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CENTRE CANADIEN DE RECHERCHES POLIÈRES

TR-09-91
Ottawa Police Department
Radiation Measurements on the Police Traffic
Radar Speed Dectectors

L. Allan
MPB Technologies Inc.

TECHNICAL REPORT

November 1991

NOTE: Further information
about this report can be
obtained by calling the
CPRC information number
(613) 998-6342

Customer No.: 70670

MPBT No.: 1126

**Test Report for
Radiation Measurements
on the
Police Traffic Radar
Speed Detectors**

L. Allan


Prepared for:

OTTAWA POLICE
474 Elgin Street
Ottawa, Ontario
K2P 2J6

Prepared by:

MPB Technologies Inc.
Building M-50, NRC
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Ottawa, Ontario
K1A 0R6

November 26, 1991
O3-R-126(MS)



Dave G. Scribailo
Manager
Electromagnetic Services
Electromagnetics Division

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1.0 SUMMARY OF RADAR MEASUREMENTS

SUMMARY

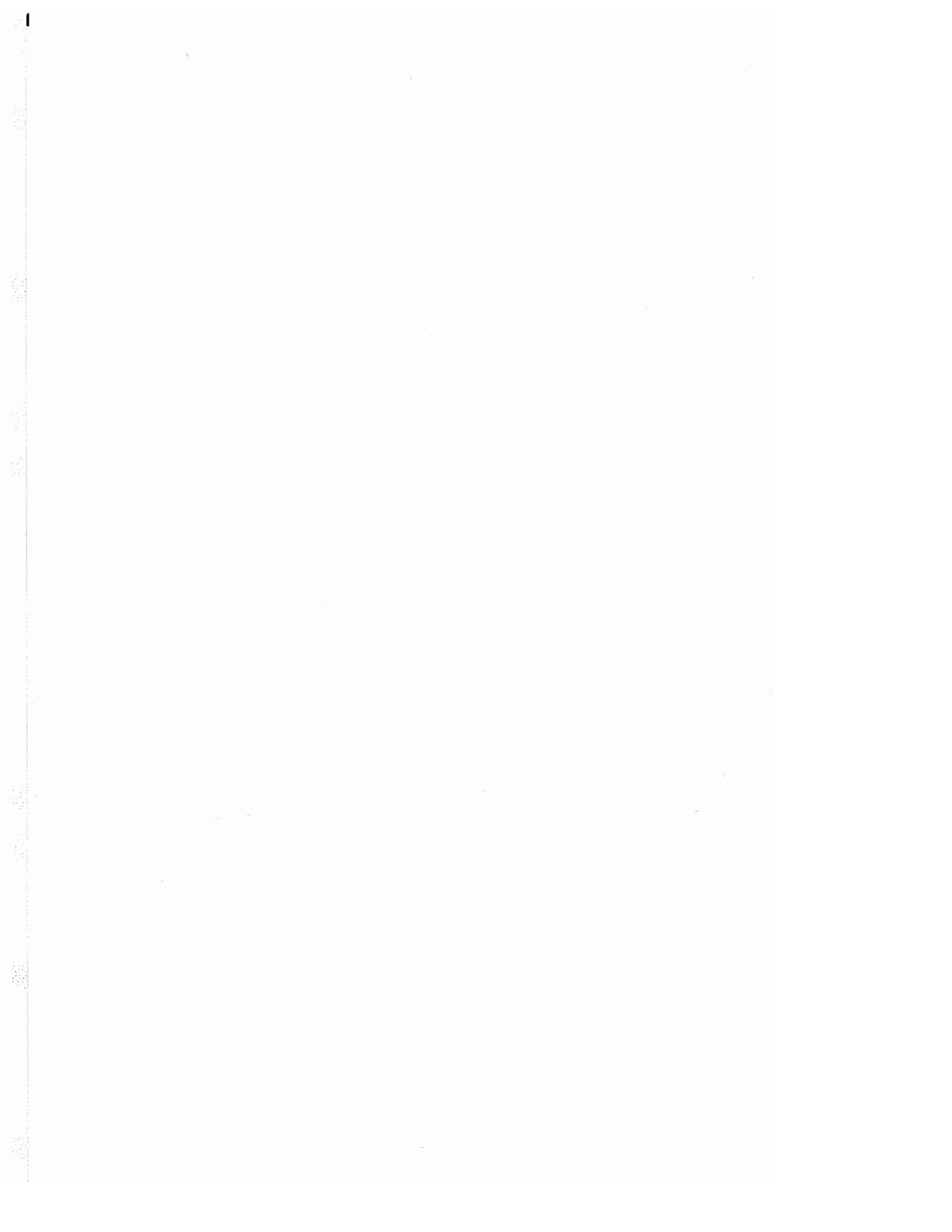
The Safety Code - 6 of National Health and Welfare states that the "General Public (those individuals that are not microwave radiation workers) shall not be exposed to power density levels greater than one (1) mW/cm² averaged over a one-minute period in the range of frequencies between 10 MHz and 300 GHz.

Units #30 (13299) and #28 (13301) operate on CW (continuous wave) and are well below the one (1) mW/cm².

The remaining units operate on a 40% duty cycle. The radiated power would be 40% of the measured value with a possible error of +20% -17%.

All units passed, with #12 (6659) being borderline at two (2) inches.

$$\text{ie: } 2.14 \text{ mW/cm}^2 \cdot 40\% \cdot 120\% = 1.0 \text{ mW}$$



2.0 RADAR MEASUREMENTS

OTTAWA POLICE RADAR SPEED DETECTORS

The radiation levels at 10.524 GHz were checked at two (2) and six (6) inches from the horn cover.

A small linear horn (2.5 cm x 2.25 cm mouth) was used to receive the radiated energy. The Horn was first calibrated, using an HP8510 Network Analyzer. With the three-antenna system, the gain of the Horn measured 9 dB. The expected power from the Horn in a 1-mW/cm² field was determined by the formula:

$$Pr = \frac{F \cdot G \cdot \lambda^2}{4 \pi}$$

Pr = Power Received

F = Field mW/cm² at the Horn focus

G = Gain of Horn

λ = Wavelength at 10.524 GHz

$$\text{ie: } Pr = \frac{1 \text{ mW/cm}^2 \times 9 \times (2.849\text{cm})^2}{4 \pi} = 5.8 \text{ mW}$$

A calibrated source of 10.524 GHz was set to 5.8 mW and fed into a receiver. The Receiver signal was noted and compared to the signals from the Horn when the Horn was placed two (2) and six (6) inches from the radars. Since the radars transmit circular polarized signals, the vertical and horizontal signal from the Horn were added. The results and shown in Table 1.

Note 1:

For measurements, all radars were set to CW operation. If the radars are modulated OFF and ON, the average radiation power will be reduced in the same ratio as of the ON and OFF time.

Note 2:

The overall accuracy of the measurement was + 0.8 dB or +20% -17%.

Note 3:

Some radiation patterns have been included for general information.

3.0 CALIBRATION CERTIFICATES



MPB TECHNOLOGIES INC.

