



**AMERICAN MICROWAVE
CORPORATION**

DATA

ON

8.3 TO 11.7 GHz

(WITH MEASURED DATA FROM 2.0 TO 18.0 GHz)

+35 dBm, HIGH POWER

+40 dBm, SURVIVAL POWER

80 dB, HIGH ISOLATION

LOW POWER CONSUMPTION

LOW DISTORTION

LOW SPURIOUS

SPDT

REFLECTIVE

AND

HIGH RELIABILITY

SOLID STATE SWITCH/MODULATOR

AMC MODEL NO:

SWN-RRA-2DRH-COMDEV

SERIAL NUMBERS: 2MS707276, 2MS704238 AND 2MS704240 THRU 2MS704243

DESIGNED

BY

A. K. GORWARA

TESTED

BY

R. AFABLE OF AMC AND COMDEV SPACE GROUP, CANADA

REPORT PREPARED

BY

P. WOOD

25 MAY 1998

WEB PAGE: [HTTP://WWW.AMWAVE.COM](http://www.amwave.com)

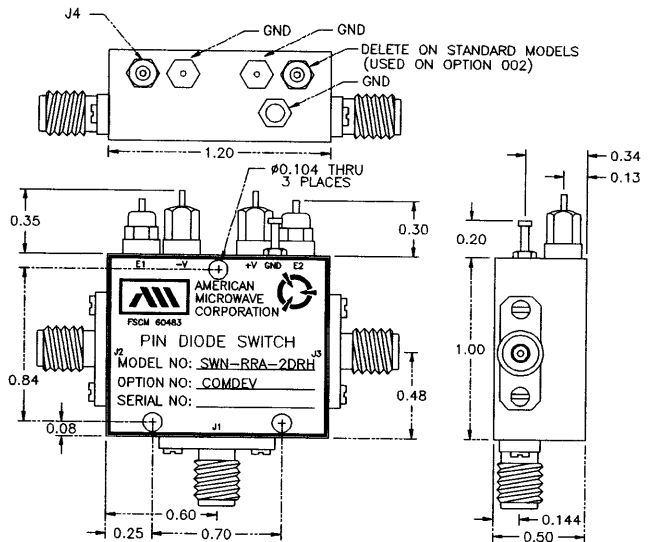
E-MAIL ADDRESS: AMCPMI@AOL.COM

7311 G GROVE ROAD, FREDERICK, MARYLAND 21704 • Tel. (301) 662-4700 • Fax (301) 662-4938

8.3 TO 11.7 GHz HIGH POWER, HIGH ISOLATION SPDT, PIN DIODE SWITCH

KEY FEATURES

- HIGH RELIABILITY
- HIGH POWER-10 WATTS MAX.
- HIGH ISOLATION-80 dB MIN.
- LOW DISTORTION
- LOW INSERTION LOSS
- TTL LOGIC COMPATIBLE



SPECIFICATIONS

- FREQUENCY : 8.3 TO 11.7 GHz (Other Frequency Ranges from 2.0 to 18.0 GHz are Available)
- INSERTION LOSS : ≤ 2.5 dB
- INSERTION LOSS VARIATION : ± 0.6 dB Max. Variation over Frequency
: ± 0.3 dB Max. Variation over Temperature
(Nominal Insertion Loss is the value measured at an ambient temperature of 25°C at 10.0 GHz. The Insertion Loss Variation is the change from Nominal Insertion Loss over Frequency and Temperature)
- INSERTION LOSS VARIATION (OUTPUTS) : ± 0.5 dB Max. Variation between outputs @ Ambient Temperature
- VSWR : 2.0:1 Max.
- ISOLATION : 80 dB Min.
- SWITCHING SPEED : 800ns Max. (10% Control to 90% RF or 90% Control to 10% RF)
- RF INPUT POWER : +35 dBm Max. Peak Pulse or CW Input Power
- HARMONIC LEVELS : -30 dBc (At Maximum Input Power)
- VIDEO TRANSIENTS : ≤ 1 Volt P-P in 300 Mhz BW (Typical),
: ≤ 200 mV P-P in 20 Mhz BW (Typical)
- SPURIOUS : -115 dBc @ 200 MHz from Carrier @ 10 GHz and +29.5 dBm
- POWER SUPPLY : + 5 vdc, $\pm 5\%$ @ 160 mA Max.
: - 12 vdc, $\pm 5\%$ @ 50 mA Max.
- OPERATING TEMPERATURE : 0° C TO +75° C
- CONTROL LOGIC : "0" = Vin LOW (ON), "1" = Vin HIGH (OFF)
- CONTROL VOLTAGES (TTL) : Vin LOW = - 0.3 vdc TO +0.8 vdc @ 1mA Max.
: Vin HIGH = +2.0 vdc TO +5.0 vdc @ 1mA Max.
- SIZE : 1.20" X 1.00" X 0.50"
- WEIGHT : ≤ 30 GRAMS., (≤ 1.06 oz.)

SUMMARY TEST DATA



- **VOLTAGE & CURRENT DRAW** : + 5 vdc @ 68 mA
: -12 vdc @ 6 Ma
- **MTBF** : ≥1,000,000 hrs.

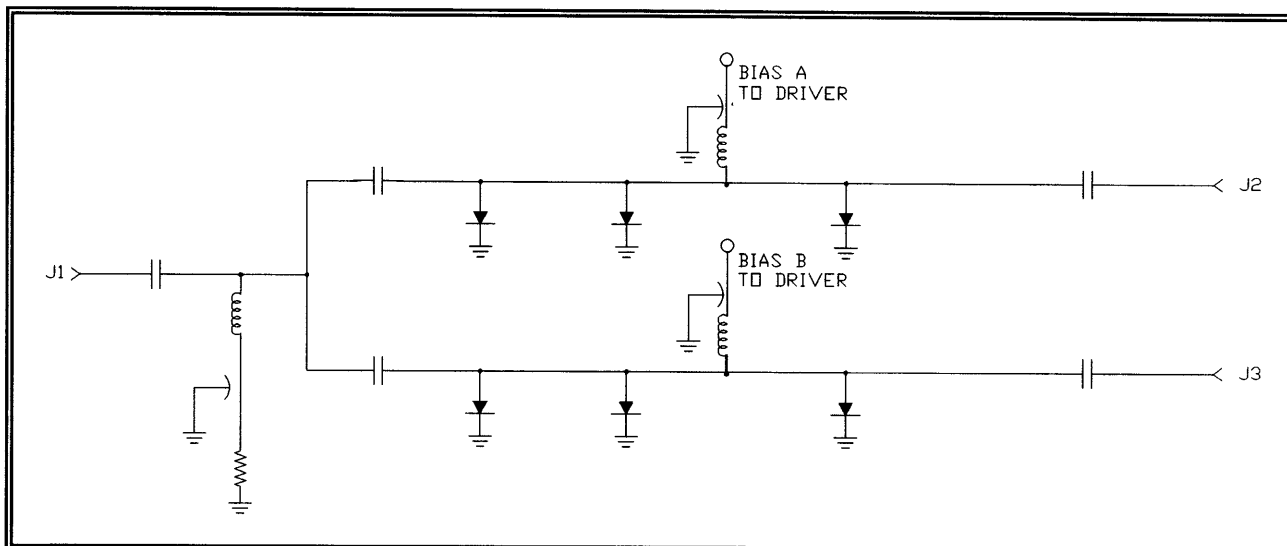
ENVIRONMENTAL CONDITIONS

- **TEMPERATURE** : -54°C TO + 85°C (OPERATING)
: -65°C TO +100°C (STORAGE)
- **HUMIDITY** : MIL-STD-202F, METHOD 103B, CONDITION B, 95%
- **SHOCK** : MIL-STD-202F, METHOD 213B, CONDITION B
- **VIBRATION** : MIL-STD-202F, METHOD 204D, CONDITION B
- **ALTITUDE** : MIL-STD-202F, METHOD 105C, CONDITION B
- **TEMPERATURE CYCLING** : MIL-STD-202F, METHOD 107D, CONDITION A

ADDITIONAL ENVIRONMENTAL CONDITIONS

- **EMC** (-115 dBc up to 200 Mhz away from the carrier frequency of 10 Ghz @ +29.5 dBm level)
- | | | |
|---------------------------------|------------------------------|------------------------------------|
| CONDUCTED EMISSIONS | : CE01 POWER LINES | 63 Hz to 15 kHz |
| | : CE03 POWER LINES | 15 kHz to 50 Mhz |
| CONDUCTED SUSCEPTIBILITY | : CS01 POWER & CONTROL LINES | 63 Hz to 50 kHz (100mV rms) |
| | : CS02 POWER & CONTROL LINES | 50 kHz to 400 MHz (100mV rms) |
| RADIATED EMISSIONS | : RE01 MAGNETIC FIELD | 30 Hz to 50 kHz |
| | : RE02 NB ELECTRIC FIELD | 14 kHz to 10 GHz |
| | : RE02 NB ELECTRIC FIELD | 10 GHz to 18 GHz (60 dB μ V/m) |
| | : RE02 NB ELECTRIC FIELD | 14 kHz to 1GHz |
| RADIATED SUSCEPTIBILITY | : RS01 MAGNETIC FIELD | 30 Hz to 50 kHz |
| | : RS02 ELECTRIC FIELD | 14 kHz to 18 GHz (1V/m) |

