 Cornell Laboratory for Accelerator-based Sciences and Education (CLASSE) CMS Pixel Phase-II upgrade	Standard Operating Procedure SOP No.: 001 Title: **Thermal and electrical resistance measuremets** Revision: v1 Date: May 6, 2019

Abstract

Describes the procedures to meassure the thermal resistance of the mock modules.

Contents

I. Scope

This is regular procedure during the TFPX Phase II R&D stage.

II. Purpose

Determination of the thermal resistance is fundamental to characterize the cooling process; in particular to model the thermal runaway (more details needed here). This document describes the procedure followed to determine the Electrical resistance and thermal resistance of the module. The procedure can be extended in case of measuring the thermal resistance of a stack of materials like module+graphite+XXX.

III. Intro

When the module is

- xxx

IV. Equipment

- TDK-Lambda power supply (Z+).
- Cables
- Digital Multmeters (DVM)
- Bread board
- Mock module (module)
- FLIR E50 IR camera (including tripod) (IRcam)
- Laptop

V. Procedure

1. Mount the circuit according to the schematic in Figure 1 left.
2. Mount the module on the brace of the support as shown in Figure 1 right.
3. Mount the IRcam, turn it on and locate it such that the module appears in the center of the field of view of the camera.
4. Check that the IRcam is set to measure the minimum, average and maximum tmperatures; The IRcam screen should looks like the image in figure 2 left.

5. Prepare an excel-spreadsheet or file to collect the values of: voltage and current as measured by the DVM and Z+ led indicators, minimum, average and maximun temperatures, timestamp.

6. Turn on the Z+; the indicators will blink for about two seconds, then, the upper led indicator will show OFF and the REM indicator will be on permanently (see figure 2 right).

7. The Z+ output is controlled by a Labview program called "$thermal_runaway_power.vi$". The basic funcionality allows the user to change the Voltage output (Vi) (the current change according to the Ohm's law) and so the power while keeping fixed the temperature; Open the program and check the initial conditions as shown in figure 3

8. Run the program; now the led indicators should show 0.00 and CV led to the right should be on (see Figure **??**). Collect measurements: voltages, currents, temperatures, timestamp.

9. Adjust the voltage to 0.20 using the voltage control (Vi) in the Labview front panel. Collect the Voltage and curent measurements (these would be stable) while the temperatures would start to increase, so wait for 10-15 minutes for stabilization and start taking temperature measurements every minute until full stabilization of the temperature (it may take about 40 minutes in total). Check that voltages and currents are stable, if not, collect those values in the table too.

10. repeat the previous step until output voltage Vi= 2V.

11. hit "End" button in the front panel to finish the Labview execution.

12. Save data files as a "comma separated values" CSV file.

13. turn off the IRcam and Z+.

Analize data to extract the electrical and thermal resistance of the modules.

VI. Documentation

Everything needs to be documented in a report.

