



ENVIRONMENTAL TEST REPORT

ON

SP2T, PIN DIODE SWITCH

**AMC MODEL No:
SWSH-810-2DR-IND-SMC**

BOEING COMPANY PART No: 380-10405-1 Rev. G

BOEING COMPANY PURCHASE ORDER No: X57189

REPORTED

BY

Dave Bruder

QA Manager

With Assistance from P. Wood

TESTED

BY

Rene Afable

Executive Vice President of Engineering

DECEMBER 07, 2002



ENVIRONMENTAL TEST REPORT
ON SP2T SOLID STATE SWITCH
BOEING MODEL No: 380-10405-1 Rev. G
BOEING PURCHASE ORDER No: X57189
AMC MODEL No: SWSH-810-2DR-IND-SMC

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INTRODUCTION

This report provides the detailed information used in the qualification evaluation of the performance of Boeing Model 380-10405-1 Rev. G (AMC Model No: SWSH-810-2DR-IND-SMC) switches.

There were four switches tested. They were divided into two groups of two switches each as directed by the Boeing procurement drawing number 380-10405 Rev. G. All four switches, serial numbers 2MS204328 through 2MS204331, were tested in order to obtain baseline data.

Group 1 switches, consisting of serial numbers 2MS204328 and 2MS204329, were temperature cycled, altitude/cold tested, and humidity tested.

Group 2 switches, consisting of serial numbers 2MS204330 and 2MS204331, were tested to the sand and dust, salt spray, vibration and shock environmental requirements as well as the 1000 hour life test.

The switches were tested and compared to the baseline data with excellent results. This test report includes both the full BAE Labs and Met Labs reports which are listed as Appendix-A and Appendix-B respectively.

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BASELINE TESTING
AT AMERICAN MICROWAVE CORPORATION

BOEING Model 380-10405-1 Rev. G
AMC Model No: SWSH-810-2DR-IND-SMC
ENVIRONMENTAL TESTING

SERIAL NUMBERS 2MS204328, 2M204329

These switches were assigned to the Group 1 set of Environmental Tests as outlined in Boeing procurement drawing number 380-10405 Revision G. The baseline tests which follow will serve as the reference point to determine if damage from exposure to Temperature Cycling, Altitude/Cold Testing and High Humidity/Temperature Cycling results in damage to the operation of the switch.

SERIAL NUMBERS 2MS204330, 2M204331

These switches were assigned to the Group 2 set of Environmental Tests as outlined in Boeing procurement drawing number 380-10405 Revision G. The baseline tests which follow will serve as the reference point to determine if damage from exposure to Sand and Dust, Salt Spray, Vibration and Shock and a 100 hour life test results in damage to the operation of the switch.

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BASELINE TESTING

BOEING Model 380-10405-1 Rev. G
 AMC Model No: SWSH-810-2DR-IND-SMC
 ENVIRONMENTAL TESTING

SWSH-810-2DR-IND-SMC SWITCH
 8.2 to 10.0 GHz

DATE: 5/24/02
 TESTED BY: R. AFABLE

SUMMARY TEST DATA		
GROUP 1	<u>SN 2MS204328</u>	<u>SN 2MS204329</u>
INSERTION LOSS	J1-J2 = 1.21 dB J1-J3 = 1.10 dB	J1-J2 = 1.36 dB J1-J3 = 1.25 dB
ISOLATION	J1-J2 = > 60 dB J1-J3 = > 60 dB	J1-J2 = > 60 dB J1-J3 = > 60 dB
INPUT VSWR	J1 to J2 = 1.19 : 1 J1 to J3 = 1.33 : 1	J1 to J2 = 1.61 : 1 J1 to J3 = 1.54 : 1
OUTPUT VSWR	J1 to J2 = 1.35 : 1 J1 to J3 = 1.30 : 1	J1 to J2 = 1.67 : 1 J1 to J3 = 1.51 : 1
DELAY – “ON”	J1 to J2 = 60 nSec J1 to J3 = 60 nSec	J1 to J2 = 62 nSec J1 to J3 = 66 nSec
DELAY – “OFF”	J1 to J2 = 42 nSec J1 to J3 = 43 nSec	J1 to J2 = 44 nSec J1 to J3 = 42 nSec
RISE TIME	J1 to J2 = 8 nSec J1 to J3 = 8 nSec	J1 to J2 = 10 nSec J1 to J3 = 8 nSec
FALL TIME	J1 to J2 = 4 nSec J1 to J3 = 4 nSec	J1 to J2 = 4 nSec J1 to J3 = 4 nSec
CURRENT DRAW	+5VDC = 36.1 mA -15VDC = 35.2 mA	+5VDC = 36.2 mA -15VDC = 36.6 mA

Testing performed on Hewlett Packard HP8720C Network Analyzer

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BASELINE TESTING

BOEING Model 380-10405-1 Rev. G
 AMC Model No: SWSH-810-2DR-IND-SMC
 ENVIRONMENTAL TESTING

SWSH-810-2DR-IND-SMC SWITCH
 8.2 to 10.0 GHz

DATE: 5/24/02
 TESTED BY: R. AFABLE

SUMMARY TEST DATA		
GROUP 2	<u>SN 2MS204330</u>	<u>SN 2MS204331</u>
INSERTION LOSS	J1-J2 = 1.09dB J1-J3 = 1.04 dB	J1-J2 = 1.46dB J1-J3 = 1.38 dB
ISOLATION	J1-J2 = > 60 dB J1-J3 = > 60 dB	J1-J2 = > 60 dB J1-J3 = > 60 dB
INPUT VSWR	J1 to J2 = 1.40 : 1 J1 to J3 = 1.28 : 1	J1 to J2 = 1.30 : 1 J1 to J3 = 1.30 : 1
OUTPUT VSWR	J1 to J2 = 1.39 : 1 J1 to J3 = 1.26 : 1	J1 to J2 = 1.42 : 1 J1 to J3 = 1.41 : 1
DELAY – “ON”	J1 to J2 = 60 nSec J1 to J3 = 69 nSec	J1 to J2 = 64 nSec J1 to J3 = 66 nSec
DELAY – “OFF”	J1 to J2 = 42 nSec J1 to J3 = 42 nSec	J1 to J2 = 42 nSec J1 to J3 = 42 nSec
RISE TIME	J1 to J2 = 9 nSec J1 to J3 = 10 nSec	J1 to J2 = 8 nSec J1 to J3 = 9 nSec
FALL TIME	J1 to J2 = 4 nSec J1 to J3 = 4 nSec	J1 to J2 = 4 nSec J1 to J3 = 4 nSec
CURRENT DRAW	+5VDC = 36.1 mA -15VDC = 35.1 mA	+5VDC = 36.1 mA -15VDC = 35.3 mA