FUNCTIONAL SCHEMATIC



SPDT HIGH POWER SWITCH, SWN-RRA-2DRH-COMDEV

MAY 25, 1998

SUMMARY TEST DATA

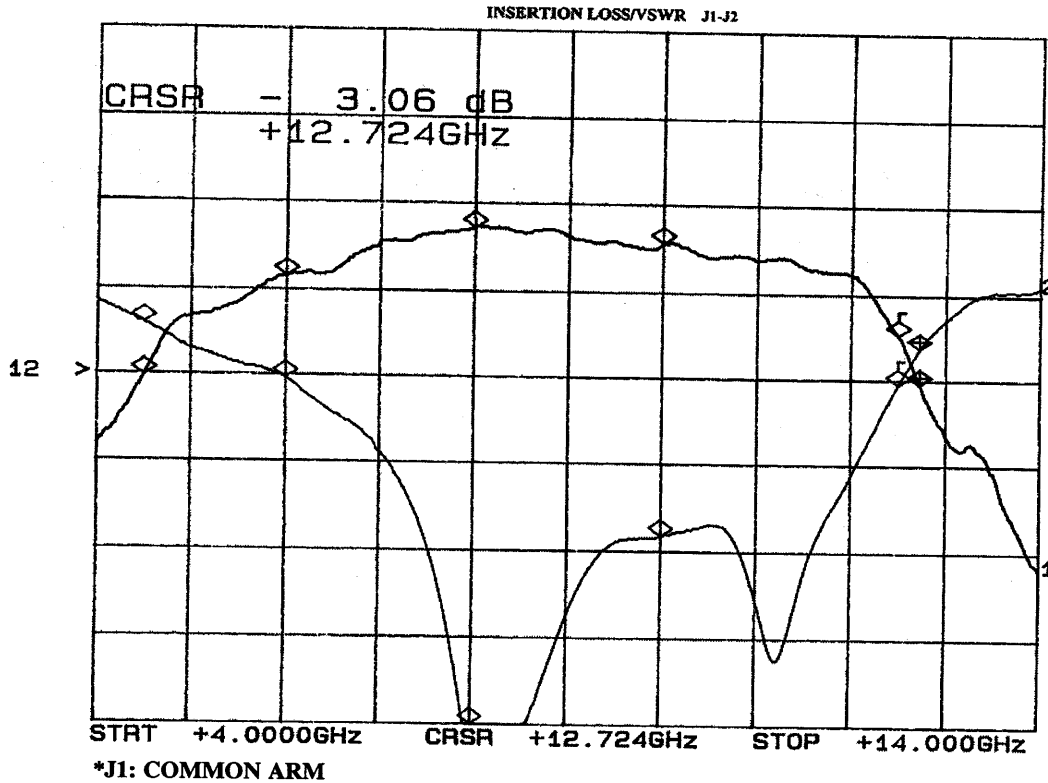


MODEL NUMBER	: SWN-RRA-2DRH-COMDEV
SERIAL NUMBER	: 2MS707276
TECHNICIAN	: RENE AFABLE
VOLTAGE & CURRENT DRAW	: + 5 vdc @ 68 mA
	: -12 vdc @ 6 mA

INSERTION LOSS AND VSWR J1-J2*

AS MEASURED FROM 4.0 TO 14.0 GHz

CH1: C -M - 3.06 dB	CH2: A -M - 7.69 dB
1.0 dB/ REF - 3.00 dB	5.0 dB/ REF - 9.54 dB



S/N	FREQUENCY	INSERTION LOSS (dB)	RETURN LOSS (dB)	VSWR
1	4.5 GHz	3.01	-6.50	2.8:1
2	6.0 GHz	1.83	-9.70	1.97:1
3	8.0 GHz	1.27	-31.6	1.05:1
4	10.0 GHz	1.44	-18.6	1.27:1
5	12.5 GHz	2.48	-9.80	1.96:1
6	12.7 GHz	3.06	-7.69	2.40:1

MAY 25, 1998

SUMMARY TEST DATA

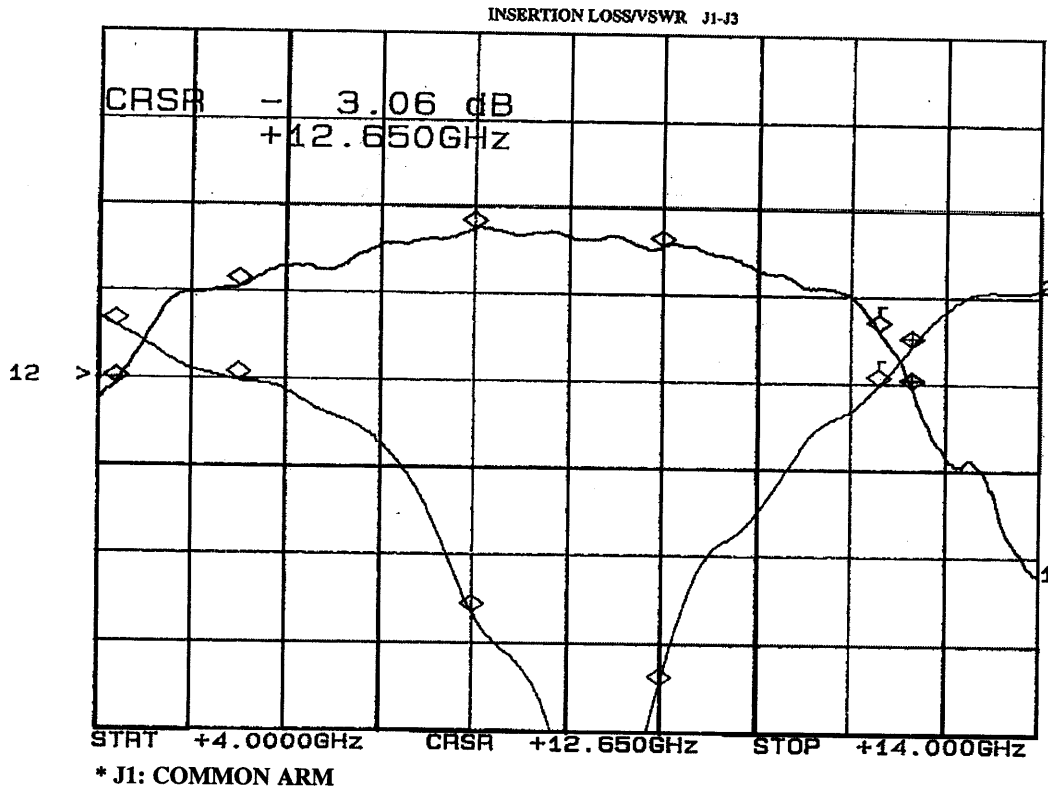


MODEL NUMBER	: SWN-RRA-2DRH-COMDEV
SERIAL NUMBER	: 2MS707276
TECHNICIAN	: RENE AFABLE
VOLTAGE & CURRENT DRAW	: + 5 vdc @ 68 mA
	: -12 vdc @ 6 mA

INSERTION LOSS AND VSWR J1-J3*

AS MEASURED FROM 4.0 TO 14.0 GHz

CH1: C -M REF - 3.06 dB	CH2: A -M REF - 7.37 dB
1.0 dB/	5.0 dB/



S/N	FREQUENCY	INSERTION LOSS (dB)	RETURN LOSS (dB)	VSWR
1	4.5 GHz	3.06	-6.60	2.76:1
2	6.0 GHz	1.93	-9.61	1.99:1
3	8.0 GHz	1.24	-22.7	1.16:1
4	10.0 GHz	1.43	-26.7	1.10:1
5	12.5 GHz	2.40	-9.57	2.00:1
6	12.7 GHz	3.06	-7.37	2.50:1

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SUMMARY TEST DATA

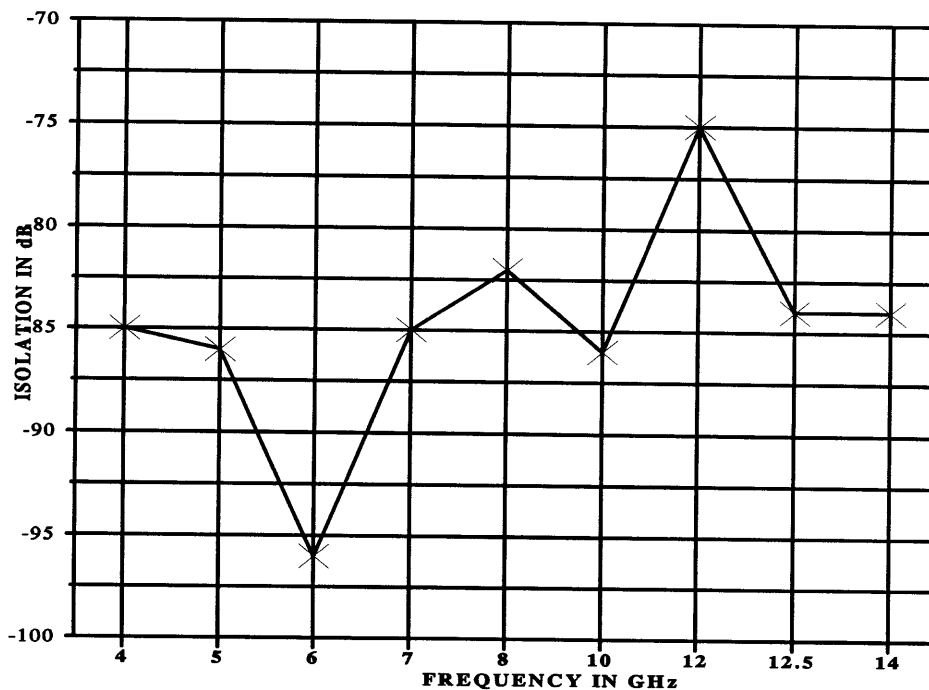


MODEL NUMBER	: SWN-RRA-2DRH-COMDEV
SERIAL NUMBER	: 2MS707276
TECHNICIAN	: RENE AFABLE
VOLTAGE & CURRENT DRAW	: + 5 vdc @ 68 mA
	: -12 vdc @ 6 mA