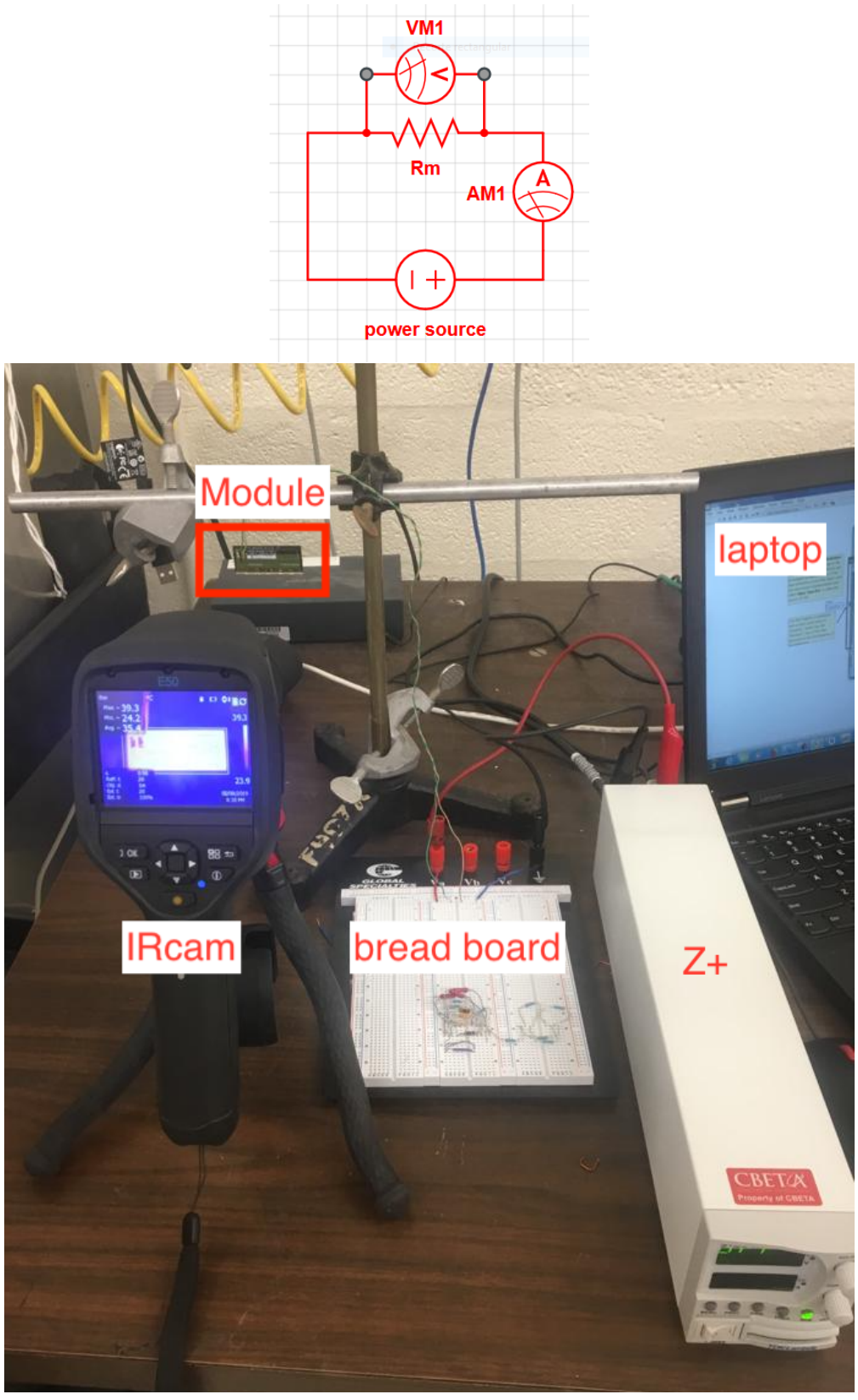

Figure 1: Electrical and Thermal resistance measurement circuit and setup.

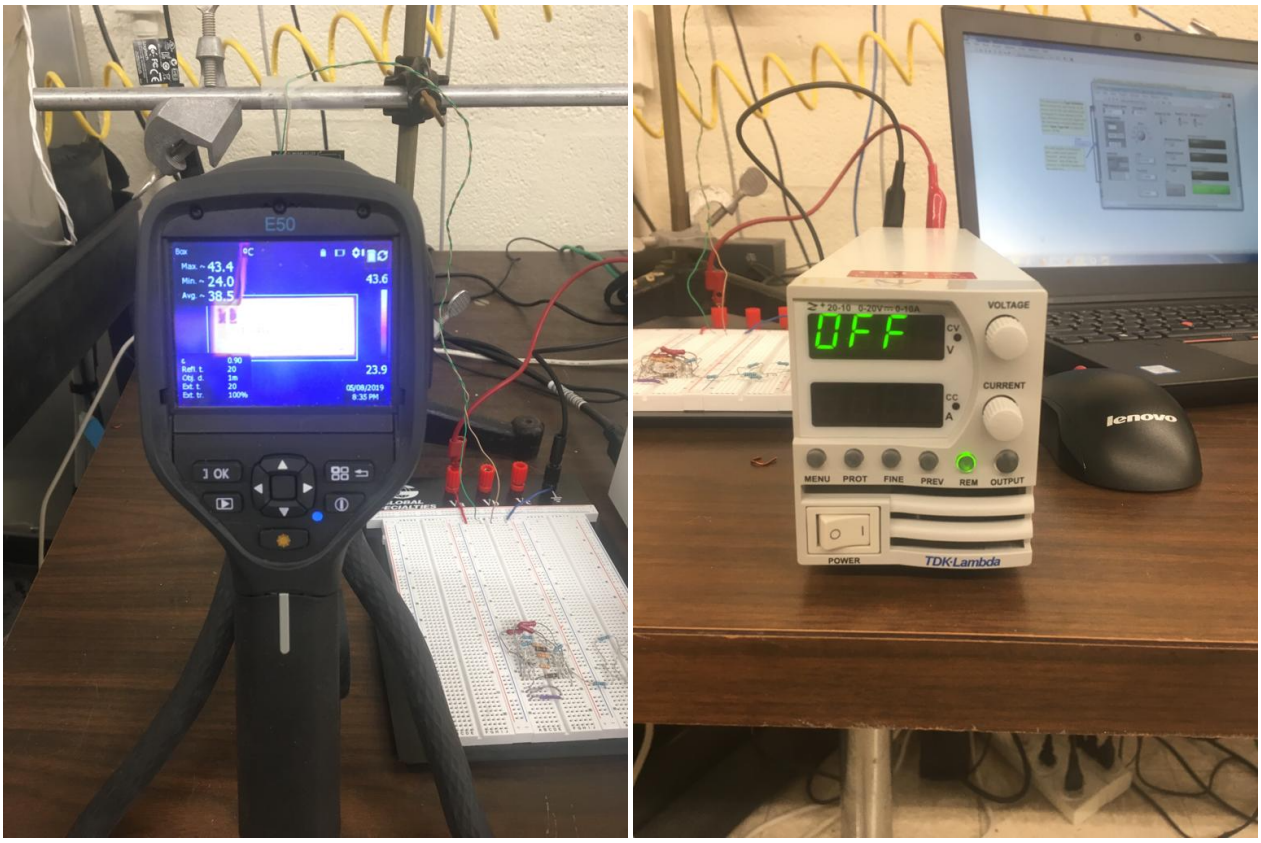
E50
Max. 43.4
Min. 24.0
Avg. 38.5
43.6
23.9
OFF
VOLTAGE
CURRENT
MENU
PROT
FINE
PREV
REM
OUTPUT
POWER
TDK·Lambda
lenovo

