CONDOR
D.C. Power Supplies, Inc.
a subsidiary of SL INDUSTRIES, INC.
ISO 9001-2000 CERTIFIED

2311 STATHAM PARKWAY
OXNARD, CALIFORNIA 93033
TELEPHONE (805) 486-4565
FAX (805) 487-8911
www.condorpower.com

ENVIRONMENTAL REPORT: EXECUTIVE SUMMARY

07/15/05

FAMILY: **GPMP / GPHP**
MODEL: **GPMP600-24**
REVISION: **A**

HALT

In order to increase the field reliability of its power supplies, Condor uses HALT (Highly Accelerated Life Test) testing. This is a design margin test, where the test specimen is exposed to successively higher levels of stress, until failure occurs. The failure mechanism is diagnosed, corrected, and the process is repeated until an acceptable level of margin is achieved. An acceptable level is usually a point where the fundamental design limit is reached, or implementation of a fix is technically or economically unfeasible. The greater the design margin, the less likely that a field failure will occur due to that particular stimulus.

HALT Temperature Cycling Step Stress

HALT Operating Temperature Range: **Pass**

HALT Vibration Step Stress

Maximum Operating Level: **Pass**

Condor Non-Operating Vibration

The product is exposed to random vibration, in order to simulate the environment encountered during transportation. The product is exposed to 5 grms, 10-2000 hz random vibration, for 1 hour per axis, in 3 axes. No mechanical or electrical damage is allowed.

Result: **Pass**

Cold Start-up Time

The time measured, from the application of input voltage, for the unit to reach the specified output voltage. This is measured at the specified temperature, as well as lower temperatures.

Result: **Pass**

IR Imaging and Thermal Survey

The unit is photographed during operation with an imaging infrared camera to locate hot spots. The major components, along with anything additionally identified during the IR scan, are thermocoupled. Temperatures are measured at the maximum specified ambient temperature.

Status: **Done**

Please see attached report for detail

CONDOR
D.C. Power Supplies, Inc.
a subsidiary of SL INDUSTRIES, INC.
ISO 9001 CERTIFIED

2311 STATHAM PARKWAY
OXNARD, CALIFORNIA 93033
TELEPHONE (805) 486-4565
FAX (805) 487-8911
www.condorpower.com

ENVIRONMENTAL / HALT TEST REPORT

07/15/05

FAMILY: **GPMP / GPHP**
MODEL: **GPMP600-24**
REVISION: **A**

Overview

A total of 2 units were exposed to the following testing:

Model	Serial Number	Test
GPMP600-24	104-7389A-0003	IR, Thermal Survey, Thermal HALT Cold, Cold Start, Vibration HALT
GPMP600-24	035-14917-0002A	Thermal HALT Hot

Test Results for GPMP

Temperature Cycling Step Stress

Specification Limits

Maximum Specified Operating Temperature	+50°C
Minimum Specified Operating Temperature	-20°C

Operational Limits

Maximum Operating Temperature (No degradation of performance):	+70°C
Minimum Operating Temperature (No degradation of performance):	-40°C

Result Table

Temp (°C)	Problem	Root Cause	Corrective Action	Incorp.
+80°C	No output.	Q7 and Q8 burned up.	None. Unit reached fundamental limit of operation.	-

Vibration Step Stress

Specification Limits

Minimum Specified Operating Level (No loss of operation): 1.5 g_{rms}

Operational Limits

Maximum Operating Level (No loss of operation): 5 g_{rms}

Result Table

Level (g_{rms})	Problem	Root Cause	Corrective Action	Incorp.
5 g_{rms}, Y axis	C13 broke.	No RTV on C13.	Added RTV between C13 and surrounding components.	-
7 g_{rms}, X axis	C10, C40, C48 broke.	No RTV on C40 or C48; a little RTV on C10.	Added generous amounts of RTV between C40, C48, C10 and their surrounding components.	-
7 g_{rms}, Y axis	#4 lead of T2 broke.	RTV only between board and T2 on one end.	Added RTV between board and T2 on both ends of T2.	-
7 g_{rms}, Y axis	L2 and part of T3 lead broken. Trace bared beneath T3.	None.	None. Unit reached fundamental limit of technology.	-

Test Summary

Infrared Baseline Photo

Unit is allowed to stabilize at approximately 25°C ambient temperature, convection cooled, with 600 W output power before infrared photo is shot. See attached topside and bottomside photo.