Testing performed on Hewlett Packard HP8720C Network Analyzer

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TEMPERATURE CYCLING AT AMERICAN MICROWAVE CORPORATION

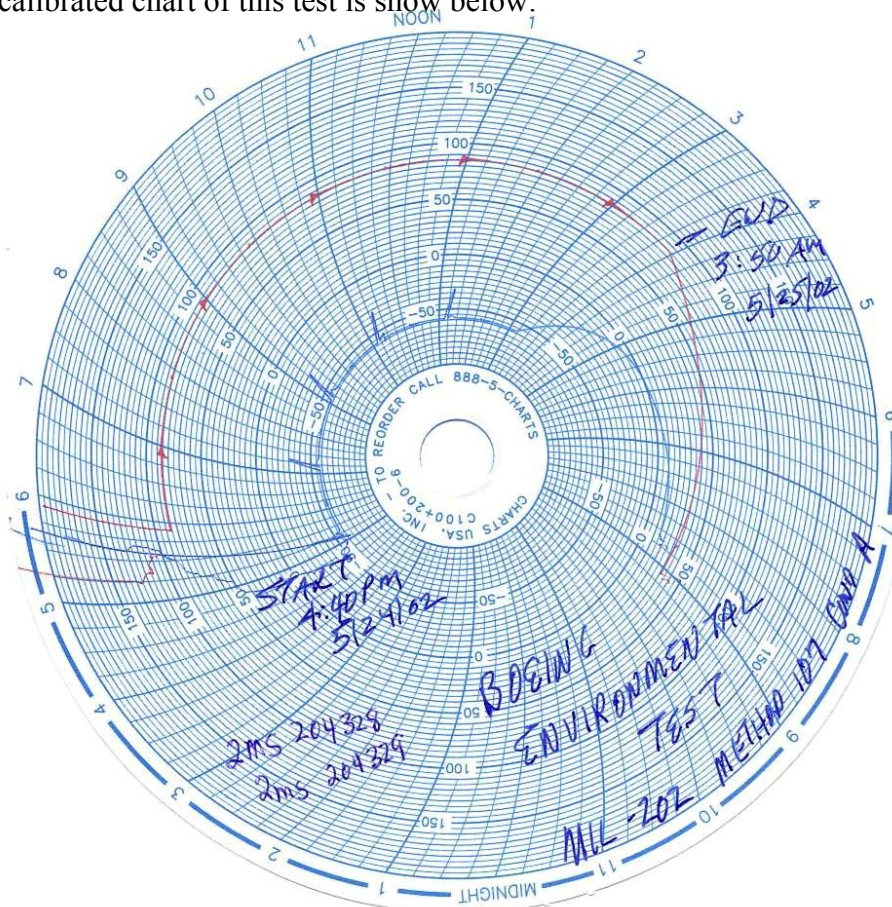
BOEING Model 380-10405-1 Rev. G
AMC Model No: SWSH-810-2DR-IND-SMC
ENVIRONMENTAL TESTING

SERIAL NUMBERS 2MS204328, 2M204329

The switches were Temperature Cycled to MIL-STD-202 Method 107 Condition-A utilizing the Tenney Jr. Cycling Oven at American Microwave Corporation.

Five cycles of 1 hour at -65°C followed by 1 hour at $+85^{\circ}\text{C}$ were performed. Transfer time from cold to hot and from hot to cold was less than 30 seconds (the specification requirement is less than five minutes) during each cycle. Temperatures stabilized at each specified temperature within 8 minutes.

A calibrated chart of this test is show below:



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POST TEMPERATURE CYCLING TESTS

BOEING Model 380-10405-1 Rev. G
 AMC Model No: SWSH-810-2DR-IND-SMC
 ENVIRONMENTAL TESTING

SWSH-810-2DR-IND-SMC SWITCH
 8.2 to 10.0 GHz

DATE: 5/25/02
 TESTED BY: R. AFABLE

SUMMARY TEST DATA		
GROUP 1	<u>SN 2MS204328</u>	<u>SN 2MS204329</u>
INSERTION LOSS	J1-J2 = 1.11 dB J1-J3 = 1.03 dB	J1-J2 = 1.29 dB J1-J3 = 1.16 dB
ISOLATION	J1-J2 = > 60 dB J1-J3 = > 60 dB	J1-J2 = > 60 dB J1-J3 = > 60 dB
INPUT VSWR	J1 to J2 = 1.19 : 1 J1 to J3 = 1.33 : 1	J1 to J2 = 1.63 : 1 J1 to J3 = 1.54 : 1
OUTPUT VSWR	J1 to J2 = 1.36 : 1 J1 to J3 = 1.31 : 1	J1 to J2 = 1.70 : 1 J1 to J3 = 1.51 : 1
DELAY – “ON”	J1 to J2 = 58 nSec J1 to J3 = 60 nSec	J1 to J2 = 60 nSec J1 to J3 = 60 nSec
DELAY – “OFF”	J1 to J2 = 42 nSec J1 to J3 = 44 nSec	J1 to J2 = 44 nSec J1 to J3 = 42 nSec
RISE TIME	J1 to J2 = 6 nSec J1 to J3 = 6 nSec	J1 to J2 = 8 nSec J1 to J3 = 8 nSec
FALL TIME	J1 to J2 = 4 nSec J1 to J3 = 4 nSec	J1 to J2 = 4 nSec J1 to J3 = 4 nSec
CURRENT DRAW	+5VDC = 36.1 mA -15VDC = 35.2 mA	+5VDC = 36.2 mA -15VDC = 36.6 mA

Testing performed on Hewlett Packard HP8720C Network Analyzer

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ALTITUDE/TEMPERATURE TESTING

AT BAE SYSTEMS, PRODUCT TESTING LAB, LANSDALE, PA

BOEING Model 380-10405-1 Rev. G
AMC Model No: SWSH-810-2DR-IND-SMC
ENVIRONMENTAL TESTING

SERIAL NUMBERS 2MS204328, 2M204329

The switches were hand carried to BAE Laboratories for high altitude (70K Ft.) testing at -55° C. Switching Speed (Delay “On” and “Off”) was measured before and after the test on both switches. In order to expose a switch to the combination of 70K Ft. altitude and -55° C temperature, it was necessary to power only one switch during testing. The heat generated by the power being applied to the switch made it impossible to maintain the temperature at altitude.

Switch Serial Number 2MS204328 was powered during the test and periodic measurements of switching speed were performed. Since this is a diode switch, not a mechanical solenoid, no changes were noted as a result of altitude or temperature.

Switch Serial Number 2MS204329 was measured before and after exposure to altitude and cold with no degradation in performance noted.

Equipment and cabling differences caused different measurement values from the baseline measurements taken at AMC. The tests were repeated at AMC with favorable results.

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ALTITUDE/TEMPERATURE TESTING

AT BAE SYSTEMS, PRODUCT TESTING LAB, LANSDALE, PA

BOEING Model 380-10405-1 Rev. G
 AMC Model No: SWSH-810-2DR-IND-SMC
 ENVIRONMENTAL TESTING

SERIAL NUMBERS: 2MS204328 (Monitored throughout test) (Altitude under power causes temp. to rise)
2MS204329 (Monitored before and after test) (-55° C throughout test)

SERIAL	DATE	TIME	TEMP*	ALTITUDE	DELAY ON	DELAY OFF
2MS204328	6/13/02	10:08 AM	25° C	Reference	76.5 nSec	71.8 nSec
		10:27 AM	-51° C	Reference	56 nSec	41 nSec
		10:42 AM	-41° C	70K Ft.	57 nSec	42 nSec
		11:33 AM	-28.1° C	70K Ft.	60 nSec	45 nSec
		12:53 PM	-37.5° C	70K Ft.	58 nSec	43 nSec
		2:10 PM	-37.6° C	70K Ft.	58 nSec	43 nSec
	6/14/02	8:30 AM	-36.9° C	70K Ft.	58 nSec.	44 nSec.
		10:05 AM	-38° C	70K Ft.	57 nSec.	43 nSec.
		11:00 AM	-37° C	70K Ft.	58 nSec.	43 nSec.
		12:45 PM	21.3° C	Reference	76.8 nSec.	66.2 nSec.

* Chamber Temperature = -55° C

Notes: Equipment and cabling differences cause different measurement values from baseline taken at AMC. The data will be repeated upon return to AMC.

Serial 204329 not powered during test in order to maintain temperature

SERIAL	DATE	TIME	TEMP*	ALTITUDE	DELAY ON	DELAY OFF
2MS204329	6/13/02	10:00 AM	25° C	Reference	78.5 nSec.	73 nSec.
	6/14/02	12:50 PM	21.3° C	Reference	79 nSec	72 nSec.

See Appendix A, Final BAE Report, for test conditions.