Figure 2: .

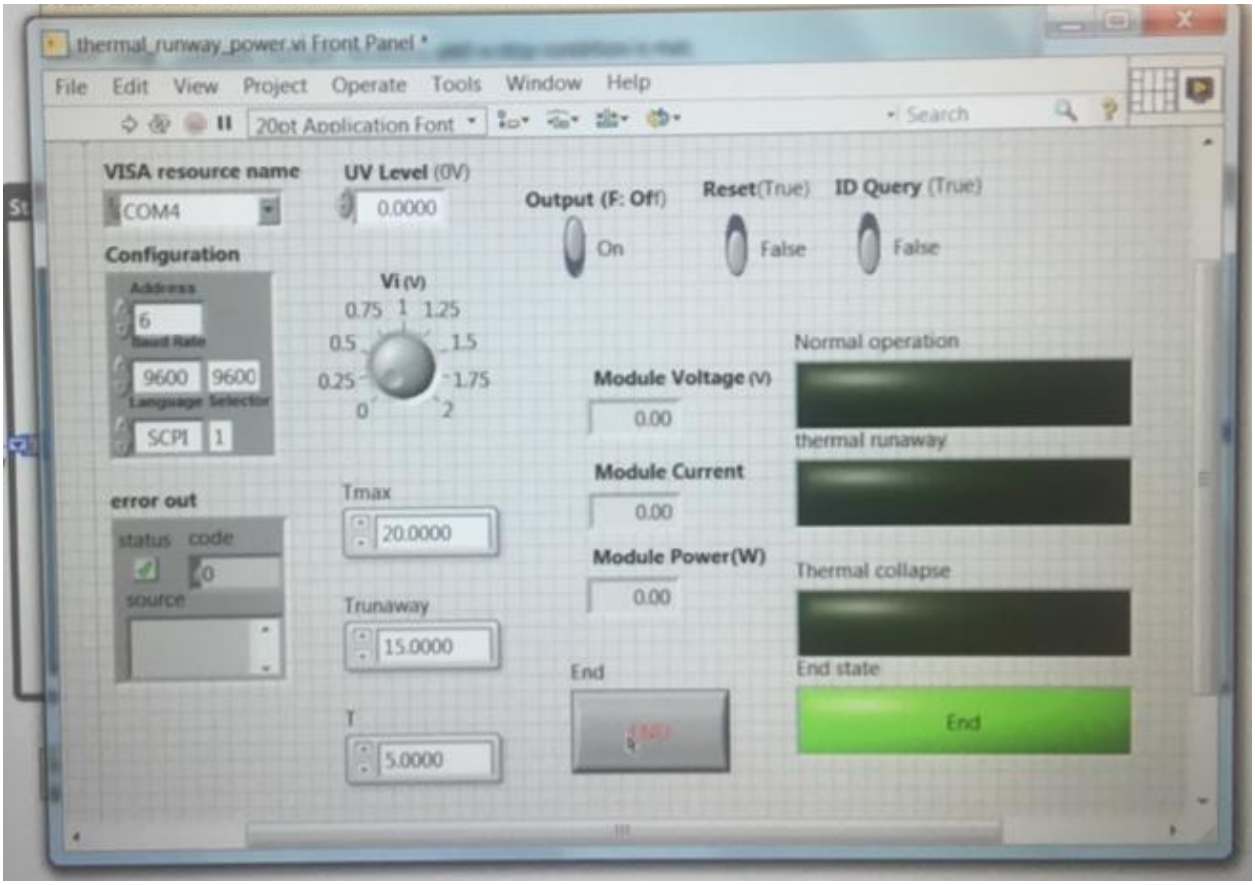
thermal_runway_power.vi Front Panel *
File Edit View Project Operate Tools Window Help
20pt Application Font
Search
VISA resource name
COM4
UV Level (0V)
0.0000
Output (F: Off)
On
Reset(True)
False
ID Query (True)
False
Configuration
Address
6
Baud Rate
9600
9600
Language Selector
SCPI
1
Vi (V)
0.75 1 1.25
0.5 1.5
0.25 1.75
0 2
Module Voltage (V)
0.00
Module Current
0.00
Module Power(W)
0.00
Normal operation
thermal runaway
Thermal collapse
End state
End
error out
status code
0
source
Tmax
20.0000
Trunaway
15.0000
T
5.0000
End