Thermal Survey

After attaching thermocouples, unit is placed in the chamber, powered on, and allowed to reach a stable temperature. Component temperature is monitored throughout the test. See attached chart for all configurations.

Cold Start

Unit is placed in the chamber, power off, and allowed to stabilize at the ambient temperature. With an oscilloscope probe attached to both the input and the output, power is applied and the time difference between application of power and output voltage is recorded. See attached chart for all configurations.

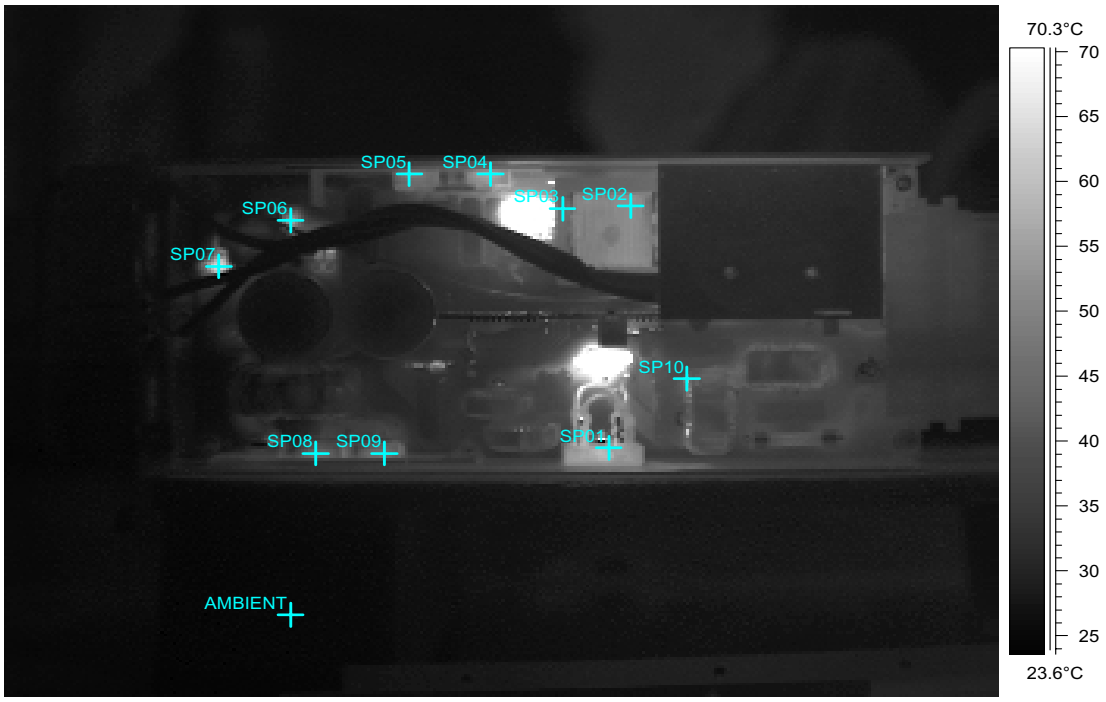
Vibration Qualification

One hour of random vibration in each of three (3) orthogonal axes. Profile: 0.038 g^2/hz, 20-350 hz; -60 B/oct, 350-2000 hz; 4.86 grms.

HALT Temperature Cycling Step Stress and Vibration

Unit is exposed to progressively more severe operating temperatures and random vibration environments. Failures that occur are diagnosed for root cause, corrective action is performed, and then the test is continued. The levels are increased unti the test extremes or the fundamental limit of the unit is reached (whether by technological or economic limitations.)

GPMP600-24 IR



Label	Value
SP01	56.1°C
SP02	52.4°C
SP03	44.8°C
SP04	56.9°C
SP05	49.0°C
SP06	54.5°C
SP07	64.7°C
SP08	44.5°C
SP09	46.2°C
SP10	60.6°C
AMBIENT	25.0°C

NOTES:
115 VAC INPUT
OUTPUT: 24 VDC @ 25 A
25°C AMBIENT
Unit cooled by internal fans.