ISOLATION READINGS USING A SPECTRUM ANALYZER

ISOLATION FROM J1 (COMMON ARM) TO J2

AS MEASURED FROM 4.0 TO 14.0 GHz



✕ J1-J2

FREQUENCY IN GHz	ISOLATION IN dB J1 TO J2
4.0	85
5.0	86
6.0	96
7.0	85
8.0	82
10.0	86
12.0	75
12.5	84
14.0	84

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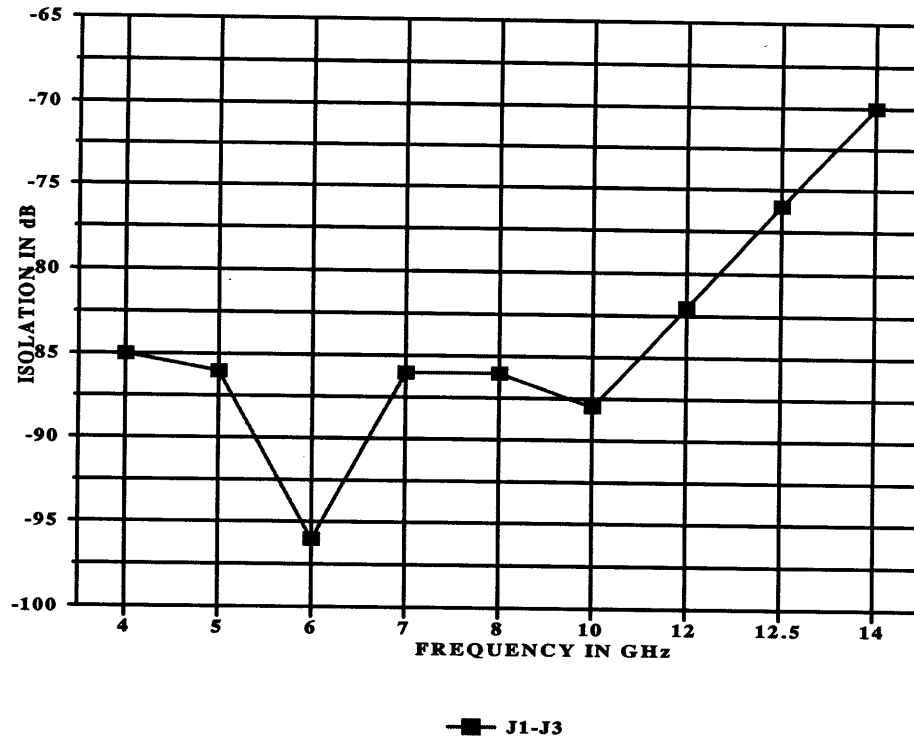
SUMMARY TEST DATA



MODEL NUMBER : SWN-RRA-2DRH-COMDEV
SERIAL NUMBER : 2MS707276
TECHNICIAN : RENE AFABLE
VOLTAGE & CURRENT DRAW : + 5 vdc @ 68 mA
: -12 vdc @ 6 mA

ISOLATION READINGS USING A SPECTRUM ANALYZER

ISOLATION FROM J1 (COMMON ARM) TO J3
AS MEASURED FROM 4.0 TO 14.0 GHz



FREQUENCY IN GHz	ISOLATION IN dB J1 TO J3
4.0	85
5.0	86
6.0	96
7.0	86
8.0	86
10.0	88
12.0	82
12.5	76
14.0	70

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SUMMARY TEST DATA

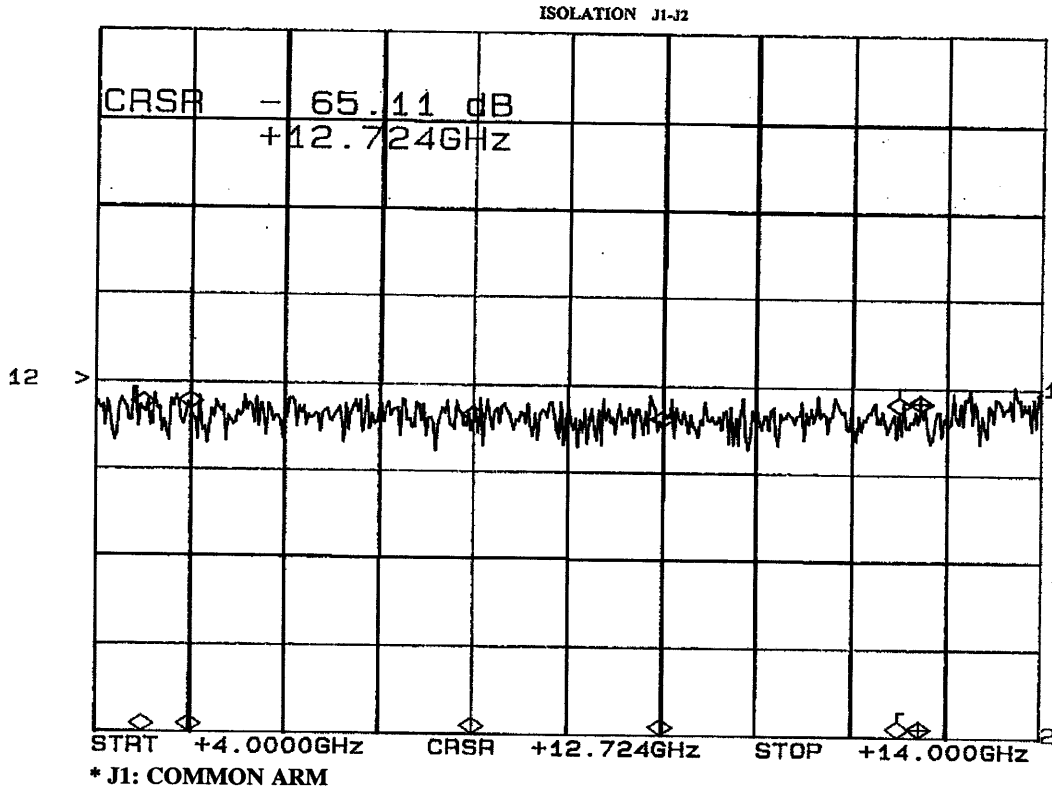


MODEL NUMBER	: SWN-RRA-2DRH-COMDEV
SERIAL NUMBER	: 2MS707276
TECHNICIAN	: RENE AFABLE
VOLTAGE & CURRENT DRAW	: + 5 vdc @ 68 mA
	: -12 vdc @ 6 mA

ISOLATION J1-J2*

AS MEASURED FROM 4.0 TO 14.0 GHz ON A SCALAR NETWORK ANALYZER

CH1: C -M	- 65.11 dB	CH2: A -M	- 48.84 dB
20.0 dB/ REF	- 60.00 dB	5.0 dB/ REF	- 9.54 dB



S/N	FREQUENCY	ISOLATION (dB)
1	4.5 GHz	> 67.9
2	6.0 GHz	> 68.1
3	8.0 GHz	> 65.7
4	10.0 GHz	> 66.3
5	12.5 GHz	> 65.2
6	12.7 GHz	> 66.2

MAY 25, 1998

SUMMARY TEST DATA

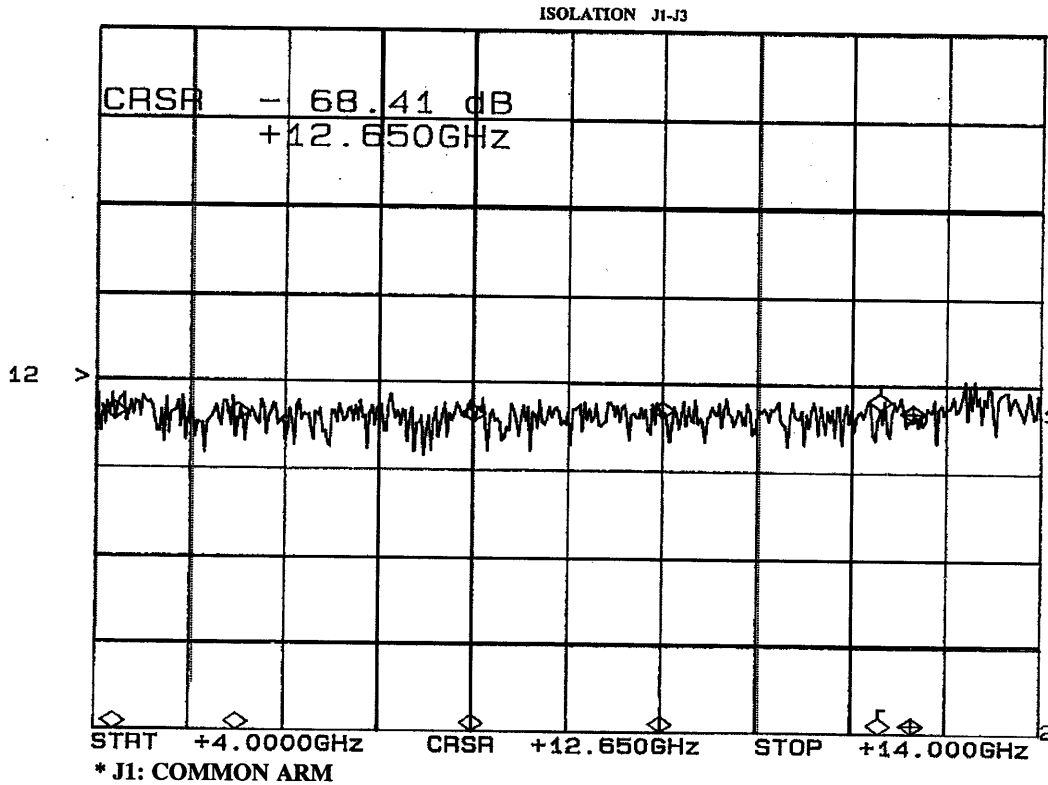


MODEL NUMBER	: SWN-RRA-2DRH-COMDEV
SERIAL NUMBER	: 2MS707276
TECHNICIAN	: RENE AFABLE
VOLTAGE & CURRENT DRAW	: + 5 vdc @ 68 mA
	: -12 vdc @ 6 mA

ISOLATION J1-J3*

AS MEASURED FROM 4.0 TO 14.0 GHz ON A SCALAR NETWORK ANALYZER

CH1: C -M - 68.41 dB	CH2: A -M - 50.07 dB
20.0 dB/ REF - 60.00 dB	5.0 dB/ REF - 9.54 dB



S/N	FREQUENCY	ISOLATION (dB)
1	4.2 GHz	> 66.0
2	5.5 GHz	> 65.9
3	8.0 GHz	> 68.8
4	10.0 GHz	> 67.4
5	12.3 GHz	> 61.2
6	12.65 GHz	> 64.3

