FAILURE ANALYSIS REPORT

NAME: Brent MacKenzie	DATE: 10/7/2014
ITEM DESCRIPTION: Mini-Rambo board prototype for the Camellia build	SERIAL NO: n/a
FAILURE REPORT DATE: 10/7/2014	ORIGIN: Internal / R&D

FAILURE MODE/ DESCRIPTION: The FAN1 port on the mini-rambo boards seem to be failing. When a board is first flashed it is able to turn both fans on and off, but after <5 hours of printing and cycling the fans, the most used port (FAN1) is failing and dumping 24V to the fan any time that the board is powered. While this was observed after several weeks of testing on 2 of the last 11 prototypes, it has happened consistently on all 3 of the first camellias to be powered on indicating that something has changed and exacerbated the problem. This was the first and only batch of mini-rambo boards that had pins populated in house at Aleph Objects, the FAN2 pins (immediately next to the FAN1 pins) were soldered by hand at ~600F. I'm not sure if this is relevant or not.	SYMPTOMS: 1. The mini-rambo FAN1 port is failing and staying permanently powered after being cycled <100 times. The fan being powered is a 12V DC 30x30x10mm fan. 2. The FAN2 port has yet to fail on any boards, but is cycled far less than FAN1. Testing is currently underway to see if FAN2 will fail in the same way if the functions of the 2 fans are switched. 3. Re-flashing the board and resetting the eeprom have no effect, indicating a hardware problem 4. The FAN1 port on machines that have shown this failure mode measures a ~500-1500 Ohm resistance between the terminals while a new undamaged board reads no connection between the terminals

OBSERVATIONS & FINDINGS & PICTURES

1. All 3 of the first prototype machines tested well when first completed and flashed with the firmware, and all 3 failed sometime in the first several hours of printing
2. A new board reads no conductivity between the 2 pins of FAN1, after several power cycles of the fan the fan will stay on constantly and a resistance of ~500-1500 ohms can be read across the terminals. I believe that this shows damage to the relay that switches the fan on and off.
3. Not sure if it's relevant but the polarity of the fan output is reversed from what we've used on full size rambo's; pin1 is positive on the full size rambo, pin2 is positive on the mini-rambo.
4.

CONCLUSION/ ROOT CAUSE:

I'm unsure as to the root cause, the fan settings in the firmware are extremely similar to what we're using on the TAZ with full size rambo, although powering a smaller fan. From what I've read it seems that it could be flyback voltage from the fan being abruptly shut off affecting the relay or transistor that's doing the PWM for the controllable fan speed, but this is pretty far from my area of expertise.

CORRECTIVE ACTIONS/ FIXES	OWNER	COMPLETION DATE
Verify that firmware settings are not the root cause, and determine whether a similar failure can be produced on FAN2 port	Brent M	
Contact Ultimachine to see if they've got any ideas/fixes or if different components on the mini-rambo might be used to protect the fan1 port from damage.	Brent M	