MPB Technologies Inc.
Electromagnetics Division
P.O. Box 9722 Station T
Ottawa, Ontario K1G 4X9

CALIBRATION CERTIFICATE

Telephone: (613) 744-3273
Fax: (613) 952-7998

Date: November 26, 1991 Calibration No.: 1126-01
 Company: Ottawa Police P.O. No.: 70670
 Equipment Type: TRIBAR Mini-Coupler
 Model No.: INDR-1 Serial No.: 13299
 Calibration Date: November 20, 1991 Calibration Due: November 20, 1992

Standard Used	Traceability No.
HP Spectrum Analyzer 8566B.	92-061321.
HP Network Analyzer 8510A	92-060521.
Weinschel 10dB Attenuator Pad. (P5027)	92-080121.
Weinschel 10dB Attenuator Pad. (R1696)	92-080122.
HP Power Meter 432B.	N/A
HP Thermistor Mount. 8478A.	N/A.
HP Directional Coupler 11691D.	N/A
Scientific Atlanta Harmonic Mixer 14-5.	N/A.
SA Harmonic Mixer 14-5 (104210C)	N/A
HP Adapter X221A.	N/A
Pro Tuner 303. (238 + 456)	N/A
Harrison Lab Power Supply 505A.	N/A.
SA Antenna Positioner RMA-3-1.	N/A
URC Standard Gain Horn.	N/A
HP Computer 23c.	N/A.

This is to certify that the instrument listed above was calibrated to MPB Technologies Inc. standards which are traceable to the National Institute of Standards and Technology to the extent allowed by the Institutes calibration facilities, or to the National Research Council, to the extent allowed by the Councils calibration facilities.

Date: _____

MPB Technologies Inc.: November 26, 1991



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ANTENNA CALIBRATION

MPB Technologies uses one or more of the following standard procedures to calibrate antennae.

Monopole and Loop Antennae:

- NBS: Technical Note 1319,
 "Generation of Standard Electromagnetic Fields in a TEM Cell"
 Ref: Kanda, M.; Orr, R. David
- NRCC: "Measurement of Antenna Factors with a TEM Cell"
 Ref: Kashyap, S.C.
- ECSM: "The Equivalent Capacitance Substitution Method"
 Ref: Jordan, E.C., "E M Waves & Radiating System", p.483
 Ref: Navship 94810, "The Radio Freq. Interference Meter",
 Univ. of Penn., 1962, Para. 12.4.1
- IEEE 302-1969: "The Institute of Electrical and Electronic Engineers",
 Sect. 2.2.2.3

Dipole, Dipole Array, Horn Antenna:

- NBS: Technical Note 1309, 1987
 "Calibration Procedures for Horizontal Dipole Antennas (25 to 1000 MHz)"
 Ref: Camell, D.G.; Larsen, E.B.; Cruz, J.E.
- ANSI C63.5: "American National Standards for Electromagnetic Compatibility,
 Radiated Emission Measurement in EMI, Calibration of Antennas"
 1988
- SAE-ARP 958 "Broadband Electromagnetic Interference Measurement Antennas; Stan-
 dard Calibration Requirements and Methods"

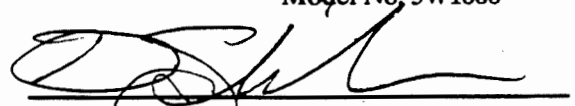
CALIBRATION ACCURACY: +/- 2 dB

CALIBRATION TRACEABILITY: All Measurement Instrumentation traceable to the
 National Institute of Standards and Technology (NIST)
 and to the National Research Council of Canada (NRCC).

ENVIRONMENT: Temperature: -10 to 35 degrees Centigrade
 Humidity: 10 to 90% (Non-Condensing)

RE-CERTIFICATION DATE: 1 year from Calibration Date

EQUIPMENT USED: HP Network Analyzer Model No. 8510
 Advantest Spectrum Analyzer Model No. R3261A
 Rohde & Schwarz Signal Generator Model No. SWP
 AR Amplifier Model No. 5W1000



 Manager, Electromagnetic Services





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Ottawa, Ontario K1G 4X9

CALIBRATION CERTIFICATE

Telephone: (613) 744-3273
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Date: November 26, 1991 Calibration No.: 1126-02
 Company: Ottawa Police P.O. No.: 70670
 Equipment Type: TRIBAR Muni-Quip
 Model No.: T3 Serial No.: 5806
 Calibration Date: November 20, 1991 Calibration Due: November 20, 1992

Standard Used	Traceability No.
HP Spectrum Analyzer 8566B	92-061321
HP Network Analyzer 8510A	92-060521
Weinschel 10dB Attenuator Pad (P5027)	92-080121
Weinschel 10dB Attenuator Pad (R1696)	92-080122
HP Power Meter 432B	N/A
HP Thermistor Mount 8478A	N/A
HP Directional Coupler 11691D	N/A
SA Harmonic Mixer 14-5(483)	N/A
SA Harmonic Mixer 14-5(104810C)	N/A
HP Adapter X281A	N/A
Pro Tuner 303(238 + 456)	N/A
Harrison Lab Power Supply 505A	N/A
SA Antenna Positioner PMA-3-1	N/A
NRC Standard Gain Horn	N/A
HP Computer 236	N/A

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 dard Calibration Requirements and Methods"

CALIBRATION ACCURACY: +/-2 dB

CALIBRATION TRACEABILITY: All Measurement Instrumentation traceable to the
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 and to the National Research Council of Canada (NRCC).

ENVIRONMENT: Temperature: -10 to 35 degrees Centigrade
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RE-CERTIFICATION DATE: 1 year from Calibration Date

EQUIPMENT USED:	HP Network Analyzer	Model No. 8510
	Advantest Spectrum Analyzer	Model No. R3261A
	Rohde & Schwarz Signal Generator	Model No. SWP
	AR Amplifier	Model No. 5W1000

Manager, Electromagnetic Services





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Date: November 26 1991 Calibration No.: 1126-03
 Company: Ottawa Police P.O. No.: 70670
 Equipment Type: TRIBAR Mini-Quip
 Model No.: T3 Serial No.: 55060
 Calibration Date: November 21, 1991 Calibration Due: November 21, 1992

Standard Used	Traceability No.
HP Spectrum Analyzer 2566B.	92-061321
HP Network Analyzer 8510A.	92-060521.
Weinschel 10dB Attenuator Pad (P5027)	92-080121.
Weinschel 10dB Attenuator Pad (P1696)	92-080122
HP Power Meter 432B.	N/A.
HP Thermistor Mount 8478A.	N/A.
HP Directional Coupler 11691D.	N/A.
SA Harmonic Mixer 14-5(483)	N/A.
SA Harmonic Mixer 14-5(104810C).	N/A.
HP Adapter X281A.	N/A.
Pro Tuner 303(232 + 456).	N/A.
Harrison Lab Power Supply 505A.	N/A.
SA Antenna Positioner P17H-3-1.	N/A.
NRC Standard Gain Horn.	N/A.
HP Computer 236.	N/A.

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 and to the National Research Council of Canada (NRCC).

ENVIRONMENT: Temperature: -10 to 35 degrees Centigrade
 Humidity: 10 to 90% (Non-Condensing)

RE-CERTIFICATION DATE: 1 year from Calibration Date

EQUIPMENT USED: HP Network Analyzer Model No. 8510
 Advantest Spectrum Analyzer Model No. R3261A
 Rohde & Schwarz Signal Generator Model No. SWP
 AR Amplifier Model No. 5W1000

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CALIBRATION CERTIFICATE

Telephone: (613) 744-3273
Fax: (613) 952-7998

Date: November 26 1991 Calibration No.: 1126-04
 Company: Ottawa Police P.O. No.: 70670
 Equipment Type: TRIBAR Mun. - Equip.
 Model No.: T3 Serial No.: 5807
 Calibration Date: November 21, 1991 Calibration Due: November 21, 1992

Standard Used	Traceability No.
HP Spectrum Analyzer 2566B.	92-061321.
HP Network Analyzer. 8510A.	92-060521.
Weinschel 10dB Attenuator Pad (P5027)	92-080121.
Weinschel 10dB Attenuator Pad (R1696)	92-080122.
HP Power Meter 432B.	N/A.
HP Thermistor Mount 8478A.	N/A.
HP Directional Coupler 11691D.	N/A.
SA Harmonic Mixer 14-5(483)	N/A.
SA Harmonic Mixer 14-5(104810C).	N/A.
HP Adapter x281A.	N/A.
Pro Tuner 303(238 + 456)	N/A.
Harrison Lab Power Supply 505A.	N/A.
SA Antenna Positioner PMA-3-1.	N/A.
NRC Standard Gain Horn.	N/A.
HP Computer 236.	N/A.