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POST ALTITUDE/COLD TESTS

BOEING Model 380-10405-1 Rev. G
 AMC Model No: SWSH-810-2DR-IND-SMC
 ENVIRONMENTAL TESTING

SWSH-810-2DR-IND-SMC SWITCH
 8.2 to 10.0 GHz

DATE: 6/17/02
 TESTED BY: R. AFABLE

SUMMARY TEST DATA		
GROUP 1	<u>SN 2MS204328</u>	<u>SN 2MS204329</u>
INSERTION LOSS	J1-J2 = 1.15 dB J1-J3 = 1.12 dB	J1-J2 = 1.38 dB J1-J3 = 1.26 dB
ISOLATION	J1-J2 = > 60 dB J1-J3 = > 60 dB	J1-J2 = > 60 dB J1-J3 = > 60 dB
INPUT VSWR	J1 to J2 = 1.16 : 1 J1 to J3 = 1.37 : 1	J1 to J2 = 1.52 : 1 J1 to J3 = 1.47 : 1
OUTPUT VSWR	J1 to J2 = 1.24 : 1 J1 to J3 = 1.23 : 1	J1 to J2 = 1.54 : 1 J1 to J3 = 1.40 : 1
DELAY – “ON”	J1 to J2 = 62 nSec J1 to J3 = 63 nSec	J1 to J2 = 68 nSec J1 to J3 = 68 nSec
DELAY – “OFF”	J1 to J2 = 42 nSec J1 to J3 = 44 nSec	J1 to J2 = 44 nSec J1 to J3 = 42 nSec
RISE TIME	J1 to J2 = 8 nSec J1 to J3 = 8 nSec	J1 to J2 = 9 nSec J1 to J3 = 8 nSec
FALL TIME	J1 to J2 = 4 nSec J1 to J3 = 4 nSec	J1 to J2 = 4 nSec J1 to J3 = 4 nSec
CURRENT DRAW	+5VDC = 35 mA -15VDC = 34 mA	+5VDC = 35 mA -15VDC = 36 mA

Testing performed on Hewlett Packard HP8720C Network Analyzer

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HUMIDITY (MOISTURE RESISTANCE) TESTING

AT MET LABS, BALTIMORE, MD

BOEING Model 380-10405-1 Rev. G
AMC Model No: SWSH-810-2DR-IND-SMC
ENVIRONMENTAL TESTING

SERIAL NUMBERS: 2MS204328 AND 2MS204329

The subject switches were sent to MET Labs for Humidity Testing after Post-Altitude testing was performed at AMC on 6/17/02.

The units were placed in a chamber at room temperature (25° C +/- 5° C) with a relative humidity between 20 and 55% (Ambient). The relative humidity was increased to 95% before the start of the first cycle. The chamber temperature was increased to +65° C in 2.5 hours while the Relative Humidity was maintained between 90 and 100%. This condition was maintained for 3 hours. The chamber temperature was reduced to 25° C in 2.5 hours while the Relative Humidity was maintained between 90 and 100%. Chamber temperature was immediately increased to +65° C in 2.5 hours while the Relative Humidity of 90 to 100% was maintained. This condition was, once again, maintained for 3 hours. . The chamber temperature was reduced to 25° C in 2.5 hours while the Relative Humidity was maintained between 90 and 100%. The chamber Temperature and Relative Humidity were held for 8 hours. This cycle was repeated 9 more times to give a total of 10 cycles.

No visual anomalies were discovered and the units were returned to AMC for immediate testing to the baseline measurements.

See Appendix B, Final MET Labs Report, for test conditions

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POST HUMIDITY TESTING

BOEING Model 380-10405-1 Rev. G
 AMC Model No: SWSH-810-2DR-IND-SMC
 ENVIRONMENTAL TESTING

SWSH-810-2DR-IND-SMC SWITCH
 8.2 to 10.0 GHz

DATE: 7/19/02
 TESTED BY: R. AFABLE

SUMMARY TEST DATA		
GROUP 1	<u>SN 2MS204328</u>	<u>SN 2MS204329</u>
INSERTION LOSS	J1-J2 = 1.30 dB J1-J3 = 1.21 dB	J1-J2 = 1.39 dB J1-J3 = 1.23 dB
ISOLATION	J1-J2 = > 60 dB J1-J3 = > 60 dB	J1-J2 = > 60 dB J1-J3 = > 60 dB
INPUT VSWR	J1 to J2 = 1.24 : 1 J1 to J3 = 1.32 : 1	J1 to J2 = 1.54 : 1 J1 to J3 = 1.48 : 1
OUTPUT VSWR	J1 to J2 = 1.39 : 1 J1 to J3 = 1.27 : 1	J1 to J2 = 1.53 : 1 J1 to J3 = 1.39 : 1
DELAY – “ON”	J1 to J2 = 66 nSec J1 to J3 = 72 nSec	J1 to J2 = 73 nSec J1 to J3 = 76 nSec
DELAY – “OFF”	J1 to J2 = 41 nSec J1 to J3 = 42 nSec	J1 to J2 = 44 nSec J1 to J3 = 40 nSec
RISE TIME	J1 to J2 = 10 nSec J1 to J3 = 10 nSec	J1 to J2 = 8 nSec J1 to J3 = 10 nSec
FALL TIME	J1 to J2 = 2 nSec J1 to J3 = 2 nSec	J1 to J2 = 2 nSec J1 to J3 = 2 nSec
CURRENT DRAW	+5VDC = 35 mA -15VDC = 35 mA	+5VDC = 35 mA -15VDC = 36 mA

Testing performed on Hewlett Packard HP8720C Network Analyzer

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CONCLUSIONS

BOEING Model 380-10405-1 Rev. G
AMC Model No: SWSH-810-2DR-IND-SMC
ENVIRONMENTAL TESTING

SERIAL NUMBERS 2MS204328, 2M204329

The testing performed at AMC on 7/19/02, after all Group 1 Environmental Tests were performed, indicated that the switches remained well within their specified tolerances for Insertion Loss, Isolation, Input and Output VSWR, Switching Time, and Power Supply Current Draw.

The Specified values for this switch are as follows:

- A. Insertion Loss must be less than 1.5 dB
- B. Isolation must be greater than 50dB
- C. Input and Output VSWR must be less than 2.0:1
- D. Switching Speed must be less than 2 uSeconds
- E. Power supply current was not specified, Voltage to be + 5VDC
And – 15 VDC +/- 0.5VDC in either case.

The switches remained well within these specified limits.

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FINAL TEST COMPARISON

BOEING Model 380-10405-1
 AMC Model No: SWSH-810-2DR-IND-SMC
 ENVIRONMENTAL TESTING

SWSH-810-2DR-IND-SMC SWITCH
 8.2 to 10.0 GHz

DATE: 5/24/02 AND 7/19/02
 TESTED BY: R. AFABLE

SUMMARY TEST DATA		
GROUP 1	<u>SN 2MS204328</u> 5/24/02 BASELINE	<u>SN 2MS204328</u> 7/19/02 FINAL
INSERTION LOSS	J1-J2 = 1.21 dB J1-J3 = 1.10 dB	J1-J2 = 1.30 dB J1-J3 = 1.21 dB
ISOLATION	J1-J2 = > 60 dB J1-J3 = > 60 dB	J1-J2 = > 60 dB J1-J3 = > 60 dB
INPUT VSWR	J1 to J2 = 1.19 : 1 J1 to J3 = 1.33 : 1	J1 to J2 = 1.24 : 1 J1 to J3 = 1.32 : 1
OUTPUT VSWR	J1 to J2 = 1.35 : 1 J1 to J3 = 1.30 : 1	J1 to J2 = 1.39 : 1 J1 to J3 = 1.27 : 1
DELAY – “ON”	J1 to J2 = 60 nSec J1 to J3 = 60 nSec	J1 to J2 = 66 nSec J1 to J3 = 72 nSec
DELAY – “OFF”	J1 to J2 = 42 nSec J1 to J3 = 43 nSec	J1 to J2 = 41 nSec J1 to J3 = 42 nSec
RISE TIME	J1 to J2 = 8 nSec J1 to J3 = 8 nSec	J1 to J2 = 10 nSec J1 to J3 = 10 nSec
FALL TIME	J1 to J2 = 4 nSec J1 to J3 = 4 nSec	J1 to J2 = 2 nSec J1 to J3 = 2 nSec
CURRENT DRAW	+5VDC = 36.1 mA -15VDC = 35.2 mA	+5VDC = 35 mA -15VDC = 36 mA

