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To: Mark6 User Community

From: Chet Ruszczyk and the Mark6 Team

Subject: Mark6 expansion chassis power supply issue: detection and repair

## Summary

There is a potential issue with overheating wires in the Mark6 expansion chassis. This memo explains what may happen and provides instruction on detecting and resolving the issue.

## Introduction

The Mark6 host chassis has a motherboard that applies loading on its power supply. The expansion chassis, however, does not have a motherboard and thus requires static loads to ensure proper voltage regulation. For this, two 25W shunt resistors are used. These provide the minimum required loads for the 12V and 5V rails.

Unfortunately, inspection of some expansion chassis wiring of systems used by the Event Horizon Telescope (EHT) in the field has shown that the insulation of the wires can overheat, leading to wire exposure and fraying of the wires connected to the resistors (Figure 1).



*Figure 1: Example of overheated and frayed expansion chassis load wires.*

Conduant has since indicated that resistor heating was naturally expected, but that wire insulation breakdown was not. They believe that the root cause of the overheating and fraying of the wire

insulation—of mostly the wires to ground (GND) above the resistors—is primarily due to heat created by the two resistors, and specifically by the heat conducted through the copper wire that was routed between the resistors. That heat conduction is baking the sheathing. The current (~3 amperes) through the wire is well within its rated capacity.

## Recommendations

MIT Haystack Observatory and Conduant recommend the following steps to rectify this problem in the field:

1. Visually inspect your Mark6 expansion chassis (see instructions below).
2. If the wire insulation appears to be overheated or burned and the wires are frayed, there are two options:
  - a. Make the modification (described below) to the wiring on site *or*
  - b. Send the unit to Conduant to have them repair it.
3. If there is no apparent damage, MIT Haystack still strongly suggests that you make this modification as soon as time is available.

## 1. Mark6 Expansion Chassis Inspection

Carefully extract the Mark6 expansion chassis from the rack, noting all cable locations, and then remove the screws in the cover. The resistor load is located on the same side as the power supply and is mounted onto the side of the chassis (Figure 2).

Visually inspect the wires connected to the resistor load for wire damage.

***WARNING: Do not touch the resistor package, as it may be extremely hot.***

## 2. Repair: Shunt Resistor Refurbishment

The recommended solution to the problem observed is to reroute and change the wires connected to the shunt resistors. This work should be completed by a trained technician; if no technician is available, please contact Chet Rusczyk ([chester@mit.edu](mailto:chester@mit.edu)) for detailed instructions on the procedure, or send the unit to Conduant for professional repair.

The original routing of the wires (Figure 3) has the wires routed through the two resistors. The new routing includes moving the black ground wires to the left of the resistors (Figure 4).

