1316A RF HIGH-POWER CALORIMETER

INSTALLATION AND CALIBRATION QUICK START GUIDE

1. EQUIPMENT LIST

The following equipment is required to complete the calibration:

- TEGAM 1316A, RF High-Power Calorimeter
- TEGAM 1300-912, Voltage/Current RF Adapter Assembly
- Preen AFV+ 31015, High Power Programmable AC Power Source
- Zimmer L64-BAS, Precision Power Analyzer
- Solid State Cooling Systems 1316-388, Thermorack Solid State Chiller (1 kW)
- Orion 1316-389, DC Inverter Chiller (12 kW)
- TEGAM HPC-CAL, Automated Calorimeter Calibration Software

WARNING: High voltage, current, and RF power are present in the system at various times throughout this procedure. This procedure should only be performed by qualified personnel sufficiently trained in the safe operation of high voltage, current, and RF power systems. Failure to follow these precautions may result in death or bodily injury, or equipment damage.

2. SYSTEM INSTALLATION

2.1 Instrument Connections

WARNING: High voltage and current are present on the system. Install proper safety equipment (e.g., fuses, breakers, etc.) as necessary between the AC Power Source and Voltage/Current RF Adapter. Failure to install adequate safety equipment may result in death or bodily injury, or equipment damage.

1. Connect the Voltage/Current RF Adapter through an appropriately sized fuse or breaker to the AC Power Source. See *Figure 1* below.

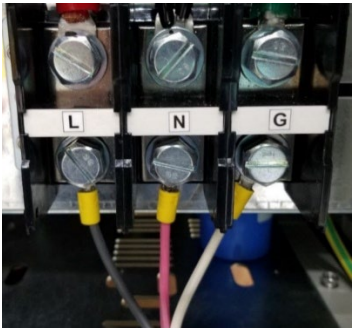

Figure 1: Voltage/Current RF Adapter connections to the AC Power Source.

WARNING: Dangerous voltage, current, and RF power may be present on the system. Users should install interlock devices as appropriate for safe operation.

2. Connect interlocks (user-supplied) to the Calorimeter and system as necessary.
3. Connect the Calorimeter and Power Analyzer ethernet ports to the network.
4. Connect the AC Power Source to the network using the ethernet port or the RS-232 serial connection. Ethernet is preferred.
5. Connect the thermocouple from the Calorimeter to the 12 kW Chiller as shown in *Figure 2*.

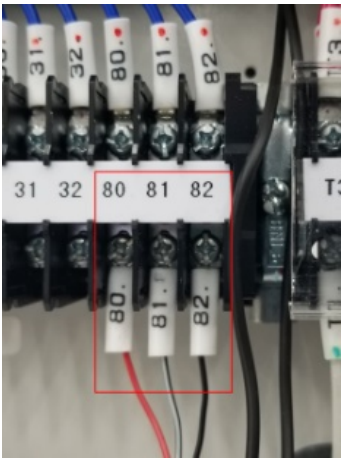

Figure 2: Thermocouple Wire Connection

WARNING: Comply with all local codes and regulations for installation of all instrumentation. Follow guidelines in supplier manuals for connections to AC Power Source and 12 kW Chiller. Failure to install equipment properly may result in death or bodily injury, or equipment damage.

6. Connect AC mains power to the Calorimeter, AC Power Source, 12 kW Chiller, and Power Analyzer. The Power Analyzer and Calorimeter are powered from separate 200-240 VAC outlets. The Calorimeter requires a 20A service.

2.2 Chiller Preparation

1. Fill the 1 kW Chiller coolant reservoir, located at the top of the system rack cabinet (see *Figure 3* below), 4 cm ($1^5/_8$ inches) above the return inlet with a coolant mixture of 25% SR-1 antifreeze to 75% distilled water.