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- IEEE 302-1969: "The Institute of Electrical and Electronic Engineers",
 Sect. 2.2.2.3

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- ANSI C63.5: "American National Standards for Electromagnetic Compatibility,
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- SAE-ARP 958 "Broadband Electromagnetic Interference Measurement Antennas; Stan-
 dard Calibration Requirements and Methods"

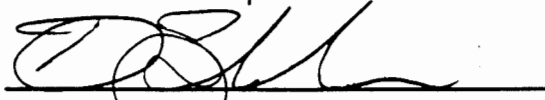
CALIBRATION ACCURACY: +/-2 dB

CALIBRATION TRACEABILITY: All Measurement Instrumentation traceable to the
 National Institute of Standards and Technology (NIST)
 and to the National Research Council of Canada (NRCC).

ENVIRONMENT: Temperature: -10 to 35 degrees Centigrade
 Humidity: 10 to 90% (Non-Condensing)

RE-CERTIFICATION DATE: 1 year from Calibration Date

EQUIPMENT USED: HP Network Analyzer Model No. 8510
 Advantest Spectrum Analyzer Model No. R3261A
 Rohde & Schwarz Signal Generator Model No. SWP
 AR Amplifier Model No. 5W1000


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CALIBRATION CERTIFICATE

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Date: November 26, 1991 Calibration No.: 1126-05
 Company: Ottawa Police P.O. No.: 70670
 Equipment Type: TRIBAR Muni-Quip
 Model No.: T3 Serial No.: 6659
 Calibration Date: November 21, 1991 Calibration Due: November 21, 1992

Standard Used	Traceability No.
HP Spectrum Analyzer 8566B.	92-061321.
HP Network Analyzer 8510A.	92-060521.
Weinschel 10dB Attenuator Pad (P5027).	92-080121.
Weinschel 10dB Attenuator Pad (R1696).	92-080122.
HP Power Meter 432B.	N/A
HP Termination Mount 8478A.	N/A
HP Directional Coupler 11691D.	N/A
SA Harmonic Mixer 14-5(483)	N/A
SA Harmonic Mixer 14-5(104810C).	N/A
HP Adapter X281A	N/A
ProTuner 303(238+456)	N/A
Harrisonlab Power Supply 505A	N/A
SA Antenna Positioner PMA-3-1.	N/A
NRC Standard Gain Horn.	N/A
HP Computer 236.	N/A

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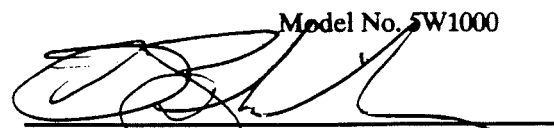
CALIBRATION ACCURACY: +/-2 dB

CALIBRATION TRACEABILITY: All Measurement Instrumentation traceable to the
 National Institute of Standards and Technology (NIST)
 and to the National Research Council of Canada (NRCC).

ENVIRONMENT: Temperature: -10 to 35 degrees Centigrade
 Humidity: 10 to 90% (Non-Condensing)

RE-CERTIFICATION DATE: 1 year from Calibration Date

EQUIPMENT USED: HP Network Analyzer Model No. 8510
 Advantest Spectrum Analyzer Model No. R3261A
 Rohde & Schwarz Signal Generator Model No. SWP
 AR Amplifier Model No. 5W1000



 Manager, Electromagnetic Services





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 Ottawa, Ontario K1G 4X9

CALIBRATION CERTIFICATE

Telephone: (613) 744-3273
 Fax: (613) 952-7998

Date: November 26, 1991 Calibration No.: 1126-06
 Company: Ottawa Police P.O. No.: 70670
 Equipment Type: TRIBAR Muni-Quip
 Model No.: MDR-1 Serial No.: 13301
 Calibration Date: November 20, 1991 Calibration Due: November 20, 1992

Standard Used	Traceability No.
HP Spectrum Analyzer 8566B	92-061321
HP Network Analyzer 8510A	92-060521
Weinschel 10dB Attenuator Pad (P5027)	92-080121
Weinschel 10dB Attenuator Pad (R1696)	92-080122
HP Power Meter 432B	N/A
HP Thermistor Mount 8478A	N/A
HP Directional Coupler 11691D	N/A
SA Harmonic Mixer 14-5 (483)	N/A
SA Harmonic Mixer 14-5 (104810C)	N/A
HP Adapter X281A	N/A
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MPB Technologies Inc.: Thomas J. Kelly



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- ECSM: "The Equivalent Capacitance Substitution Method"
Ref: Jordan, E.C., "E M Waves & Radiating System", p.483
Ref: Navship 94810, "The Radio Freq. Interference Meter",
Univ. of Penn., 1962, Para. 12.4.1
- IEEE 302-1969: "The Institute of Electrical and Electronic Engineers",
Sect. 2.2.2.3

Dipole, Dipole Array, Horn Antenna:

- NBS: Technical Note 1309, 1987
"Calibration Procedures for Horizontal Dipole Antennas (25 to 1000 MHz)"
Ref: Camell, D.G.; Larsen, E.B.; Cruz, J.E.
- ANSI C63.5: "American National Standards for Electromagnetic Compatibility,
Radiated Emission Measurement in EMI, Calibration of Antennas"
1988
- SAE-ARP 958 "Broadband Electromagnetic Interference Measurement Antennas; Stan-
dard Calibration Requirements and Methods"

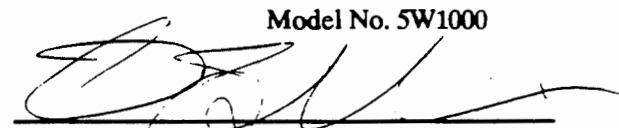
CALIBRATION ACCURACY: +/-2 dB

CALIBRATION TRACEABILITY: All Measurement Instrumentation traceable to the
National Institute of Standards and Technology (NIST)
and to the National Research Council of Canada (NRCC).

ENVIRONMENT: Temperature: -10 to 35 degrees Centigrade
Humidity: 10 to 90% (Non-Condensing)

RE-CERTIFICATION DATE: 1 year from Calibration Date

EQUIPMENT USED: HP Network Analyzer Model No. 8510
Advantest Spectrum Analyzer Model No. R3261A
Rohde & Schwarz Signal Generator Model No. SWP
AR Amplifier Model No. 5W1000



Manager, Electromagnetic Services





MPB TECHNOLOGIES INC.