GPFM600-24 THERMAL SURVEY
20 JANUARY 2005

COMPONENT	25°C			50°C		
	LOW	NOM	HIGH	LOW	NOM	HIGH
C1	40 °C	35 °C	32 °C	66 °C	63 °C	57 °C
C14	29 °C	28 °C	28 °C	53 °C	54 °C	53 °C
C16	30 °C	29 °C	29 °C	54 °C	55 °C	54 °C
C2	40 °C	36 °C	34 °C	65 °C	63 °C	58 °C
C3	39 °C	35 °C	32 °C	65 °C	63 °C	58 °C
C38	39 °C	37 °C	38 °C	64 °C	64 °C	64 °C
PCB BY CR22	63 °C	61 °C	62 °C	89 °C	90 °C	89 °C
CR1	60 °C	51 °C	39 °C	83 °C	77 °C	63 °C
CR22	69 °C	68 °C	68 °C	93 °C	93 °C	92 °C
CR6	56 °C	51 °C	46 °C	79 °C	76 °C	69 °C
L1	41 °C	35 °C	31 °C	67 °C	62 °C	56 °C
L2	43 °C	36 °C	31 °C	69 °C	64 °C	57 °C
L3	54 °C	53 °C	53 °C	80 °C	81 °C	80 °C
Q15	55 °C	44 °C	35 °C	84 °C	72 °C	60 °C
Q6	48 °C	40 °C	34 °C	74 °C	67 °C	59 °C
Q7	41 °C	39 °C	40 °C	67 °C	68 °C	68 °C
Q8	57 °C	55 °C	56 °C	85 °C	86 °C	85 °C
R59	49 °C	48 °C	48 °C	73 °C	74 °C	73 °C
PCB BY RT1	80 °C	71 °C	54 °C	101 °C	93 °C	75 °C
T1	55 °C	43 °C	34 °C	80 °C	71 °C	59 °C
T2	46 °C	38 °C	32 °C	71 °C	65 °C	57 °C
T3	37 °C	33 °C	31 °C	62 °C	60 °C	56 °C
T6 COIL	45 °C	43 °C	44 °C	69 °C	70 °C	69 °C
T6 CORE	51 °C	50 °C	51 °C	74 °C	75 °C	75 °C
T7 COIL	32 °C	31 °C	32 °C	56 °C	57 °C	57 °C
T7 CORE	30 °C	29 °C	30 °C	54 °C	55 °C	55 °C
U1	36 °C	34 °C	35 °C	60 °C	61 °C	60 °C
U2	43 °C	41 °C	41 °C	67 °C	67 °C	65 °C
U3	33 °C	31 °C	31 °C	57 °C	57 °C	56 °C
UNDER BY RT1	74 °C	65 °C	51 °C	96 °C	89 °C	73 °C
UNDER CR27	61 °C	60 °C	61 °C	90 °C	92 °C	91 °C
UNDER CR7	42 °C	41 °C	41 °C	70 °C	71 °C	70 °C
UNDER Q1	59 °C	59 °C	62 °C	81 °C	83 °C	83 °C
UNDER BY R31	78 °C	77 °C	78 °C	95 °C	96 °C	96 °C
UNDER U3	41 °C	40 °C	40 °C	69 °C	70 °C	69 °C
AMBIENT	25 °C	24 °C	24 °C	49 °C	50 °C	50 °C
AC INPUT	92 VAC	118 VAC	263 VAC	91 VAC	116 VAC	264 VAC
OUTPUT	24 VDC	24 VDC	24 VDC	24 VDC	24 VDC	24 VDC
CURRENT	25 A	25 A	25 A	25 A	25 A	25 A