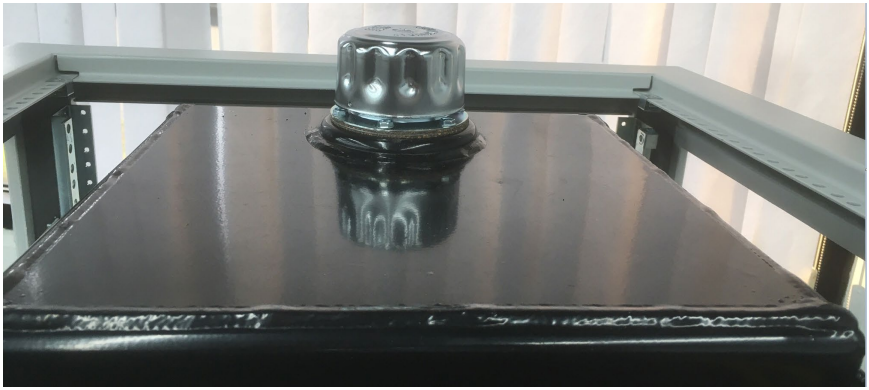

Figure 3: 1 kW Chiller coolant reservoir

2. Power ON the Calorimeter and the 1 kW Chiller. Once the Calorimeter completes the boot process:
    a. On the Calorimeter front panel, press the *SETUP* softkey.
    b. Navigate to *Instrument* using the arrow keys and press **ENTER.**
    c. Navigate to *PUMP* and press **ENTER.**
    d. Navigate to *USE PUMP* and press **ENTER.**
    e. Press **ENTER** again to begin editing the parameter value.
    f. Press the **UP** arrow key to change the parameter value to *TRUE* and press **ENTER.**
3. Allow sufficient time for the coolant to circulate through the system before proceeding to the next step.

NOTE: *The coolant level may drop as coolant fills the system hoses, Calorimeter, and 1 kW Chiller. If necessary, add additional coolant mixture as necessary to the 1 kW Chiller reservoir to bring the coolant level back to 4 cm above the return inlet.*

4. Power OFF the 1 kW Chiller.
5. Power OFF the Calorimeter and chiller pump using the system rack power switch.
6. Connect the supply and return hoses between the 12 kW Chiller and the system rack cabinet as shown in *Figure 4*.
7. Fill the 12 kW Chiller coolant reservoir using about 50 liters (13.2 gallons) of a 25% SR-1 antifreeze and 75% distilled water mixture.

Figure 4: Supply and return hose connections

8. Power ON the 12 kW Chiller.
9. On the 12 kW Chiller display, touch the **PUMP ONLY** icon and hold for 2-3 seconds to circulate coolant.
10. Allow sufficient time for the coolant to circulate through the system before proceeding to the next step.

NOTE: *If the coolant level drops and triggers a low coolant alarm, add additional coolant mixture as necessary to the 12 kW Chiller reservoir until the alarm turns off. Clear the alarm on the 12 kW Chiller display.*

11. On the 12 kW Chiller display, touch the **PUMP ONLY** icon and hold for 2-3 seconds to stop flow circulation coolant.
12. Power OFF the 12 kW Chiller.

3. CALIBRATION

3.1 Preparation and Instrument Setup

1. Install the HPC-CAL calibration software on the system workstation.
2. Power ON the 12 kW Chiller.
3. On the 12 kW Chiller display, touch **RUN** and hold for 2-3 seconds.
4. Power ON the Calorimeter. Once the Calorimeter completes the boot process:
    a. On the Calorimeter front panel, press the *SETUP* softkey.
    b. Navigate to *Instrument* using the arrow keys and press **ENTER.**
    c. Navigate to *PUMP* and press **ENTER.**
    d. Press **ENTER** again to begin editing the parameter value.
    e. Navigate to *USE PUMP* and press **ENTER.**
    f. Press the **UP** arrow key to change the parameter value to *TRUE* and press **ENTER.**
5. Verify that the green **FLOW OK** indicator is lit.
6. Power ON the 1 kW Chiller.
7. Connect cables CA-70-5 and CA-71-5 to the Power Analyzer as shown in *Figure 5* below.