MPB Technologies Inc.
Electromagnetics Division
P.O. Box 9722 Station T
Ottawa, Ontario K1G 4X9

CALIBRATION CERTIFICATE

Telephone: (613) 744-3273
Fax: (613) 952-7998

Date: November 26, 1991 Calibration No.: 1126-07
 Company: Ottawa Police P.O. No.: 70670
 Equipment Type: TRIBAR Muni-Quip
 Model No.: 13 Serial No.: 5810
 Calibration Date: November 21, 1991 Calibration Due: November 21, 1992

Standard Used	Traceability No.
HP Spectrum Analyzer 2566B.	92-061321.
HP Network Analyzer 2510A.	92-060521.
Weinshel 10dB Attenuator Pad (P5027)	92-080121.
Weinshel 10dB Attenuator Pad (R1696)	92-080122.
HP Power Meter 432B.	N/A.
HP Thermistor Micro 8473A.	N/A.
HP Directional Coupler 11691D	N/A.
SA Harmonic Mixer 14-5(483)	N/A.
SA Harmonic Mixer 14-5(104810C).	N/A.
HP Adapter X281A	N/A.
Pro Tuner 303 (238+456)	N/A.
Harrison Lab Power Supply 505A	N/A.
SA Antenna Positioner PMA-3-1.	N/A.
NRC Standard Gain Horn.	N/A.
HP Computer 236.	N/A.

This is to certify that the instrument listed above was calibrated to MPB Technologies Inc. standards which are traceable to the National Institute of Standards and Technology to the extent allowed by the Institutes calibration facilities, or to the National Research Council, to the extent allowed by the Councils calibration facilities.

Date: November 26, 1991

MPB Technologies Inc.: [Signature]



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 1725 North Service Road
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 Dorval, Quebec H9P 1J1
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 151 Hymus Boulevard
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 Fax: (514) 695-7492

✓ ELECTROMAGNETICS
 MEASUREMENT FACILITY
 NRC, Montreal Road Building M-50
 Ottawa, Ontario K1A 0R6
 Telephone: (613) 744-3273
 Fax: (613) 952-7998

ANTENNA CALIBRATION

MPB Technologies uses one or more of the following standard procedures to calibrate antennae.

Monopole and Loop Antennae:

- NBS: Technical Note 1319,
 "Generation of Standard Electromagnetic Fields in a TEM Cell"
 Ref: Kanda, M.; Orr, R. David
- NRCC: "Measurement of Antenna Factors with a TEM Cell"
 Ref: Kashyap, S.C.
- ECSM: "The Equivalent Capacitance Substitution Method"
 Ref: Jordan, E.C., "E M Waves & Radiating System", p.483
 Ref: Navship 94810, "The Radio Freq. Interference Meter",
 Univ. of Penn., 1962, Para. 12.4.1
- IEEE 302-1969: "The Institute of Electrical and Electronic Engineers",
 Sect. 2.2.2.3

Dipole, Dipole Array, Horn Antenna:

- NBS: Technical Note 1309, 1987
 "Calibration Procedures for Horizontal Dipole Antennas (25 to 1000 MHz)"
 Ref: Camell, D.G.; Larsen, E.B.; Cruz, J.E.
- ANSI C63.5: "American National Standards for Electromagnetic Compatibility,
 Radiated Emission Measurement in EMI, Calibration of Antennas"
 1988
- SAE-ARP 958 "Broadband Electromagnetic Interference Measurement Antennas; Stan-
 dard Calibration Requirements and Methods"

CALIBRATION ACCURACY: +/-2 dB

CALIBRATION TRACEABILITY: All Measurement Instrumentation traceable to the
 National Institute of Standards and Technology (NIST)
 and to the National Research Council of Canada (NRCC).

ENVIRONMENT: Temperature: -10 to 35 degrees Centigrade
 Humidity: 10 to 90% (Non-Condensing)

RE-CERTIFICATION DATE: 1 year from Calibration Date

EQUIPMENT USED:	HP Network Analyzer	Model No. 8510
	Advantest Spectrum Analyzer	Model No. R3261A
	Rohde & Schwarz Signal Generator	Model No. SWP
	AR Amplifier	Model No. 5W1000

Manager, Electromagnetic Services





MPB TECHNOLOGIES INC.

MPB Technologies Inc.
Electromagnetics Division
P.O. Box 9722 Station T
Ottawa, Ontario K1G 4X9

CALIBRATION CERTIFICATE

Telephone: (613) 744-3273

Fax: (613) 952-7998

Date: November 26, 1991 Calibration No.: 1126-08
 Company: Ottawa Police P.O. No.: 70670
 Equipment Type: TRIBAR Muni-Quip
 Model No.: T3 Serial No.: 6656
 Calibration Date: November 21, 1991 Calibration Due: November 21, 1992

Standard Used	Traceability No.
HP Spectrum Analyzer 8566B	92-061321
HP Network Analyzer 2510A	92-060521
Weinschel 10dB Attenuator Pad (P5027)	92-080121
Weinschel 10dB Attenuator Pad (P1696)	92-080122
HP Power Meter 432B	N/A
HP Thermistor Mount 8478A	N/A
HP Directional Coupler 11691D	N/A
SA Harmonic Mixer 14-5(483)	N/A
SA Harmonic Mixer 14-5(104810C)	N/A
HP Adapter x281A	N/A
Pro Tuner 303(238+456)	N/A
Harrison Lab Power Supply 505A	N/A
SA Antenna Positioner PMA-3-1	N/A
NRC Standard Gain Horn	N/A
HP Computer 236	N/A

This is to certify that the instrument listed above was calibrated to MPB Technologies Inc. standards which are traceable to the National Institute of Standards and Technology to the extent allowed by the Institutes calibration facilities, or to the National Research Council, to the extent allowed by the Councils calibration facilities.

Date: November 26, 1991

MPB Technologies Inc.: [Signature]



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 Ottawa, Ontario K1A 0R6
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Monopole and Loop Antennae:

- NBS: Technical Note 1319,
 "Generation of Standard Electromagnetic Fields in a TEM Cell"
 Ref: Kanda, M.; Orr, R. David
- NRCC: "Measurement of Antenna Factors with a TEM Cell"
 Ref: Kashyap, S.C.
- ECSM: "The Equivalent Capacitance Substitution Method"
 Ref: Jordan, E.C., "E M Waves & Radiating System", p.483
 Ref: Navship 94810, "The Radio Freq. Interference Meter",
 Univ. of Penn., 1962, Para. 12.4.1
- IEEE 302-1969: "The Institute of Electrical and Electronic Engineers",
 Sect. 2.2.2.3

Dipole, Dipole Array, Horn Antenna:

- NBS: Technical Note 1309, 1987
 "Calibration Procedures for Horizontal Dipole Antennas (25 to 1000 MHz)"
 Ref: Camell, D.G.; Larsen, E.B.; Cruz, J.E.
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 Radiated Emission Measurement in EMI, Calibration of Antennas"
 1988
- SAE-ARP 958 "Broadband Electromagnetic Interference Measurement Antennas; Stan-
 dard Calibration Requirements and Methods"

CALIBRATION ACCURACY: +/-2 dB

CALIBRATION TRACEABILITY: All Measurement Instrumentation traceable to the
 National Institute of Standards and Technology (NIST)
 and to the National Research Council of Canada (NRCC).