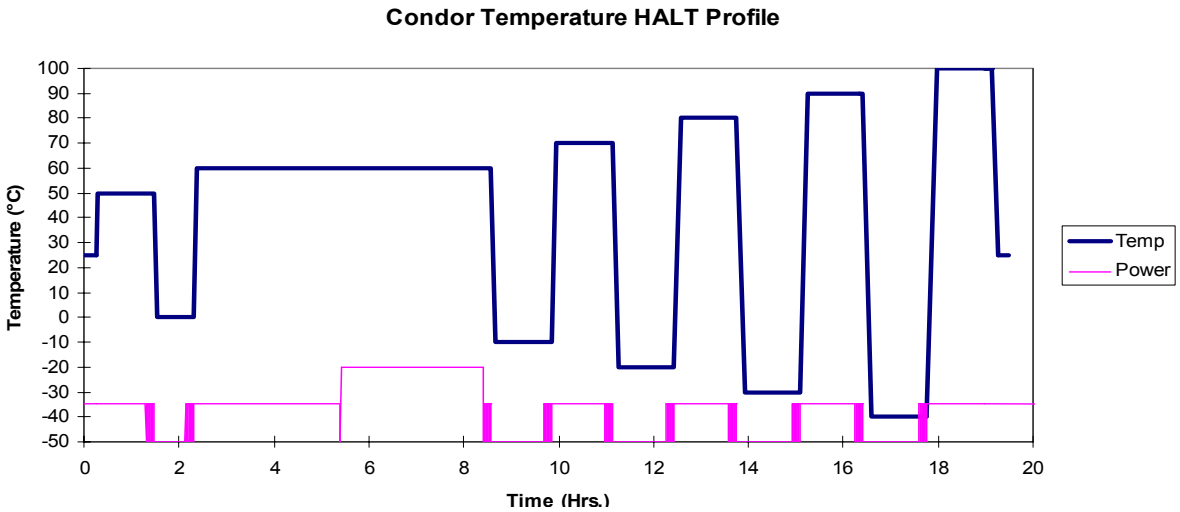
Note: Component names with "under" are on the underside of the board. The thermocouples by RT1 and R31 are attached on the underside of the board to the board itself; the reference designators are given to tell the general area where they are attached.

Cold Start Results

Time between application of AC power and measured output voltage:

Ambient	Input Voltage		
	90 VAC	120 VAC	260 VAC
25°C	3.575 s	2.645 s	1.265 s

Input	Ambient Temperature				
	0°C	-10°C	-20°C	-30°C	-40°C
120 VAC	2.665 s	2.665 s	2.695 s	2.695 s	2.765 s

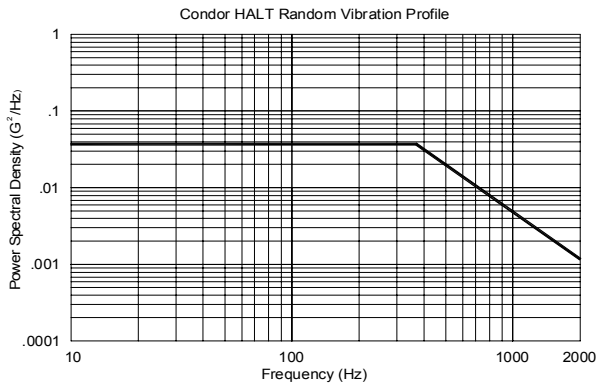


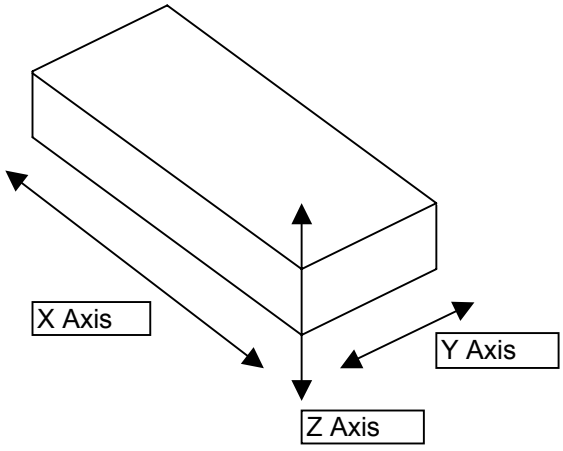
Power Cycling: Five OFF/ON cycles (1 Min ON / 1 Min OFF) are performed at the end of each dwell.
Parameters monitored: Vin, Vout, signals as required (power good, etc.)
Pass/Fail criteria: Loss of output, or output is outside specified limit.