Figure 5: CA-70-5 and CA-71-5 connections to Power Analyzer

8. Connect cables CA-70-5 and CA-71-5 to the Voltage/Current RF Adapter as shown in *Figure 6* below.

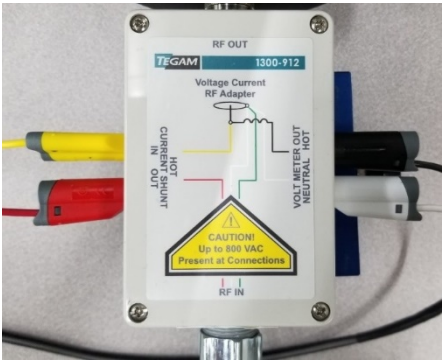

Figure 6: CA-70-5 and CA-71-5 connections to Voltage/Current RF Adapter

9. Connect the Voltage/Current RF Adapter output HN RF connector to the Calorimeter input HN RF connector.
10. Allow the system to stabilize for no less than two (2) hours before performing the remaining steps of this procedure.

3.2 Calibration

1. Launch the HPC-CAL calibration software on the system workstation.
2. Click the **Test Definition** tab (see *Figure 7* below).
3. Click the **Read Test Definition** button (see *Figure 7*).

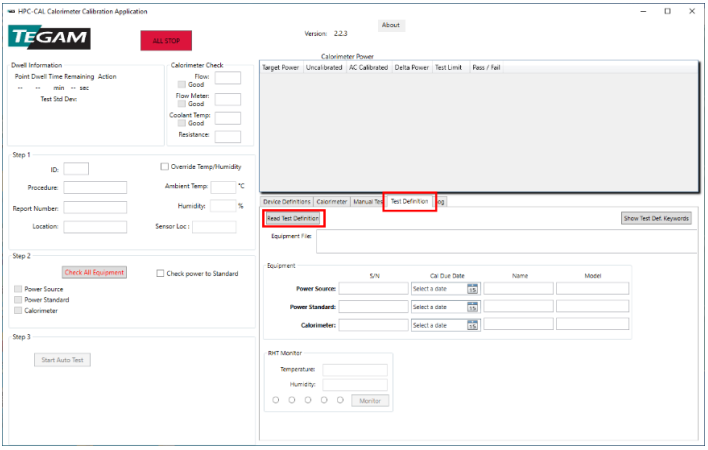

Figure 7: HPC-CAL calibration software main window

4. In the *Open File* dialog box, select the Test Definition file titled *HPC-Cal_TestDefinitions_SNxxxx.XML*.
5. Click **Open** to load the selected calibration test parameters into the HPC-CAL calibration software as shown in *Figure 8* below.