Testing performed on Hewlett Packard HP8720C Network Analyzer

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FINAL TEST COMPARISON

BOEING Model 380-10405-1 Rev. G
 AMC Model No: SWSH-810-2DR-IND-SMC
 ENVIRONMENTAL TESTING

SWSH-810-2DR-IND-SMC SWITCH
 8.2 to 10.0 GHz

DATE: 5/24/02 AND 7/19/02
 TESTED BY: R. AFABLE

SUMMARY TEST DATA		
GROUP 1	<u>SN 2MS204329</u> 5/24/02 BASELINE	<u>SN 2MS204329</u> 7/19/02 FINAL
INSERTION LOSS	J1-J2 = 1.36dB J1-J3 = 1.25 dB	J1-J2 = 1.39 dB J1-J3 = 1.23 dB
ISOLATION	J1-J2 = > 60 dB J1-J3 = > 60 dB	J1-J2 = > 60 dB J1-J3 = > 60 dB
INPUT VSWR	J1 to J2 = 1.61 : 1 J1 to J3 = 1.54 : 1	J1 to J2 = 1.54 : 1 J1 to J3 = 1.48 : 1
OUTPUT VSWR	J1 to J2 = 1.67 : 1 J1 to J3 = 1.51 : 1	J1 to J2 = 1.53 : 1 J1 to J3 = 1.39 : 1
DELAY – “ON”	J1 to J2 = 60 nSec J1 to J3 = 60 nSec	J1 to J2 = 73 nSec J1 to J3 = 76 nSec
DELAY – “OFF”	J1 to J2 = 44 nSec J1 to J3 = 42 nSec	J1 to J2 = 44 nSec J1 to J3 = 40 nSec
RISE TIME	J1 to J2 = 10 nSec J1 to J3 = 8 nSec	J1 to J2 = 8 nSec J1 to J3 = 10 nSec
FALL TIME	J1 to J2 = 4 nSec J1 to J3 = 4 nSec	J1 to J2 = 2 nSec J1 to J3 = 2 nSec
CURRENT DRAW	+5VDC = 36.2 mA -15VDC = 36.6 mA	+5VDC = 35 mA -15VDC = 36 mA

Testing performed on Hewlett Packard HP8720C Network Analyzer

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**SAND AND DUST, SALT SPRAY,
VIBRATION AND SHOCK TESTING**
AT MET LABS, BALTIMORE, MD

BOEING Model 380-10405-1 Rev. G
AMC Model No: SWSH-810-2DR-IND-SMC
ENVIRONMENTAL TESTING

SERIAL NUMBERS: 2MS204330 AND 2MS204331

The subject switches were sent to MET Labs for Sand and Dust, Salt Spray, Vibration and Shock testing after Baseline testing was performed at AMC on 5/24/02.

MET Labs performed the Salt Spray, Vibration and Shock tests in house. Dayton Brown Engineering and Test Division, Long Island, NY was subcontracted to perform the Sand and Dust test.

These tests were performed to MIL-STD-202F – Test Method Standard-Electronic and Electrical Component Parts:

- Method 110 – Condition A, Sand and Dust
- Method 101 – Condition B, Salt Spray
- Method 204 – Condition D, Vibration
- Method 213 – Condition B, Shock

No visual anomalies were discovered and the units were returned to AMC for immediate testing to the baseline measurements.

See Appendix B, Final MET Labs Report, for test conditions

DECEMBER 07, 2002

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POST MET LABS TESTING

BOEING Model 380-10405-1 Rev. G
 AMC Model No: SWSH-810-2DR-IND-SMC
 ENVIRONMENTAL TESTING

SWSH-810-2DR-IND-SMC SWITCH
 8.2 to 10.0 GHz

DATE: 6/13/02
 TESTED BY: R. AFABLE

SUMMARY TEST DATA		
GROUP 2	<u>SN 2MS204330</u>	<u>SN 2MS204331</u>
INSERTION LOSS	J1-J2 = 1.33dB J1-J3 = 1.35 dB	J1-J2 = 1.35dB J1-J3 = 1.19 dB
ISOLATION	J1-J2 = > 60 dB J1-J3 = > 60 dB	J1-J2 = > 60 dB J1-J3 = > 60 dB
INPUT VSWR	J1 to J2 = 1.09 : 1 J1 to J3 = 1.18 : 1	J1 to J2 = 1.46 : 1 J1 to J3 = 1.36 : 1
OUTPUT VSWR	J1 to J2 = 1.17 : 1 J1 to J3 = 1.26 : 1	J1 to J2 = 1.24 : 1 J1 to J3 = 1.18 : 1
DELAY – “ON”	J1 to J2 = 60 nSec J1 to J3 = 65 nSec	J1 to J2 = 63 nSec J1 to J3 = 66 nSec
DELAY – “OFF”	J1 to J2 = 42 nSec J1 to J3 = 42 nSec	J1 to J2 = 42 nSec J1 to J3 = 42 nSec
RISE TIME	J1 to J2 = 9 nSec J1 to J3 = 12 nSec	J1 to J2 = 8 nSec J1 to J3 = 9 nSec
FALL TIME	J1 to J2 = 4 nSec J1 to J3 = 4 nSec	J1 to J2 = 4 nSec J1 to J3 = 4 nSec
CURRENT DRAW	+5VDC = 35mA -15VDC = 30mA	+5VDC = 35mA -15VDC = 34mA

Testing performed on Hewlett Packard HP8720C Network Analyzer

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1000 HOUR LIFE TEST

AT AMERICAN MICROWAVE CORPORATION, FREDERICK, MD

BOEING Model 380-10405-1 Rev. G
AMC Model No: SWSH-810-2DR-IND-SMC
ENVIRONMENTAL TESTING

SERIAL NUMBERS: 2MS204330 AND 2MS204331

The subject switches were placed in an oven stabilized at 110° C on 6/13/02 after tests were performed following MET Labs testing. The two units remained in the oven for a total of 1000 hours. The following charts document the performance of this test.

No visual anomalies were discovered and the units were tested and compared to the baseline measurements.

