

DATA

ON

0.5 GHz TO 18.0 Ghz

(10MHz to 18GHz optional)

AND

8.3 GHz TO 11.7 GHz

LOW LOSS

LOW VIDEO TRANSIENT

HIGH ISOLATION

ABSORPTIVE/REFLECTIVE

SP4T

MINIATURE RECTANGULAR

MULTI-THROW SOLID-STATE SWITCH

MSNC-4DT-045-STANDARD (Option 0518)

(Serial Number: 4MS70549)

MSN-4DT-COMDEV

(Serial Number: 4MS70563)

(Pages 25-44)

(Serial Number 2MS70305)

(Page 45)

DESIGNED

BY

ASH GORWARA, RENE AFABLE, & WAYNE PURDHAM

REPORT PREPARED

BY

RENE AFABLE

DECEMBER 17, 1997

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

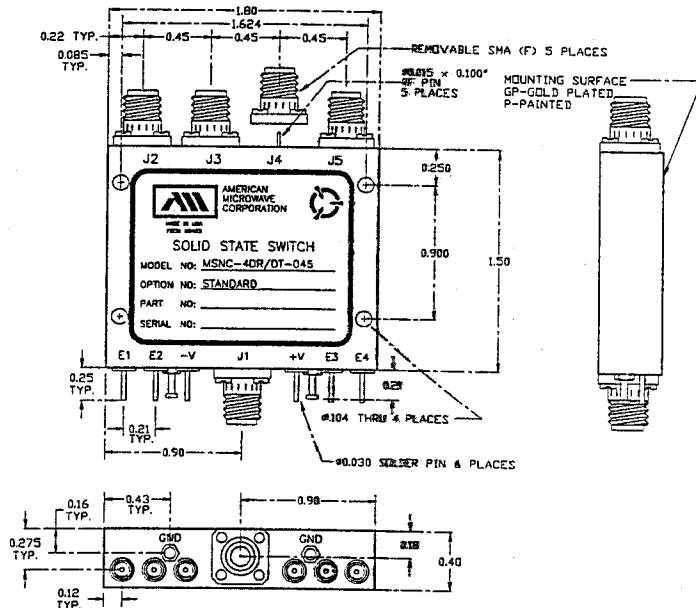
E-MAIL ADDRESS: AMCPMI@AOL.COM

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

SP4T ABSORPTIVE/REFLECTIVE PIN-DIODE SWITCH

KEY FEATURES

- 0.5 GHz TO 18 GHz (10MHz to 18GHz optional)
- LOW LOSS
- LOW VIDEO TRANSIENT
- HIGH ISOLATION
- MINIATURE
- TTL LOGIC COMPATIBLE



AMC MODEL No: MSNC-4DT-045-STANDARD (Option 0518)

SPECIFICATIONS:(ABSORPTIVE)

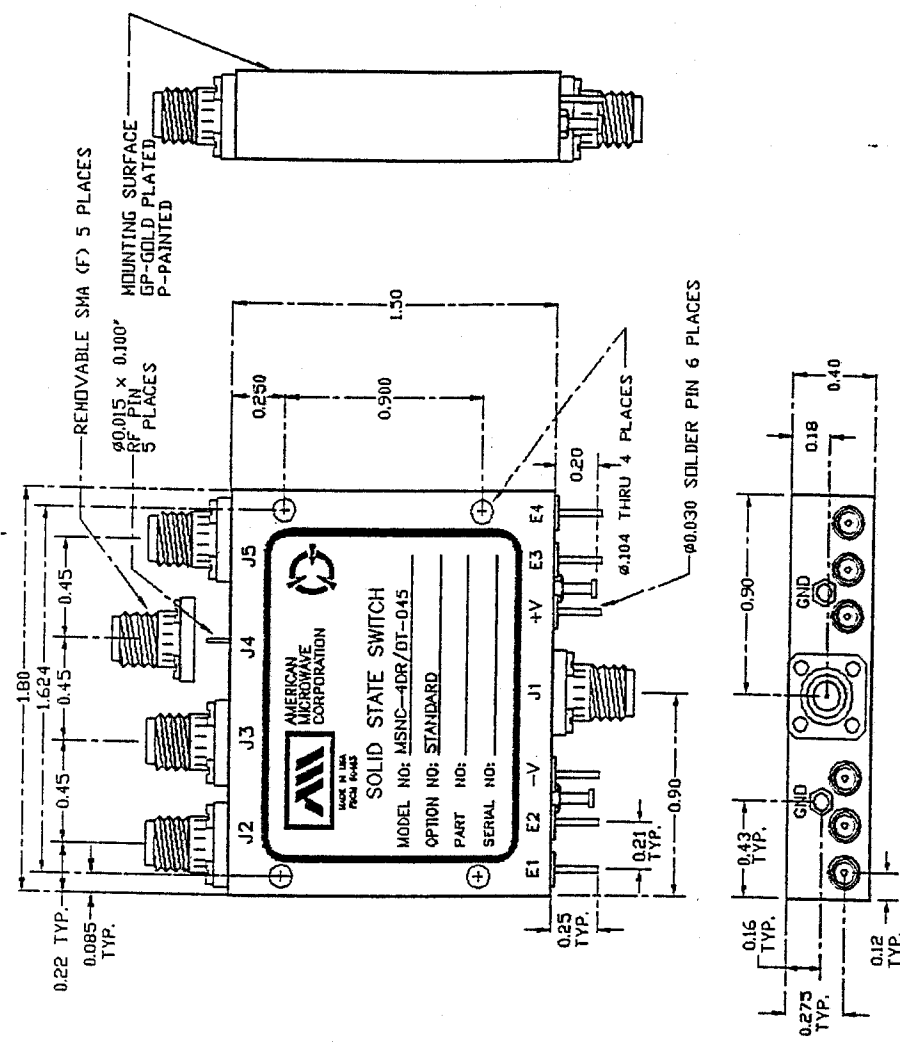
● FREQUENCY RANGE	:	0.5 GHz to 18.0 GHz (10MHz to 18GHz optional)
● INSERTION LOSS	:	3.75 dB MAX.
	:	0.95 dB TYP. @ 2.0 GHz
	:	2.00 dB TYP. @ 8.0 GHz
	:	3.00 dB TYP. @ 18.0 GHz
● ISOLATION	:	≥ 60 dB MIN.
	:	≥ 85 dB TYP. @ 2.0 GHz
	:	≥ 80 dB TYP. @ 8.0 GHz
	:	≥ 70 dB TYP. @ 18.0 GHz
● VSWR	:	2.0:1
● SWITCHING SPEED	:	"RISE" 15nS MAX., 10nS TYP.
	:	"FALL" 15nS MAX., 10nS TYP.
	:	"ON" 100nS MAX., 75nS TYP.
	:	"OFF" 100nS MAX., 75nS TYP.
● CONTROL	:	TTL Compatible (Independent or with Decoder)
● VIDEO TRANSIENTS	:	≤1.5V Peak to Peak, 300 MHz Bandwidth
(Low video transients available)	:	≤0.36V Peak to Peak, 20 MHz Bandwidth
● RF INPUT POWER	:	+20dBm Operating, 1 Watt Survival (Other power Levels available)
● DC POWER SUPPLY	:	+5vdc @ +200mA MAX.
(Other supply voltages available)	:	-5vdc @ -100mA MAX.
● SIZE	:	1.3" X 1.5" X 0.4"
● WEIGHT	:	≤ 2.5 oz.

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- SPECIFICATIONS:**
- FREQUENCY: 0.5 GHz TO 18 GHz
 - INSERTION LOSS: REFLECTIVE: 3.0db
ABSORPTIVE: 3.75db
 - ISOLATION: 0.5 GHz TO 2 GHz: 60db
2 GHz TO 18 GHz: 70db
 - VSWR: REFLECTIVE IN/OUT: 2.0:1
ABSORPTIVE IN/OUT: 2.0:1
ABSORPTIVE OUT/OFF: 2.0:1
 - SPEED: RISE: 10ns TYPICAL, 15ns MAX.
FALL: 10ns TYPICAL, 15ns MAX.
DELAY ON: 75ns TYPICAL, 100ns MAX.
DELAY OFF: 75ns TYPICAL, 100ns MAX.
 - POWER INPUT: (CW)+20dBm (STANDARD), +10 dBm (HIGH SPEED)
 - SURVIVAL POWER: 1 WATT CW, 10 WATTS PEAK 1 μ SEC
 - CONTROL: TTL LOGIC "0"=ON "1"=OFF
 - POWER SUPPLY: +5V @ 200 mA MAX.
-5V @ 75mA MAX.(REFLECTIVE)
100mA MAX.(ABSORPTIVE/NON-REFLECTIVE)

- OPTIONS:**
- INDEPENDENT CONTROL WITH SOLDER PIN STANDARD
- DEC-SP: 2 BIT DECODER WITH SOLDER PIN
 - 10M18: 10 MHz TO 18 GHz (INSERTION LOSS INCREASES BY 1.5db AT 10 MHz AND 0.5db AT 18 GHz)
 - 100M18: 100 MHz TO 18 GHz (INSERTION LOSS INCREASES BY 1.5db AT 100 MHz AND 0.5db AT 18 GHz)
 - 11B: 1 GHz TO 18 GHz (NO CHANGE IN INSERTION LOSS)
 - 21B: 2 GHz TO 18 GHz (NO CHANGE IN INSERTION LOSS)
 - 412: 4 GHz TO 12.4 GHz (NO CHANGE IN INSERTION LOSS)
 - 618: 6 GHz TO 18 GHz (NO CHANGE IN INSERTION LOSS)
 - 1218: 12 GHz TO 18 GHz (NO CHANGE IN INSERTION LOSS)
 - 100M20: 100 MHz TO 20 GHz (INSERTION LOSS INCREASES BY 1.5db AT 100 MHz AND 1.0db AT 20 GHz)
 - 220: 2 GHz TO 20 GHz (INSERTION LOSS INCREASES BY 1.0db AT 20 GHz)
 - 1020: 10 GHz TO 20 GHz (INSERTION LOSS INCREASES BY 1.0db AT 20 GHz)
 - B01: -12V POWER SUPPLIES
 - B02: -15V POWER SUPPLIES
 - B03: REVERSE LOGIC "1"=ON "0"=OFF
 - B04: DRIVERLESS, CURRENT CONTROLLED
 - B05: HIGH SPEED, TURNON/TURNOFF 25 nsec MAXIMUM WHEN APPLICABLE
 - B06: HIGH POWER - SPECIFY CW POWER, PEAK POWER, PULSE WIDTH, DUTY CYCLE, RF FREQUENCY AND BANDWIDTH
 - B07: CUSTOM DESIGNED PRODUCT - SPECIFY INITIALS OF CUSTOMER
 - B08: LOW VIDEO TRANSIENTS - SPECIFY VIDEO BANDWIDTH
 - B09: LOW INSERTION LOSS VERSION
 - B10: HIGHER ISOLATION VERSION

- ENVIRONMENTAL RATINGS:**
- TEMPERATURE: -55°C TO +85°C (OPERATING)
-65°C TO +125°C (STORAGE)
 - HUMIDITY: MIL-STD-202F, METHOD 103B COND. B
 - SHOCK: MIL-STD-202F, METHOD 213B COND. B
 - VIBRATION: MIL-STD-202F, METHOD 204D COND. B
 - ALTITUDE: MIL-STD-202F, METHOD 105C COND. B
 - TEMPERATURE CYCLE: MIL-STD-202F, METHOD 107D COND. A
- NOTE: THE ABOVE SPECIFICATIONS ARE SUBJECT TO CHANGE OR REVISION



NOTE:
DR=WITH DRIVER, REFLECTIVE
DT=WITH DRIVER, NON-REFLECTIVE/ABSORPTIVE

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FREDERICK, MARYLAND

OUTLINE DRAWING
MSNC-4DR/DT-045-STANDARD
REFLECTIVE OR NON-REFLECTIVE/ABSORPTIVE
SOLID STATE SWITCH

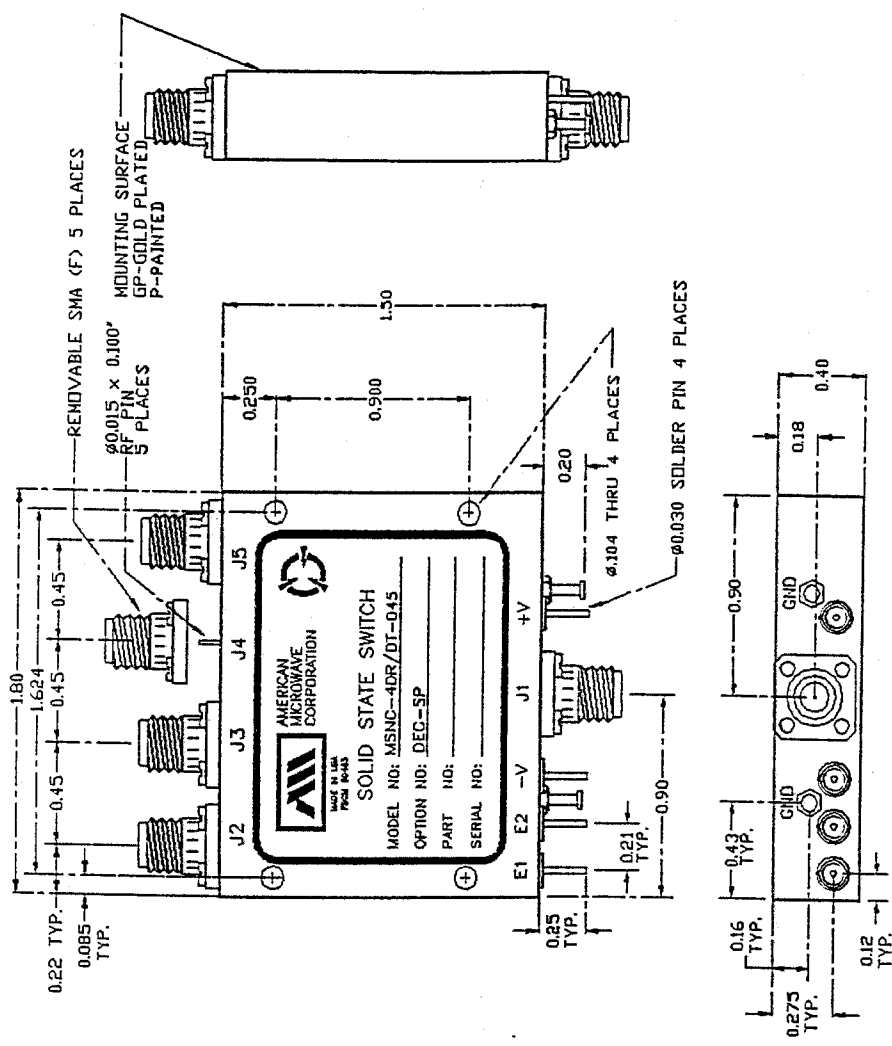
APPROVALS: *W. J. ...* DATE: 1/21/97
DESIGN: *W. J. ...*
CHECKED: *W. J. ...*
ISSUED: *W. J. ...*

PART NO. _____
SCALE N/S
SIZE: A
FSCM NO. A
DWG NO. 60483
REV. A
100-3989-1
SHEET 1 of 1

- SPECIFICAL**
- FREQUENCY: 0.5 GHz TO 18 GHz
 - INSERTION LOSS: REFLECTIVE: 3.0db
ABSORPTIVE: 3.75db
 - ISOLATION: 0.5 GHz TO 2 GHz: 60db
2 GHz TO 18 GHz: 70db
 - VSWR: REFLECTIVE IN/OUT: 2.0:1
ABSORPTIVE IN/OUT: 2.0:1
REFLECTIVE OUT/OFF: 2.0:1
 - SPEED: RISE: 10ns TYPICAL, 15ns MAX.
FALL: 10ns TYPICAL, 15ns MAX.
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100mA MAX.(ABSORPTIVE/NDN--REFLECTIVE)

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 - 218 2 GHz TO 18 GHz (NO CHANGE IN INSERTION LOSS)
 - 412 4 GHz TO 12.4 GHz (NO CHANGE IN INSERTION LOSS)
 - 618 6 GHz TO 18 GHz (NO CHANGE IN INSERTION LOSS)
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 - B10 HIGHER ISOLATION VERSION

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NOTE:
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AMERICAN MICROWAVE CORPORATION
FREDERICK, MARYLAND

OUTLINE DRAWING
MSNC-4DR/DT-045-DEC-SP
REFLECTIVE OR NON-REFLECTIVE/ABSORPTIVE
SOLID STATE SWITCH

APPROVALS: DRAWN BY: J. J. & W. J. P. DATE: 7/21/97
CHECKED BY: DATE: 8/2/97

PART NO. TITLE
REV. A SIZE FSC# NO. A 60483 DWG NO. 100-3989-2 REV. A
SCALE N/S SHEET 1 of 1

ALL DIMENSIONS ARE IN INCHES
TOLERANCES:
X.XX ±0.020
X.XXX ±0.010



**AMERICAN MICROWAVE
CORPORATION**

**TYPICAL
MEASURED
TEST DATA
ON
0.5 GHz TO 18 GHz
ABSORPTIVE
SP4T
PIN-DIODE SWITCH**

MODEL NO: MSNC-4DT-045-STANDARD (Option 0518)
(Serial Number: 4MS70549)

DECEMBER 17, 1997

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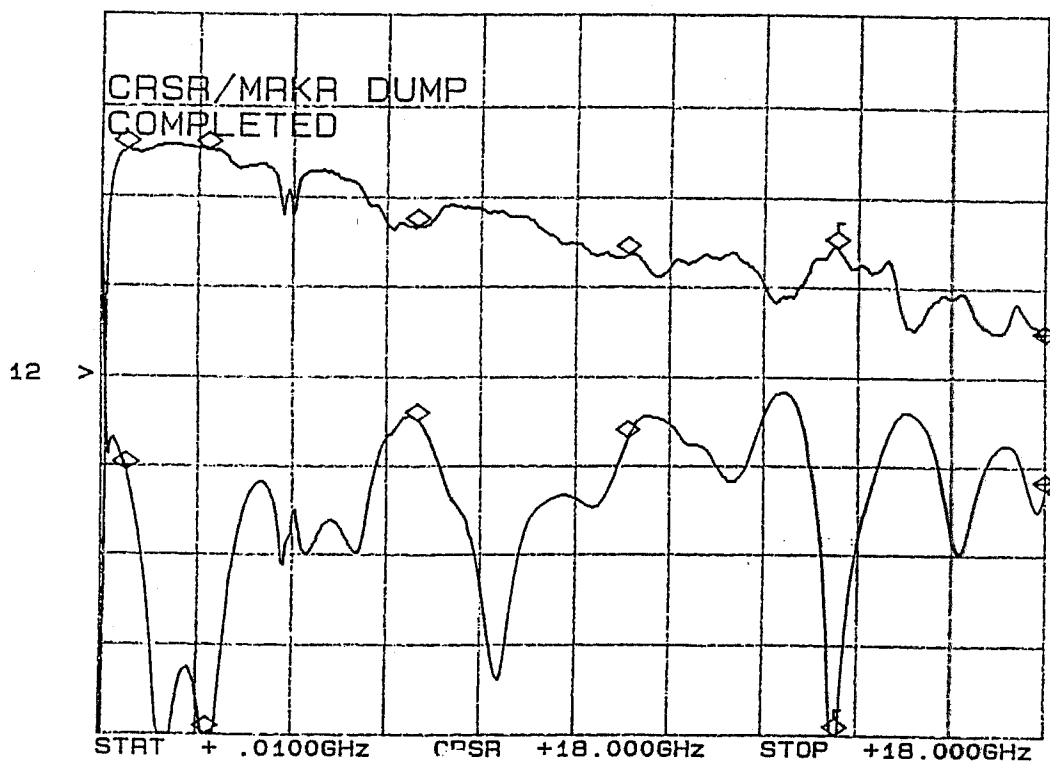