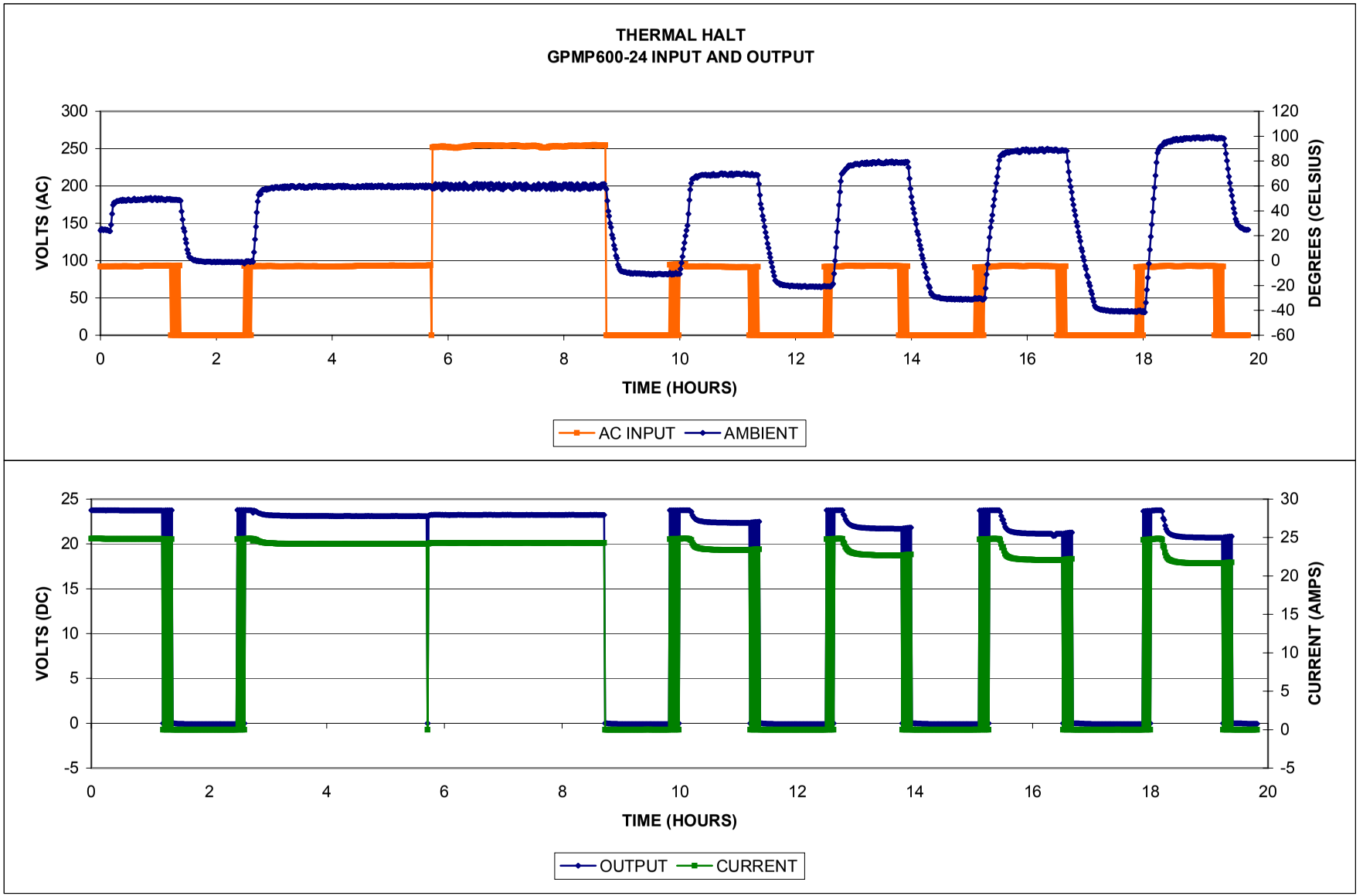
Random Vibration Step Stress

Level	Time (min:sec)	Overall G_{rms}	PSD Gsqd/Hz			Cum. Damage (Qual=1)
			10 Hz	350 Hz	2000 Hz	
1	10:00	5	0.038	0.038	0.0012	0.17
2	10:00	7	0.078	0.078	0.0024	1.6
3	10:00	9	0.129	0.129	0.004	9
4	10:00	11	0.192	0.192	0.0059	37
5	10:00	13	0.269	0.269	0.0082	120