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1000 HOUR LIFE TEST

BOEING Model 380-10405-1 Rev. G
AMC Model No: SWSH-810-2DR-IND-SMC
ENVIRONMENTAL TESTING

SERIAL NUMBERS:
2MS204330
2MS204331

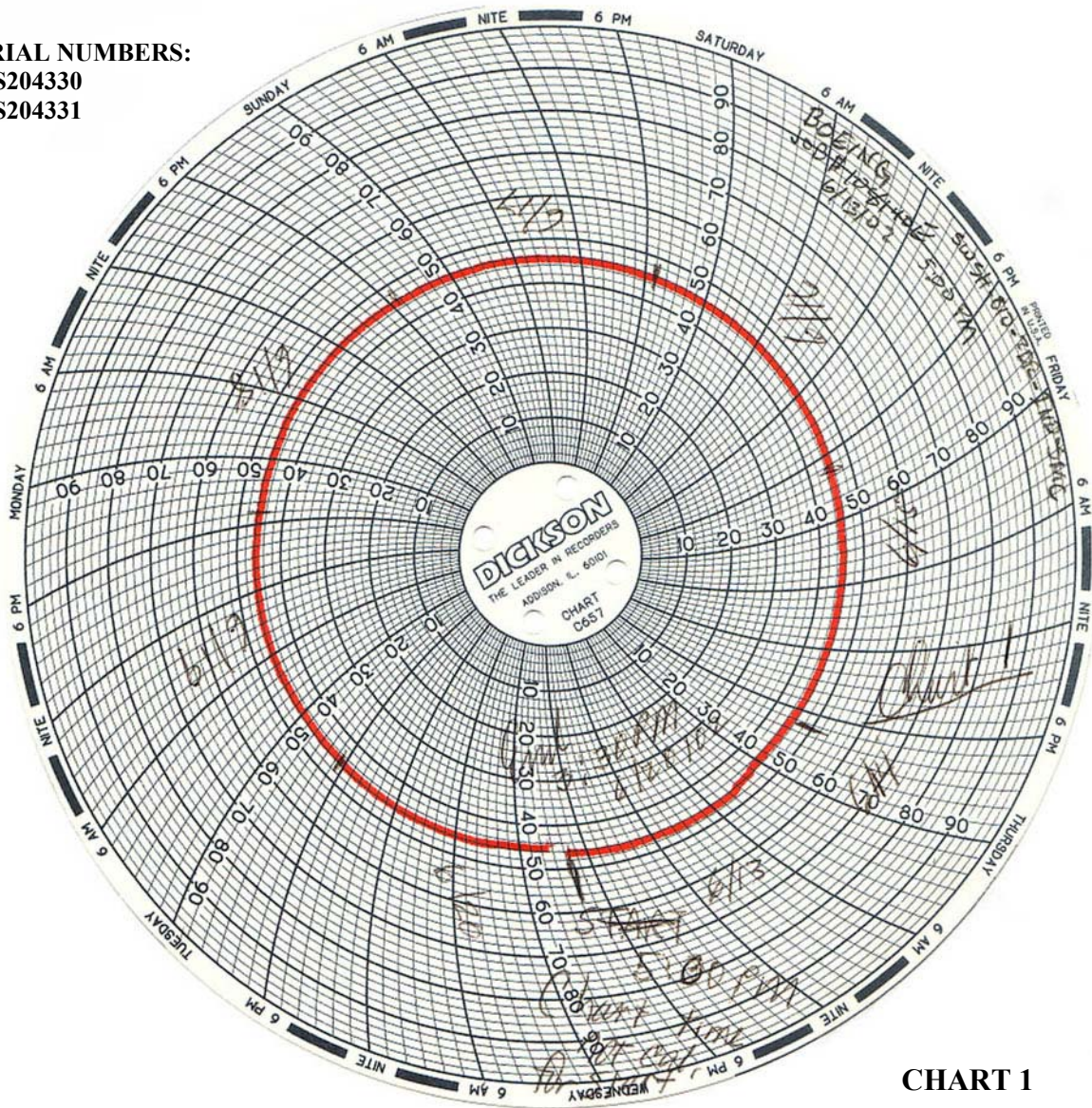


CHART 1

FULL SCALE = 250° C
TEST TEMPERATURE = 110° C
OVEN STABILITY = ± 5° C

START TIME: 6/13/02 @ 5:00PM
END TIME: 6/20/02 @ 3:30PM
TOTAL TIME THIS CHART = 166.5 HRS

(CHART DATE/TIME IS NOT REFERENCED. ACTUAL DATES AND TIMES ARE RECORDED)

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1000 HOUR LIFE TEST

BOEING Model 380-10405-1 Rev. G
AMC Model No: SWSH-810-2DR-IND-SMC
ENVIRONMENTAL TESTING

SERIAL NUMBERS:
2MS204330
2MS204331

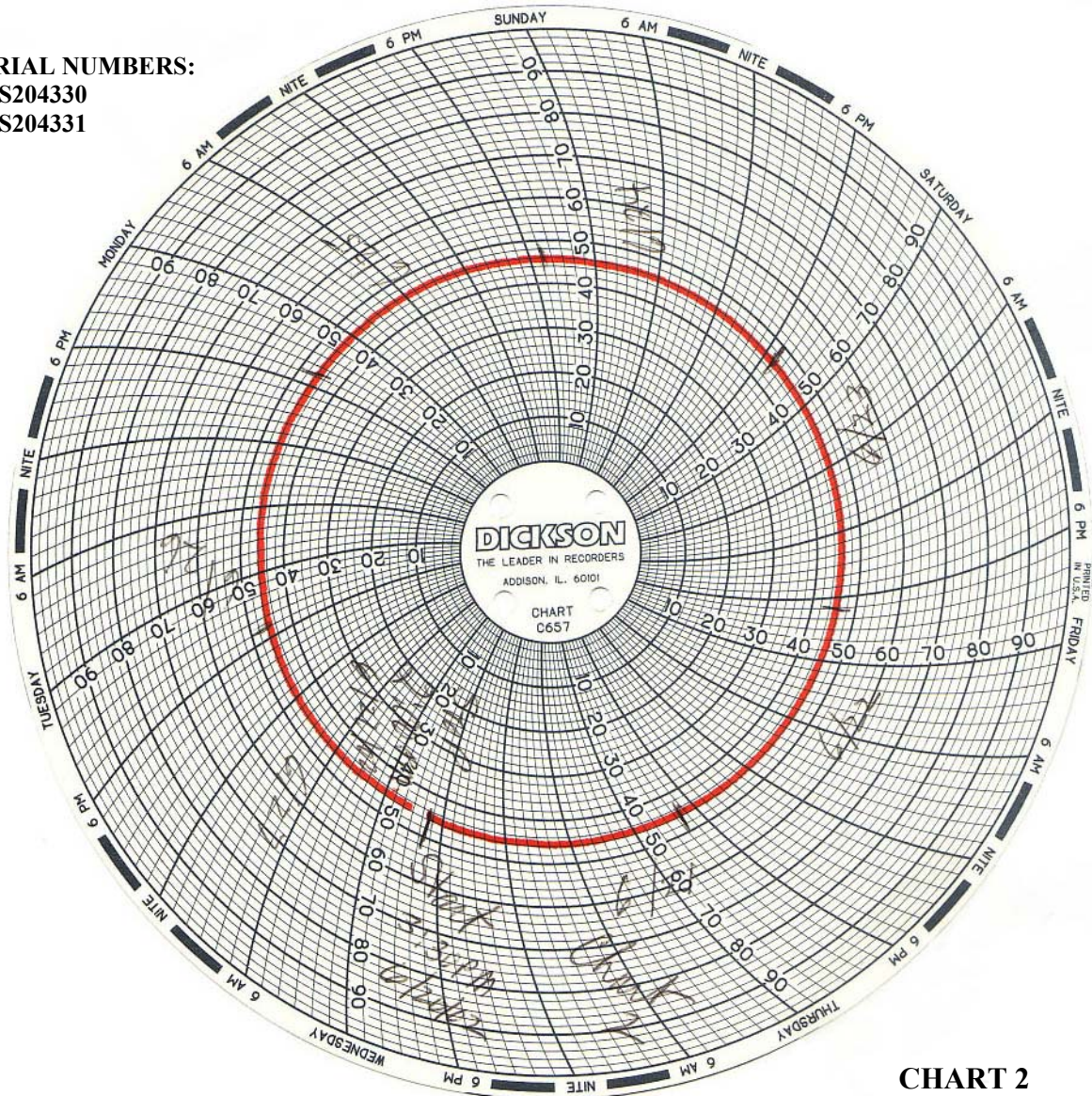


CHART 2

FULL SCALE = 250° C
TEST TEMPERATURE = 110° C
OVEN STABILITY = ± 5° C

START TIME: 6/20/02 @ 3:30PM
END TIME: 6/27/02 @ 2:00PM
TOTAL TIME THIS CHART = 166.5 HRS

(CHART DATE/TIME IS NOT REFERENCED. ACTUAL DATES AND TIMES ARE RECORDED)