SUMMARY TEST DATA

MODEL NUMBER : MSNC-4DT-045-STANDART (Option 0518)
SERIAL NUMBER : 4MS70549
TECHNICIAN : RENE AFABLE
VOLTAGE & CURRENT DRAW : $\pm 5\text{vdc}$: +92mA, -62mA

INSERTION LOSS & RETURN LOSS*

CH1: A -M - 3.09 dB CH2: C -M - 15.86 dB
1.0 dB/ REF - 3.50 dB 5.0 dB/ REF - 9.54 dB
INSERTION LOSS/VSWR J1-J2



*J1: COMMON ARM

FREQUENCY	INSERTION LOSS	RETURN LOSS
0.5 GHz	-0.97 dB	-14.8 dB
2.0 GHz	-0.96 dB	-31.5 dB
6.0 GHz	-1.83 dB	-11.9 dB
10.0 GHz	-2.14 dB	-12.9 dB
14.0 GHz	-2.04 dB	-33.4 dB
18.0 GHz	-3.09 dB	-15.8 dB

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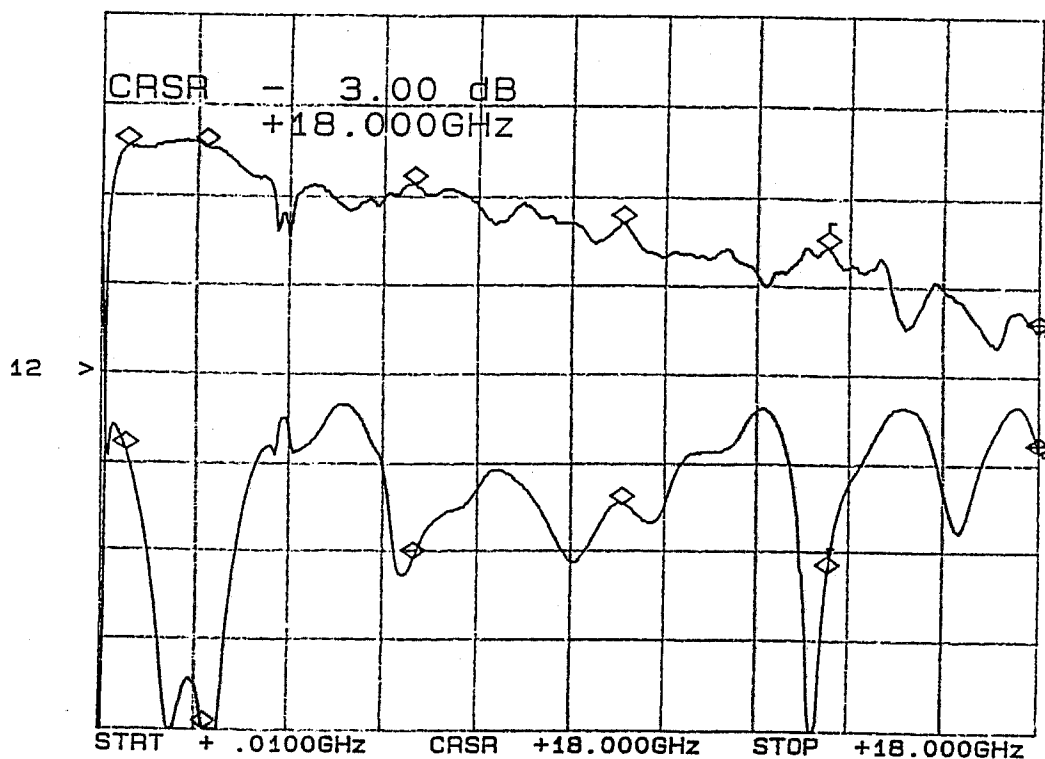


SUMMARY TEST DATA

MODEL NUMBER : MSNC-4DT-045-STANDART (Option 0518)
SERIAL NUMBER : 4MS70549
TECHNICIAN : RENE AFABLE
VOLTAGE & CURRENT DRAW : $\pm 5\text{vdc}$: +92mA, -62mA

INSERTION LOSS & RETURN LOSS*

CH1: R -M - 3.00 dB CH2: C -M - 13.83 dB
1.0 dB/ REF - 3.50 dB 5.0 dB/ REF - 9.54 dB
INSERTION LOSS/VSWR J1-J3



*J1: COMMON ARM

FREQUENCY	INSERTION LOSS	RETURN LOSS
0.5 GHz	-0.95 dB	-13.8 dB
2.0 GHz	-0.95 dB	-30.0 dB
6.0 GHz	-1.36 dB	-20.0 dB
10.0 GHz	-1.78 dB	-16.7 dB
14.0 GHz	-2.05 dB	-20.7 dB
18.0 GHz	-3.00 dB	-13.8 dB

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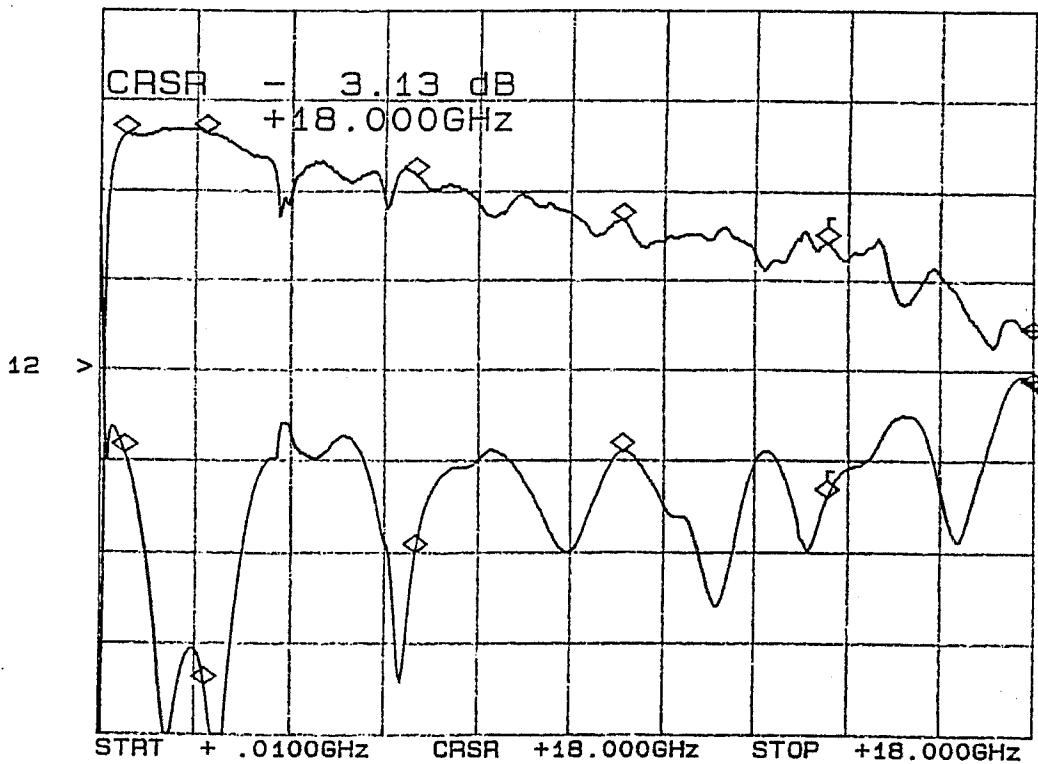
SUMMARY TEST DATA

MODEL NUMBER	: MSNC-4DT-045-STANDART (Option 0518)
SERIAL NUMBER	: 4MS70549
TECHNICIAN	: RENE AFABLE
VOLTAGE & CURRENT DRAW	: $\pm 5\text{vdc}$: +92mA, -62mA

INSERTION LOSS & RETURN LOSS*

CH1: R -M - 3.13 dB	CH2: C -M - 10.52 dB
1.0 dB/ REF - 3.50 dB	5.0 dB/ REF - 9.54 dB

INSERTION LOSS/ SWR J1-J4



*J1: COMMON ARM

FREQUENCY	INSERTION LOSS	RETURN LOSS
0.5 GHz	-0.87 dB	-14.1 dB
2.0 GHz	-0.86 dB	-26.7 dB
6.0 GHz	-1.31 dB	-19.4 dB
10.0 GHz	-1.80 dB	-13.9 dB
14.0 GHz	-2.06 dB	-16.4 dB
18.0 GHz	-3.13 dB	-10.5 dB

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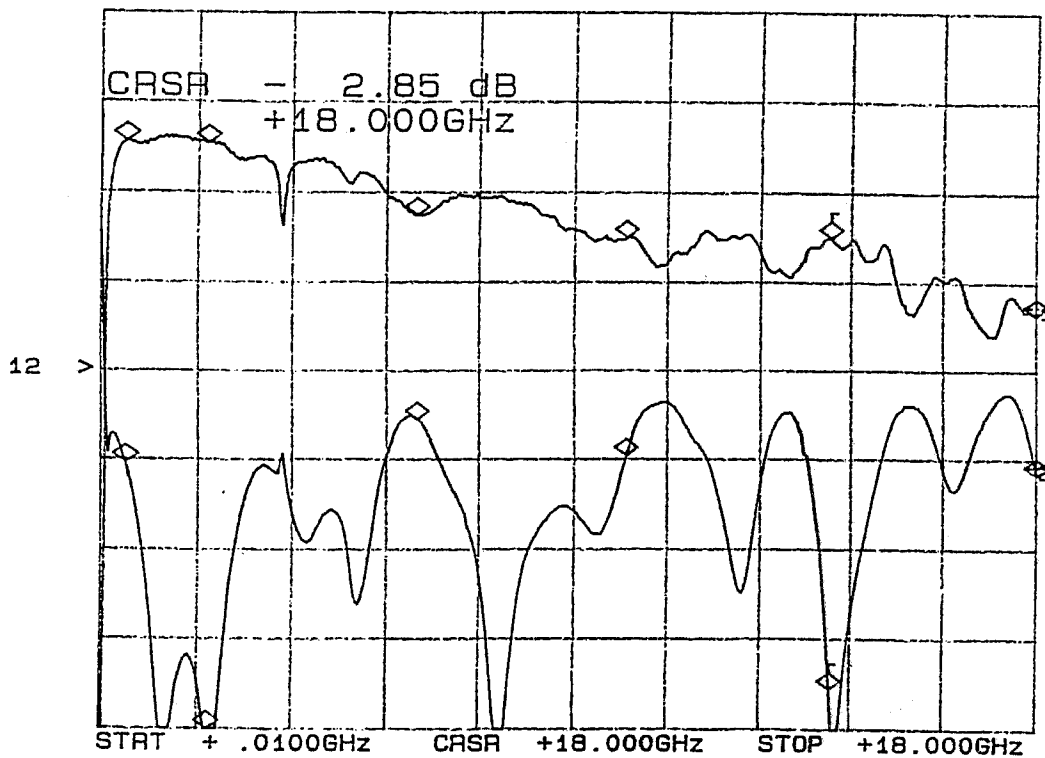
SUMMARY TEST DATA

MODEL NUMBER	: MSNC-4DT-045-STANDART (Option 0518)
SERIAL NUMBER	: 4MS70549
TECHNICIAN	: RENE AFABLE
VOLTAGE & CURRENT DRAW	: $\pm 5\text{vdc}$: +92mA, -62mA

INSERTION LOSS & RETURN LOSS*

CH1: R -M - 2.85 dB	CH2: C -M - 15.33 dB
1.0 dB/ REF - 3.50 dB	5.0 dB/ REF - 9.54 dB

INSERTION LOSSVSWR J1-J5



*J1: COMMON ARM

FREQUENCY	INSERTION LOSS	RETURN LOSS
0.5 GHz	-0.94 dB	-14.7 dB
2.0 GHz	-0.94 dB	-31.4 dB
6.0 GHz	-1.74 dB	-12.2 dB
10.0 GHz	-1.99 dB	-14.3 dB
14.0 GHz	-2.00 dB	-27.4 dB
18.0 GHz	-2.85 dB	-15.3 dB

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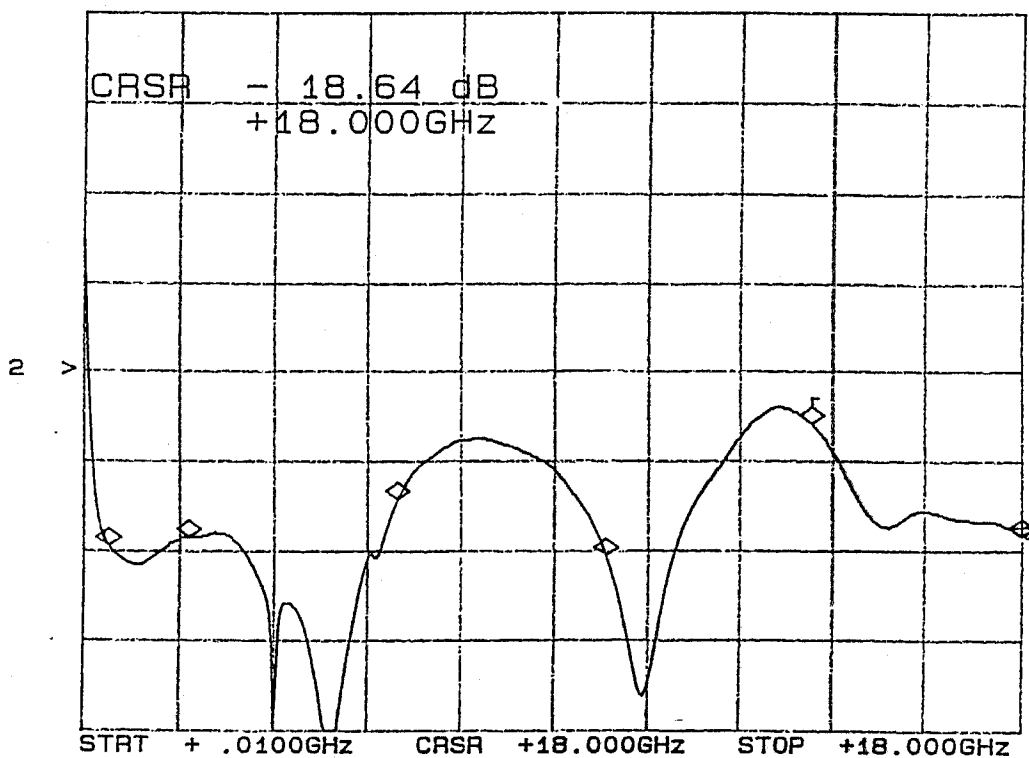
SUMMARY TEST DATA

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SERIAL NUMBER : 4MS70549
TECHNICIAN : RENE AFABLE
VOLTAGE & CURRENT DRAW : $\pm 5\text{vdc}$: +92mA, -62mA

OFF ARM TERMINATION

CH2: C -M - 18.64 dB
5.0 dB/ REF - 9.54 dB

OFF ARM TERMINATION J2



FREQUENCY	RETURN LOSS
0.5 GHz	-19.2 dB
2.0 GHz	-18.7 dB
6.0 GHz	-16.6 dB
10.0 GHz	-19.7 dB
14.0 GHz	-12.4 dB
18.0 GHz	-18.6 dB

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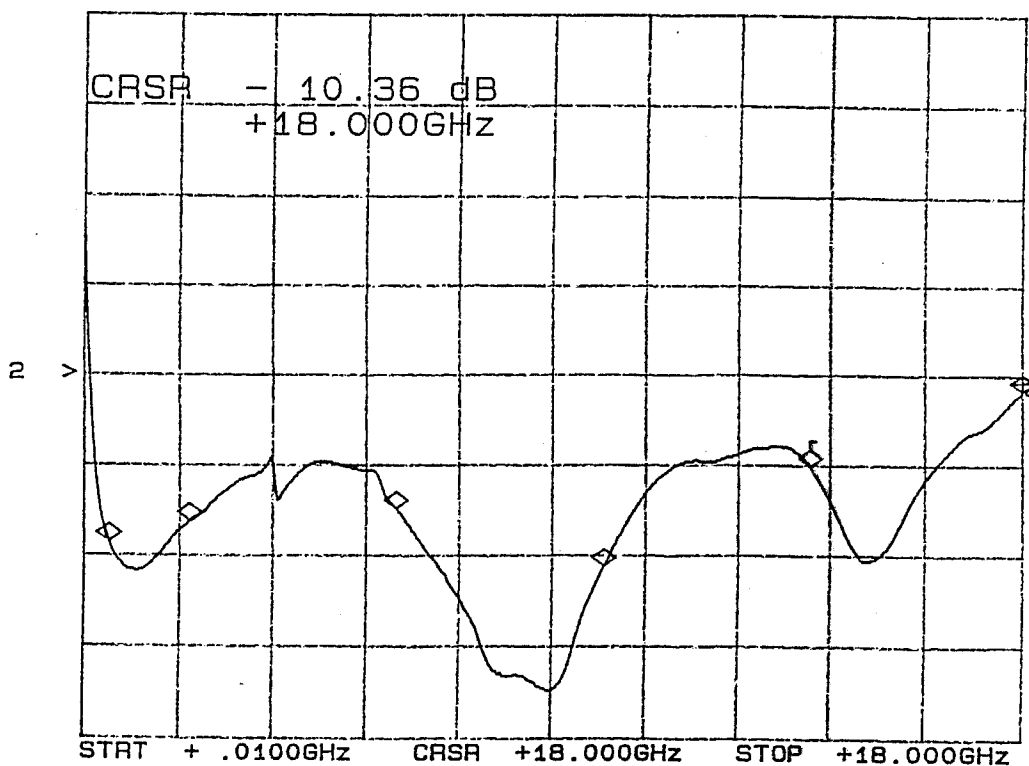
SUMMARY TEST DATA