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SUMMARY TEST DATA



MODEL NUMBER : SWN-RRA-2DRH-COMDEV
SERIAL NUMBER : 2MS707276
TECHNICIAN : RENE AFABLE
VOLTAGE & CURRENT DRAW : + 5 vdc @ 68 mA
 : -12 vdc @ 6 mA

ACTUAL TEST DATA AS PRESENTED TO THE CUSTOMER

FORM: SW-01/0791



DATE: 7/28/97

MICROWAVE SWITCH FINAL TEST DATA

JOB NO: 70236-1 MODEL NO: SWN-RRA-2DRH SERIAL NO: 2MS707276
 CUSTOMER: COMDEV TECHNICIAN: R.A.
 SPECIFICATION: _____ FREQUENCY RANGE: _____

INSERTION LOSS	VSWR		
	INPUT	OUTPUT ON	OUTPUT OFF
J1-J2 -1.75 dB	-13.40 dB	-13.28 dB	—
J1-J3 -1.99 dB	-10.17 dB	-10.78 dB	—

ISOLATION	SWITCHING SPEED			
	DELAY ON	RISE TIME	DELAY OFF	FALL TIME
J1-J2 -85 dB	800 ns	—	100 ns	—
J1-J3 -85 dB	800 ns	—	100 ns	—

NOTE: Any additional Test Data on Back

Test: R.A.
 QA/QC: _____
 Date: _____

MAY 25, 1998

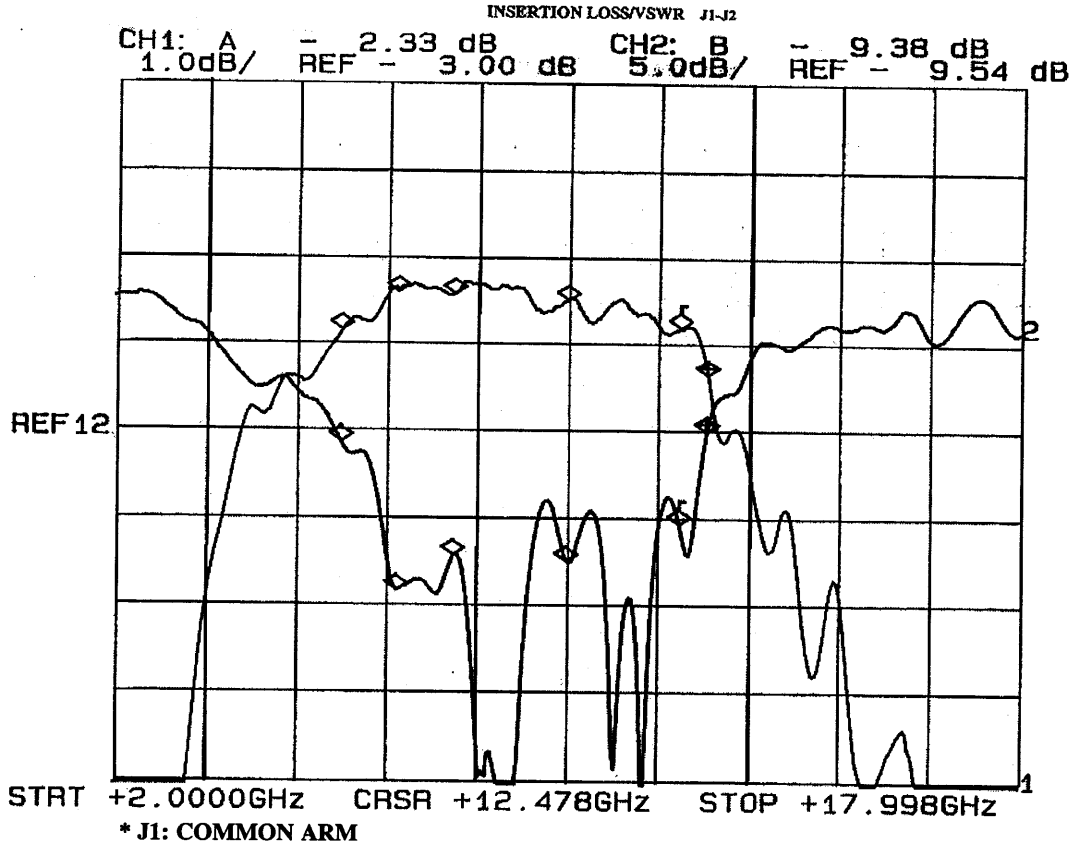
SUMMARY TEST DATA



MODEL NUMBER	: SWN-RRR-2DRH-COMDEV
SERIAL NUMBER	: 2MS707276
TECHNICIAN	: RENE AFABLE
VOLTAGE & CURRENT DRAW	: + 5 vdc @ 68 mA
	: -12 vdc @ 6 mA

INSERTION LOSS AND VSWR J1-J2*

AS MEASURED FROM 2.0 TO 18.0 GHz



S/N	FREQUENCY	INSERTION LOSS (dB)	RETURN LOSS (dB)	VSWR
1	6.0 GHz	1.81	-9.72	1.97:1
2	7.0 GHz	1.42	-13.8	1.51:1
3	8.0 GHz	1.28	-31.5	1.05:1
4	10.0 GHz	1.43	-18.6	1.27:1
5	12.0 GHz	1.77	-15.2	1.42:1
6	12.5 GHz	2.52	-9.70	1.97:1

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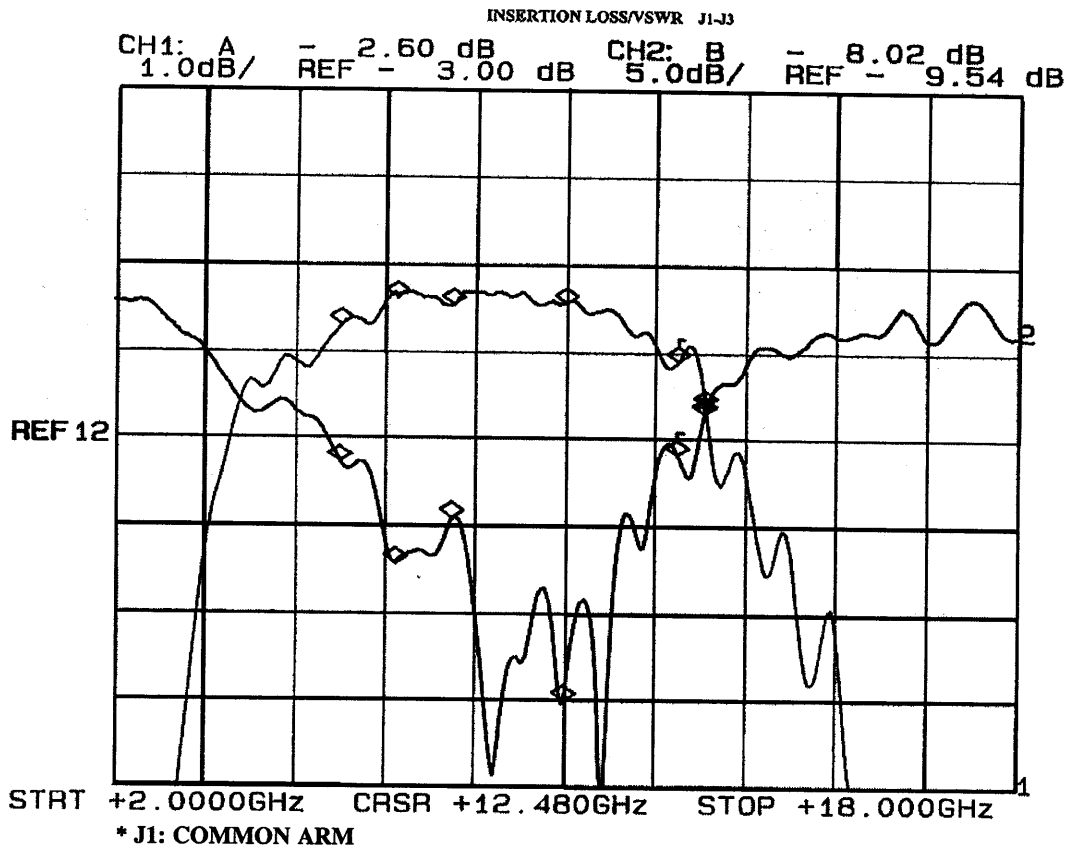
SUMMARY TEST DATA



MODEL NUMBER	: SWN-RRA-2DRH-COMDEV
SERIAL NUMBER	: 2MS707276
TECHNICIAN	: RENE AFABLE
VOLTAGE & CURRENT DRAW	: + 5 vdc @ 68 mA
	: -12 vdc @ 6 mA

INSERTION LOSS AND VSWR J1-J3*

AS MEASURED FROM 2.0 TO 18.0 GHz



S/N	FREQUENCY	INSERTION LOSS (dB)	RETURN LOSS (dB)	VSWR
1	6.0 GHz	1.68	-10.2	1.93:1
2	7.0 GHz	1.41	-13.2	1.56:1
3	8.0 GHz	1.25	-22.8	1.16:1
4	10.0 GHz	1.41	-26.7	1.10:1
5	12.0 GHz	2.00	-11.2	1.76:1
6	12.5 GHz	2.73	-8.39	2.23:1