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1000 HOUR LIFE TEST

BOEING Model 380-10405-1 Rev. G
AMC Model No: SWSH-810-2DR-IND-SMC
ENVIRONMENTAL TESTING

SERIAL NUMBERS:
2MS204330
2MS204331

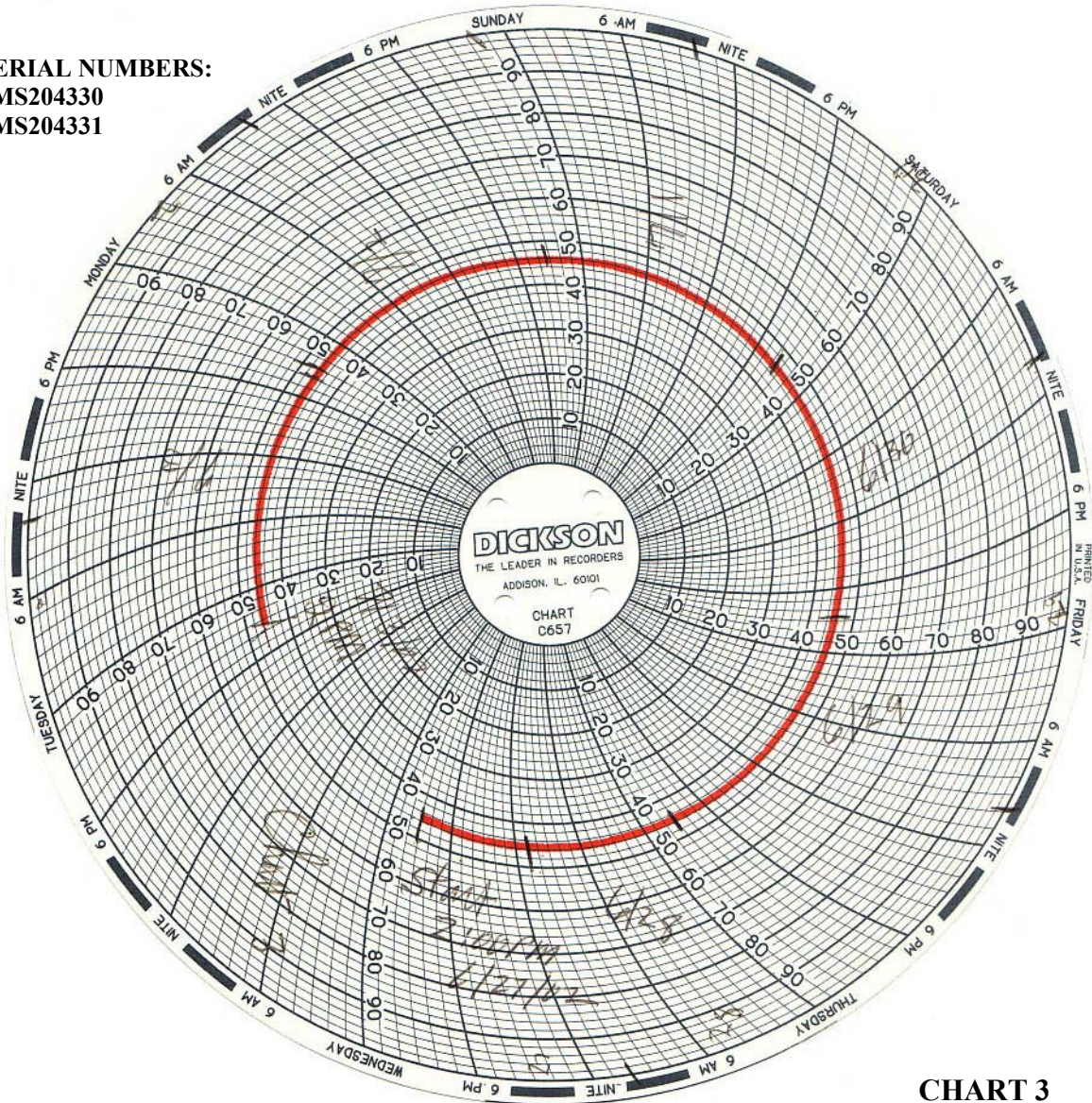


CHART 3

FULL SCALE = 250° C
TEST TEMPERATURE = 110° C
OVEN STABILITY = ± 5° C

START TIME: 6/27/02 @ 2:00PM
END TIME: 7/03/02 @ 2:00PM
TOTAL TIME THIS CHART = 144.0 HRS

(CHART DATE/TIME IS NOT REFERENCED. ACTUAL DATES AND TIMES ARE RECORDED)

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1000 HOUR LIFE TEST

BOEING Model 380-10405-1 Rev. G
AMC Model No: SWSH-810-2DR-IND-SMC
ENVIRONMENTAL TESTING

SERIAL NUMBERS:
2MS204330
2MS204331

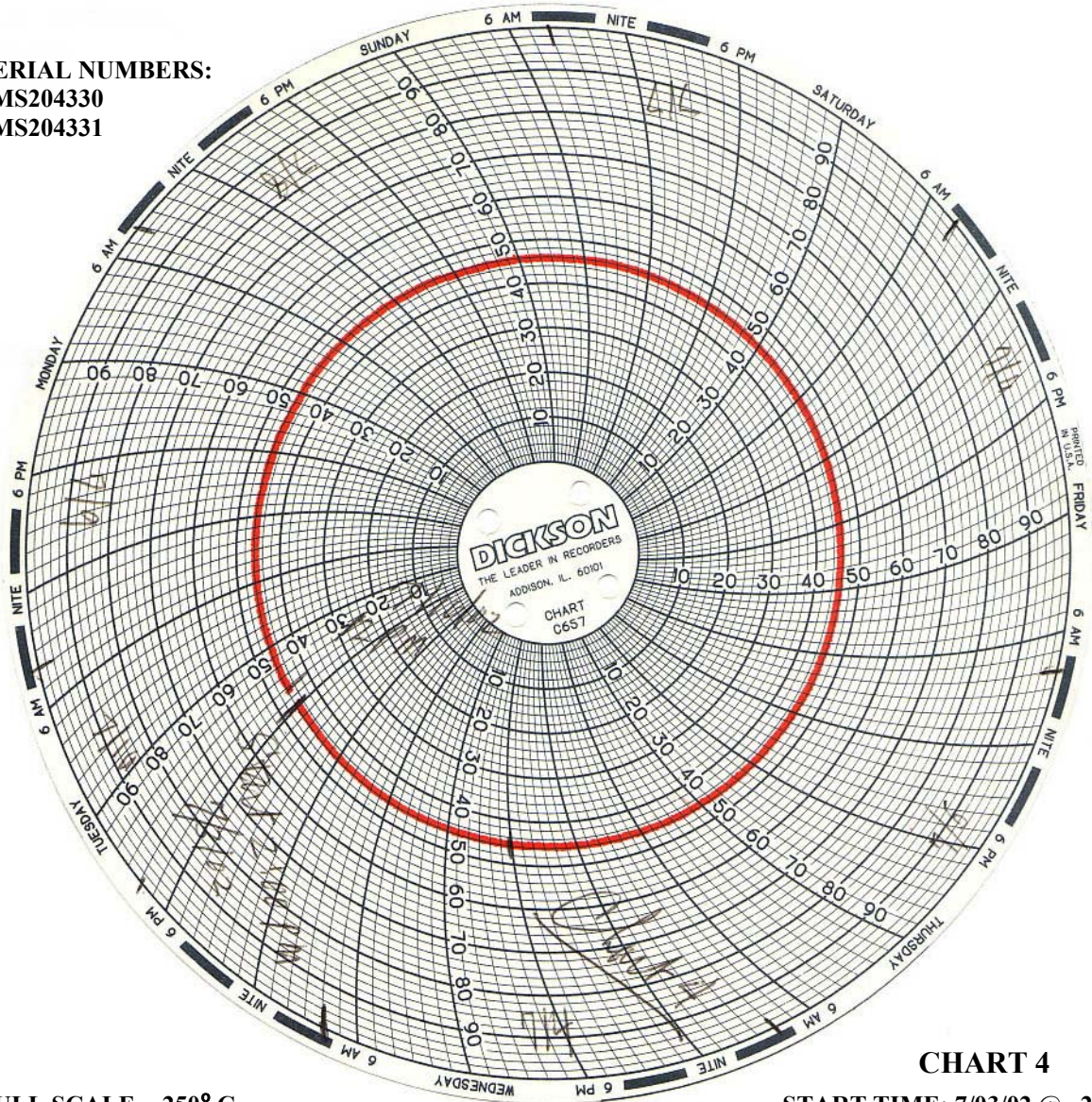


CHART 4

FULL SCALE = 250° C
TEST TEMPERATURE = 110° C
OVEN STABILITY = ± 5° C

START TIME: 7/03/02 @ 2:00PM
END TIME: 7/10/02 @ 12:00PM
TOTAL TIME THIS CHART = 166.0 HRS

(CHART DATE/TIME IS NOT REFERENCED. ACTUAL DATES AND TIMES ARE RECORDED)