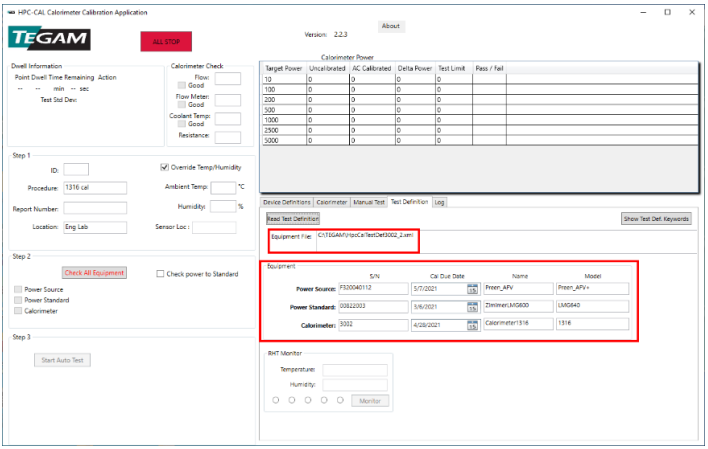

Figure 8: HPC-CAL calibration software with Test Definitions file loaded

6. Click the **Device Definitions** tab (see *Figure 9*, Step 1 below).
7. Click the **Configure Definition** drop-down box (*Figure 9*, Step 2).
8. Click *Calorimeter1316* in the drop-down box (*Figure 9*, Step 3).
9. Click the **Network** tab (*Figure 9*, Step 4).
10. Verify that the IP address displayed in the **IP Addr** textbox matches the Calorimeter IP address (*Figure 9*, Step 5).
11. Click the **Check** button. If communication is properly configured, the Calorimeter will respond with the instrument model number (*Figure 9*, Step 6).
12. Repeat *Steps 7* through *11* above for the AC Power Source and Power Analyzer. In Step 9, click the tab that corresponds to the appropriate communication protocol for the instrument being configured.

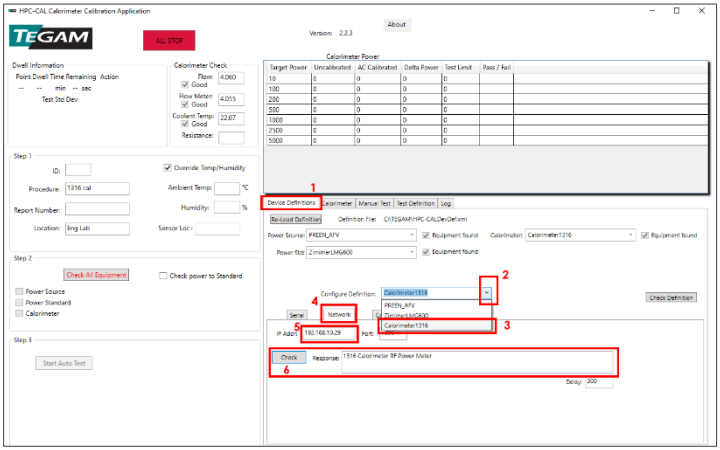

Figure 9: HPC-CAL calibration software Device Definitions tab

13. Complete the fields contained in the **Step 1** group as shown in *Figure 10*. TEGAM has defined the fields as described in *Table 1* below, but the user may

choose to input additional or different information in any field. Note that the information will appear in various HPC-CAL calibration software output files.

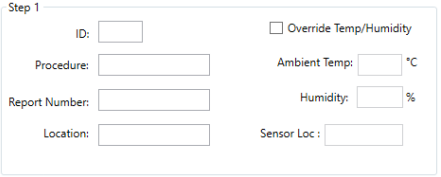

*Figure 10: **Step 1** group fields*

Field	Description
ID	Technician ID or initials.
Procedure	The calibration authority/procedure for the test.
Report Number	The report number must be 10 characters and should be unique. The date, including minutes (yymmddhhmm), is recommended to ensure each report number is unique.
Location	Company or department name, or test station number.
Ambient Temp	Ambient temperature of the calibration environment.
Humidity	Ambient humidity in the calibration environment.
Sensor Loc	Physical location of the temperature/humidity sensor

Table 1: Step 1 group field definitions

14. In the **Calorimeter Check** group, verify the Calorimeter **Flow:** and **Flow Meter:** fields indicate 4.05 GPM ±0.03, and that **Coolant Temp:** indicates 22.1 °C ±0.4 (see *Figure 11*, Step 1 below).
15. (Optional) In the **Step 2** group, click to select the **Check power to standard** check box (*Figure 11*, Step 2).This setting instructs the HPC-CAL calibration software to verify the connection between the Power Analyzer and AC Power Source.
16. In the **Step 2** group, click the **Check All Equipment** button (*Figure 11*, Step 3).
17. Wait approximately 60 seconds for the HPC-CAL calibration software to verify communication with the connected instruments. Verify the **Power Source**, **Power Standard**, and **Calorimeter** checkboxes are checked. The **Check All Equipment** button text should be black (*Figure 11*, Step 4).
18. In the **Step 3** group, click the **Start Auto Test** button (*Figure 11*, Step 5).