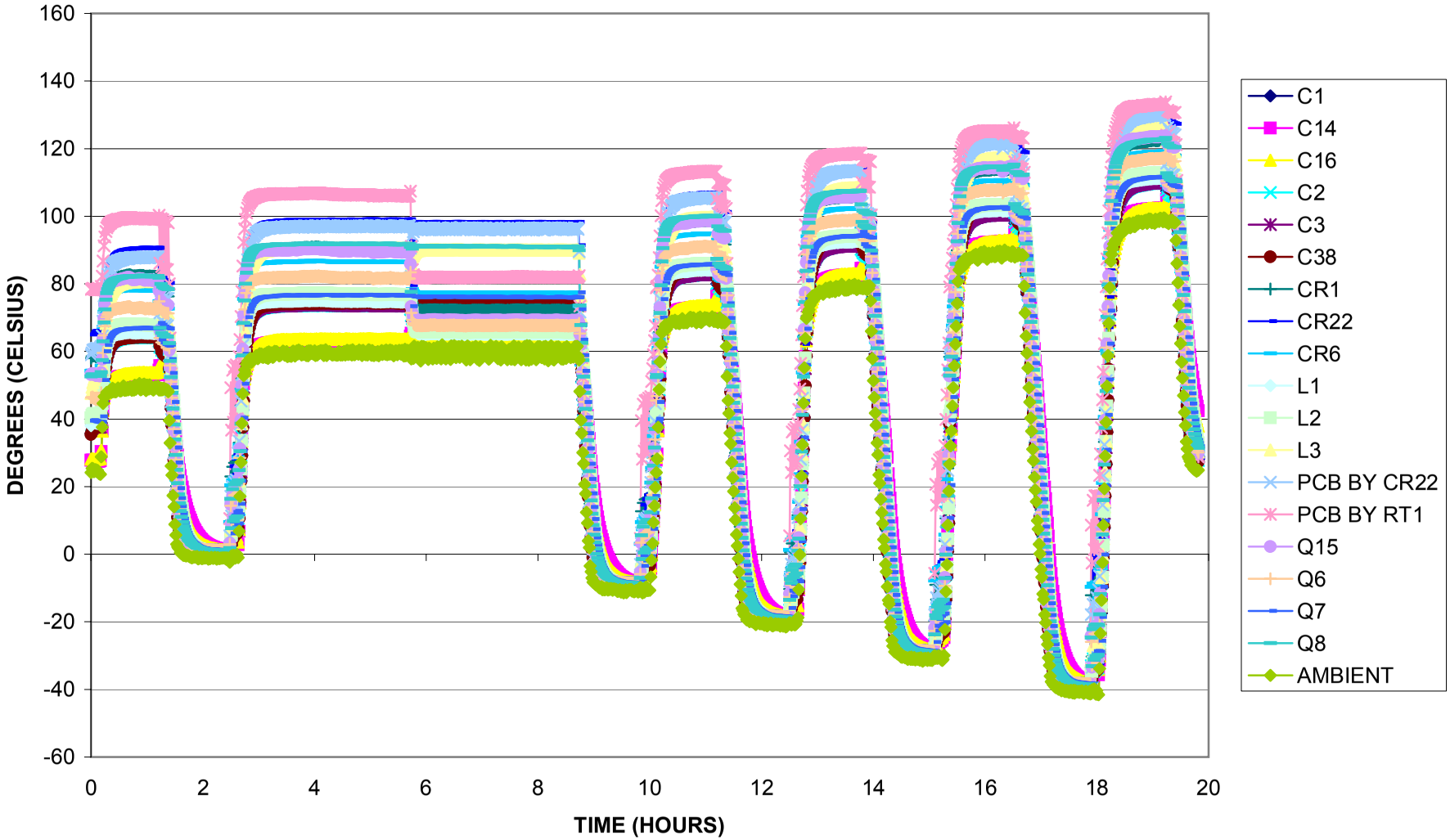
Parameters Monitored: Vin, Vout, signals as required (power good, etc.)
Pass/Fail criteria: Loss of output, or output is outside specified limit.