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1000 HOUR LIFE TEST

BOEING Model 380-10405-1 Rev. G
AMC Model No: SWSH-810-2DR-IND-SMC
ENVIRONMENTAL TESTING

SERIAL NUMBERS:
2MS204330
2MS204331

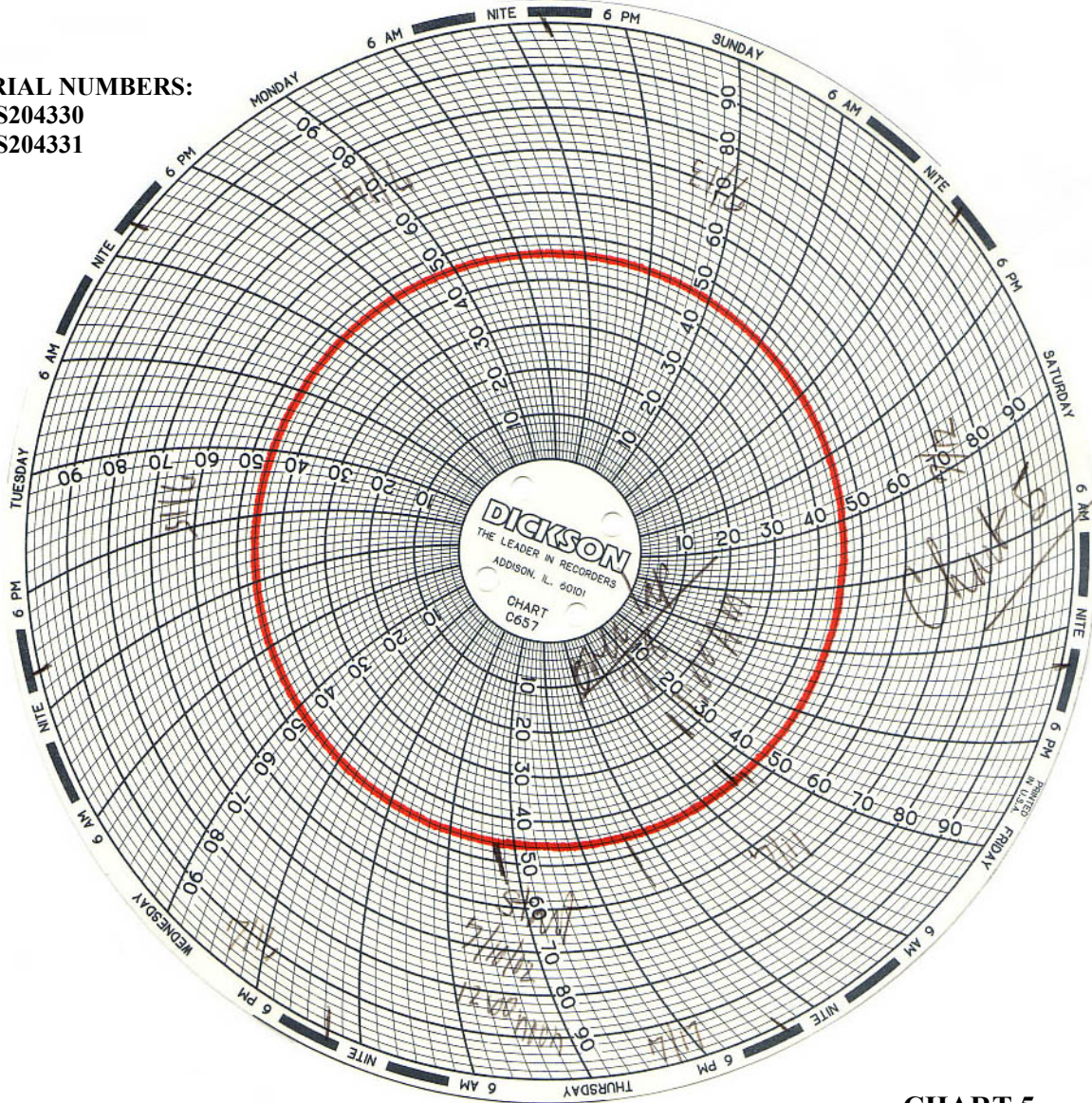


CHART 5

FULL SCALE = 250° C NOTE: THIS CHART OVERLAPPED START TIME: 7/10/02 @ 12:00PM
TEST TEMPERATURE = 110° C END TIME: 7/18/02 @ 11:00AM
OVEN STABILITY = ± 5° C TOTAL TIME THIS CHART = 191.0 HRS
(CHART DATE/TIME IS NOT REFERENCED. ACTUAL DATES AND TIMES ARE RECORDED)

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1000 HOUR LIFE TEST

BOEING Model 380-10405-1 Rev. G
AMC Model No: SWSH-810-2DR-IND-SMC
ENVIRONMENTAL TESTING

SERIAL NUMBERS:
2MS204330
2MS204331

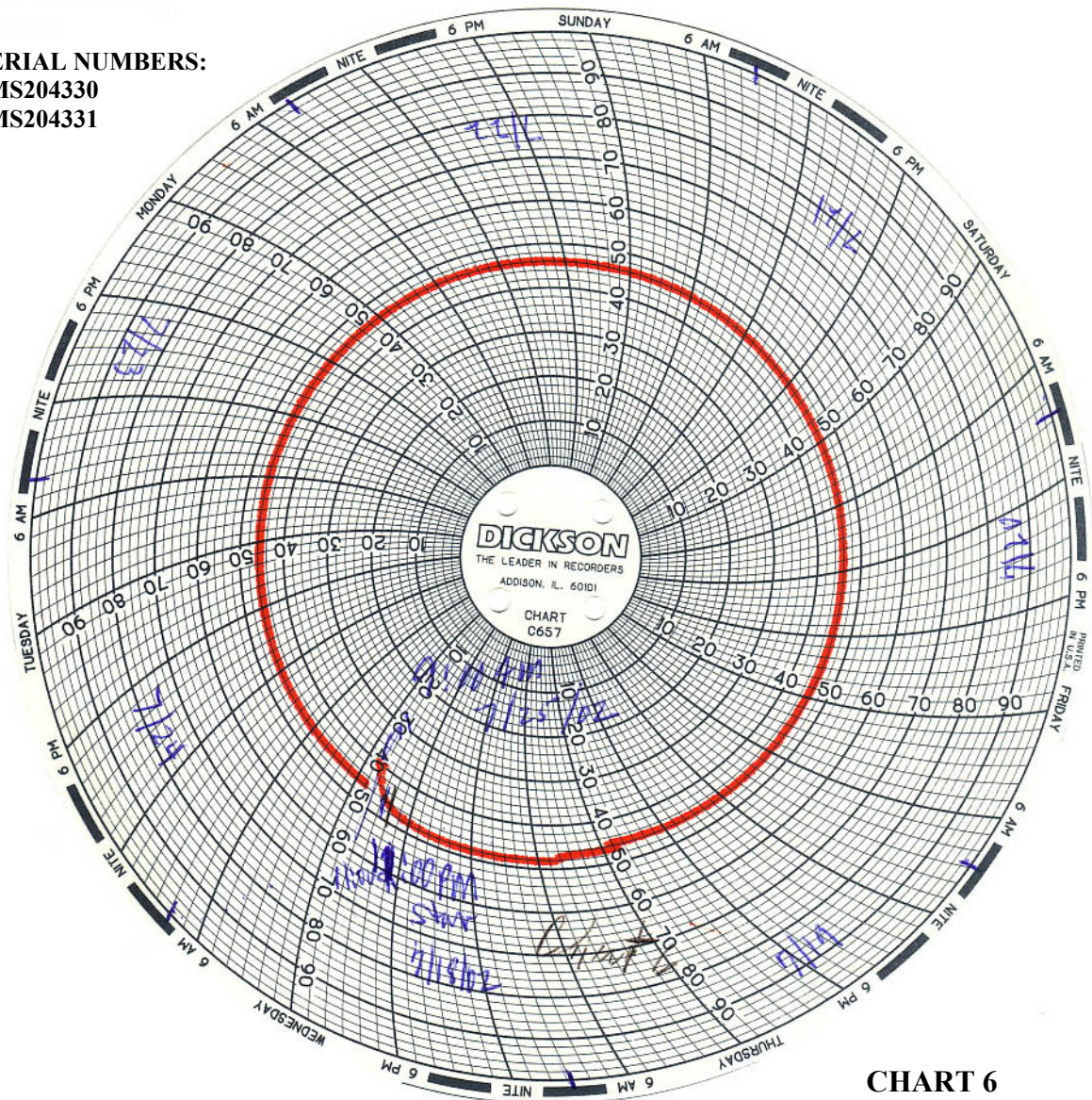


CHART 6

FULL SCALE = 250° C
TEST TEMPERATURE = 110° C
OVEN STABILITY = ± 5° C

START TIME: 7/18/02 @ 11:00AM
END TIME: 7/25/02 @ 09:00AM
TOTAL TIME THIS CHART = 166.0 HRS
(CHART DATE/TIME IS NOT REFERENCED. ACTUAL DATES AND TIMES ARE RECORDED)

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1000 HOUR LIFE TEST

BOEING Model 380-10405-1 Rev. G
AMC Model No: SWSH-810-2DR-IND-SMC
ENVIRONMENTAL TESTING

SERIAL NUMBERS: 2MS204330 & 2MS204331

TEST SUMMARY

CHART	START TIME	END TIME	TOTAL TIME	CUMULATIVE
1	6/13/02 @ 5:00PM	6/20/02 @ 3:30PM	166.5 HOURS	
2	6/20/02 @ 3:30PM	6/27/02 @ 2:00PM	166.5 HOURS	333 HOURS
3	6/27/02 @ 2:00PM	7/03/02 @ 2:00PM	144 HOURS	477 HOURS
4	7/03/02 @ 2:00PM	7/10/02 @ 12:00PM	166 HOURS	643 HOURS
5*	7/10/02 @ 12:00PM	7/18/02 @ 11:00AM	191 HOURS	834 HOURS
6	7/18/02 @ 11:00AM	7/25/02 @ 9:00AM	166 HOURS	1000 HOURS

* CHART 5 OVERLAPPED

THE OVEN WAS SHUT DOWN AND THE UNITS WERE ALLOWED TO COOL FOR 3 HOURS BEFORE REMOVAL.