MODEL NUMBER : MSNC-4DT-045-STANDARD (Option 0518)
SERIAL NUMBER : 4MS70549
TECHNICIAN : RENE AFABLE
VOLTAGE & CURRENT DRAW : $\pm 5\text{vdc}$: +92mA, -62mA

OFF ARM TERMINATION

CH2: C -M - 10.36 dB
5.0 dB/ REF - 9.54 dB

OFF ARM TERMINATION J3-



FREQUENCY	RETURN LOSS
0.5 GHz	-18.7 dB
2.0 GHz	-17.6 dB
6.0 GHz	-16.9 dB
10.0 GHz	-20.1 dB
14.0 GHz	-14.5 dB
18.0 GHz	-10.3 dB

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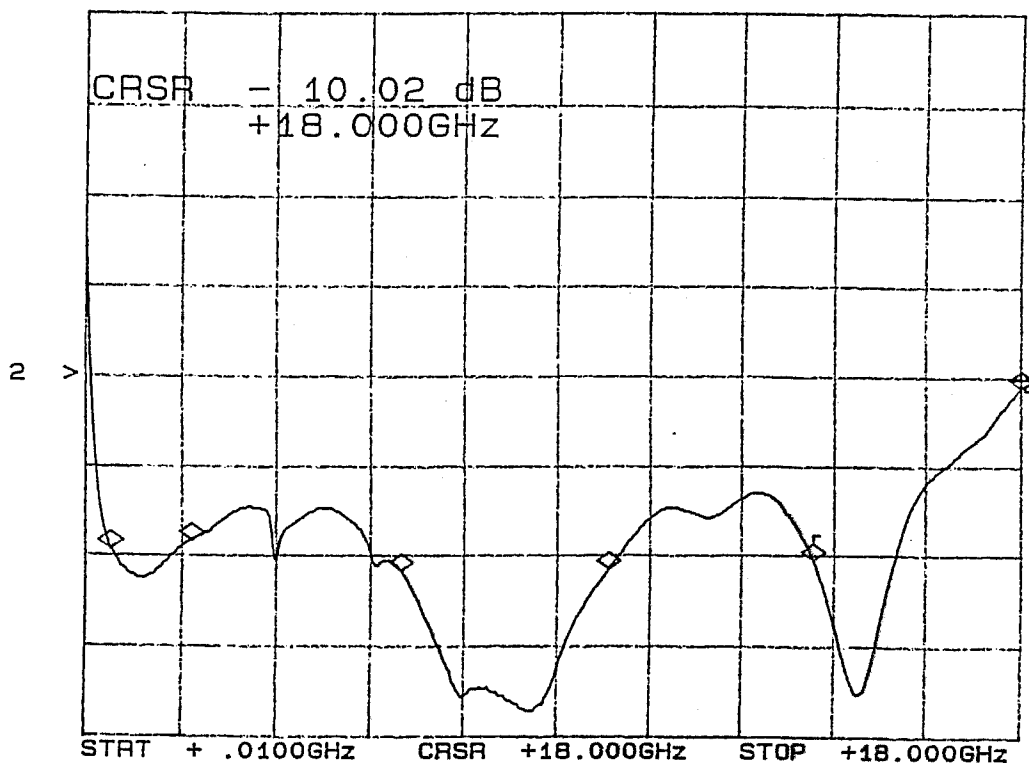
SUMMARY TEST DATA

MODEL NUMBER : MSNC-4DT-045-STANDARD (Option 0518)
SERIAL NUMBER : 4MS70549
TECHNICIAN : RENE AFABLE
VOLTAGE & CURRENT DRAW : $\pm 5\text{vdc}$: +92mA, -62mA

OFF ARM TERMINATION

CH2: C -M - 10.02 dB
5.0 dB/ REF - 9.54 dB

OFF ARM TERMINATION J4-



FREQUENCY	RETURN LOSS
0.5 GHz	-19.0 dB
2.0 GHz	-18.5 dB
6.0 GHz	-20.4 dB
10.0 GHz	-20.2 dB
14.0 GHz	-19.7 dB
18.0 GHz	-10.0 dB

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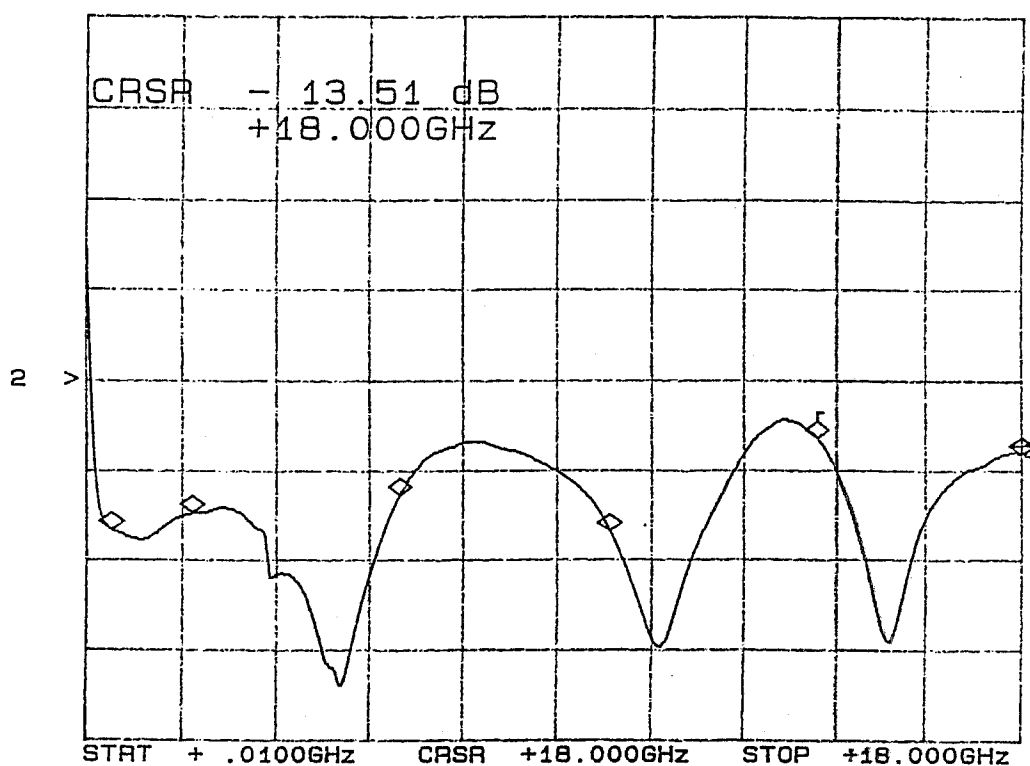
SUMMARY TEST DATA

MODEL NUMBER : MSNC-4DT-045-STANDARD (Option 0518)
SERIAL NUMBER : 4MS70549
TECHNICIAN : RENE AFABLE
VOLTAGE & CURRENT DRAW : $\pm 5\text{vdc}$: +92mA, -62mA

OFF ARM TERMINATION

CH2: C -M - 13.51 dB
5.0 dB/ REF - 9.54 dB

OFF ARM TERMINATION J5



FREQUENCY	RETURN LOSS
0.5 GHz	-17.7 dB
2.0 GHz	-16.8 dB
6.0 GHz	-15.7 dB
10.0 GHz	-17.7 dB
14.0 GHz	-12.6 dB
18.0 GHz	-13.5 dB

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SUMMARY TEST DATA

MSN-0518-4DT-045 : MSNC-4DT-045-STANDARD (Option 0518)
SERIAL NUMBER : 4MS70549
TECHNICIAN : RENE AFABLE
VOLTAGE & CURRENT DRAW : $\pm 5\text{vdc}$: +92mA, -62mA

ISOLATION* (AS MEASURED ON A SPECTRUM ANALYZER)

FREQUENCY	J2	J3	J4	J5
200 MHz	-90 dB	-89 dB	-90 dB	-90 dB
500 MHz	-100 dB	-100 dB	-96 dB	-96 dB
1 GHz	-93 dB	-93 dB	-92 dB	-92 dB
2 GHz	-93 dB	-94 dB	-93 dB	-92 dB
4 GHz	-100 dB	-96 dB	-97 dB	-100 dB
6 GHz	-92 dB	-91 dB	-92 dB	-92 dB
8 GHz	-95 dB	-89 dB	-91 dB	-94 dB
10 GHz	-90 dB	-88 dB	-87 dB	-88 dB
12 GHz	-85 dB	-86 dB	-88 dB	-85 dB
14 GHz	-84 dB	-84 dB	-80 dB	-84 dB
16 GHz	-81 dB	-80 dB	-80 dB	-80 dB
18 GHz	-77 dB	-76 dB	-76 dB	-78 dB

J1: COMMON ARM

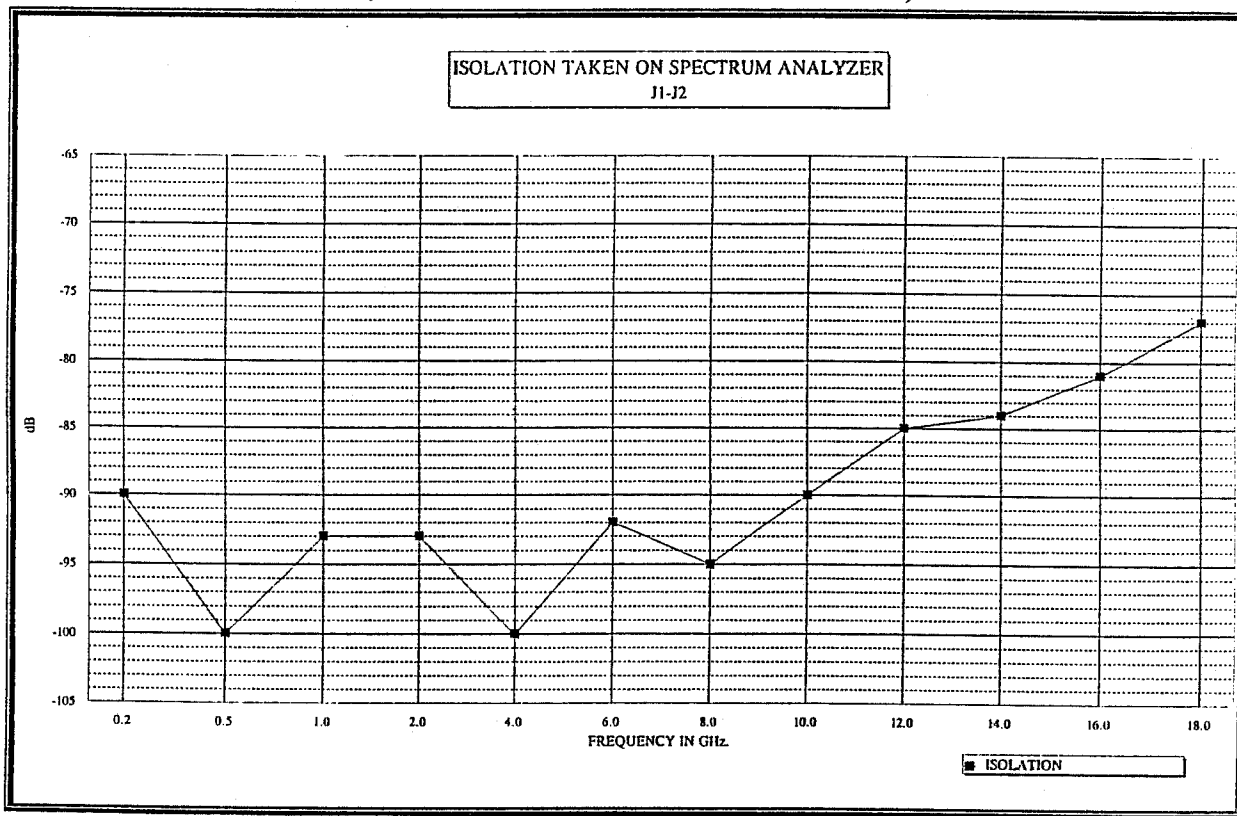
DECEMBER 17,1997



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SERIAL NUMBER : 4MS70549
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VOLTAGE & CURRENT DRAW : $\pm 5\text{vdc}$: +92mA, -62mA

ISOLATION* (AS MEASURED ON A SPECTRUM ANALYZER)



*J1: COMMON ARM

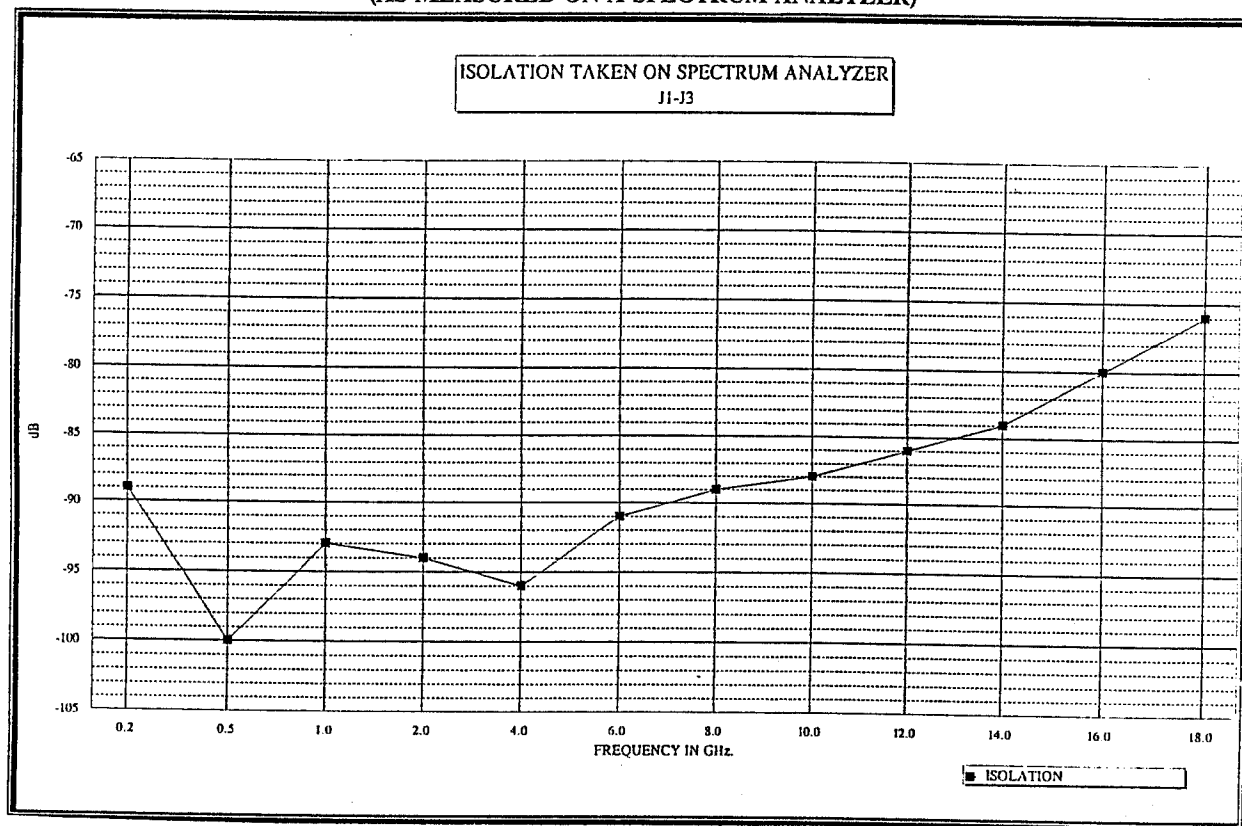
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ISOLATION* (AS MEASURED ON A SPECTRUM ANALYZER)



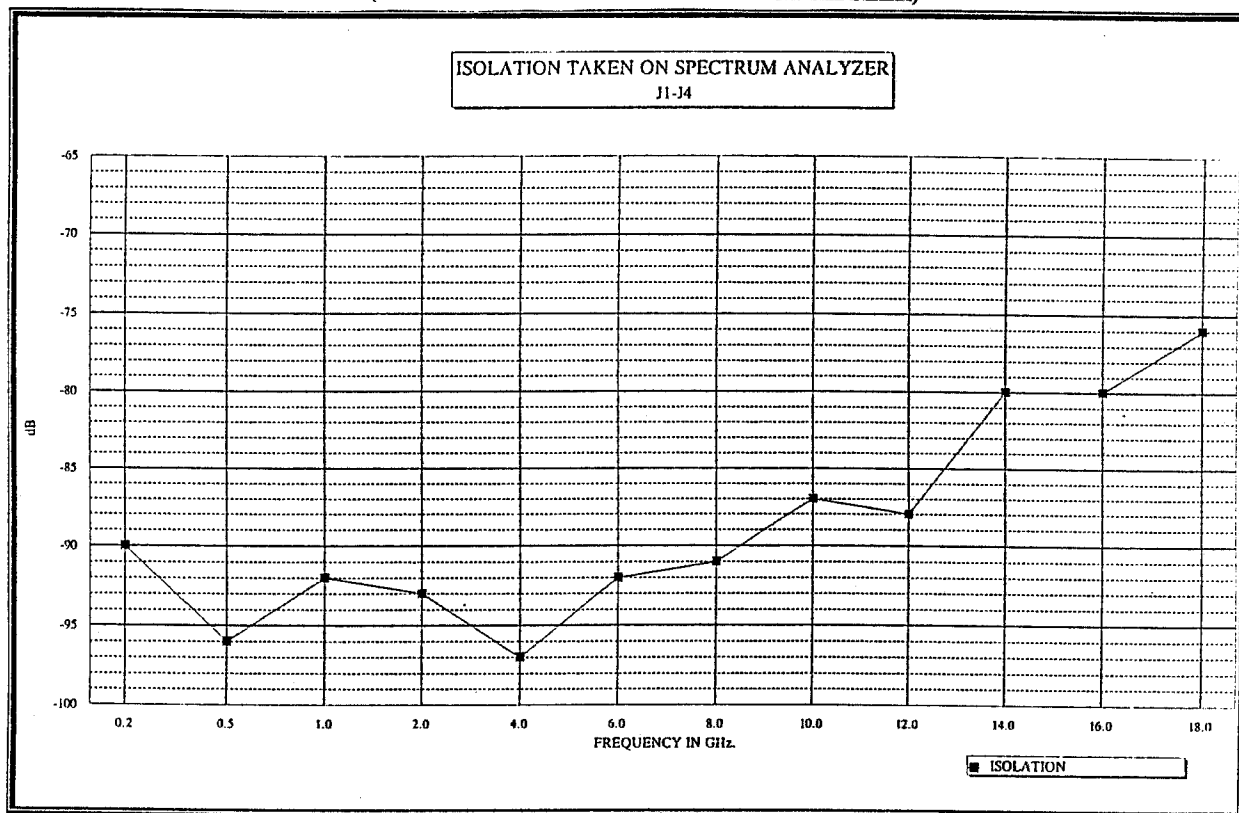
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TECHNICIAN : RENE AFABLE
VOLTAGE & CURRENT DRAW : ± 5 vdc: +92mA, -62mA