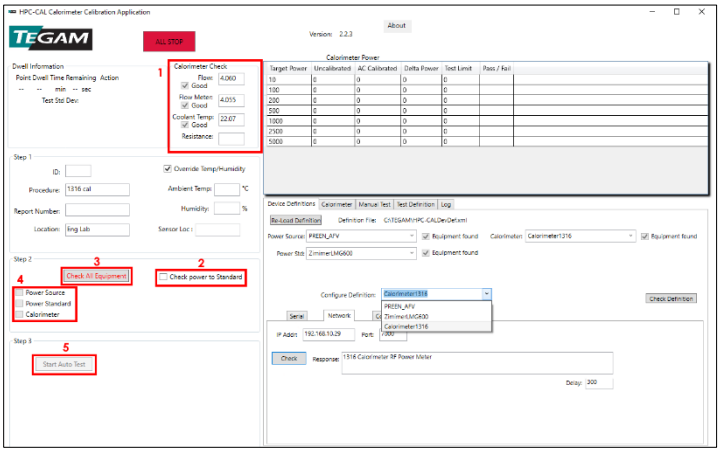

Figure 11: HPC-CAL calibration software communication and test parameter verification

19. In the dialog box, verify that the test power level, and Calorimeter serial and model numbers are correct.
20. Click **OK** to dismiss the dialog box and begin the automated calibration.
21. The HPC-CAL calibration software will save a calibration data file in the current user's *Documents* directory at the completion of the test.

3.3 Data Analysis

NOTE: *In rare cases, pop-ups may appear announcing that the measurement settling criteria have not been met. If this happens, evaluate the warning and obtain Engineering approval to continue test or abort test. Failure to meet settling criteria could be a sign of an equipment malfunction, and each such failure should be analyzed. Repeated failure on one step may indicate that the criteria is too tight, or the settling time is too short. In either of those cases, the test definition can be changed consistent with quality requirements.*

1. Navigate to the current user's *Documents* directory (*%userprofile%\documents*).
2. Locate and open the data file from the calibration completed in the previous steps. The filename will be *HPC-CALTest_yyyy_MM_dd_HH_mm_ss.log* (*yyyy* = four-digit year, *MM* = month, *dd* = day of month, *HH* = 24-hour clock hour, *mm* = minutes, *ss* = seconds). The date/time portion of the file name corresponds to the time the calibration finished.
3. If required for reporting or auditing purposes, copy the data file to an appropriate location.

3.4 Alignment

1. In the HPC-CAL calibration software, click the **Calorimeter** tab (see *Figure 12* below).
2. Click **Create Cal. File and Save** to create a new calibration file based on the calibration data collected in *Step 3.2. Calibration* above (*Figure 12*).
3. In the dialog box, save the new calibration file in appropriate location. The file name must be *Calibration.ini* as the Calorimeter will not read a calibration file with any other name.

NOTE: *It is recommended to store the calibration file in its own directory, and name the directory using the current date and other descriptive information as necessary. The directory should contain no other calibration.ini files. Save the file as "Calibration.ini" and not as any other name. The calorimeter will not use files with a different name.*

4. Click **Send Cal. File and Restart** (*Figure 12*).

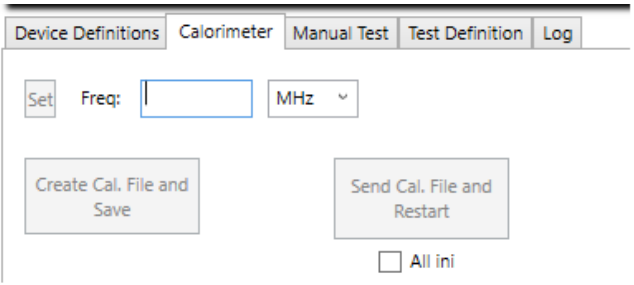

Figure 12: HPC-CAL calibration software Calorimeter alignment tab

5. In the dialog box, pick the calibration file saved in *Step 3* above.
6. Click **OK** to load the calibration file.
7. The Calorimeter will restart after loading the calibration file. The alignment is complete when the Calorimeter restarts and completes the boot process.