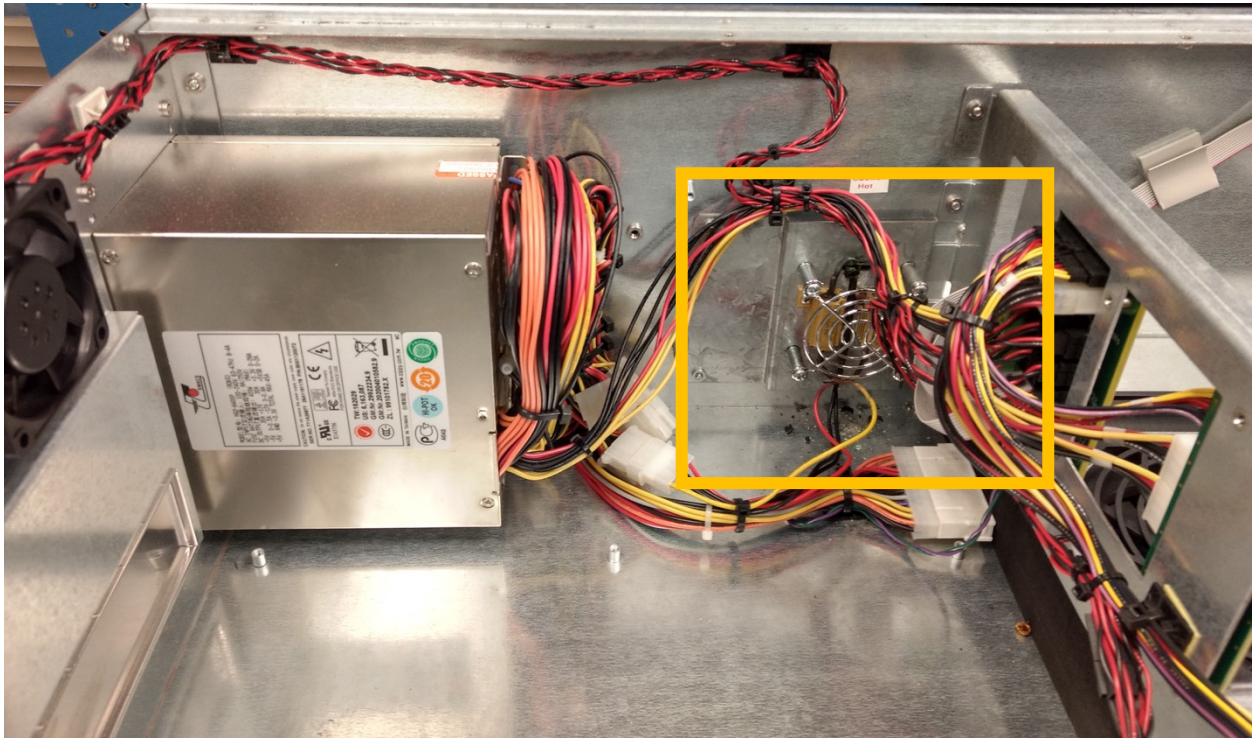


Figure 2: Expansion chassis resistor load location.

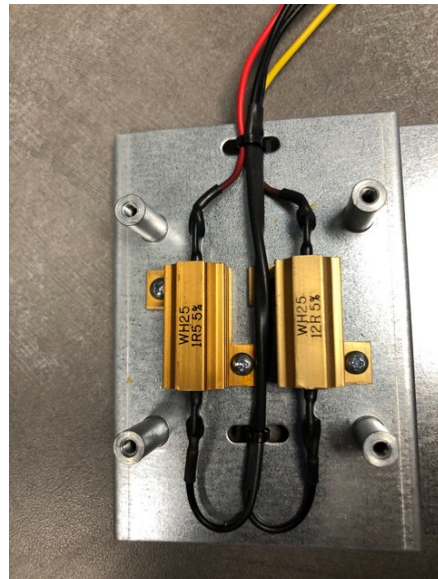


Figure 3: Original routing of shunt wiring.

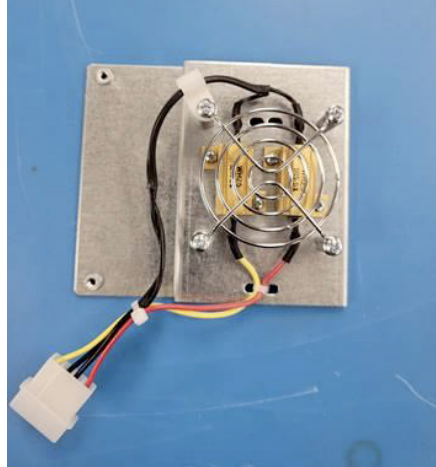


Figure 4: New routing of the ground wires to the shunt resistor.

## Appendix: Refurbishment Instructions (supplies, tools, and steps)

*Note: Should you need any support for this refurbishment, please contact Chet (chester@mit.edu).*

Supplies required for the refurbishment:

- 12 inches or about 31 cm of 16-gauge Teflon wire
  - 2 black replacement wires for the ground wire
  - 1 red replacement wire
  - 1 yellow replacement wire
- Shrink tubing
- Wire guide
- Tie wraps

Tools required for the refurbishment:

- Soldering iron
- Wire cutter
- Phillips-head screwdriver

Steps for refurbishment:

1. Wait for the unit to cool before proceeding. The resistors and unit may be very hot.
2. Unplug the shunt plate 4-wire power connector.

3. Remove the 2 screws on the side of the Mark6 expansion chassis (Figure 5). Remove the unit and place it on a bench.



*Figure 5: Shunt plate screws.*

4. Remove the protective cage from the plate and remove the 2 resistors from the plate.
5. Remove the 4 soldered connections from the shunt resistors.
6. Cut the 4 existing wires about 3" or about 8 cm from the connector.
7. Strip the wires, and solder the new Teflon extensions and shrink-wrap onto the connector.
8. Place the shrink-wrap over the wire strands and solder the ends onto the shunt resistors.
9. Shrink-wrap the connections.
10. Route and secure the wires onto the plate and protective cover and secure as shown in Figure 4.
11. Secure the plate back on the side wall of the Mark6.
12. Reconnect the power connector to the supply.
13. Power up the unit and perform a smoke test of work. If it is good, re-assemble and re-rack the unit.
14. If it is not, check the work again.