ISOLATION* (AS MEASURED ON A SPECTRUM ANALYZER)



*J1: COMMON ARM

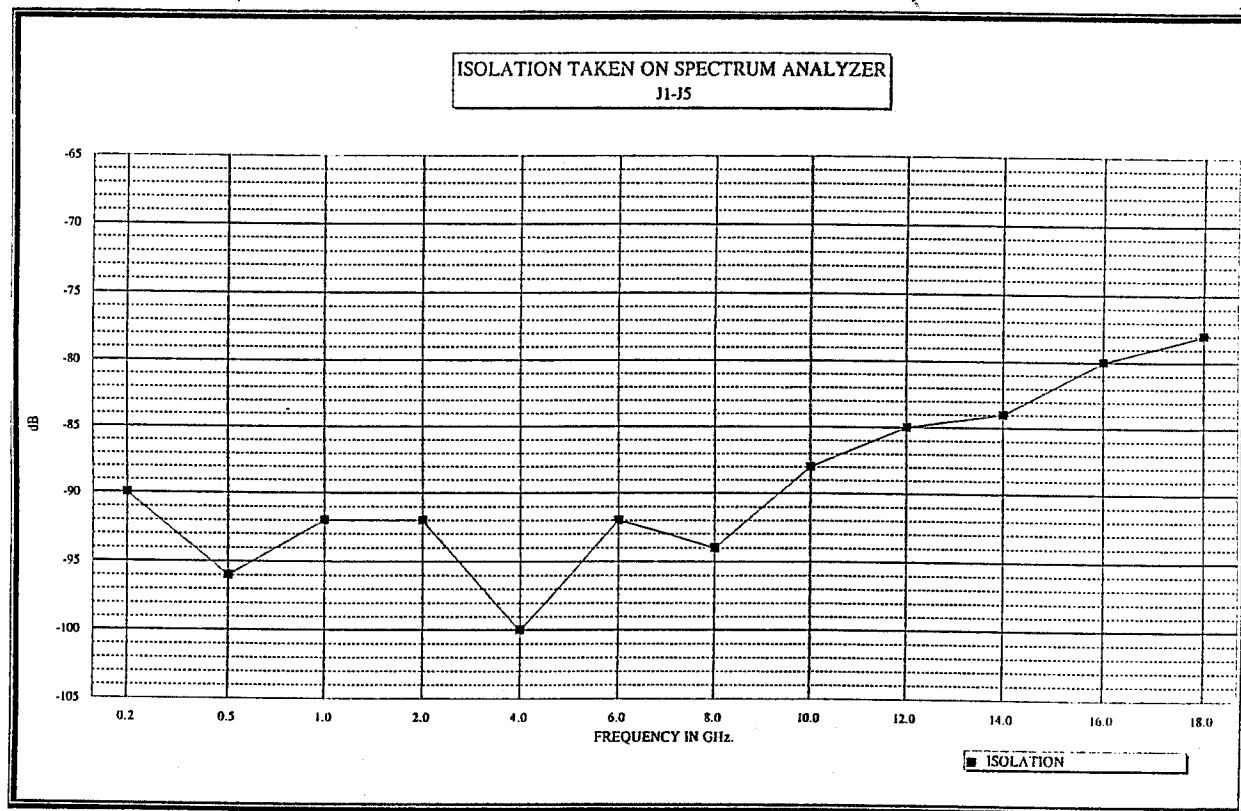
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TECHNICIAN : RENE AFABLE
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ISOLATION* (AS MEASURED ON A SPECTRUM ANALYZER)



*J1: COMMON ARM

DECEMBER 17, 1997



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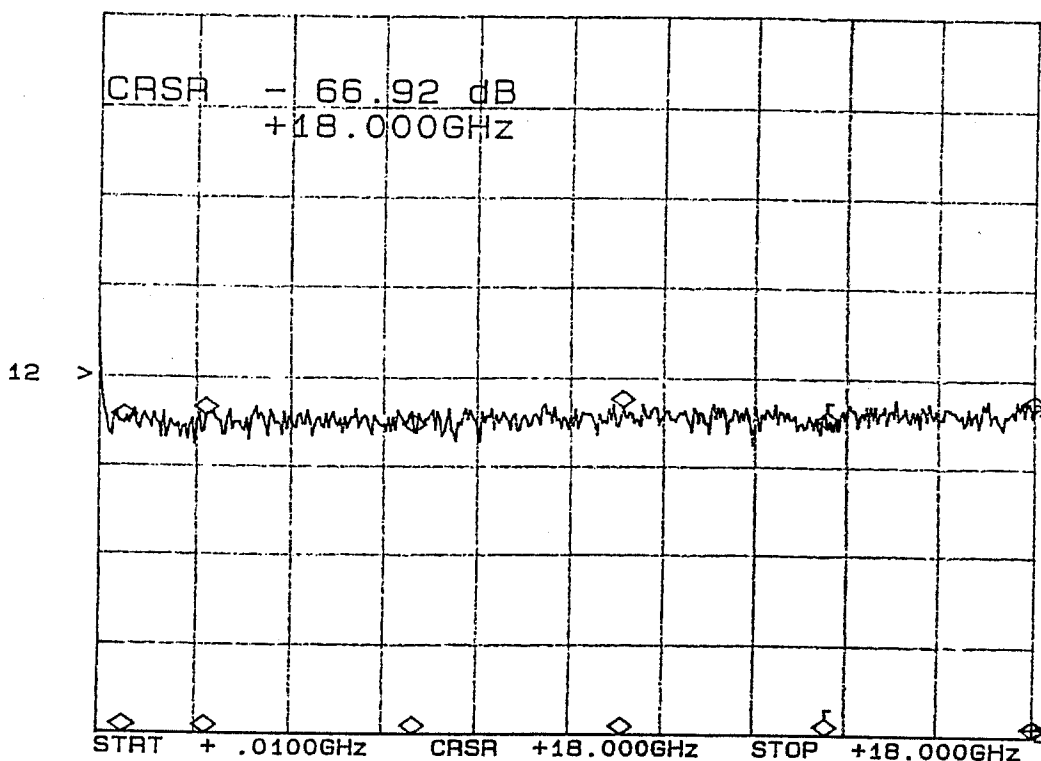
MODEL NUMBER : MSNC-4DT-045-STANDARD (Option 0518)
SERIAL NUMBER : 4MS70549
TECHNICIAN : RENE AFABLE
VOLTAGE & CURRENT DRAW : ± 5 vdc: +92mA, -62mA

ISOLATION*

(AS MEASURED ON A SCALAR NETWORK ANALYZER)

CH1: R -M A - 66.92 dB CH2: C -M - 48.70 dB
20.0 dB/ REF - 60.00 dB 5.0 dB/ REF - 9.54 dB

ISOLATION J1-J2



*J1: COMMON ARM

FREQUENCY	ISOLATION
0.5 GHz	<-69.0 dB
2.0 GHz	<-68.8 dB
6.0 GHz	<-69.3 dB
10.0 GHz	<-67.3 dB
14.0 GHz	<-66.4 dB
18.0 GHz	<-66.9 dB

DECEMBER 17, 19977



SUMMARY TEST DATA

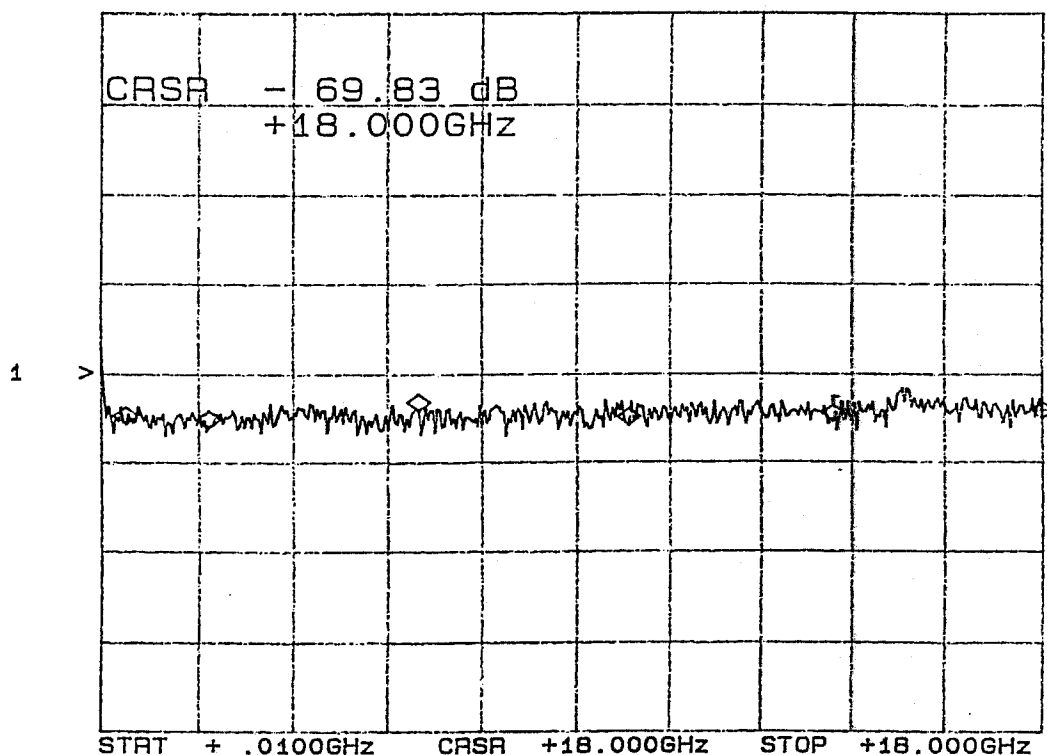
MODEL NUMBER : MSNC-4DT-045-STANDARD (Option 0518)
SERIAL NUMBER : 4MS70549
TECHNICIAN : RENE AFABLE
VOLTAGE & CURRENT DRAW : ± 5 vdc: +92mA, -62mA

ISOLATION*

(AS MEASURED ON A SCALAR NETWORK ANALYZER)

CH1: R -M A - 69.83 dB
20.0 dB/ REF - 60.00 dB

ISOLATION J1-J3



*J1: COMMON ARM

FREQUENCY	ISOLATION
0.5 GHz	< -69.8 dB
2.0 GHz	< -70.7 dB
6.0 GHz	< -71.9 dB
10.0 GHz	< -70.5 dB
14.0 GHz	< -71.3 dB
18.0 GHz	< -69.8 dB

DECEMBER 17, 19977



SUMMARY TEST DATA

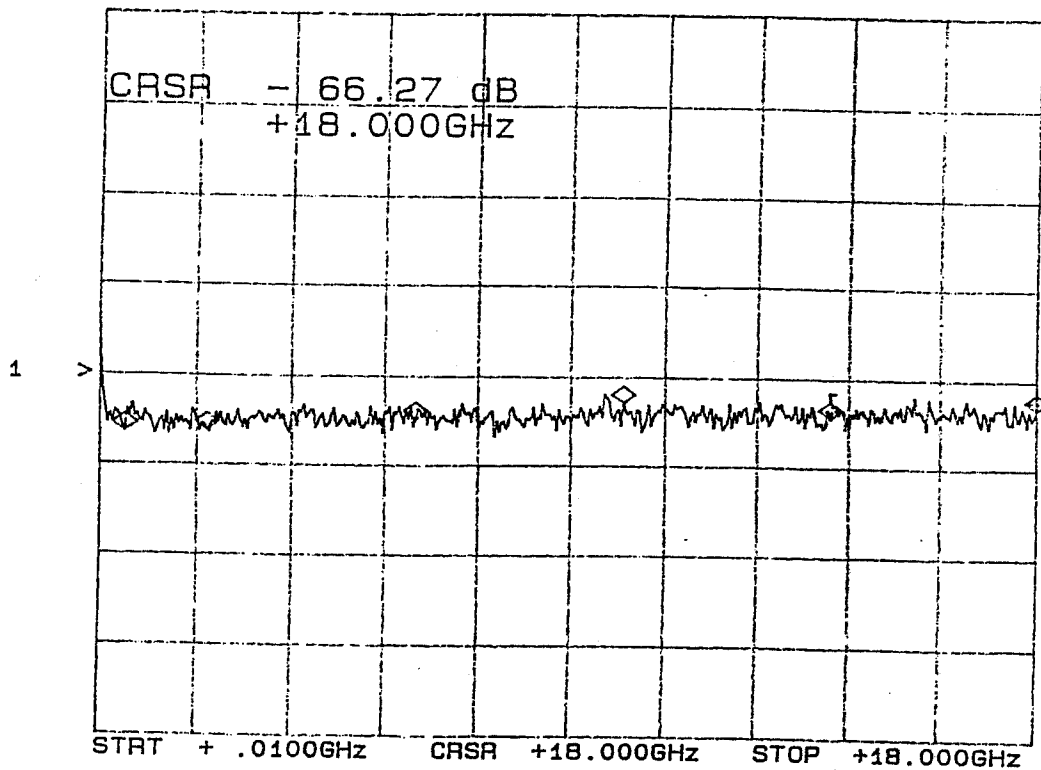
MODEL NUMBER : MSNC-4DT-045-STANDARD (Option 0518)
SERIAL NUMBER : 4MS70549
TECHNICIAN : RENE AFABLE
VOLTAGE & CURRENT DRAW : $\pm 5\text{vdc}$: +92mA, -62mA

ISOLATION*

(AS MEASURED ON A SCALAR NETWORK ANALYZER)

CH1: R -M A - 66.27 dB
 20.0 dB/ REF - 60.00 dB

ISOLATION J1-J4



*J1: COMMON ARM

FREQUENCY	ISOLATION
0.5 GHz	<-68.9 dB
2.0 GHz	<-72.6 dB
6.0 GHz	<-68.2 dB
10.0 GHz	<-67.5 dB
14.0 GHz	<-70.0 dB
18.0 GHz	<-66.2 dB

DECEMBER 17, 1997



SUMMARY TEST DATA

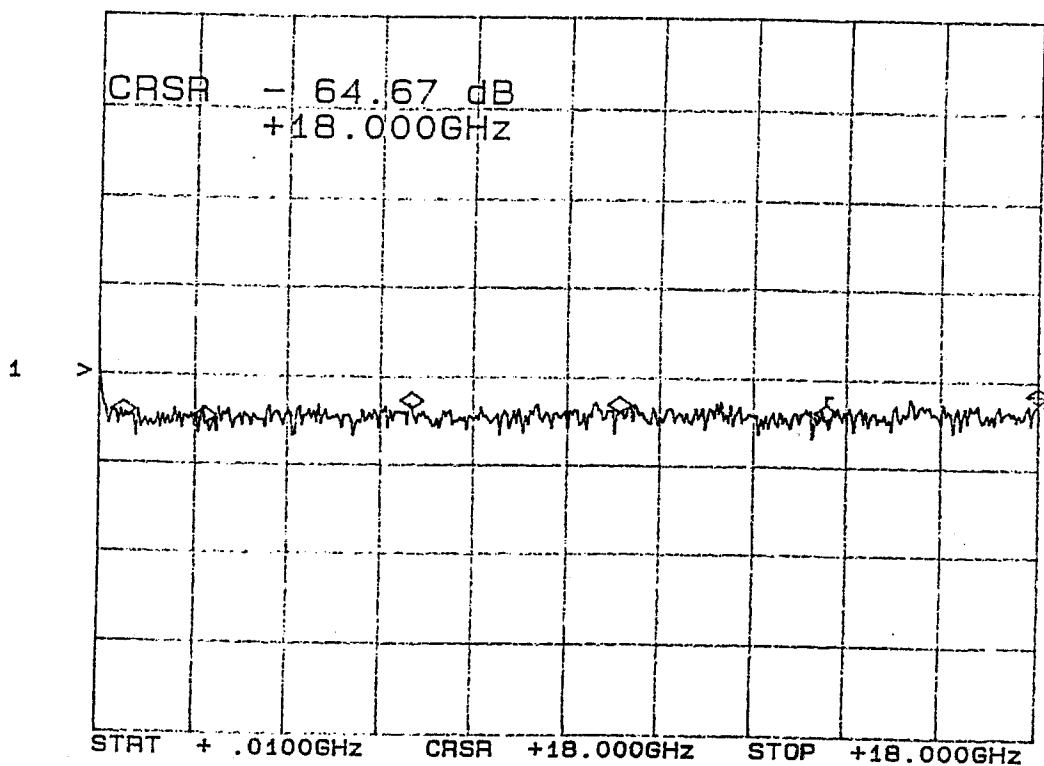
MODEL NUMBER : MSNC-4DT-045-STANDARD (Option 0518)
SERIAL NUMBER : 4MS70549
TECHNICIAN : RENE AFABLE
VOLTAGE & CURRENT DRAW : ± 5 vdc: +92mA, -62mA

ISOLATION*

(AS MEASURED ON A SCALAR NETWORK ANALYZER)

CH1: R -M A - 64.67 dB
20.0 dB/ REF - 60.00 dB

ISOLATION J1-J5



*J1: COMMON ARM

FREQUENCY	ISOLATION
0.5 GHz	<-68.6 dB
2.0 GHz	<-69.9 dB
6.0 GHz	<-67.6 dB
10.0 GHz	<-66.6 dB
14.0 GHz	<-68.1 dB
18.0 GHz	<-64.6 dB

DECEMBER 17, 19977



SUMMARY TEST DATA

MODEL NUMBER : MSNC-4DT-045-STANDARD (Option 0518)
SERIAL NUMBER : 4MS70549
TECHNICIAN : RENE AFABLE
VOLTAGE & CURRENT DRAW : $\pm 5\text{vdc}$: +92mA, -62mA