ENVIRONMENT: Temperature: -10 to 35 degrees Centigrade
 Humidity: 10 to 90% (Non-Condensing)

RE-CERTIFICATION DATE: 1 year from Calibration Date

EQUIPMENT USED:	HP Network Analyzer	Model No. 8510
	Advantest Spectrum Analyzer	Model No. R3261A
	Rohde & Schwarz Signal Generator	Model No. SWP
	AR Amplifier	Model No. 5W1000

Manager, Electromagnetic Services





MPB Technologies Inc.
Electromagnetics Division
P.O. Box 9722 Station T
Ottawa, Ontario K1G 4X9

CALIBRATION CERTIFICATE

Telephone: (613) 744-3273
Fax: (613) 952-7998

Date: November Calibration No.: 1126-09
 Company: Ottawa Police P.O. No.: 70670
 Equipment Type: TRIBAR Muni-Quip
 Model No.: T3 Serial No.: 6905
 Calibration Date: November 21, 1991 Calibration Due: November 21, 1992

Standard Used	Traceability No.
HP Spectrum Analyzer 8566B.	92-061321
HP Network Analyzer 8510A	92-060521
Weinschel 10dB Attenuator Pad (P5027)	92-080121
Weinschel 10dB Attenuator Pad (R1696)	92-080122
HP Power Meter 432B.	N/A.
HP Thermistor Mount 8478A.	N/A.
HP Directional Coupler 11691D.	N/A.
SA Harmonic Mixer 14-5 (483)	N/A.
SA Harmonic Mixer 14-5 (104810C)	N/A.
HP Adapter X261A	N/A.
Pro Tuner 303 (238+456)	N/A.
Harrison Lab Power Supply 505A	N/A.
SA Antenna Positioner PMA-3-1.	N/A.
NRC Standard Gain Horn.	N/A.
HP Computer 236.	N/A.

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Date: November 26, 1991

MPB Technologies Inc.: _____



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 Ref: Kanda, M.; Orr, R. David
- NRCC: "Measurement of Antenna Factors with a TEM Cell"
 Ref: Kashyap, S.C.
- ECSM: "The Equivalent Capacitance Substitution Method"
 Ref: Jordan, E.C., "E M Waves & Radiating System", p.483
 Ref: Navship 94810, "The Radio Freq. Interference Meter",
 Univ. of Penn., 1962, Para. 12.4.1
- IEEE 302-1969: "The Institute of Electrical and Electronic Engineers",
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Dipole, Dipole Array, Horn Antenna:

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CALIBRATION ACCURACY: +/-2 dB

CALIBRATION TRACEABILITY: All Measurement Instrumentation traceable to the
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 and to the National Research Council of Canada (NRCC).

ENVIRONMENT: Temperature: -10 to 35 degrees Centigrade
 Humidity: 10 to 90% (Non-Condensing)

RE-CERTIFICATION DATE: 1 year from Calibration Date

EQUIPMENT USED: HP Network Analyzer Model No. 8510
 Advantest Spectrum Analyzer Model No. R3261A
 Rohde & Schwarz Signal Generator Model No. SWP
 AR Amplifier Model No. 5W1000



 Manager, Electromagnetic Services





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P.O. Box 9722 Station T
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CALIBRATION CERTIFICATE

Telephone: (613) 744-3273
Fax: (613) 952-7998

Date: November 26 1991 Calibration No.: 1126-10
 Company: Ottawa Police P.O. No.: 70670
 Equipment Type: TRIBAR Muni-Quip
 Model No.: T3 Serial No.: 7324
 Calibration Date: November 21, 1991 Calibration Due: November 21, 1992

Standard Used	Traceability No.
HP Spectrum Analyzer 8566B.	92-061321.
HP Network Analyzer 8510A.	92-060521.
Weinschel 10dB Attenuator Pad (P5027).	92-080121.
Weinschel 10dB Attenuator Pad (R1691b).	92-080122.
HP Power Meter 432B.	N/A.
HP Thermistor Mount 8478A.	N/A.
HP Directional Coupler 11691D.	N/A.
SA Harmonic Mixer 14-5 (483).	N/A.
SA Harmonic Mixer 14-5 (104810C).	N/A.
HP Adapter X261A.	N/A.
Pro Tuner 303 (238+456).	N/A.
Harrison Lab Power Supply 505A.	N/A.
SA Antenna Positioner PMA-3-1.	N/A.
NRC Standard Gain Horn.	N/A.
HP Computer 236.	N/A.

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Date: November 26, 1991
 MPB Technologies Inc.: [Signature]



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- NRCC: "Measurement of Antenna Factors with a TEM Cell"
 Ref: Kashyap, S.C.
- ECSM: "The Equivalent Capacitance Substitution Method"
 Ref: Jordan, E.C., "E M Waves & Radiating System", p.483
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 Ref: Camell, D.G.; Larsen, E.B.; Cruz, J.E.
- ANSI C63.5: "American National Standards for Electromagnetic Compatibility,
 Radiated Emission Measurement in EMI, Calibration of Antennas"
 1988
- SAE-ARP 958 "Broadband Electromagnetic Interference Measurement Antennas; Stan-
 dard Calibration Requirements and Methods"


CALIBRATION ACCURACY: +/-2 dB

CALIBRATION TRACEABILITY: All Measurement Instrumentation traceable to the
 National Institute of Standards and Technology (NIST)
 and to the National Research Council of Canada (NRCC).

ENVIRONMENT: Temperature: -10 to 35 degrees Centigrade
 Humidity: 10 to 90% (Non-Condensing)

RE-CERTIFICATION DATE: 1 year from Calibration Date

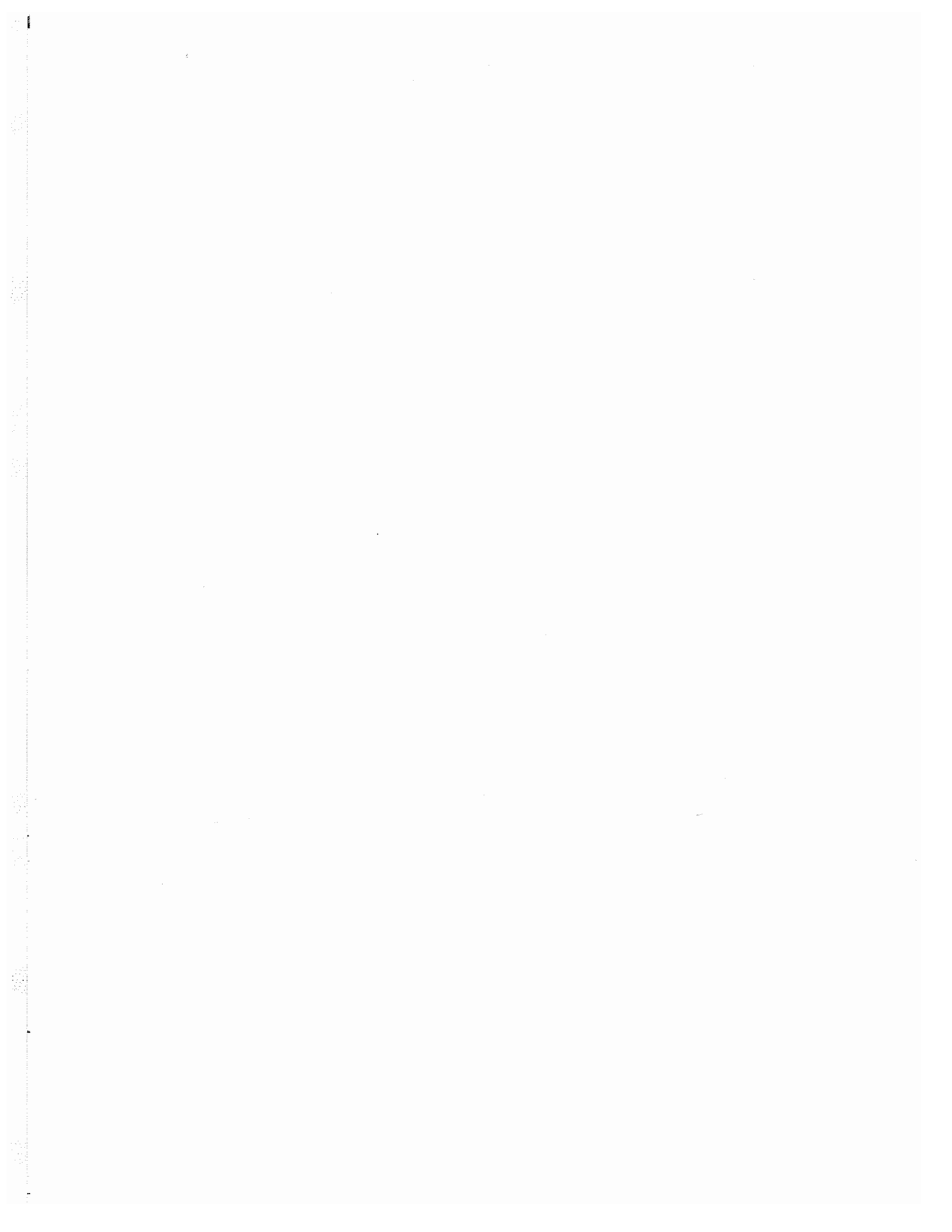
EQUIPMENT USED: HP Network Analyzer Model No. 8510
 Advantest Spectrum Analyzer Model No. R3261A
 Rohde & Schwarz Signal Generator Model No. SWP
 AR Amplifier Model No. 5W1000