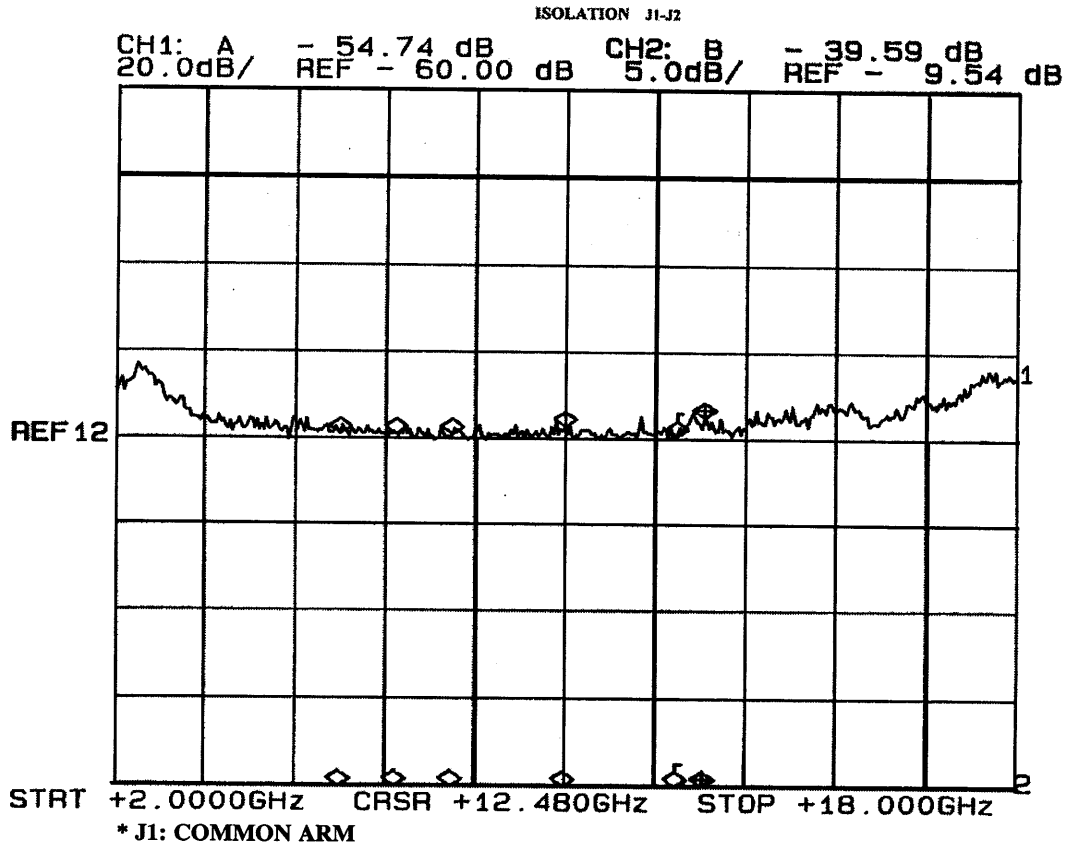
MAY 25, 1998

SUMMARY TEST DATA



MODEL NUMBER	: SWN-RRA-2DRH-COMDEV
SERIAL NUMBER	: 2MS707276
TECHNICIAN	: RENE AFABLE
VOLTAGE & CURRENT DRAW	: + 5 vdc @ 68 mA
	: -12 vdc @ 6 mA

ISOLATION J1-J2* AS MEASURED FROM 2.0 TO 18.0 GHz



S/N	FREQUENCY	ISOLATION (dB)
1	6.0 GHz	> 63.0
2	7.0 GHz	> 70.1
3	8.0 GHz	> 70.3
4	10.0 GHz	> 75.8
5	12.0 GHz	> 73.6
6	12.5 GHz	> 67.2

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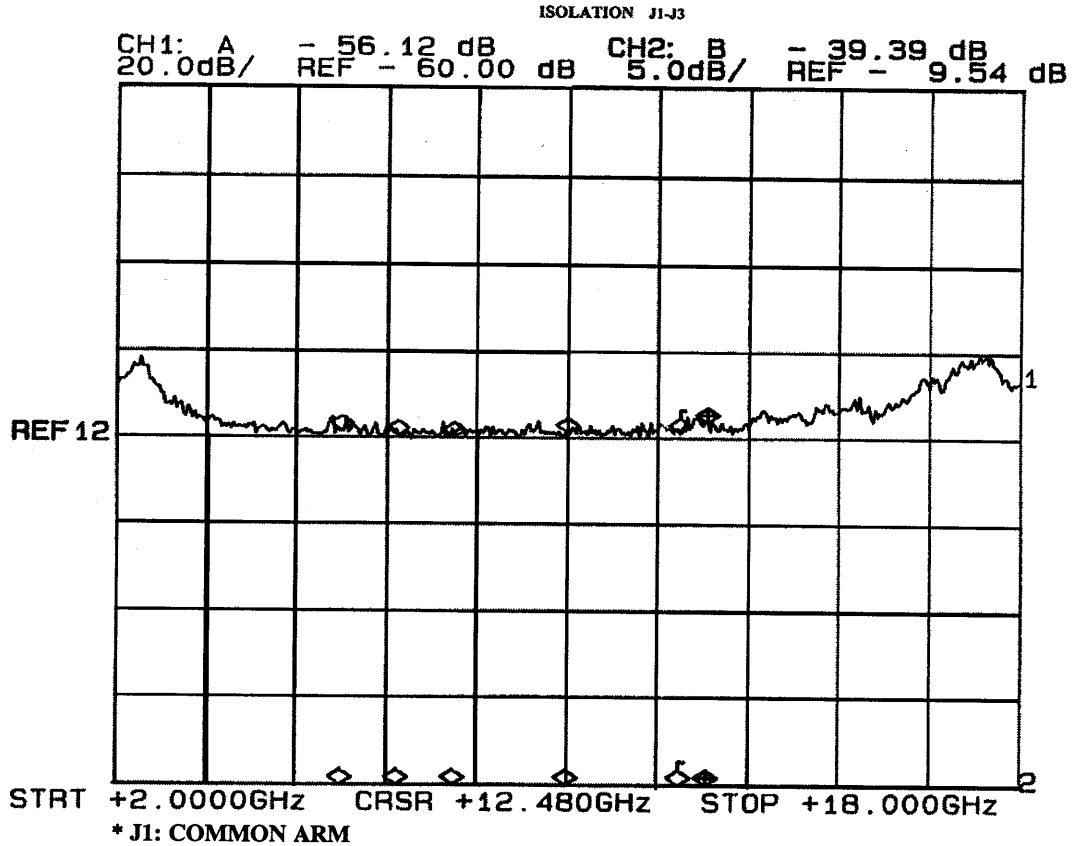
SUMMARY TEST DATA



MODEL NUMBER	: SWN-RRA-2DRH-COMDEV
SERIAL NUMBER	: 2MS707276
TECHNICIAN	: RENE AFABLE
VOLTAGE & CURRENT DRAW	: + 5 vdc @ 68 mA
	: -12 vdc @ 6 mA

ISOLATION J1-J3*

AS MEASURED FROM 2.0 TO 18.0 GHz



S/N	FREQUENCY	ISOLATION (dB)
1	6.0 GHz	69.1
2	7.0 GHz	65.3
3	8.0 GHz	73.4
4	10.0 GHz	74.1
5	12.0 GHz	67.7
6	12.5 GHz	64.8

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SUMMARY TEST DATA



MODEL NUMBER	: SWN-RRA-2DRH-COMDEV
SERIAL NUMBER	: 2MS707276
TECHNICIAN	: RENE AFABLE
VOLTAGE & CURRENT DRAW	: + 5 vdc @ 68 mA
	: -12 vdc @ 6 mA

SWITCHING SPEED

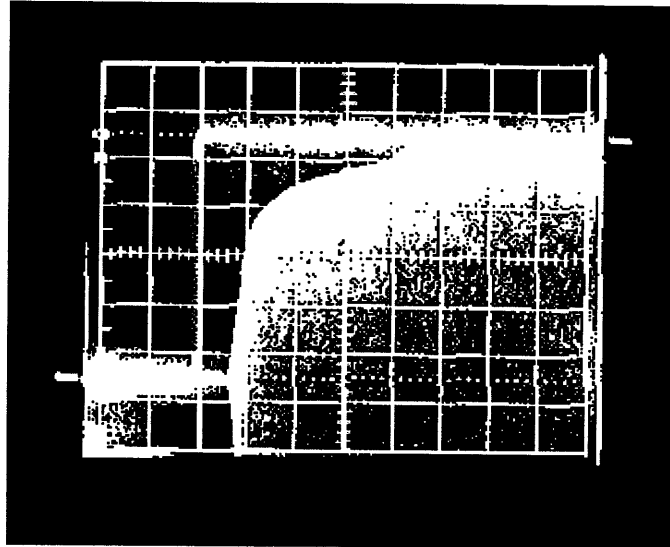
"RISE/FALL" TIME: 10% RF TO 90% RF & 90% RF TO 10% RF

"ON/OFF" TIME: 50% TTL TO 90% RF OR 10% RF

"DELAY ON": 800 nS
"RISE TIME": 620 nS

HORIZONTAL SCALE:
200 nS PER DIVISION

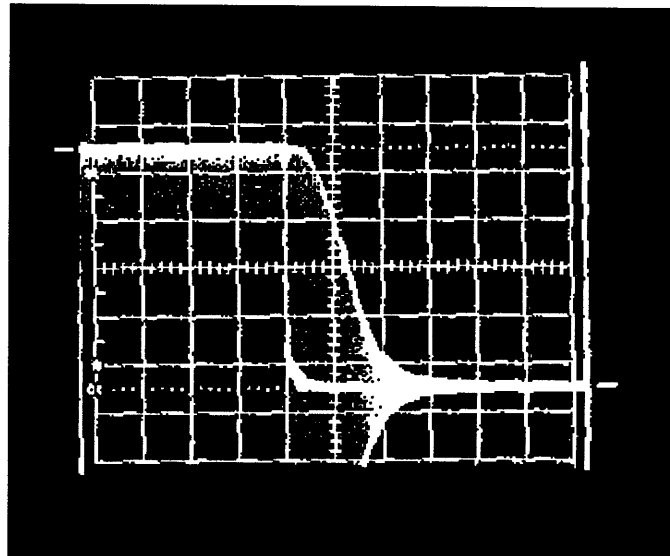
VERTICAL SCALE:
10mV PER DIVISION



"DELAY OFF": 100 nS
"FALL TIME": 70 nS

HORIZONTAL SCALE:
50 nS PER DIVISION

VERTICAL SCALE:
10mV PER DIVISION



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SUMMARY TEST DATA



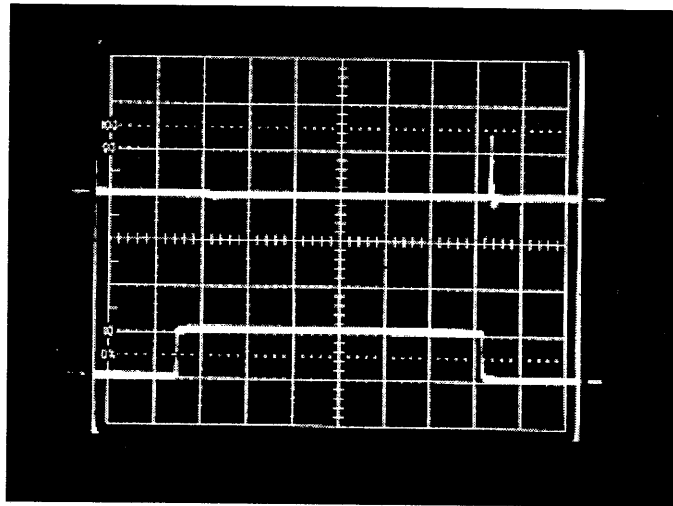
MODEL NUMBER	: SWN-RRA-2DRH-COMDEV
SERIAL NUMBER	: 2MS707276
TECHNICIAN	: RENE AFABLE
VOLTAGE & CURRENT DRAW	: + 5 vdc @ 68 mA
	: -12 vdc @ 6 mA

