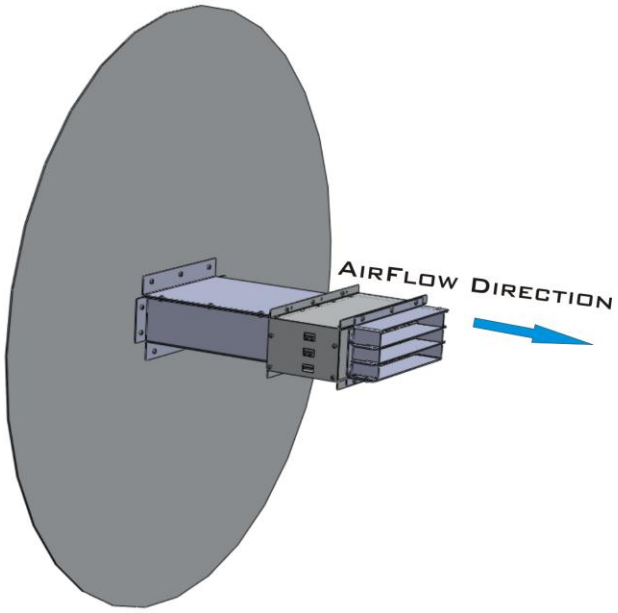


Figure C2, 3 slot Thermal Test Chassis attached to Pressure plate via air duct

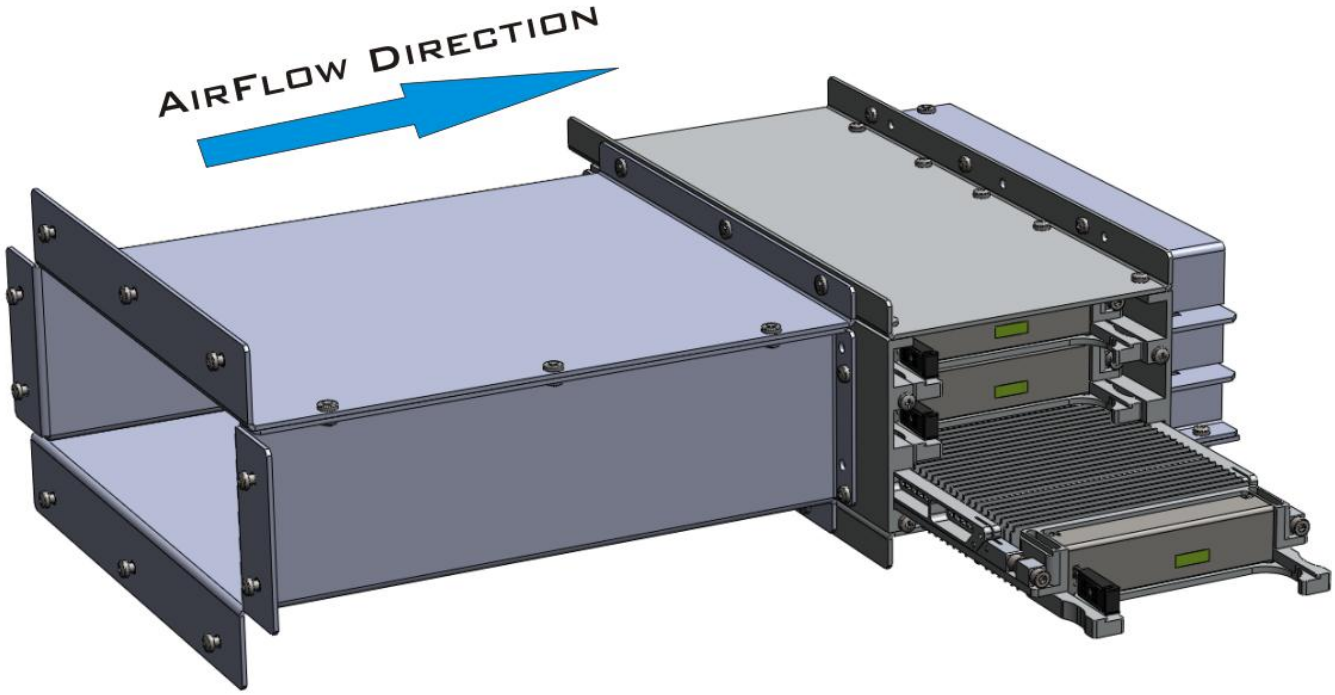


Figure C3, 3 slot Thermal Test Chassis attached to air duct

Appendix D: Thermal References

1. **Thermal and operating environment**
   - **VITA 47** — **Classes EFC1 to EFC4**
2. **Temp. rise (°C)**
   - **MTCA.1 R1.0 [4x=12°C])** — **Section 5.4 Para 12 (3.0°C rise single tier**
     REQ 5.6 12°C (or less) at 55°C inlet (single tier)
3. **Heat dissipation (W)**
   - **AMC.0 R2.0 size)** — **Section 5.2.2 Para 17 (max 80W any Module**
     Table 5-2 Recommended W
4. **Pressure drop (inch/H_2O)**
   - **MTCA.1 R1.0** — **Section 5.4.1 Tables 5-6 & 5-7**
     Section 10.6
5. **English Flow Impedance (EFI)**
   - **MTCA.1 R1.0** — **Referenced**
6. **Airflow (CFM) reporting**
   - **MTCA.1 R1.0** — **Section 5.4**
7. **Standard Air, Sea Level (SL)**
   - **MTCA.1 R1.0** — **Section 5.14 & 10.6**
8. **Module based impedance balancing**
   - **MTCA.1 R1.0** — **Section 5.4.1 & 5.4.2**
9. **Airflow test Modules**
   - **MTCA.1 R1.0** — **Section 5.9; 10.6.4 (for calibration of test setup)**
10. **Airflow path**
    - **MTCA.1 R1.0** — **Figure 10-29 & 10-30**