 Manager, Electromagnetic Services



APPENDIX A

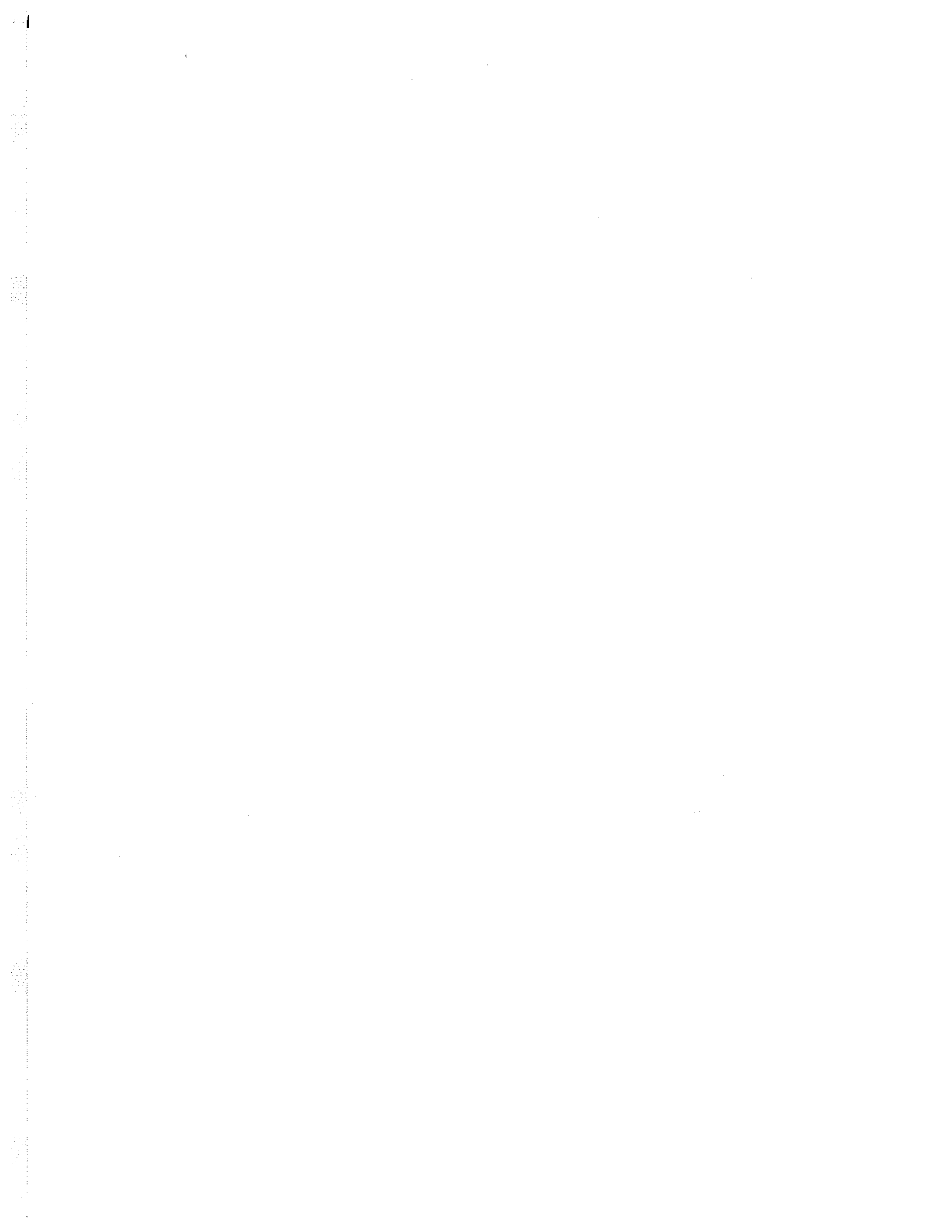


**POWER DENSITY
AT 2 TO 6 INCHES FROM ANTENNA FACE**

Table 1

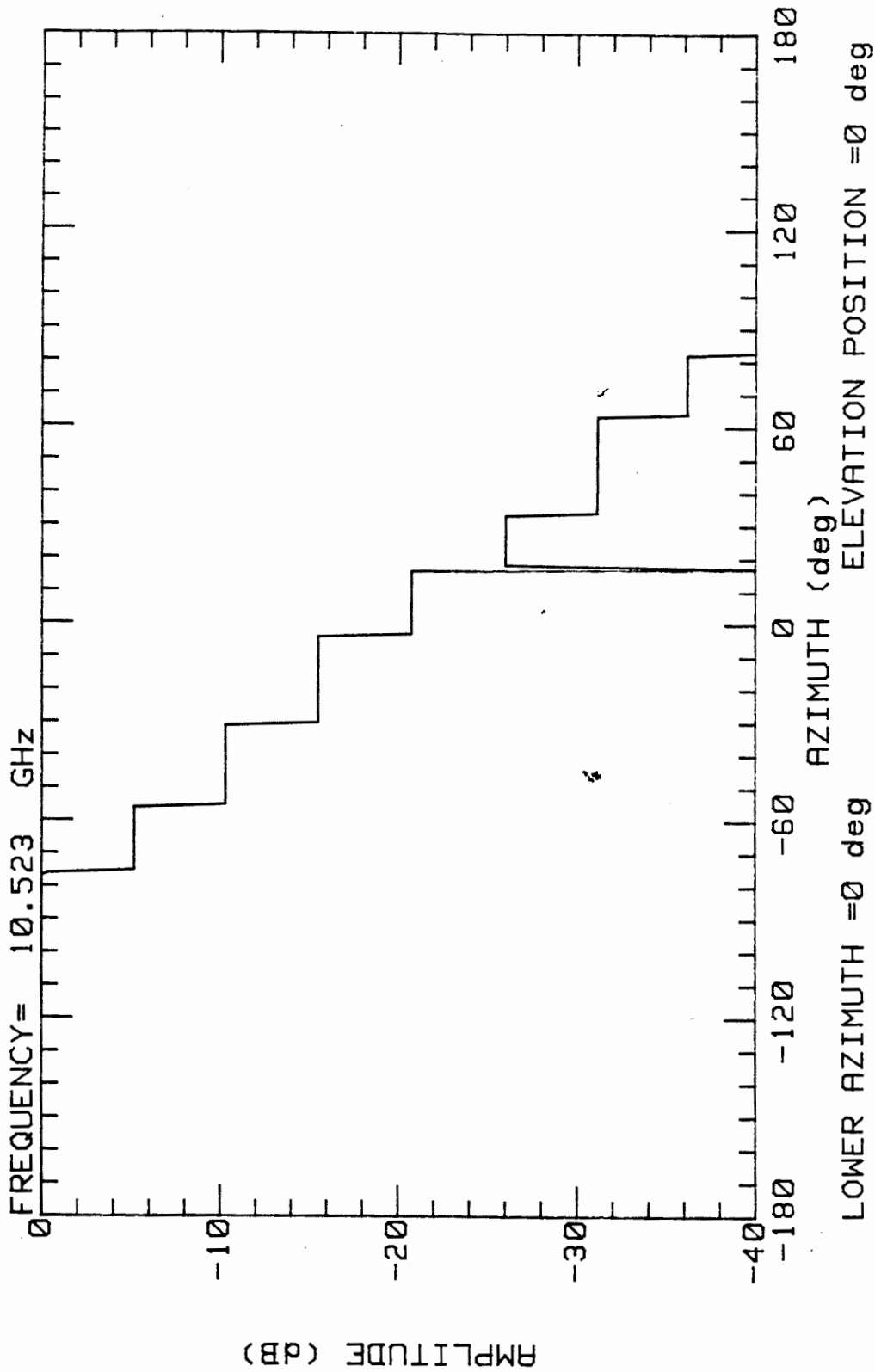
UNIT #	SPACING (INCHES)	POWER (mW/cm²)
T₃ 55060 #27	2	0.76
	6	0.66
T₃ 5810 # 08	2	0.84
	6	0.76
T₃ 6656 # 09	2	0.82
	6	0.66
T₃ 6905 # 19	2	0.93
	6	0.78
T₃ 5807 # 05	2	1.45
	6	1.35
Muni-Quip 6659 # 12	2	2.14