VIDEO TRANSIENTS TYPICAL OF ALL ARMS

≤0.8 Volt P-P Transient
300 MHz Bandwidth

HORIZONTAL SCALE:
0.1 μS PER DIVISION

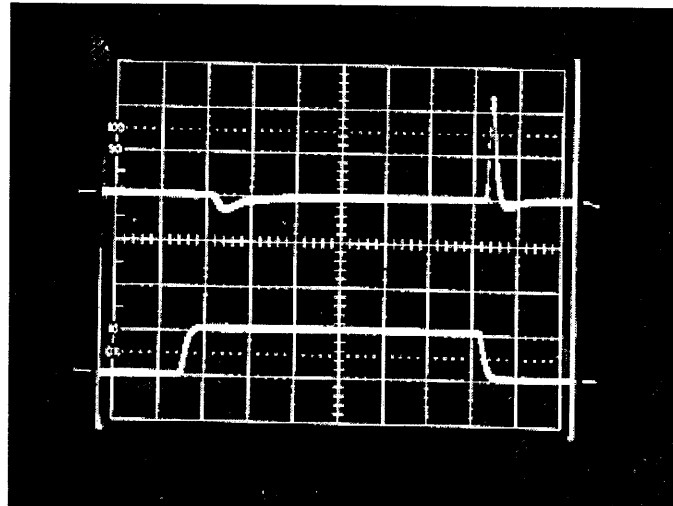
VERTICAL SCALE:
0.5 Volts PER DIVISION



≤140 mV P-P Transient
20 MHz Bandwidth

HORIZONTAL SCALE:
0.1 μS PER DIVISION

VERTICAL SCALE:
50 mV PER DIVISION



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SUMMARY TEST DATA



MODEL NUMBER : SWN-RRA-2DRH-COMDEV
SERIAL NUMBER :
TECHNICIAN : RENE AFABLE
VOLTAGE & CURRENT DRAW : + 5 vdc @ 68 mA
 : -12 vdc @ 6 mA

ACTUAL DATA AS PRESENTED TO THE CUSTOMER

FORM: SW-01/0791



DATE: 5/1/97

MICROWAVE SWITCH FINAL TEST DATA

JOB NO: 70236-1 **MODEL NO:** SWN-RRA-2DRH-COMDEV **SERIAL NO:** 2M5704238
CUSTOMER: COMDEV. **TECHNICIAN:** R.A.
SPECIFICATION: +5V I=24 mA -12V I=6 mA **FREQUENCY RANGE:** 8.3 - 11.7 GHz.

INSERTION LOSS	VSWR		
	INPUT	OUTPUT ON	OUTPUT OFF
J1-J2 -1.79 dB	-13.65 dB	-13.65 dB	—
J1-J3 -1.84 dB	-15.73 dB	-15.12 dB	—

ISOLATION	SWITCHING SPEED			
	DELAY ON	RISE TIME	DELAY OFF	FALL TIME
J1-J2 -80 dB	—	400 nS	—	100 nS
J1-J3 -80 dB	—	380 nS	—	90 nS

NOTE: Any additional Test Data on Back
 Insertion loss variation vs. frequency: 0.37 dB @ 52, 0.42 dB @ 53 Test: R.A.
 Insertion loss variation vs. Temp.: 0.07 dB @ 0.03 dB @ 0.03 dB QA/QC: R.A.
 Insertion loss variation bet. outputs: 0.03 dB Date: 5-7-97
 mass weight 28.5 grams AH 5//

MAY 25, 1998

SUMMARY TEST DATA



MODEL NUMBER : SWN-RRA-2DRH-COMDEV
SERIAL NUMBER :
TECHNICIAN : RENE AFABLE
VOLTAGE & CURRENT DRAW : + 5 vdc @ 68 mA
 : -12 vdc @ 6 mA

ACTUAL DATA AS PRESENTED TO THE CUSTOMER

FORM: SW-01/0791



DATE: 5/1/97

MICROWAVE SWITCH FINAL TEST DATA

JOB NO: 70236-1 MODEL NO: SWN-RRA-2DRH SERIAL NO: 2M5704240
 CUSTOMER: COMDEV TECHNICIAN: R.A.
 SPECIFICATION: +5V I=24 mA FREQUENCY RANGE: 8.3 - 11.7 GHz.
-12V I=6 mA

INSERTION LOSS		VSWR		
		INPUT	OUTPUT ON	OUTPUT OFF
J1-J2	-1.85 dB	-13.11 dB	-13.37 dB	—
J1-J3	-1.81 dB	-13.53 dB	-13.40 dB	—

SWITCHING SPEED				
ISOLATION	DELAY ON	RISE TIME	DELAY OFF	FALL TIME
J1-J2 -80 dB	—	400 nS	—	100 nS
J1-J3 -80 dB	—	400 nS	—	100 nS

NOTE: Any additional Test Data on Back
 Insertion loss variation vs. Frequency: 0.40 dB 0.49 QA/QC: f.h. INSP
 Insertion loss variation vs. Temp.: 0.01 dB 0.01 Date: 8-4-97
 Insertion loss variation bet. outputs: 0.04 dB
 mass weight 28.5 grams AH/5/1

MAY 25, 1998

SUMMARY TEST DATA



MODEL NUMBER : SWN-RRA-2DRH-COMDEV
SERIAL NUMBER :
TECHNICIAN : RENE AFABLE
VOLTAGE & CURRENT DRAW : + 5 vdc @ 68 mA
 : -12 vdc @ 6 mA

ACTUAL DATA AS PRESENTED TO THE CUSTOMER

FORM: SW-01/0791



DATE: 5/1/97

MICROWAVE SWITCH FINAL TEST DATA

JOB NO: 70236-1 MODEL NO: SWN-RRA-2DRH SERIAL NO: 2M570424
 CUSTOMER: COMDEV TECHNICIAN: R.A.
 SPECIFICATION: _____ FREQUENCY RANGE: 8.3 - 11.7 GHz.
 +5V I=24 mA
 -12V I=6 mA

INSERTION LOSS		VSWR		
		INPUT	OUTPUT ON	OUTPUT OFF
J1-J2	-1.86 dB	-12.25 dB	-13.61 dB	—
J1-J3	-1.86 dB	-12.36 dB	-11.94 dB	—

SWITCHING SPEED				
ISOLATION	DELAY ON	RISE TIME	DELAY OFF	FALL TIME
J1-J2 -80 dB	—	400 nS	—	90 nS
J1-J3 -80 dB	—	320 nS	—	100 nS

NOTE: Any additional Test Data on Back
 Insertion loss variation vs. frequency: 0.56 dB. 0.53
 Insertion loss variation vs. Temp.: 0.02 dB. 0.01
 Insertion loss variation bet. outputs: 0.06 dB
 mass weight 28.4 grams AH 5/

J2 J3 Test: R.A. INSP
 BY
 QA/QC:
 Date: 8-4-97

MAY 25, 1998

SUMMARY TEST DATA



MODEL NUMBER : SWN-RRA-2DRH-COMDEV
SERIAL NUMBER :
TECHNICIAN : RENE AFABLE
VOLTAGE & CURRENT DRAW : + 5 vdc @ 68 mA
 : -12 vdc @ 6 mA

ACTUAL DATA AS PRESENTED TO THE CUSTOMER

FORM: SW-01/0791



DATE: 5/1/97

MICROWAVE SWITCH FINAL TEST DATA

JOB NO: 70236-1 MODEL NO: SWN-RRA-2DRH SERIAL NO: 2M5704242
 CUSTOMER: COMDEV TECHNICIAN: R.A.
 SPECIFICATION: _____ FREQUENCY RANGE: 8.3 - 11.7 GHz.