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POST LIFE TEST

BOEING Model 380-10405-1 Rev. G
 AMC Model No: SWSH-810-2DR-IND-SMC
 ENVIRONMENTAL TESTING

SWSH-810-2DR-IND-SMC SWITCH
 8.2 to 10.0 GHz

DATE: 7/29/02
 TESTED BY: R. AFABLE

SUMMARY TEST DATA		
GROUP 2	<u>SN 2MS204330</u>	<u>SN 2MS204331</u>
INSERTION LOSS	J1-J2 = 1.11 dB J1-J3 = 1.13 dB	J1-J2 = 1.14 dB J1-J3 = 0.97 dB
ISOLATION	J1-J2 = > 60 dB J1-J3 = > 60 dB	J1-J2 = > 60 dB J1-J3 = > 60 dB
INPUT VSWR	J1 to J2 = 1.13 : 1 J1 to J3 = 1.18 : 1	J1 to J2 = 1.43 : 1 J1 to J3 = 1.33 : 1
OUTPUT VSWR	J1 to J2 = 1.16 : 1 J1 to J3 = 1.24 : 1	J1 to J2 = 1.32 : 1 J1 to J3 = 1.22 : 1
DELAY – “ON”	J1 to J2 = 48 nSec J1 to J3 = 48 nSec	J1 to J2 = 70 nSec J1 to J3 = 82 nSec
DELAY – “OFF”	J1 to J2 = 42 nSec J1 to J3 = 42 nSec	J1 to J2 = 42 nSec J1 to J3 = 42 nSec
RISE TIME	J1 to J2 = 8 nSec J1 to J3 = 12 nSec	J1 to J2 = 10 nSec J1 to J3 = 12 nSec
FALL TIME	J1 to J2 = 2 nSec J1 to J3 = 2 nSec	J1 to J2 = 2 nSec J1 to J3 = 2 nSec
CURRENT DRAW	+5VDC = 35 mA -15VDC = 34 mA	+5VDC = 35 mA -15VDC = 34 mA

Testing performed on Hewlett Packard HP8720C Network Analyzer

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CONCLUSIONS

BOEING Model 380-10405-1 Rev. G
AMC Model No: SWSH-810-2DR-IND-SMC
ENVIRONMENTAL TESTING

SERIAL NUMBERS: 2MS204330, 2M204331

The testing performed at AMC on 7/29/02, after all Group 2 Environmental Tests were performed, indicated that the switches remained well within their specified tolerances for Insertion Loss, Isolation, Input and Output VSWR, Switching Time, and Power Supply Current Draw.

The Specified values for this switch are as follows:

- A. Insertion Loss must be less than 1.5 dB
- B. Isolation must be greater than 50dB
- C. Input and Output VSWR must be less than 2.0:1
- D. Switching Speed must be less than 2 uSeconds
- E. Power supply current was not specified, Voltage to be + 5VDC
And – 15 VDC +/- 0.5VDC in either case.

The switches remained well within these specified limits.

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FINAL TEST COMPARISON

BOEING Model 380-10405-1 Rev. G
 AMC Model No: SWSH-810-2DR-IND-SMC
 ENVIRONMENTAL TESTING

SWSH-810-2DR-IND-SMC SWITCH
 8.2 to 10.0 GHz

DATE: 5/24/02 AND 7/29/02
 TESTED BY: R. AFABLE

SUMMARY TEST DATA		
GROUP 2	<u>SN 2MS204330</u> 5/24/02 BASELINE	<u>SN 2MS204330</u> 7/29/02 FINAL
INSERTION LOSS	J1-J2 = 1.11 dB J1-J3 = 1.13 dB	J1-J2 = 1.11 dB J1-J3 = 1.13 dB
ISOLATION	J1-J2 = > 60 dB J1-J3 = > 60 dB	J1-J2 = > 60 dB J1-J3 = > 60 dB
INPUT VSWR	J1 to J2 = 1.13 : 1 J1 to J3 = 1.18 : 1	J1 to J2 = 1.13 : 1 J1 to J3 = 1.18 : 1
OUTPUT VSWR	J1 to J2 = 1.16 : 1 J1 to J3 = 1.24 : 1	J1 to J2 = 1.16 : 1 J1 to J3 = 1.24 : 1
DELAY – “ON”	J1 to J2 = 48 nSec J1 to J3 = 48 nSec	J1 to J2 = 48 nSec J1 to J3 = 48 nSec
DELAY – “OFF”	J1 to J2 = 42 nSec J1 to J3 = 42 nSec	J1 to J2 = 42 nSec J1 to J3 = 42 nSec
RISE TIME	J1 to J2 = 8 nSec J1 to J3 = 12 nSec	J1 to J2 = 8 nSec J1 to J3 = 12 nSec
FALL TIME	J1 to J2 = 2 nSec J1 to J3 = 2 nSec	J1 to J2 = 2 nSec J1 to J3 = 2 nSec
CURRENT DRAW	+5VDC = 35 mA -15VDC = 34 mA	+5VDC = 35 mA -15VDC = 34 mA

Testing performed on Hewlett Packard HP8720C Network Analyzer

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FINAL TEST COMPARISON

BOEING Model 380-10405-1 Rev. G
 AMC Model No: SWSH-810-2DR-IND-SMC
 ENVIRONMENTAL TESTING

SWSH-810-2DR-IND-SMC SWITCH
 8.2 to 10.0 GHz

DATE: 5/24/02 AND 7/29/02
 TESTED BY: R. AFABLE

SUMMARY TEST DATA		
GROUP 2	<u>SN 2MS204331</u> 5/24/02 BASELINE	<u>SN 2MS204331</u> 7/29/02 FINAL
INSERTION LOSS	J1-J2 = 1.46dB J1-J3 = 1.38 dB	J1-J2 = 1.14 dB J1-J3 = 0.97 dB
ISOLATION	J1-J2 = > 60 dB J1-J3 = > 60 dB	J1-J2 = > 60 dB J1-J3 = > 60 dB
INPUT VSWR	J1 to J2 = 1.30 : 1 J1 to J3 = 1.30 : 1	J1 to J2 = 1.43 : 1 J1 to J3 = 1.33 : 1
OUTPUT VSWR	J1 to J2 = 1.42 : 1 J1 to J3 = 1.41 : 1	J1 to J2 = 1.32 : 1 J1 to J3 = 1.22 : 1
DELAY – “ON”	J1 to J2 = 64 nSec J1 to J3 = 66 nSec	J1 to J2 = 70 nSec J1 to J3 = 82 nSec
DELAY – “OFF”	J1 to J2 = 42 nSec J1 to J3 = 42 nSec	J1 to J2 = 42 nSec J1 to J3 = 42 nSec
RISE TIME	J1 to J2 = 8 nSec J1 to J3 = 9 nSec	J1 to J2 = 10 nSec J1 to J3 = 12 nSec
FALL TIME	J1 to J2 = 4 nSec J1 to J3 = 4 nSec	J1 to J2 = 2 nSec J1 to J3 = 2 nSec
CURRENT DRAW	+5VDC = 36.1 mA -15VDC = 35.3 mA	+5VDC = 35 mA -15VDC = 34 mA

Testing performed on Hewlett Packard HP8720C Network Analyzer

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