	6	1.23
T₃ 5806 # 04	2	1.68
	6	1.51
T₃ 7324 # 23	2	1.29
	6	1.15
MDR-1 13299 # 30	2	0.75
	6	0.69
MDR-1 13301 # 28	2	0.69
	6	0.58

APPENDIX B





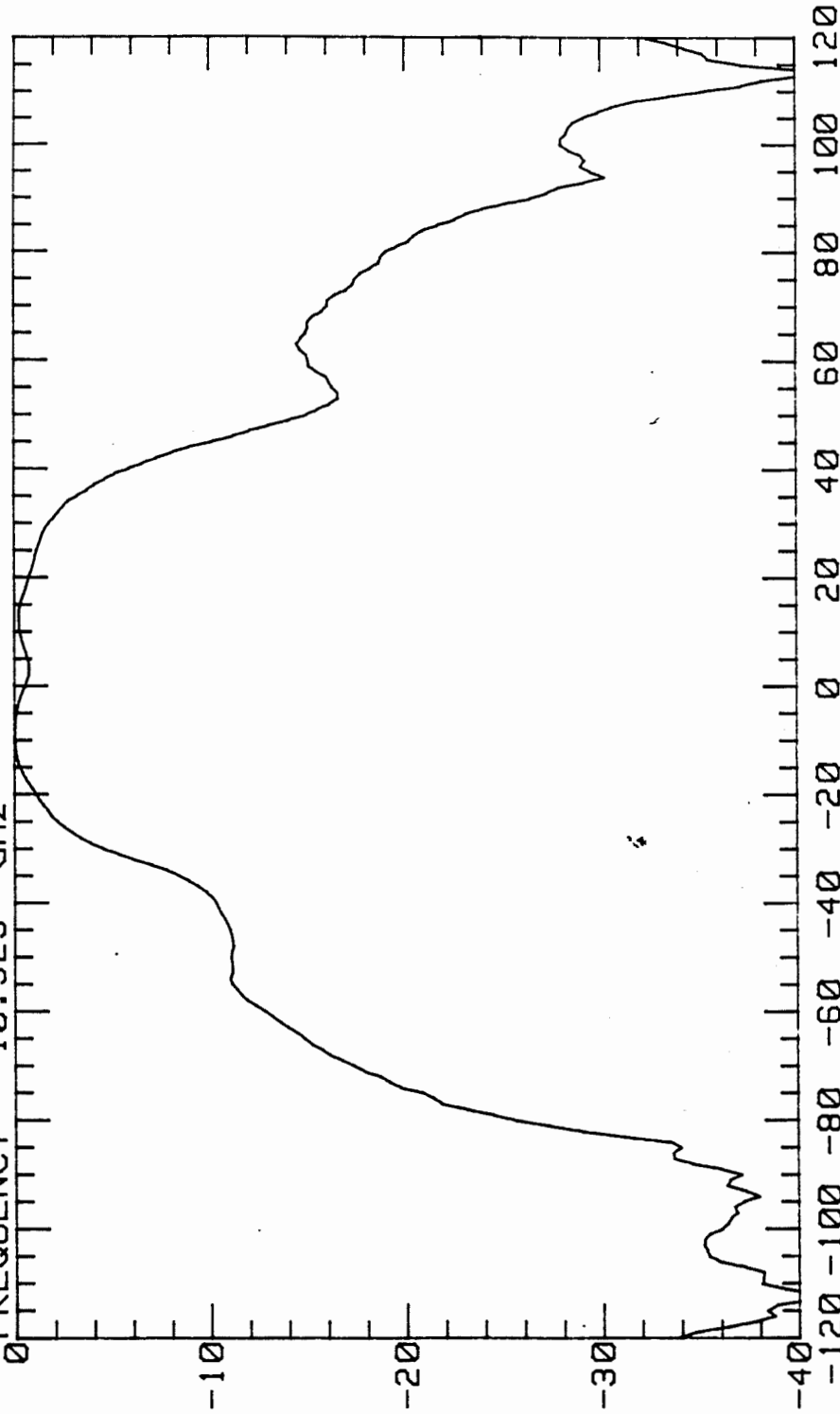
RADIATION PATTERN MEASUREMENT
CALIBRATION 5 dB STEPS





RADIATION PATTERN MEASUREMENT
TRIBAR INDUSTRIES MUNI QUIP MDR-1 #13299 -30
Rx V
2 INCH SPACING

FREQUENCY = 10.523 GHz



AZIMUTH (deg)