INSERTION LOSS		VSWR		
		INPUT	OUTPUT ON	OUTPUT OFF
J1-J2	-1.81 dB	-14.08 dB	-14.74 dB	—
J1-J3	-1.86 dB	-15.69 dB	-15.84 dB	—

ISOLATION	SWITCHING SPEED			
	DELAY ON	RISE TIME	DELAY OFF	FALL TIME
J1-J2 -80 dB	—	380 nS	—	90 nS
J1-J3 -80 dB	—	400 nS	—	100 nS

NOTE: Any additional Test Data on Back
 Insertion loss variation vs. frequency: 0.56dB. 0.52dB
 Insertion loss variation vs. Temp.: 0.03dB. 0.05dB
 Insertion loss variation bet. outputs: 0.03dB
 mass weight 29.3 grams AHG/1

Test: J2 J3
 BY: R.A.
 QAIQC: 01
 Date: 8-4-97

MAY 25, 1998

SUMMARY TEST DATA



MODEL NUMBER : SWN-RRA-2DRH-COMDEV
SERIAL NUMBER :
TECHNICIAN : RENE AFABLE
VOLTAGE & CURRENT DRAW : + 5 vdc @ 68 mA
 : -12 vdc @ 6 mA

ACTUAL DATA AS PRESENTED TO THE CUSTOMER

FORM: SW-01/0791



DATE: 5/1/97

MICROWAVE SWITCH FINAL TEST DATA

JOB NO: 70236-1 MODEL NO: SWN-RRA-2DRH SERIAL NO: 2M5704243
 CUSTOMER: COMDEV TECHNICIAN: R.A.
 SPECIFICATION: +5V I+23 mA FREQUENCY RANGE: 8.3 - 11.7 GHz
-12V I-6 mA

INSERTION LOSS	VSWR		
	INPUT	OUTPUT ON	OUTPUT OFF
J1-J2 -1.76 dB	-13.01 dB	-13.08 dB	—
J1-J3 -1.77 dB	-14.45 dB	-13.98 dB	—

ISOLATION	SWITCHING SPEED			
	DELAY ON	RISE TIME	DELAY OFF	FALL TIME
J1-J2 -80 dB	—	390 nS	—	80 nS
J1-J3 -80 dB	—	390 nS	—	90 nS

NOTE: Any additional Test Data on Back
 Insertion loss variation vs. frequency: 0.43dB. 0.57dB
 Insertion loss variation vs. Temp.: 0.03 dB. 0.03dB
 Insertion loss variation bet. outputs: 0.03 dB
 mass weight 28.4 grams A/H 5/1

Test: R.A. INSP. BY Q1
 Date: 8-4-97

MAY 25, 1998



DATA

AS

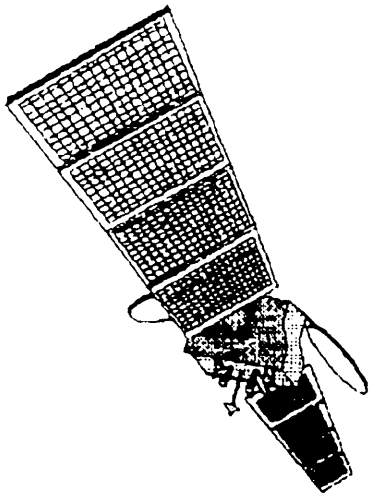
MEASURED

BY

COMDEV SPACE GROUP
(CANADA)

MAY 25, 1998

PAGE 22



FAX MESSAGE

TO: Helen
COMPANY: American Microwave
FAX #: 301-662-4938
FROM: Joan Westlake
FAX #: 519-621-7670
OF PAGES: 15

OUR REF.:

DATE: December 3, 1997

YR. REF.:

SUBJECT: performance data

A while ago, a request came from your facility to provide any performance data that was available on the switches that American Microwave have manufactured for us. Attached is this data for your files. Please feel free to call me if you have any questions.

Regards,

Joan Westlake
Buyer

155 Sheldon Drive, Cambridge, Ontario Canada N1R 7H6
Telephone: (519) 622-2300 FAX: (519) 621-7670

1. **SPDT, SP4T AND HIGH POWER SPDT SWITCH PERFORMANCE**

1.1 **S-parameter Characterization**

S-parameter characterization is used to verify performance parameters such as insertion loss, isolation and delay differences between paths. The S-parameter measurements were made using an HP8510 network analyzer. Tables 1.1-1 and 1.1-2 provide worst case results, over the frequency band, for the SPDT and SP4T switches respectively.

Table 1.1-1: SPDT S-parameter Characterization

AMC P/N: SWN-RRA-2DT, S/N: 2MS703161

Path	Insertion Loss (dB)	Input	Output	Isolation (dB)	Delay (ps)
Specification	3.0	9.5	9.5	80	not specified
J1-J2	1.5	18.6	19.4	>85	222
J1-J3	1.4	16.5	18.8	>85	222

Table 1.1-2: SP4T S-parameter Characterization

AMC P/N: MSN-4DT, S/N: 2MS70305

Path	Insertion Loss (dB)	Input	Output	Isolation (dB)	Delay (ps)
Specification	3.5	9.5	9.5	80	not specified
J1-J3	1.6	21.7	21.1	>85	248
J1-J4	1.7	17.7	14.7	>85	247
J1-J6	1.5	24.2	22.9	>85	247
J1-J7	1.6	28.0	23.2	>85	246

1.2 **Pulse Response**

Pulse response measurements were performed to ensure the switch would not distort the input RF pulse. The test set-up is shown in Figure 1.2-1. Table 1.2-1 contains the results for the SPDT switch.

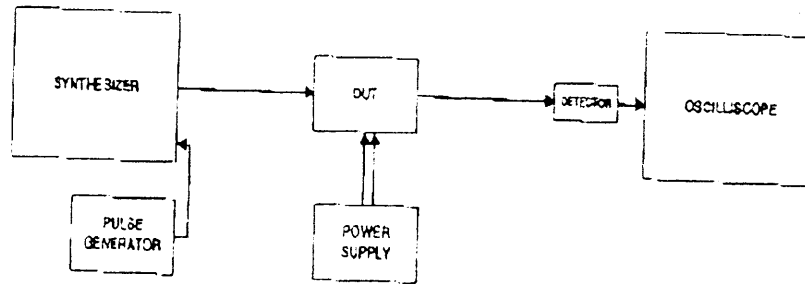


Figure 1.2-1: Pulse Response Test Set-up

Table 1.2-1: SPDT Switch Pulse Response

AMC P/N: SWN-RRA-2DT, S/N: 2MS703161

Specification	Pulse Width	Period	Duty Cycle (%)	Rise Time (ns)	Fall Time (ns)	CWRFused Amplitude Difference (dB)
	0.2 to 120 μ s	0.5 to 120 μ s PPS	5-95	< 10	< 20	0
	120 μ s	1.2 ms	10	9.0	11.1	-
	10 μ s	100 μ s	10	9.2	13.0	-
	1 μ s	10 μ s	10	9.2	12.2	-
	500 ns	5 μ s	10	9.0	11.8	-
	200 ns	2 μ s	10	8.9	12.1	-

1.3 Residual Amplitude and Phase Noise

All of the AM and PM noise measurements have been made using a HP3048A test set.

Table 1.3-1: SPDT Residual Phase Noise

AMC P/N: SWN-RRA-2DT, S/N: 2MS703161

Offset Frequency (Hz)	Phase Noise (dBc/Hz)	Phase Noise (dBc/Hz)
10	-132	-131
100	-142	-140
1000	-150	-150
10000	-160	-160
100000	-167	-167
1000000	-170	-170
10000000	-170	-168
100000000	-167	-167

Table 1.3-2: SPDT Residual Amplitude Noise

COM DEV P/N: 123055-1

Offset Frequency (Hz)	Measured Performance			
	Switch S/N: 2MS704186 (dBc/Hz)	Switch S/N: 2MS704187 (dBc/Hz)	Switch S/N: 2MS704188 (dBc/Hz)	Switch S/N: 2MS704189 (dBc/Hz)
10	-114	-110	-110	-110
100	-122	-120	-120	-118
1000	-140	-140	-140	-135
10000	-150	-152	-152	-147
100000	-157	-157	-157	-155
1000000	-163	-164	-163	-162
10000000	-163	-163	-163	-163

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Table 1.3-3: High Power SPDT Residual Amplitude Noise

COM DEV P/N: 124043-1

Carrier Frequency (MHz)	Residual Amplitude Noise (dBm)	Residual Amplitude Noise (dBm)
120	-120	-120
128	-128	-127
141	-141	-142
152	-152	-153
157	-157	-157
163	-163	-163
162	-162	-162

1.4 Conducted Susceptibility

Conducted susceptibility measurements provide an indication of the components tolerance to noise on its supply or control lines. Performance is measured by monitoring the spurious levels with the AM/PM noise measurement test set for various frequencies and amplitudes of noise injected. The phase noise test set (HP3048A) is used (due to the dynamic range requirements of the specification) for all measurements up to 40 MHz offset from the carrier frequency. Above 40 MHz offset, measurements are made using a HP8563E spectrum analyzer. Two possible set ups can be used for measuring the spurious with the AM/PM test set: AM set up or PM set up. The AM set up will yield the worst case results since the PM set up provides some suppression of AM signals. The following tables provide results summaries.

The information contained herein is proprietary to COM DEV LTD. and is used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by COM DEV LTD.

Table 1.4-1: SPDT Switch Conducted Susceptibility (PM Noise Set-up)

AMC P/N: SWN-RRA-2DT, S/N: 2MS703161

CS Frequency (MHz)	Switching Frequency (kHz)	Measured Susceptibility (dBμV) for		
		Low Power SPDT	High Power SPDT	Control Line
100.0	100.0	-	-124	-
100.0	200.0	-	-123	-
100.0	400.0	-154	-	-
100.0	800.0	-116	-	-118
100.0	1600.0	-	-	-170
100.0	3200.0	-165	-	-165
100.0	6400.0	-120	-	-166

The following results were obtained using input power levels of + 15 dBm into the switches. This was necessary to achieve a + 10 dBm level at the detector input. The specification calls for the measurements to be made at - 3 dBm for the low power SPDT, and + 29.5 dBm for the high power SPDT.

Table 1.4-2: SPDT Switch Conducted Susceptibility (AM Noise Set-up)

COM DEV P/N: 123065-1, S/N: 2MS704203

CS Frequency (MHz)	Switching Frequency (kHz)	Measured Susceptibility (dBμV) for		
		Low Power SPDT	High Power SPDT	Control Line
100.0	100.0	< -115	-73	< -125
100.0	200.0	-124	-74	-
100.0	400.0	-123	-73	-
100.0	800.0	-121	-80	< -150
100.0	1600.0	-121	-85	-
100.0	3200.0	-120	-89	< -150
100.0	6400.0	-126	-126	-
100.0	12800.0	-120	-123	-

Table 1.4-3: High Power SPDT Switch Conducted Susceptibility (AM Noise Set-up)

COM DEV P/N: 124043-1, S/N: 2MS704240

Frequency (MHz)	Power (dBm)	Power (dBm)	Power (dBm)
-73	-85	< -130	
-73	-85	-	
-74	-87	-	
-78	-102	-	
-82	-107	-	
-86	-110	< -150	
-118	-126	-	
< -125	< -125	-	

1.5

Conducted Emissions

As discussed in the previous section, the conducted emissions are important in determining the effect that RF pulse reaction of a component will have on the overall unit performance. The conducted emissions output will generate noise on power supply and control lines and consequently could cause spurious outputs. By measuring the conducted emissions in the frequency and time domains for various input RF pulses, the effective noise level can be calculated. For the switches, only the frequency domain information is provided since there were no observable current spikes in the time domain monitoring. The conducted emissions are measured using a current probe and the HP8563E spectrum analyzer. The following tables provide a summary of the conducted emissions performance under pulsed RF operating conditions.