SWITCHING SPEED

"Rise/Fall" Time: 10% RF to 90% RF & 90% RF to 10% RF

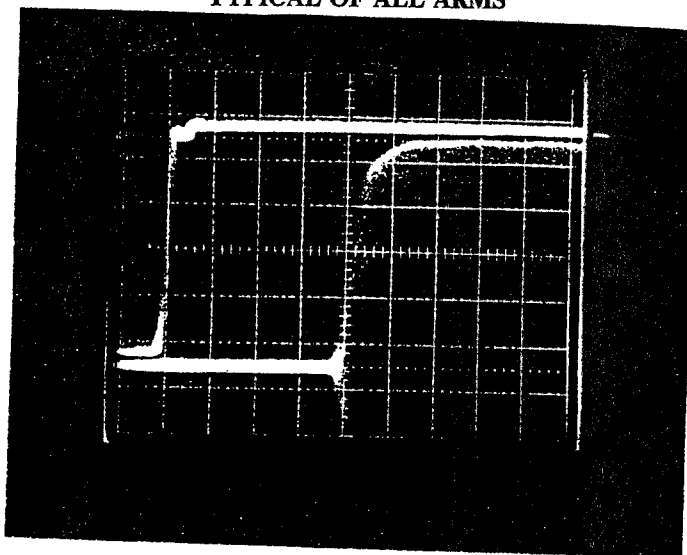
"On/Off" Time: 50% TTL to 90% RF or 10% RF

TYPICAL OF ALL ARMS

"DELAY ON": 46nS
"RISE TIME": 8nS

HORIZONTAL SCALE:
10nS PER DIVISION

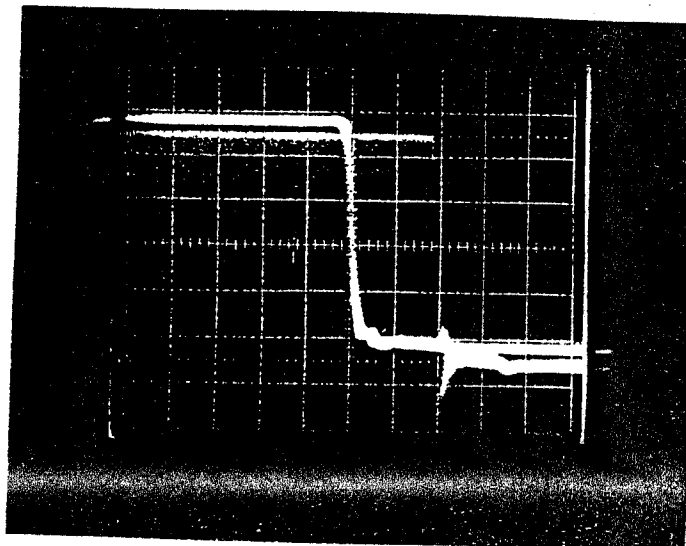
VERTICAL SCALE:
5mV PER DIVISION



"DELAY OFF": 22nS
"FALL TIME": 2nS

HORIZONTAL SCALE:
10nS PER DIVISION

VERTICAL SCALE:
5mV PER DIVISION



DECEMBER 17, 1997



SUMMARY TEST DATA

MODEL NUMBER	: MSNC-4DT-045-STANDARD (Option 0518)
SERIAL NUMBER	: 4MS70549
TECHNICIAN	: RENE AFABLE
VOLTAGE & CURRENT DRAW	: $\pm 5\text{vdc}$: +92mA, -62mA

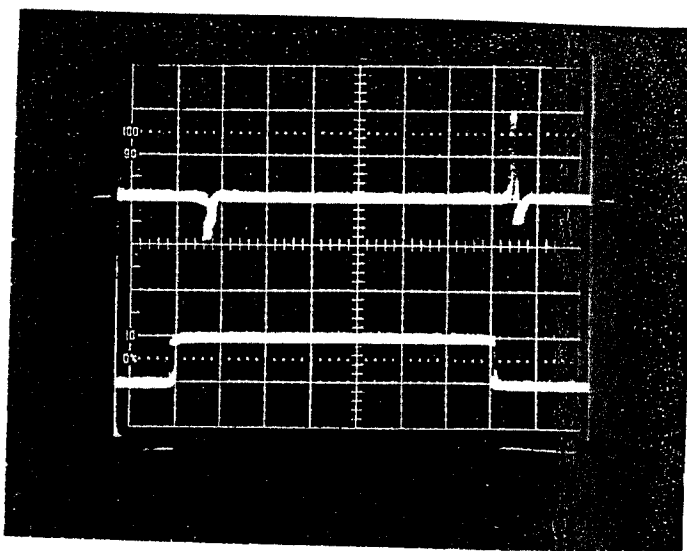
VIDEO TRANSIENTS

TYPICAL OF ALL ARMS

$\leq 1.5 \text{ V P-P}$
MEASURED IN A
300 MHz BANDWIDTH

VERTICAL SCALE:
0.5V PER DIVISION

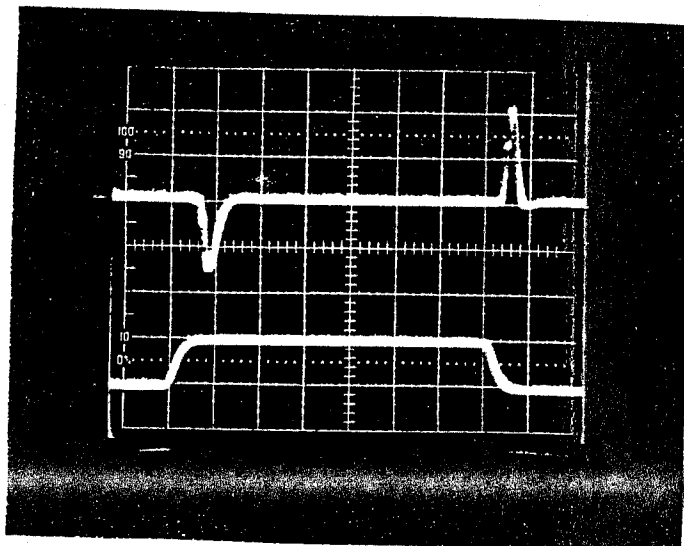
HORIZONTAL SCALE:
50ns PER DIVISION



$\leq 0.36 \text{ V P-P}$
MEASURED IN A
20 MHz BANDWIDTH

VERTICAL SCALE:
0.1V PER DIVISION

HORIZONTAL SCALE:
50ns PER DIVISION



DECEMBER 17, 1997



**AMERICAN MICROWAVE
CORPORATION**

**TYPICAL
MEASURED
TEST DATA
ON
8.3 GHz TO 11.7 GHz
LOW VIDEO TRANSIENT
ABSORPTIVE
SP4T
PIN-DIODE SWITCH**

MODEL NO: MSNC-4DT-COMDEV
(Serial Number: 4MS70563)

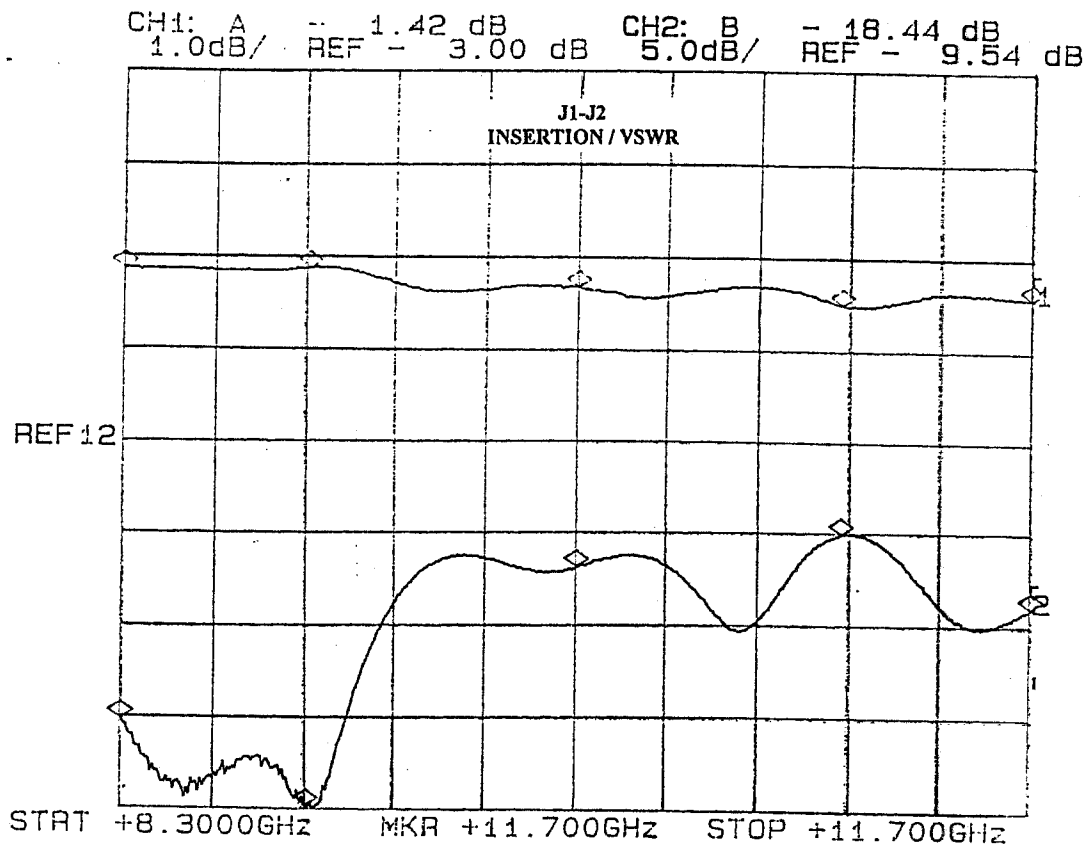
DECEMBER 17, 1997



SUMMARY TEST DATA

MODEL NUMBER : MSN-4DT-COMDEV
SERIAL NUMBER : 4MS70563
TECHNICIAN : BOBBIE GRAY
VOLTAGE & CURRENT DRAW : +5vdc: +108mA
: -12vdc: -74mA

INSERTION LOSS & RETURN LOSS*



*J1: COMMON ARM

FREQUENCY	INSERTION LOSS	RETURN LOSS
8.3 GHz	-1.12 dB	-24.5 dB
9.0 GHz	-1.11 dB	-29.1 dB
10.0 GHz	-1.31 dB	-16.2 dB
11.0 GHz	-1.48 dB	-14.5 dB
11.7 GHz	-1.41 dB	-18.4 dB

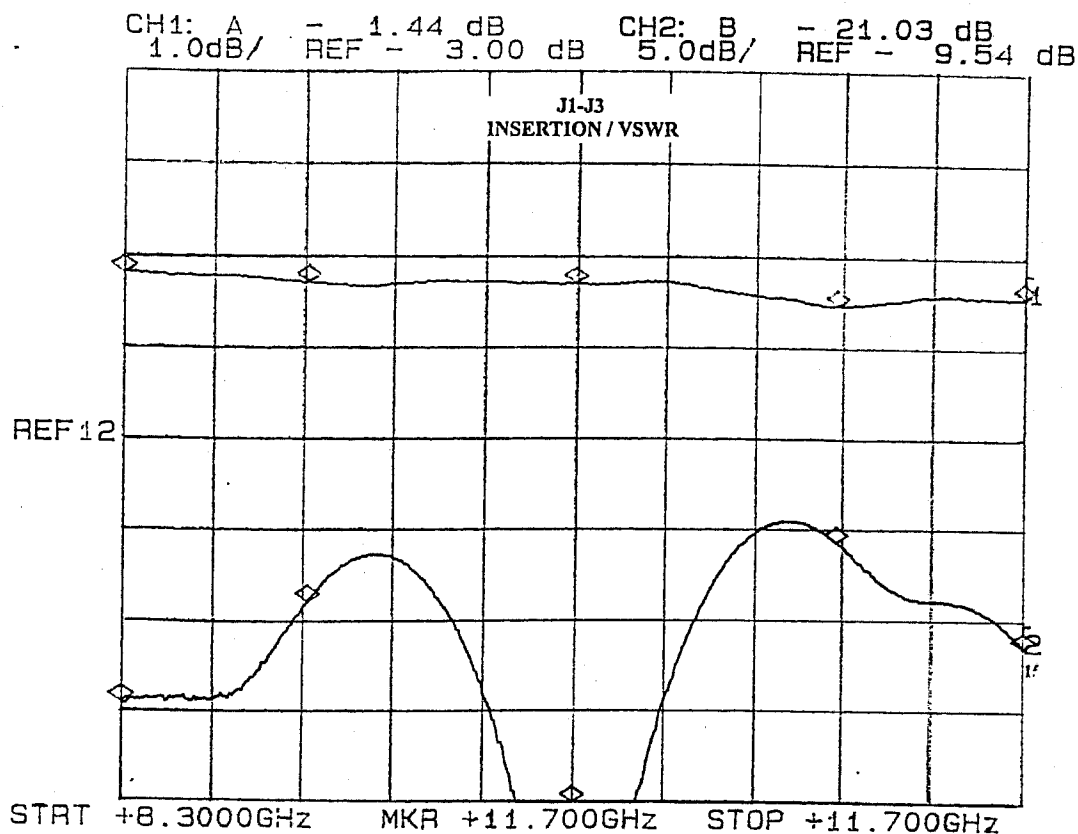
DECEMBER 17, 1997



SUMMARY TEST DATA

MODEL NUMBER	: MSN-4DT-COMDEV
SERIAL NUMBER	: 4MS70563
TECHNICIAN	: BOBBIE GRAY
VOLTAGE & CURRENT DRAW	: +5vdc: +108mA
	: -12vdc: -74mA

INSERTION LOSS & RETURN LOSS*



*J1: COMMON ARM

FREQUENCY	INSERTION LOSS	RETURN LOSS
8.3 GHz	-1.18 dB	-24.1 dB
9.0 GHz	-1.27 dB	-18.5 dB
10.0 GHz	-1.29 dB	-37.9 dB
11.0 GHz	-1.53 dB	-15.1 dB
11.7 GHz	-1.43 dB	-20.9 dB

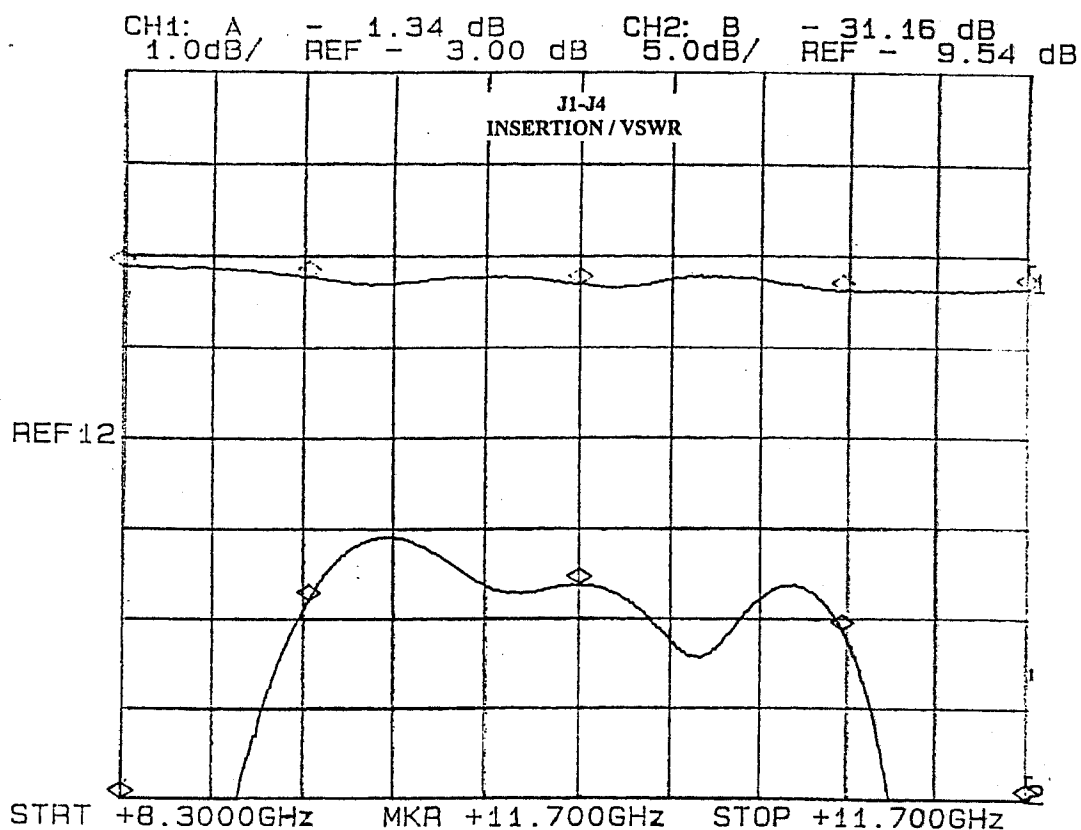
DECEMBER 17, 1997



SUMMARY TEST DATA

MODEL NUMBER	: MSN-4DT-COMDEV
SERIAL NUMBER	: 4MS70563
TECHNICIAN	: BOBBIE GRAY
VOLTAGE & CURRENT DRAW	: +5vdc: +108mA
	: -12vdc: -74mA

INSERTION LOSS & RETURN LOSS*



*J1: COMMON ARM

FREQUENCY	INSERTION LOSS	RETURN LOSS
8.3 GHz	-1.11 dB	-31.1 dB
9.0 GHz	-1.23 dB	-18.3 dB
10.0 GHz	-1.30 dB	-17.5 dB
11.0 GHz	-1.36 dB	-20.1 dB
11.7 GHz	-1.34 dB	-31.9 dB