Figure 3: .

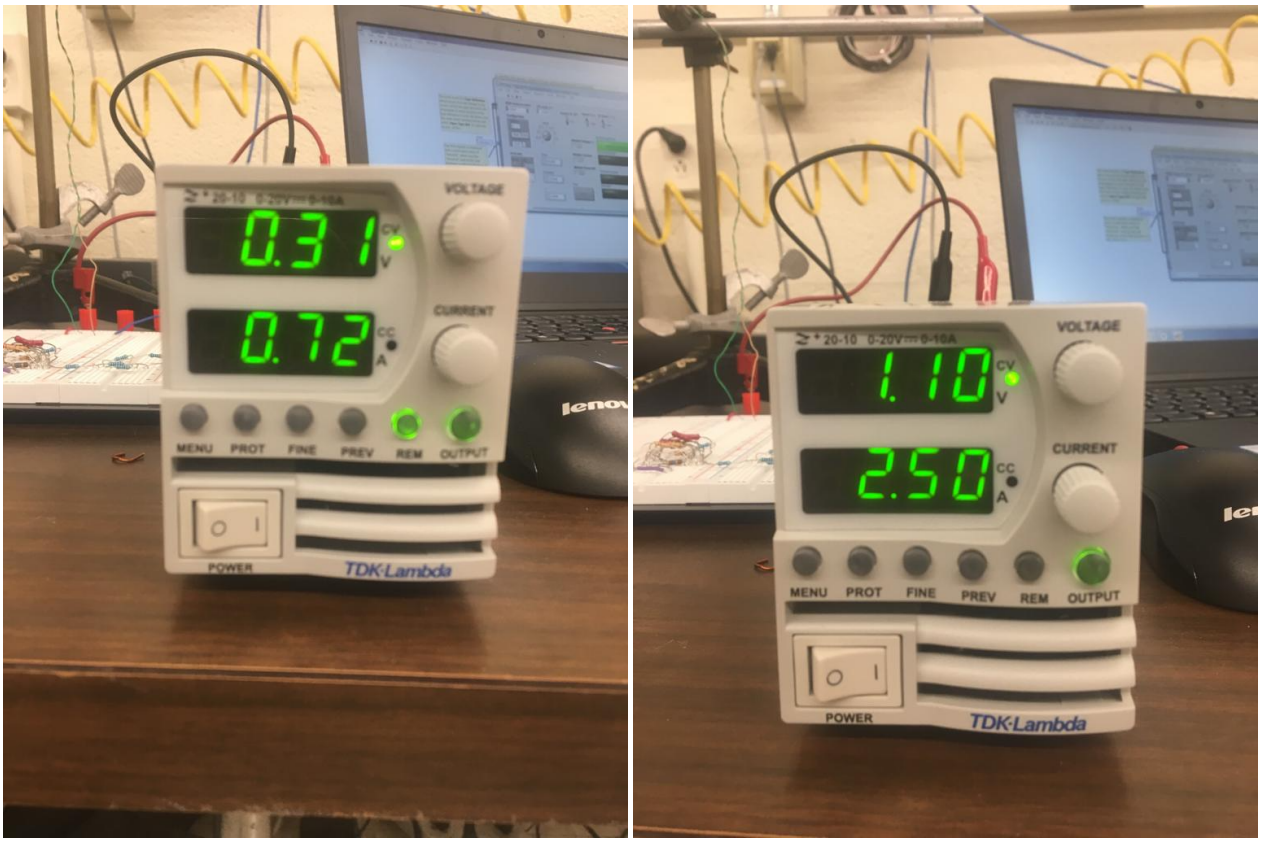
VOLTAGE
0.31
CV
V
CURRENT
0.72
CC
A
MENU
PROT
FINE
PREV
REM
OUTPUT
POWER
TDK·Lambda
VOLTAGE
1.10
CV
V
CURRENT
2.50
CC
A
MENU
PROT
FINE
PREV
REM
OUTPUT
POWER
TDK·Lambda

Figure 4: .