Table 1.5-1: SPDT Conducted Emissions: Frequency Domain

COM DEV P/N: 124065-1, S/N: 2MS704203

Diode Characteristics		Conducted Emissions +5 V Supply Line	Conducted Emissions +12 V Supply Line
PRF (kHz)	Pulse Width (μ s)		
100	2.9	15.7 kHz @ -86 dBm 102.9 kHz @ -100 dBm 714 kHz @ -82 dBm 13 MHz @ -100 dBm	15.9 kHz @ -89 dBm 102.9 kHz @ -99 dBm 714 kHz @ -82 dBm 13 MHz @ -99 dBm 14 MHz @ -103 dBm
100	1.0	15.9 kHz @ -90 dBm 31.8 kHz @ -96 dBm 714 kHz @ -82 dBm 13.1 MHz @ -99 dBm	16 kHz @ -87 dBm 32 kHz @ -95 dBm 100 kHz @ -106 dBm 714 kHz @ -80 dBm 13.2 MHz @ -101 dBm 14.6 MHz @ -103 dBm

Table 1.5-1: High Power SPDT Conducted Emissions: Frequency Domain (Pulsed)

COM DEV P/N: 123043-1, S/N: 2MS704240

Pulse Characteristics		Conducted Emissions - 5 V Supply Line	Conducted Emissions - 12 V Supply Line
RRF (kHz)	Pulse Width (µs)		
0.5	1.0	500 Hz @ < -103 dBm 714 kHz @ -85 dBm 13 MHz @ -94 dBm 39.9 MHz @ -75 dBm	184 Hz @ -88 dBm 304 Hz @ -95 dBm 500 Hz @ -104 dBm 786 kHz @ -87 dBm 13 MHz @ -100 dBm 14.6 MHz @ -102 dBm 22 MHz @ -98 dBm
0.5	120	500 Hz @ -101 dBm 180 Hz @ -91 dBm 299 Hz @ -95 dBm	
100	2.9	100 kHz @ -87 dBm 786 kHz @ -82 dBm 13 MHz @ -96 dBm	100 kHz @ -96 dBm 786 kHz @ -85 dBm 1.79 MHz @ -77 dBm 13.3 MHz @ -101 dBm
100	1.0	100 kHz @ -94 dBm 429 kHz @ -76 dBm 13 MHz @ -94 dBm	

Additionally, the high power SPDT was monitored for conducted emissions output under CW conditions. The following table contains a summary of the results.

Table 1.5-1: High Power SPDT Conducted Emissions: Frequency Domain (CW)

COM DEV P/N: 123043-1, S/N: 2MS704240

Conducted Emissions - 5 V Supply Line	Conducted Emissions - 12 V Supply Line
786 kHz @ -89 dBm 13 MHz @ -96 dBm 30 MHz @ -92 dBm	857 kHz @ -91 dBm 1.86 MHz @ -87 dBm 13.1 MHz @ -99 dBm

2. VARIABLE ATTENUATOR PERFORMANCE

2.1 S-Parameter Characterization

S-parameter characterization is used to verify performance parameters such as insertion loss, return loss and delay. The data is measured using the HP8510 network analyzer. Tables 2.5.1-1 provides the worst case results for the variable attenuator over the frequency band.

Table 2.1-1: Variable Attenuator S-parameter Characterization

AMC P/N: AGH-0612-60DDSF, S/N: AH310303

Specification	Insertion Loss (dB)	Return Loss (dB)		Delay (ps)
		Input	Output	
	3.0	10.9	10.9	not specified
	3.0	20.7	19.0	377

An additional set of S-parameter measurements were made to determine the accuracy and frequency flatness performance of the attenuator. The flatness is calculated as the maximum attenuation less the minimum attenuation over the frequency band. The attenuation accuracy is calculated as the programmed attenuation setting less the nominal attenuation value, where the nominal attenuation value is the sum of the maximum and minimum attenuation (over the frequency band) divided by 2. The measurements were made using a HP8510 network analyzer. Since this unit was different from the unit previously tested, the return loss data was measured again. The insertion loss measurements were also repeated, however, that data forms part of the flatness and accuracy results. Tables 2.5.1-2 and 2.5.1-3 summarize the results. Note that the return loss measurements are worst case.

Table 2.1-2: Variable Attenuator Return Loss

COM DEV P/N: 123469-1, S/N: DV70435

Specification	Return Loss (dB)	
	Input	Output
0	17.4	21.0
33	20.3	20.0
63	18.4	18.0

Table 2.1-3: Variable Attenuator Accuracy and Flatness

COM DEV P/N: 123469-1, S/N: DV70435

Attenuator Setting (dB)	Accuracy Specification (dB)	Measured Attenuation @ 10 GHz (dB)	Calculated Accuracy from Nominal Attenuation (dB)	Pk-Pk Flatness Specification (dB)	Measured Flatness Pk-Pk (dB)
0.0		1.40 ¹	-		
0.5		0.02	0.34		0.28
1.0		0.05	0.95		0.33
1.5		0.05	1.48		0.30
2.0		0.10	1.94		0.29
2.5		0.27	2.26		0.38
3.0		0.60	2.41		0.28
3.5		1.22	2.31		0.30
4.0		1.95	2.02		0.33
4.5		2.71	1.75		0.20
5.0		3.51	1.49		0.20
5.5		4.20	1.27		0.20
6.0		4.89	1.11		0.11
6.5		5.57	0.91		0.07
7.0		6.23	0.91		0.32
7.5		6.86	0.61		0.35
8.0		7.45	0.48		0.48
8.5		8.02	0.44		0.61
9.0		8.59	0.34		0.63
9.5		9.17	0.35		0.85
10.0		9.67	0.29		0.66
10.5		10.2	0.27		0.70
11.0		10.76	0.24		0.85
11.5		11.22	0.26		0.82
12.0		11.72	0.23		0.96
12.5		12.17	0.29		0.99
13.0		12.63	0.32		1.05
13.5		13.10	0.39		1.12
14.0		13.54	0.40		1.09
14.5		14.03	0.48		1.13
15.0		14.45	0.54		1.17
21.0		21.24	0.07		1.12
27.0		27.68	0.58		1.73
33.0		33.36	0.21		2.14
39.0		39.43	0.34		2.28
45.0		44.87	0.62		2.51
51.0		51.83	0.47		2.29
57.0		57.70	0.30		2.46
63.0		65.39	1.15		2.85
					4.01

¹ Insertion loss at 0 dB attenuation state.

2.2 Pulse Response

Pulse response measurements were performed to ensure the attenuator would not distort the input RF pulse. The measurement set-up was shown previously in Figure 2.2-1. Table 2.2-1 contains the results for the SPDT switch.

Table 2.2-1: Variable Attenuator Pulse Response

AMC P/N: AGH-0612-60DDSF, S/N: AH310303

Specification	Pulse Width	Period	Duty Cycle (%)	Rise Time (ns)	Fall Time (ns)	CW/Pulsed Amplitude Difference (dB)
	120 us	1.2 ms	10	9.3	11.0	-
	10 us	100 us	10	9.3	11.3	-
	1 us	10 us	10	9.5	11.3	-
	500 ns	5 us	10	9.0	11.3	-
	200 ns	2 us	10	9.3	11.5	-

The measured insertion loss / attenuation did not change when the input signal was changed from CW to pulse.

2.3 Residual Amplitude and Phase Noise

All of the AM and PM measurements have been made using a HP3048A test set.

Table 2.3-1: Variable Attenuator Residual Phase Noise

AMC P/N: AGH-0612-60DDSF, S/N: AH310303

Frequency (MHz)	Phase Noise (dBc/Hz)	Phase Noise (dBc/Hz)
100	-132	-131
1000	-142	-139
10000	-150	-149
100000	-160	-158
1000000	-167	-166
10000000	-170	-169
100000000	-170	-167
1000000000	-167	-167

Table 2.3-2: Variable Attenuator Amplitude Noise

AMC P/N: AGH-0612-60DDSF, S/N: AH310303

Frequency (MHz)	Amplitude Noise (dBc)	Amplitude Noise (dBc)
100	-114	-113
1000	-123	-121
10000	-132	-132
100000	-143	-141
1000000	-152	-150
10000000	-158	-158
100000000	-162	-162
1000000000	-162	-160

2.4 Conducted Susceptibility

Conducted susceptibility measurements provide an indication of the components tolerance to noise on its supply or control lines. Performance is measured by monitoring the spurious levels with the AM/PM noise measurement test set for various frequencies and amplitudes of noise injected. The phase noise test set (HP3048A) is used due to the dynamic range requirements of the specification

for all measurements up to 40 MHz offset from the carrier frequency. Above 40 MHz offset, measurements are made using a HP8563E spectrum analyzer is used. Two possible set ups can be used for measuring the spurious with the AM/PM test set: AM set up or PM set up. The am set up will yield the worst case results since the PM set up provides some suppression of AM signals. It was determined through measurement that the -15 V rail for the attenuator provided the worst case results. Consequently, all of the measurements were made for the -15 V rail. The following tables provide results summaries.

Table 2.4-1: Variable Attenuator Conducted Susceptibility (PM Noise Set-up)

AMC P/N: AGH-0612-60DDSF, S/N: AH310303

		-128
		-113
		-113
		-113

Table 2.4-2: Variable Attenuator Conducted Susceptibility (AM Noise Set-up)

AMC P/N: AGH-0612-60DDSF, S/N: AH310303

		-120	-
		-116	-
		-91	-88