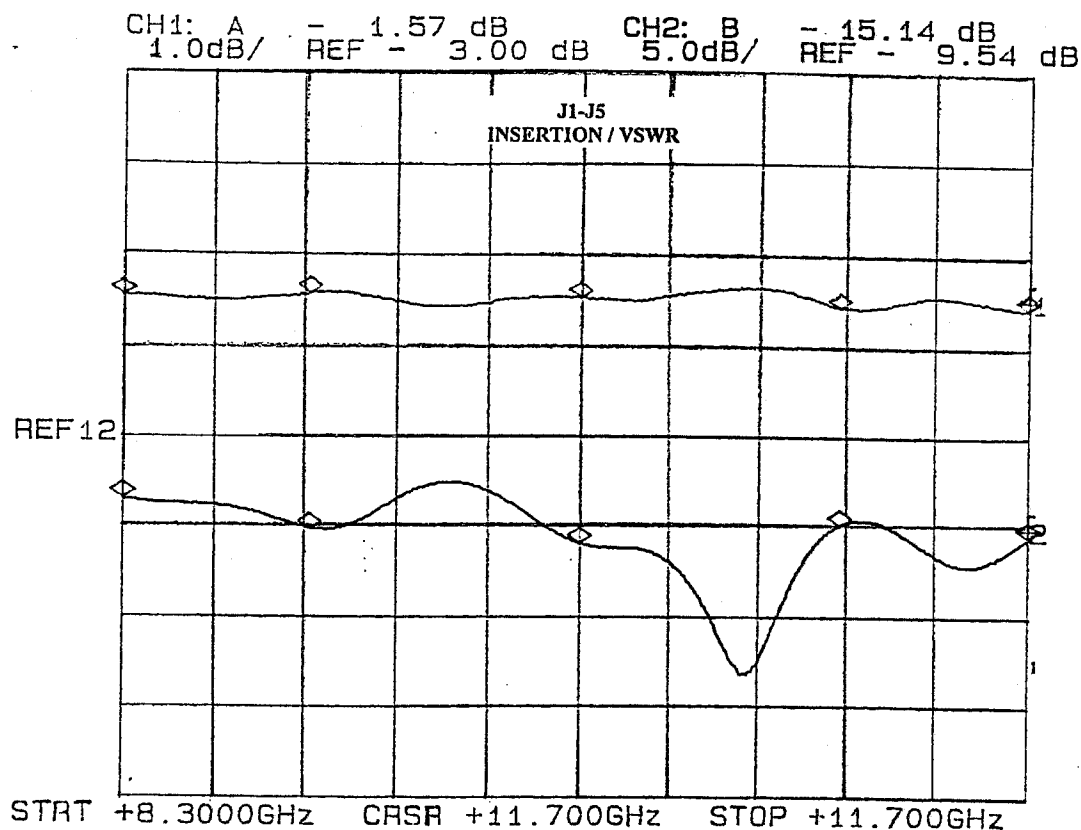
DECEMBER 17, 1997



SUMMARY TEST DATA

MODEL NUMBER	: MSN-4DT-COMDEV
SERIAL NUMBER	: 4MS70563
TECHNICIAN	: BOBBIE GRAY
VOLTAGE & CURRENT DRAW	: +5vdc: +108mA
	: -12vdc: -74mA

INSERTION LOSS & RETURN LOSS*



*J1: COMMON ARM

FREQUENCY	INSERTION LOSS	RETURN LOSS
8.3 GHz	-1.43 dB	-13.0 dB
9.0 GHz	-1.40 dB	-14.6 dB
10.0 GHz	-1.45 dB	-15.4 dB
11.0 GHz	-1.55 dB	-14.4 dB
11.7 GHz	-1.57 dB	-15.1 dB

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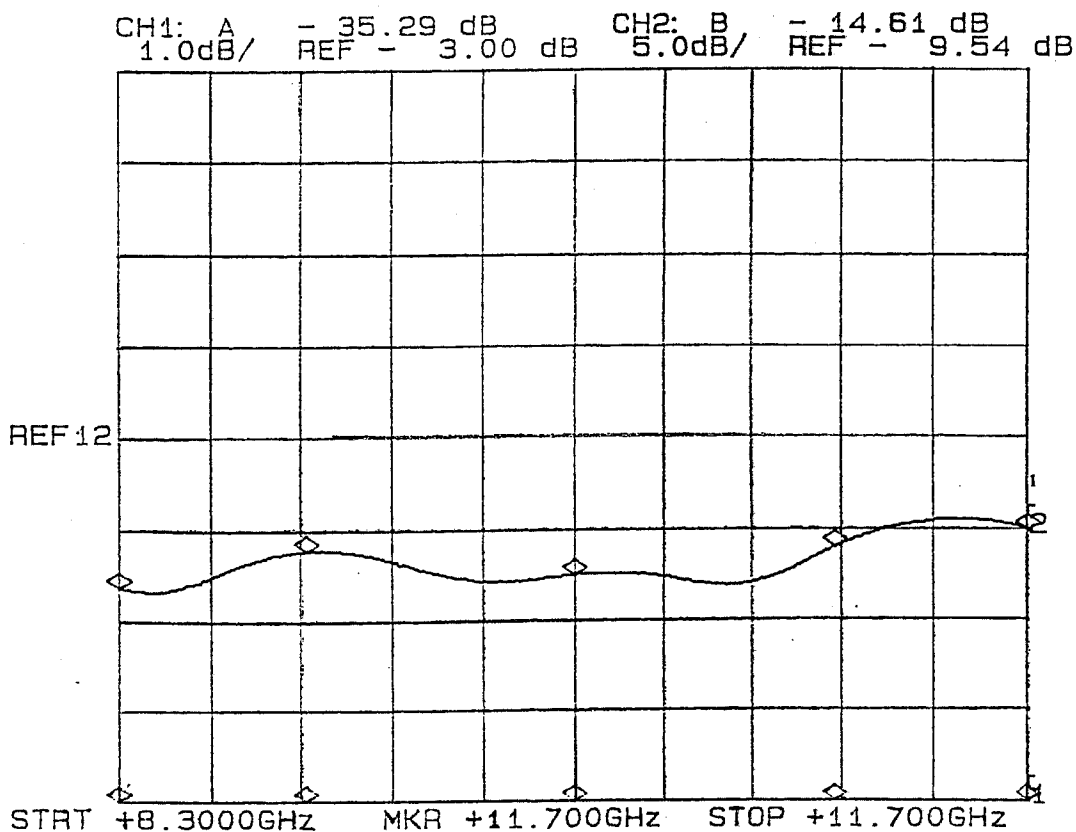


SUMMARY TEST DATA

MODEL NUMBER : MSN-4DT-COMDEV
SERIAL NUMBER : 4MS70563
TECHNICIAN : BOBBIE GRAY
VOLTAGE & CURRENT DRAW : +5vdc: +108mA
: -12vdc: -74mA

OFF ARM TERMINATION

J2



FREQUENCY	RETURN LOSS
8.3 GHz	-17.6 dB
9.0 GHz	-15.7 dB
10.0 GHz	-17.0 dB
11.0 GHz	-15.5 dB
11.7 GHz	-14.6 dB

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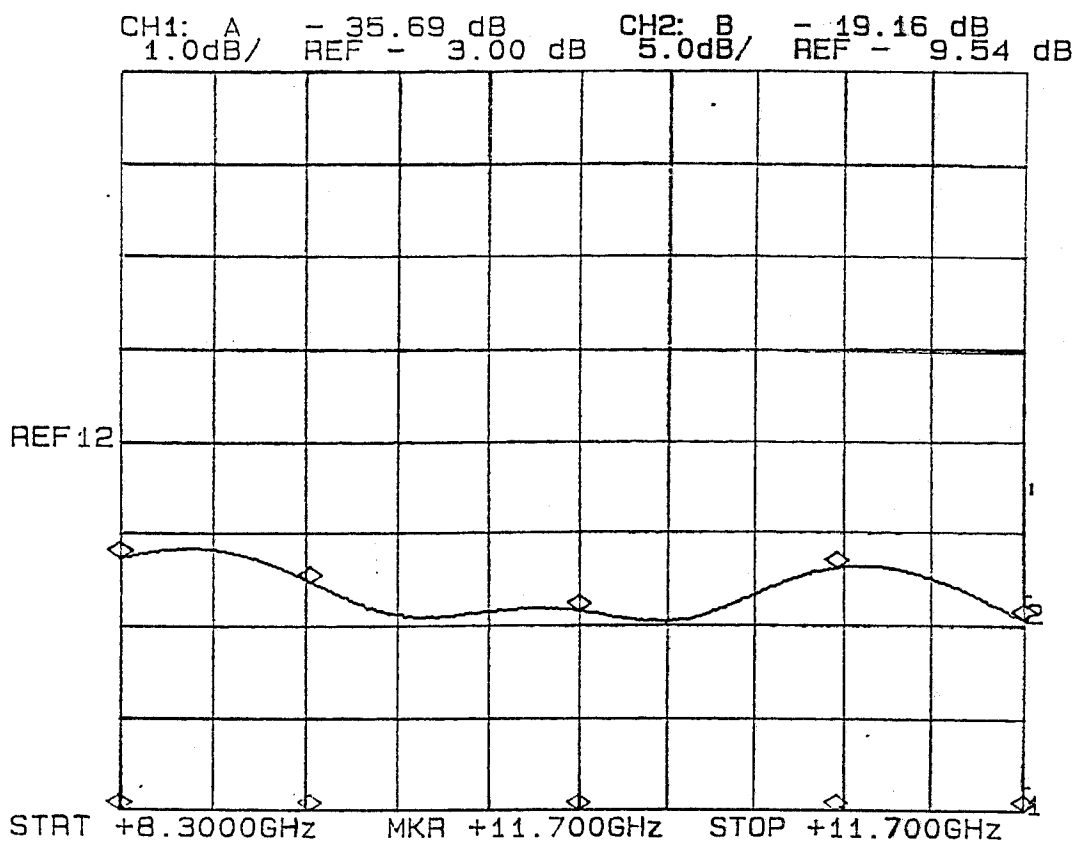


SUMMARY TEST DATA

MODEL NUMBER : MSN-4DT-COMDEV
SERIAL NUMBER : 4MS70563
TECHNICIAN : BOBBIE GRAY
VOLTAGE & CURRENT DRAW : +5vdc: +108mA
: -12vdc: -74mA

OFF ARM TERMINATION

J3



FREQUENCY	RETURN LOSS
8.3 GHz	-15.8 dB
9.0 GHz	-17.1 dB
10.0 GHz	-18.7 dB
11.0 GHz	-16.3 dB
11.7 GHz	-19.1 dB

DECEMBER 17, 1997

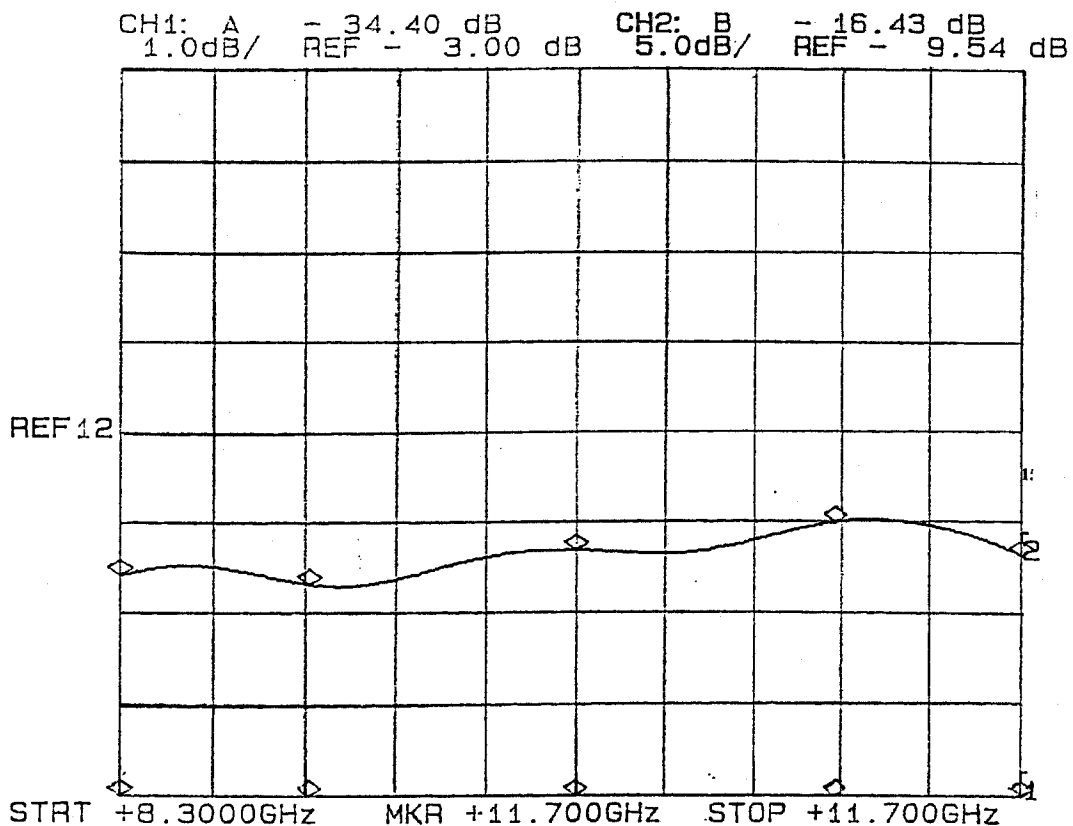


SUMMARY TEST DATA

MODEL NUMBER : MSN-4DT-COMDEV
SERIAL NUMBER : 4MS70563
TECHNICIAN : BOBBIE GRAY
VOLTAGE & CURRENT DRAW : +5vdc: +108mA
: -12vdc: -74mA

OFF ARM TERMINATION

J4



FREQUENCY	RETURN LOSS
8.3 GHz	-17.5 dB
9.0 GHz	-17.9 dB
10.0 GHz	-16.0 dB
11.0 GHz	-14.5 dB
11.7 GHz	-16.4 dB

DECEMBER 17, 1997

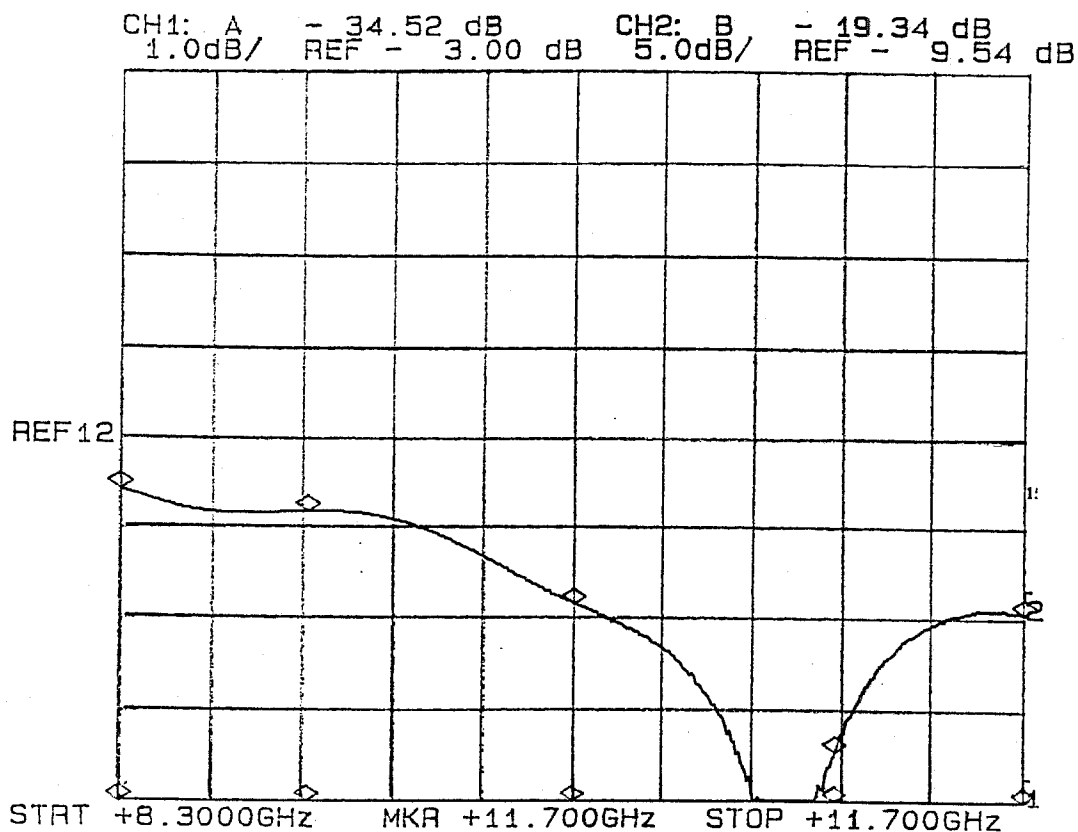


SUMMARY TEST DATA

MODEL NUMBER : MSN-4DT-COMDEV
SERIAL NUMBER : 4MS70563
TECHNICIAN : BOBBIE GRAY
VOLTAGE & CURRENT DRAW : +5vdc: +108mA
: -12vdc: -74mA

OFF ARM TERMINATION

J5



FREQUENCY	RETURN LOSS
8.3 GHz	-12.3 dB
9.0 GHz	-13.5 dB
10.0 GHz	-18.7 dB
11.0 GHz	-26.8 dB
11.7 GHz	-19.3 dB

DECEMBER 17, 1997



SUMMARY TEST DATA

MODEL NUMBER : MSN-4DT-COMDEV
SERIAL NUMBER : 4MS70563
TECHNICIAN : BOBBIE GRAY
VOLTAGE & CURRENT DRAW : +5vdc: +108mA
: -12vdc: -74mA

ISOLATION *

(AS MEASURED ON A SPECTRUM ANALYZER)

FREQUENCY	J2	J3	J4	J5
500 MHz	-78 dB	-85 dB	-75 dB	-76 dB
1 GHz	-90 dB	-82 dB	-95 dB	-94 dB
2 GHz	-96 dB	-96 dB	-92 dB	-92 dB
4 GHz	-92 dB	-96 dB	-96 dB	-96 dB
6 GHz	-95 dB	-95 dB	-95 dB	-95 dB
8 GHz	-92 dB	-94 dB	-92 dB	-90 dB
10 GHz	-89 dB	-91 dB	-90 dB	-88 dB
12 GHz	-88 dB	-90 dB	-86 dB	-90 dB
14 GHz	-91 dB	-90 dB	-88 dB	-92 dB
16 GHz	-90 dB	-86 dB	-83 dB	-88 dB
18 GHz	-76 dB	-74 dB	-68 dB	-74 dB