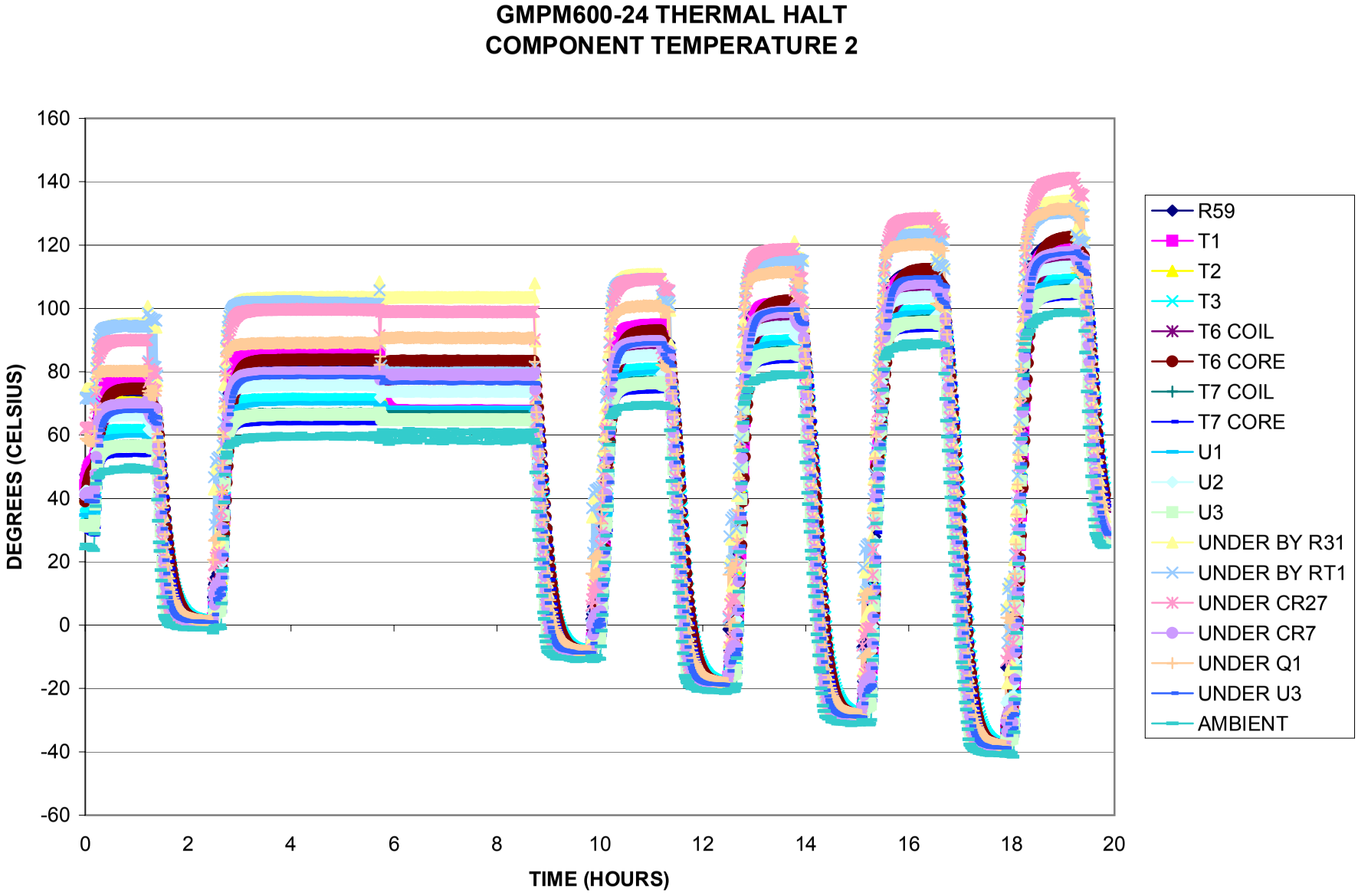





THERMAL HALT
GPMP600-24 INPUT AND OUTPUT
VOLTS (AC)
DEGREES (CELSIUS)
TIME (HOURS)
AC INPUT
AMBIENT
VOLTS (DC)
CURRENT (AMPS)
TIME (HOURS)
OUTPUT
CURRENT