*J1: COMMON ARM

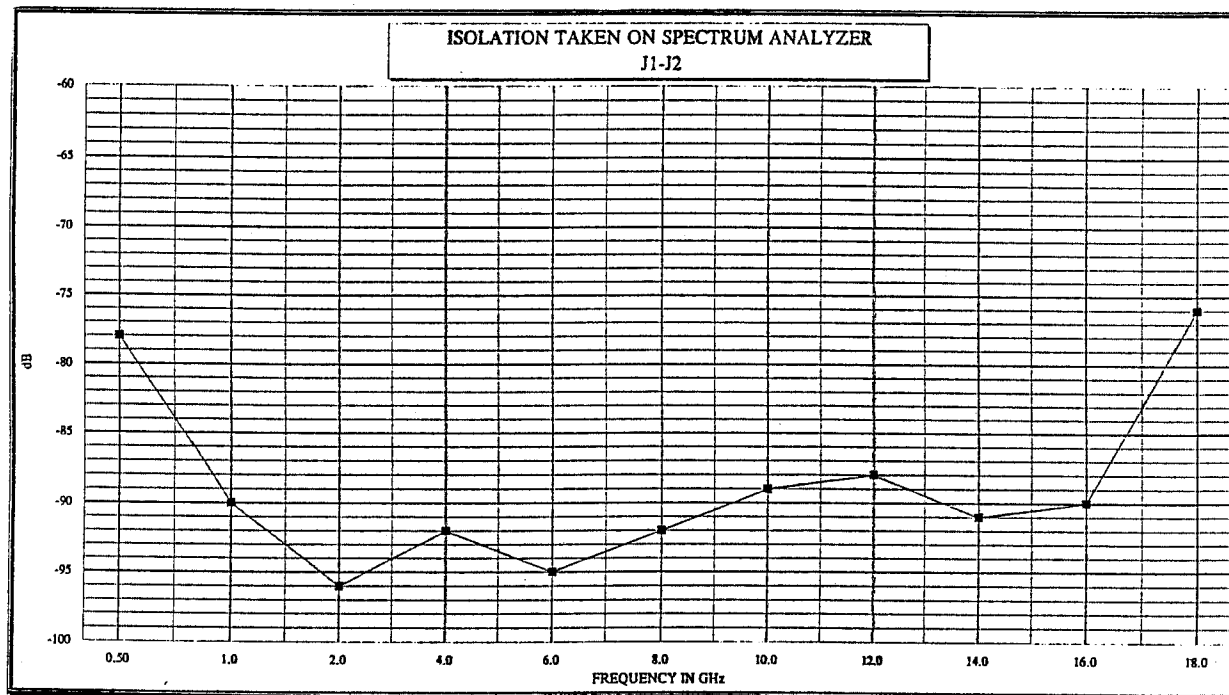
DECEMBER 17, 1997



SUMMARY TEST DATA

MODEL NUMBER : MSN-4DT-COMDEV
SERIAL NUMBER : 4MS70563
TECHNICIAN : BOBBIE GRAY
VOLTAGE & CURRENT DRAW : +5vdc: +108mA
: -12vdc: -74mA

ISOLATION* (AS MEASURED ON A SPECTRUM ANALYZER)



*J1: COMMON ARM

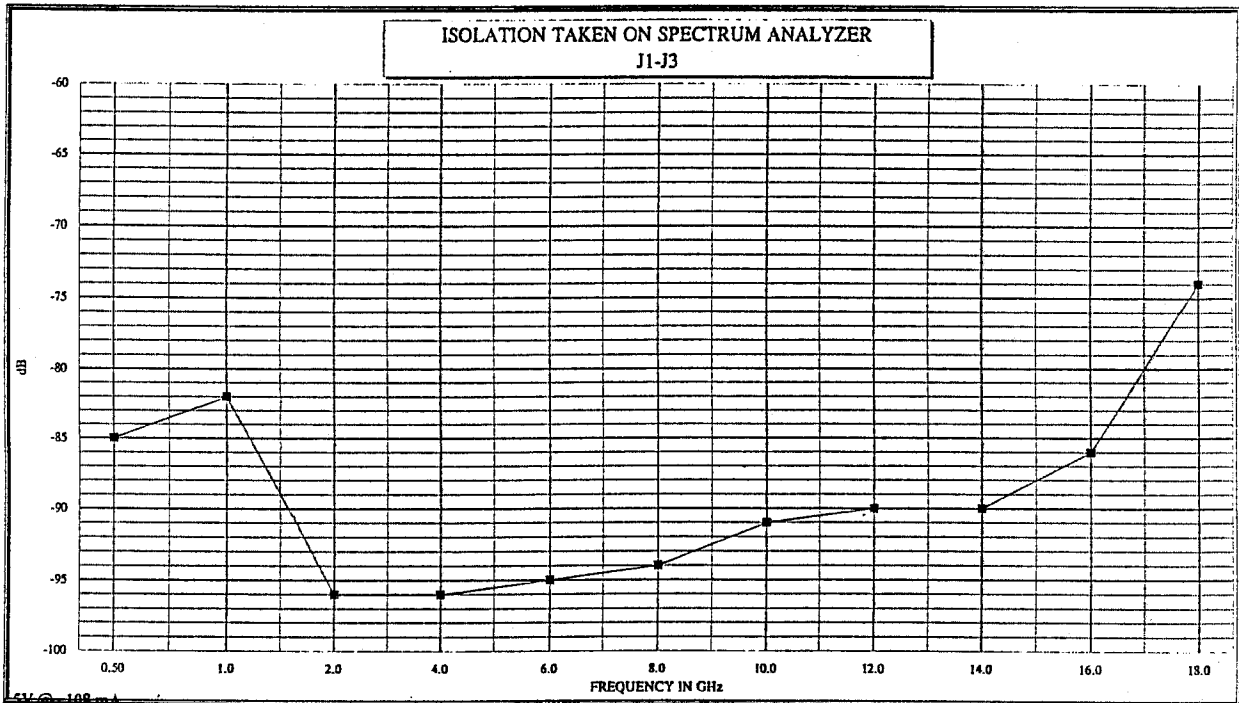
DECEMBER 17, 1997



SUMMARY TEST DATA

MODEL NUMBER : MSN-4DT-COMDEV
SERIAL NUMBER : 4MS70563
TECHNICIAN : BOBBIE GRAY
VOLTAGE & CURRENT DRAW : +5vdc: +108mA
: -12vdc: -74mA

ISOLATION* (AS MEASURED ON A SPECTRUM ANALYZER)



*J1: COMMON ARM

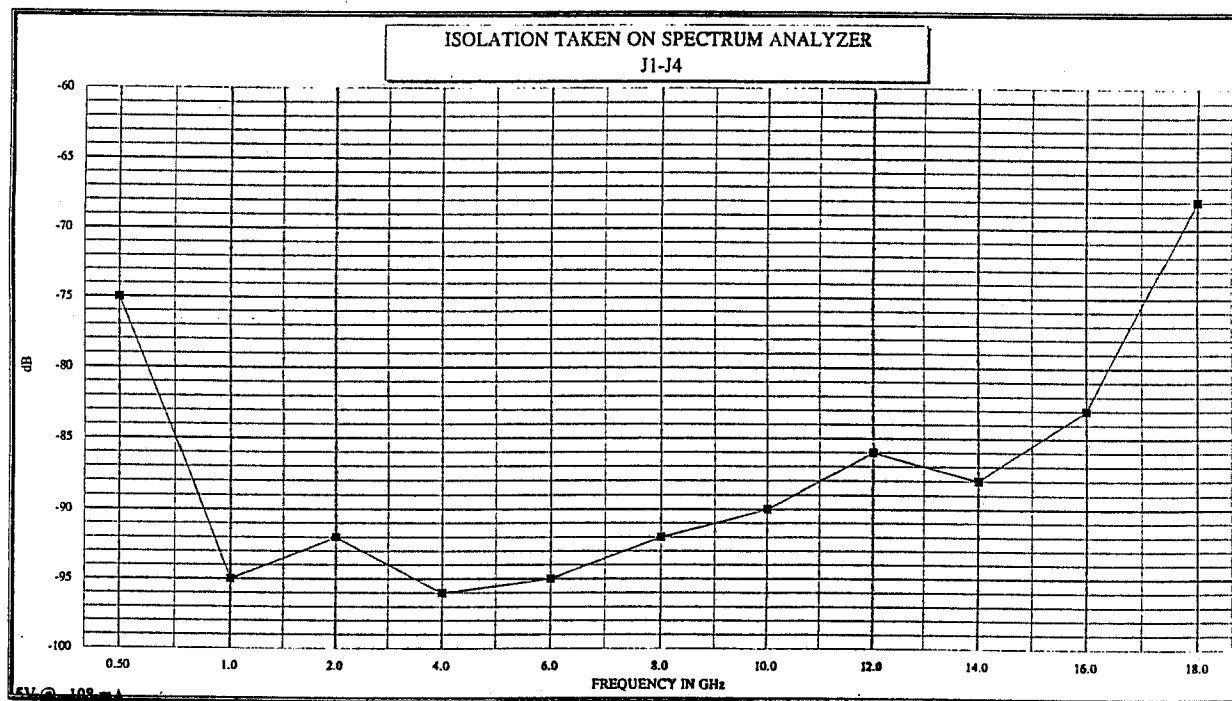
DECEMBER 17, 1997



SUMMARY TEST DATA

MODEL NUMBER	: MSN-4DT-COMDEV
SERIAL NUMBER	: 4MS70563
TECHNICIAN	: BOBBIE GRAY
VOLTAGE & CURRENT DRAW	: +5vdc: +108mA
	: -12vdc: -74mA

ISOLATION* (AS MEASURED ON A SPECTRUM ANALYZER)



*J1: COMMON ARM

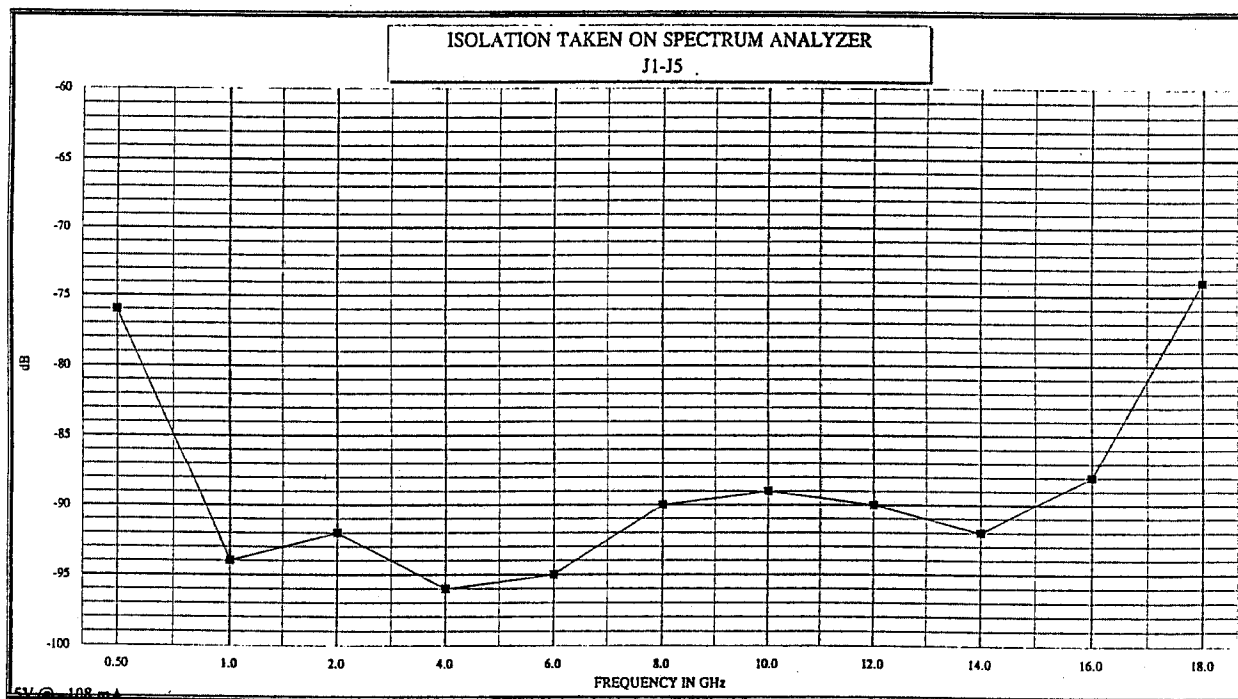
DECEMBER 17, 1997



SUMMARY TEST DATA

MODEL NUMBER	: MSN-4DT-COMDEV
SERIAL NUMBER	: 4MS70563
TECHNICIAN	: BOBBIE GRAY
VOLTAGE & CURRENT DRAW	: +5vdc: +108mA
	: -12vdc: -74mA

ISOLATION* (AS MEASURED ON A SPECTRUM ANALYZER)



*J1: COMMON ARM

DECEMBER 17, 1997



SUMMARY TEST DATA

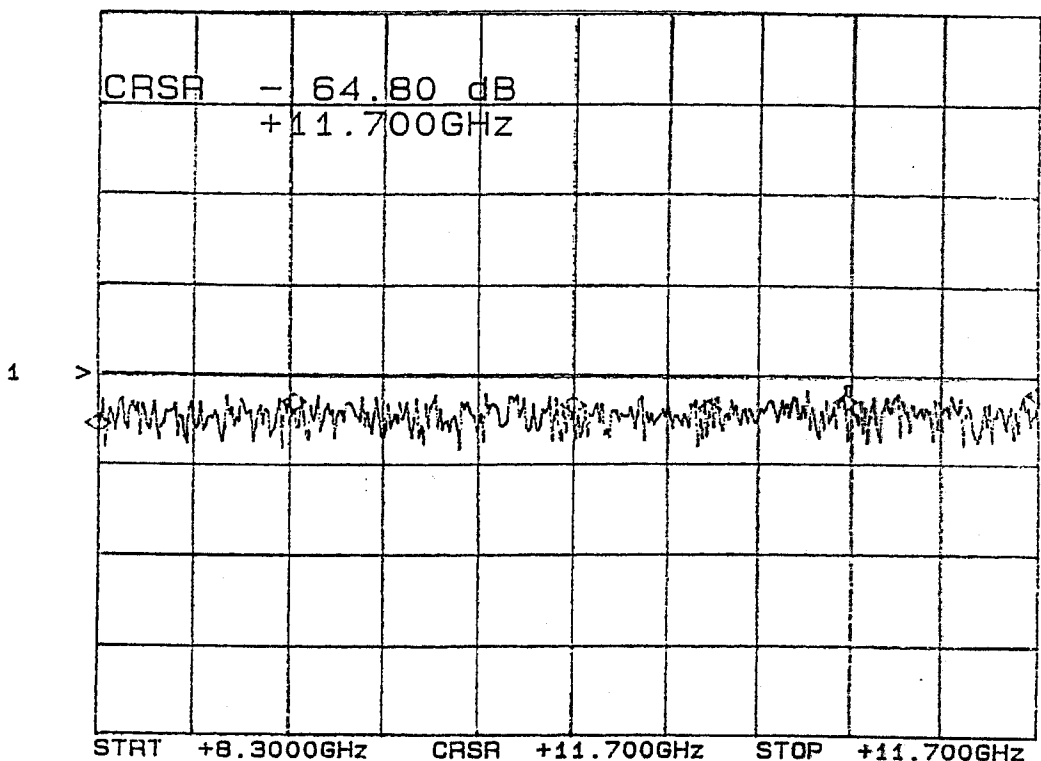
MODEL NUMBER : MSN-4DT-COMDEV
SERIAL NUMBER : 4MS70563
TECHNICIAN : BOBBIE GRAY
VOLTAGE & CURRENT DRAW : +5vdc: +108mA
: -12vdc: -74mA

ISOLATION*

(AS MEASURED ON A SCALAR NETWORK ANALYZER)

CH1: R -M - 64.80 dB
20.0 dB/ REF - 60.00 dB

ISOLATION J1-J2



*J1: COMMON ARM

FREQUENCY	ISOLATION
8.3 GHz	-68.4 dB
9.0 GHz	-67.8 dB
10.0 GHz	-70.5 dB
11.0 GHz	-70.4 dB
11.7 GHz	-64.8 dB

DECEMBER 17, 1997



SUMMARY TEST DATA

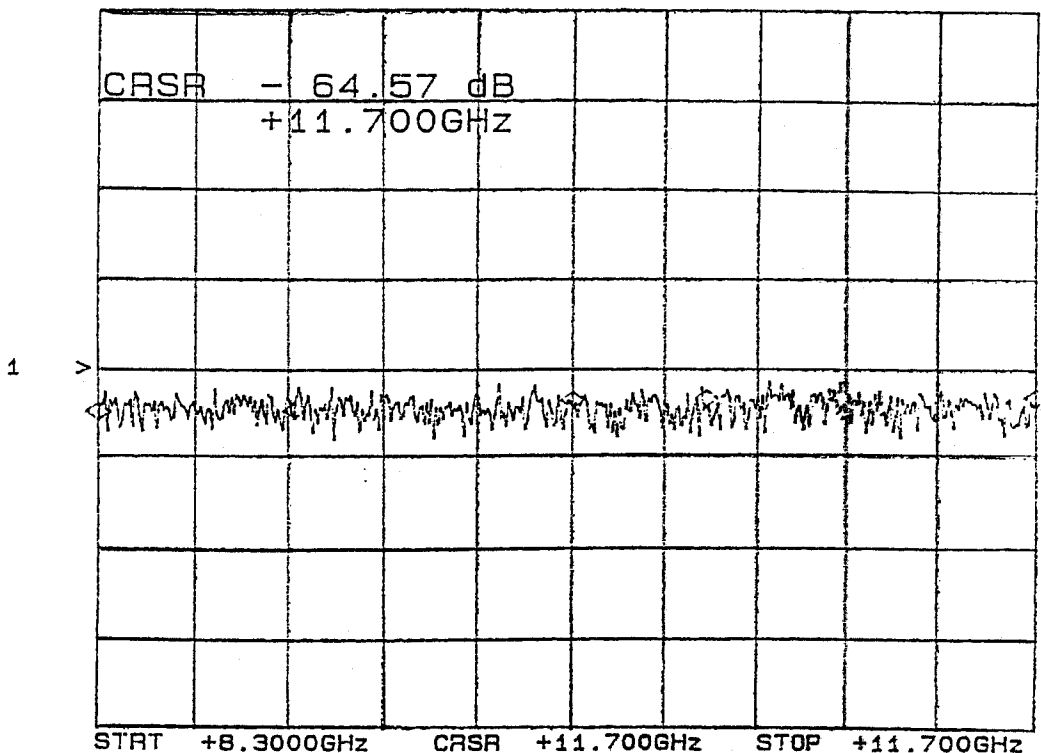
MODEL NUMBER : MSN-4DT-COMDEV
SERIAL NUMBER : 4MS70563
TECHNICIAN : BOBBIE GRAY
VOLTAGE & CURRENT DRAW : +5vdc: +108mA
 : -12vdc: -74mA

ISOLATION*

(AS MEASURED ON A SCALAR NETWORK ANALYZER)

CH1: R -M - 64.57 dB
 20.0 dB/ REF - 60.00 dB

ISOLATION J1-J3



*J1: COMMON ARM

FREQUENCY	ISOLATION
8.3 GHz	-73.7 dB
9.0 GHz	-72.3 dB
10.0 GHz	-71.5 dB
11.0 GHz	-65.6 dB
11.7 GHz	-64.5 dB

DECEMBER 17, 1997



SUMMARY TEST DATA

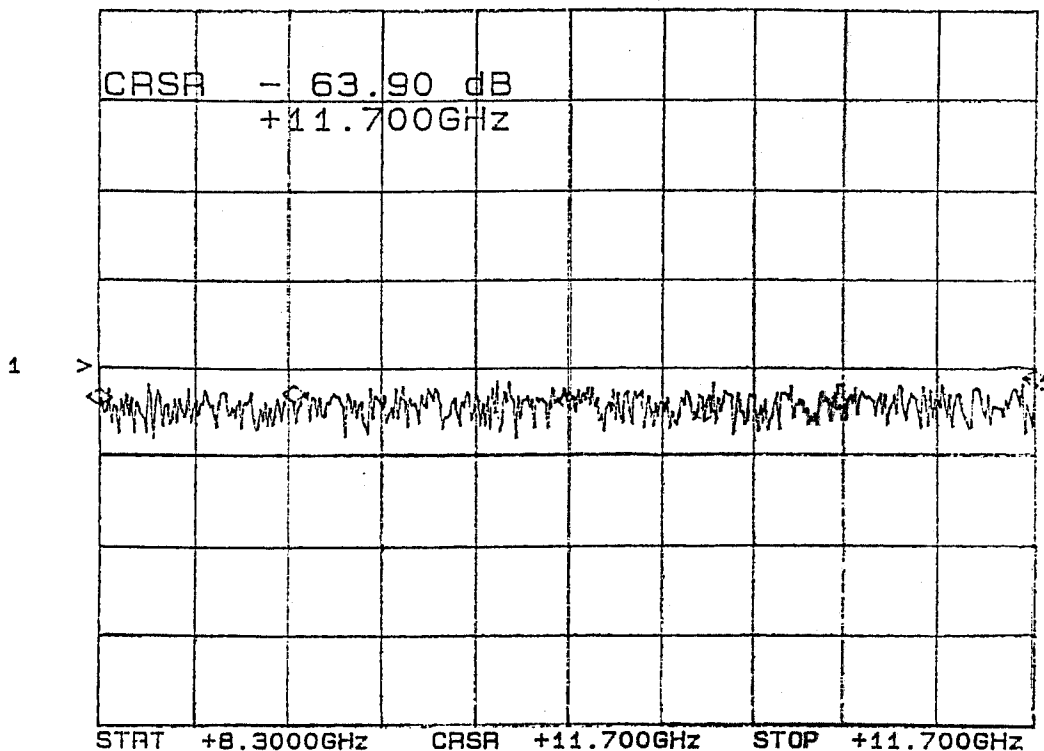
MODEL NUMBER : MSN-4DT-COMDEV
SERIAL NUMBER : 4MS70563
TECHNICIAN : BOBBIE GRAY
VOLTAGE & CURRENT DRAW : +5vdc: +108mA
: -12vdc: -74mA

ISOLATION*

(AS MEASURED ON A SCALAR NETWORK ANALYZER)

CH1: R -M - 63.90 dB
20.0 dB/ REF - 60.00 dB

ISOLATION J1-J4



*J1: COMMON ARM

FREQUENCY	ISOLATION
8.3 GHz	-74.0 dB
9.0 GHz	-66.0 dB
10.0 GHz	-68.3 dB
11.0 GHz	-66.5 dB
11.7 GHz	-63.9 dB

DECEMBER 17, 1997



SUMMARY TEST DATA

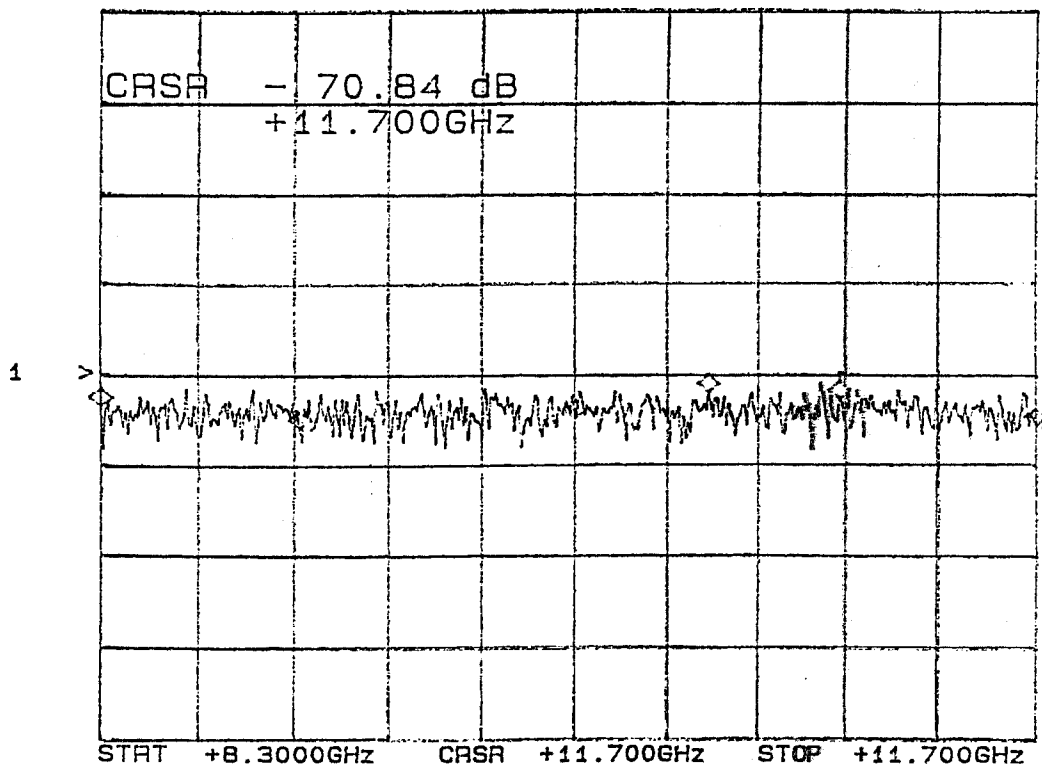
MODEL NUMBER : MSN-4DT-COMDEV
SERIAL NUMBER : 4MS70563
TECHNICIAN : BOBBIE GRAY
VOLTAGE & CURRENT DRAW : +5vdc: +108mA
: -12vdc: -74mA

ISOLATION*

(AS MEASURED ON A SCALAR NETWORK ANALYZER)

CH1: R -M - 70.84 dB
20.0 dB/ REF - 60.00 dB

ISOLATION J1-J5



*J1: COMMON ARM

FREQUENCY	ISOLATION
8.3 GHz	-67.2 dB
9.0 GHz	-71.2 dB
10.0 GHz	-70.5 dB
11.0 GHz	-64.6 dB
11.7 GHz	-70.8 dB

DECEMBER 17, 1997



SUMMARY TEST DATA

MODEL NUMBER	: MSN-4DT-COMDEV
SERIAL NUMBER	: 4MS70563
TECHNICIAN	: BOBBIE GRAY
VOLTAGE & CURRENT DRAW	: +5vdc: +108mA
	: -12vdc: -74mA

SWITCHING SPEED

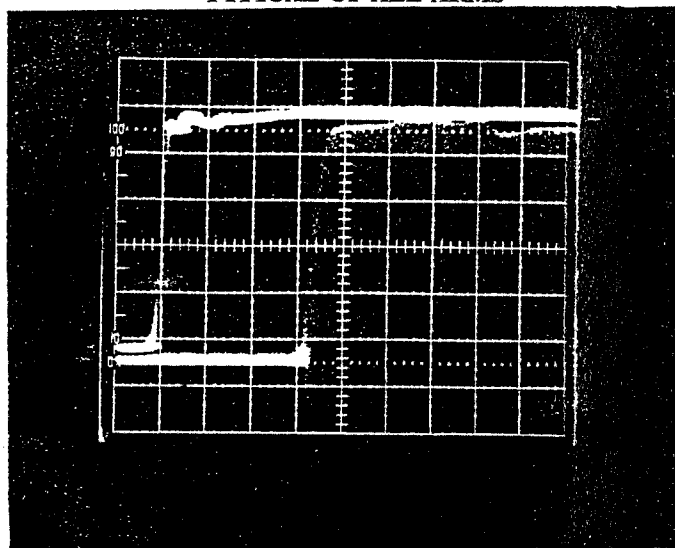
"Rise/Fall" Time: 10% RF to 90% RF & 90% RF to 10% RF
"On/Off" Time: 50% TTL to 90% RF or 10% RF

TYPICAL OF ALL ARMS

"DELAY ON": 36nS
"RISE TIME": 6nS

HORIZONTAL SCALE:
10nS PER DIVISION

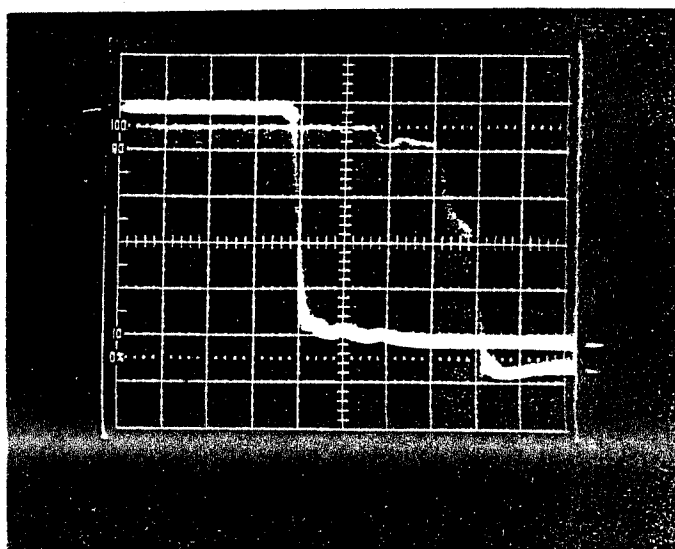
VERTICAL SCALE:
20mV PER DIVISION



"DELAY OFF": 42nS
"FALL TIME": 10nS

HORIZONTAL SCALE:
10nS PER DIVISION

VERTICAL SCALE:
20mV PER DIVISION



DECEMBER 17, 1997



SUMMARY TEST DATA

MODEL NUMBER	: MSN-4DT-COMDEV
SERIAL NUMBER	: 4MS70563
TECHNICIAN	: BOBBIE GRAY
VOLTAGE & CURRENT DRAW	: +5vdc: +108mA
	: -12vdc: -74mA

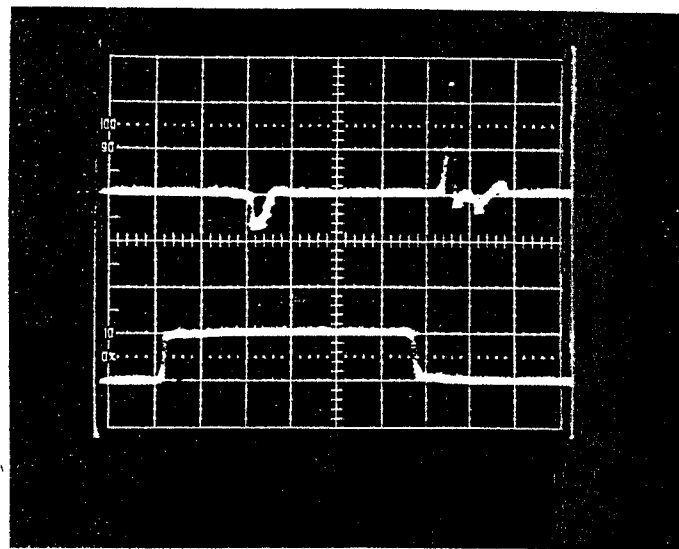
VIDEO TRANSIENTS

TYPICAL OF ALL ARMS

≤ 0.3 V P-P
MEASURED IN A
300 MHz BANDWIDTH

VERTICAL SCALE:
0.1V PER DIVISION

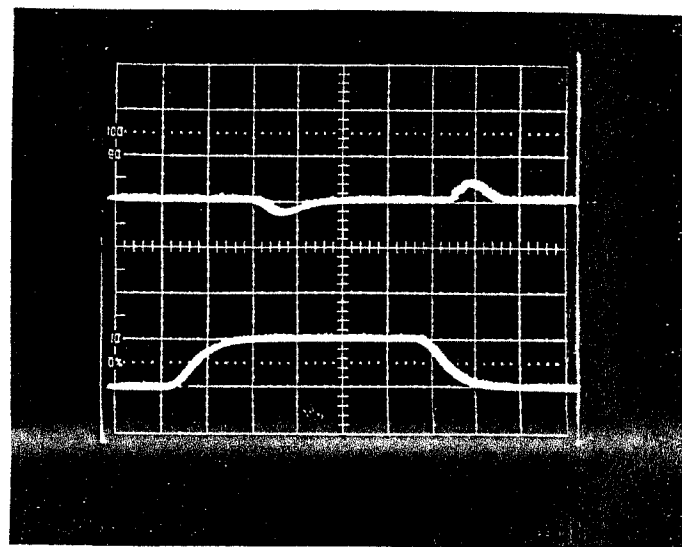
HORIZONTAL SCALE:
20ns PER DIVISION



≤ 0.10 V P-P
MEASURED IN A
20 MHz BANDWIDTH

VERTICAL SCALE:
0.1V PER DIVISION

HORIZONTAL SCALE:
20ns PER DIVISION



DECEMBER 17, 1997



COM DEV

REPORT

ON

VARIOUS TESTS

PERFORMED

ON

8.3 GHz TO 11.7 GHz

ABSORPTIVE

SP4T

PIN-DIODE SWITCH

MODEL NO: MSN-4DT-COMDEV

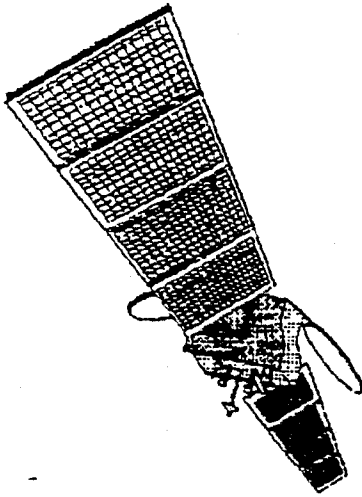
(Serial Number 2MS70305)

PLUS

OTHER SWITCHES AND ATTENUATORS

DECEMBER 17, 1997

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



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,

A handwritten signature in black ink, appearing to read "Joan Westlake". The signature is fluid and cursive.

Joan Westlake
Buyer



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-RRR-2DT, S/N: 2MS703161

Path	Insertion Loss (dB)	Input	Output	Isolation (dB)	Delay (ps)
Specification	2.0	9.3	9.1	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

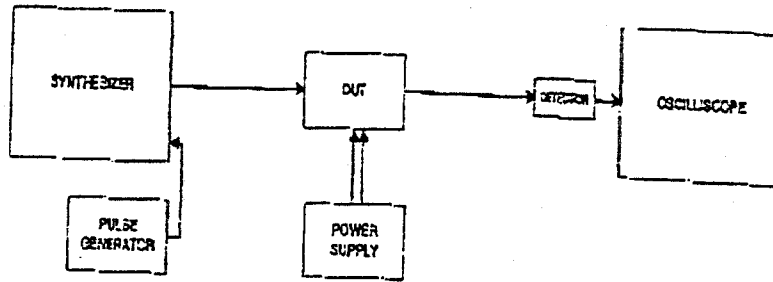
AMC P/N: MSN-4DT, S/N: 2MS70305

Path	Insertion Loss (dB)	Input	Output	Isolation (dB)	Delay (ps)
Specification	3.5	9.5	9.8	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.

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Figures 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

Frequency (MHz)	Pulse Width (ns)	Period (ns)	Duty Cycle (%)	Rise Time (ns)	Fall Time (ns)	CW Input Amplitude (dBm)
100	0.1 to 120	10 to 120	10	20	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.

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Table 1.3-1: SPDT Residual Phase Noise

AMC P/N: SWN-FRA-2D7, S/N: 2MS703161

Offset Frequency (Hz)	Switch S/N: 2MS704186 (dBc/Hz)	Switch S/N: 2MS704187 (dBc/Hz)	Switch S/N: 2MS704188 (dBc/Hz)	Switch S/N: 2MS704189 (dBc/Hz)
18 Hz	-132	-131	-131	-131
100 Hz	-142	-140	-140	-140
1 kHz	-150	-150	-150	-150
10 kHz	-160	-160	-160	-160
100 kHz	-167	-167	-167	-167
1 MHz	-170	-170	-170	-170
10 MHz	-170	-168	-168	-168
100 MHz	-167	-167	-167	-167

Table 1.3-2: SPDT Residual Amplitude Noise

COM DEV P/N: 123065-1

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)
18 Hz	-114	-110	-110	-110
100 Hz	-122	-120	-120	-118
1 kHz	-140	-140	-140	-135
10 kHz	-150	-152	-152	-147
100 kHz	-157	-157	-157	-155
1 MHz	-163	-164	-163	-162
10 MHz	-163	-163	-163	-163

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Table 1.3-3: High Power SPDT Residual Amplitude Noise

COM DEV P/N: 124043-1

	-120	-120
	-128	-127
	-141	-142
	-152	-153
	-157	-157
	-163	-163
	-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.



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

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

Frequency (MHz)	Low Power Susceptibility (dBm)	High Power Susceptibility (dBm)	Reference Susceptibility (dBm)
12.125	-	-124	-
12.150	-	-123	-
12.175	-154	-	-
12.200	-116	-	-118
12.225	-	-	-170
12.250	-165	-	-165
12.275	-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

Frequency (MHz)	Low Power Susceptibility (dBm)	High Power Susceptibility (dBm)	Reference Susceptibility (dBm)
12.125	< -115	-73	< -125
12.150	-124	-74	-
12.175	-123	-73	-
12.200	-121	-80	< -150
12.225	-121	-85	-
12.250	-120	-89	< -150
12.275	-126	-126	-
12.300	-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 Level (dBm)	Power Level (dBm)	Power Level (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

Power Characteristics		Conducted Emissions -12 V Supply Line	Conducted Emissions -12 V Supply Line
Power (W)	Power (W)	Power (W)	Power (W)
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 - 12V Supply Line	Conducted Emissions - 12V Supply Line
SPDT (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 - 12V Supply Line	Conducted Emissions - 12V 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-0612-80DDSF, S/N: AH310303

Specification	Insertion Loss (dB)	Return Loss (dB)	Output	Delay (ps)
	3.0	10.9	10.5	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

Attenuation (dB)	Return Loss (dB)	Return Loss (dB)
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)	Specified 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		0.92	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		0.36
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	0.81		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		10.78	0.24		0.85
11.5		11.22	0.26		0.82
12.0		11.72	0.23		0.96
12.5		12.17	0.20		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	0.59		1.73
33.0		33.38	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-0612-50DDSF, S/N: AH310303

Specification	Pulse Width	Period	Reps Cycles	Rise Time (ns)	Fall Time (ns)	Amplitude Change (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

Variable Attenuator Conducted Susceptibility (PM Noise Set-up)	
[REDACTED]	-128
[REDACTED]	-113
[REDACTED]	-113
[REDACTED]	-113

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

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

Variable Attenuator Conducted Susceptibility (AM Noise Set-up)		
[REDACTED]	-120	-
[REDACTED]	-116	-
[REDACTED]	-91	-88