GPMP600-24 THERMAL HALT
COMPONENT TEMPERATURE 1

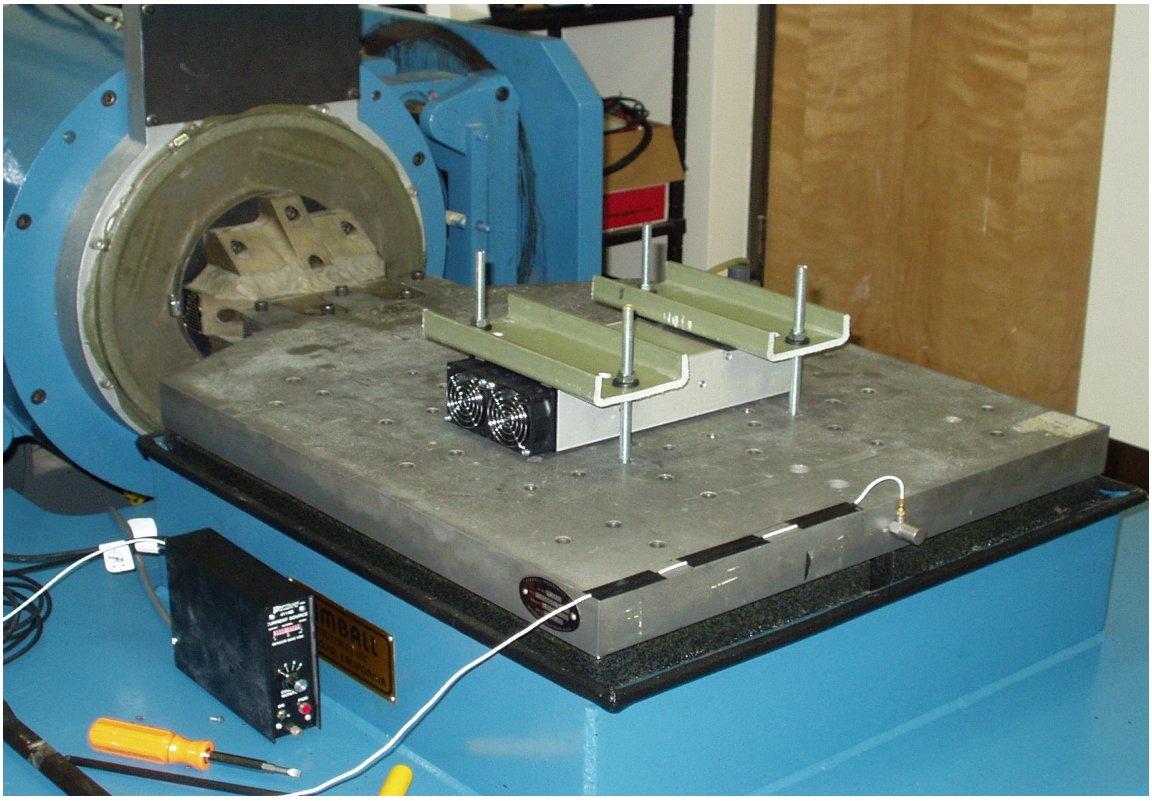



GMPM600-24 THERMAL HALT
COMPONENT TEMPERATURE 2
DEGREES (CELSIUS)
160
140
120
100
80
60
40
20
0
-20
-40
-60
0
2
4
6
8
10
12
14
16
18
20
TIME (HOURS)
R59
T1
T2
T3
T6 COIL
T6 CORE
T7 COIL
T7 CORE
U1
U2
U3
UNDER BY R31
UNDER BY RT1
UNDER CR27
UNDER CR7
UNDER Q1
UNDER U3
AMBIENT

Test Setup



Typical thermal survey and HALT setup.



Typical vibration qualification and HALT setup.

Test Equipment

Ransco 1310 Temperature Chamber (24"x24"x30")
HP 34970A 60 Channel Data Acquisition System
Ling Electronics DMA-5/390-3 3000 lb_f Electrodynamic Shaker
Kimbal 24"x24" Oil Film Slip Table
24" Head Expander
Data Physics Corporation SignalCalc 350 Vibration Controller
Dytran Model 3100B Accelerometer/4114B Power Supply (Control)