ELEVATION POSITION = 0 deg

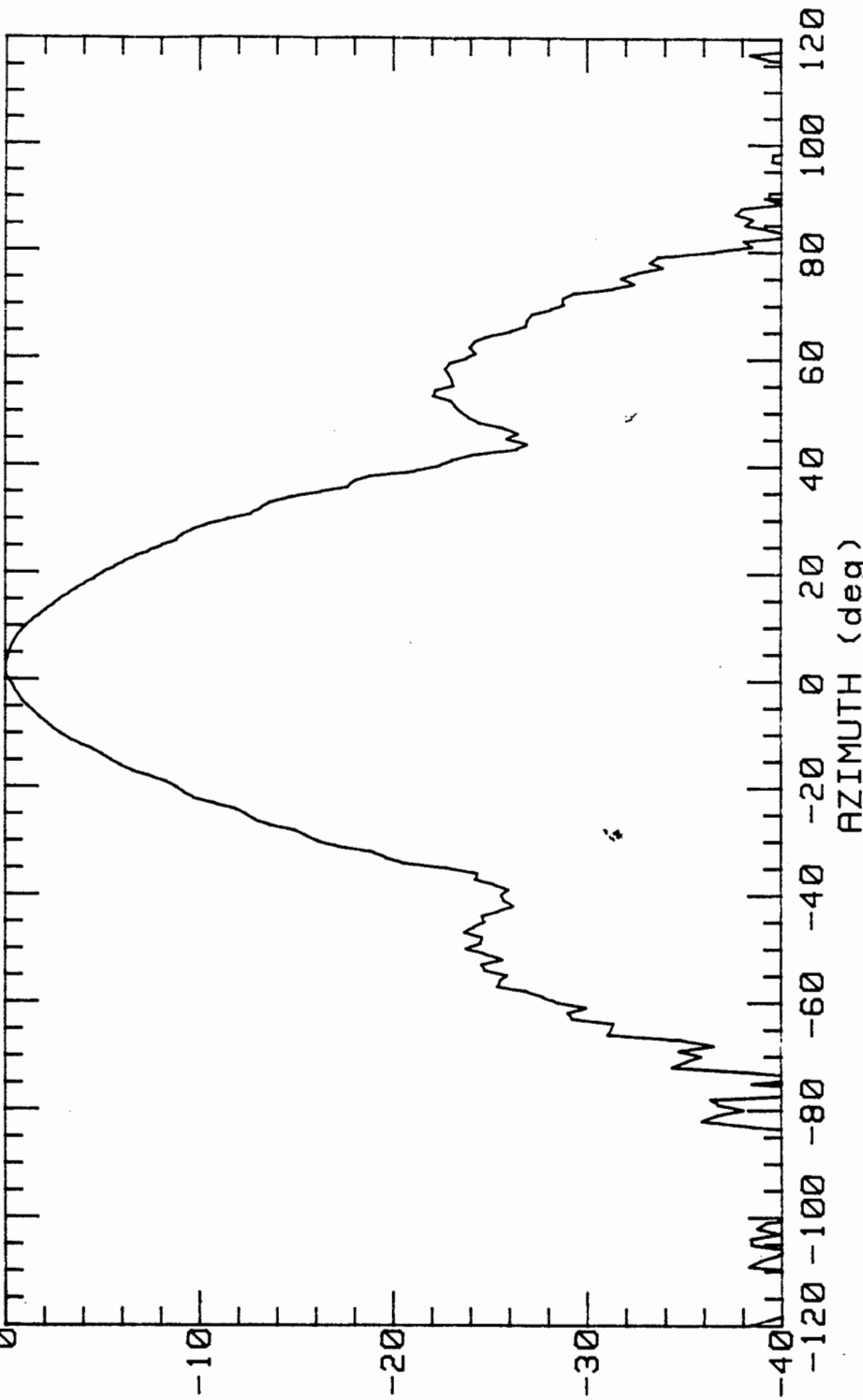
LOWER AZIMUTH = 0 deg



RADIATION PATTERN MEASUREMENT

TRIBAR INDUSTRIES MUNI QUIP MDR-1 #13299 -30 Rx V
6 INCH SPACING

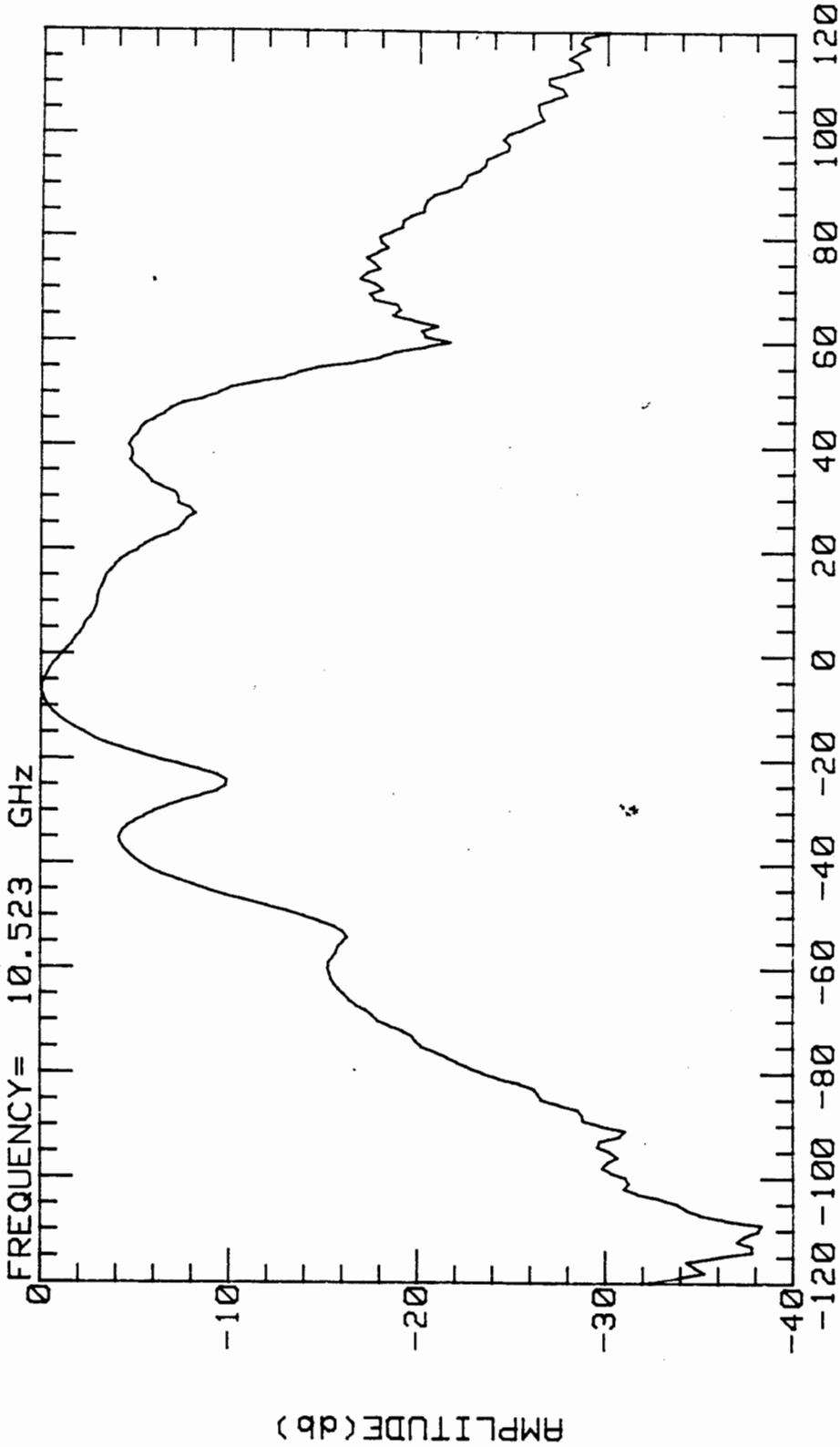
FREQUENCY = 10.523 GHz



LOWER AZIMUTH = 0 deg ELEVATION POSITION = 0 deg



RADIATION PATTERN MEASUREMENT
TRIBAR INDUSTRIES MUNI QUIP T3 #5806 -4
2 INCH SPACING Rx H



LOWER AZIMUTH = 0 deg
AZIMUTH (deg)
ELEVATION POSITION = 0 deg



RADIATION PATTERN MEASUREMENT

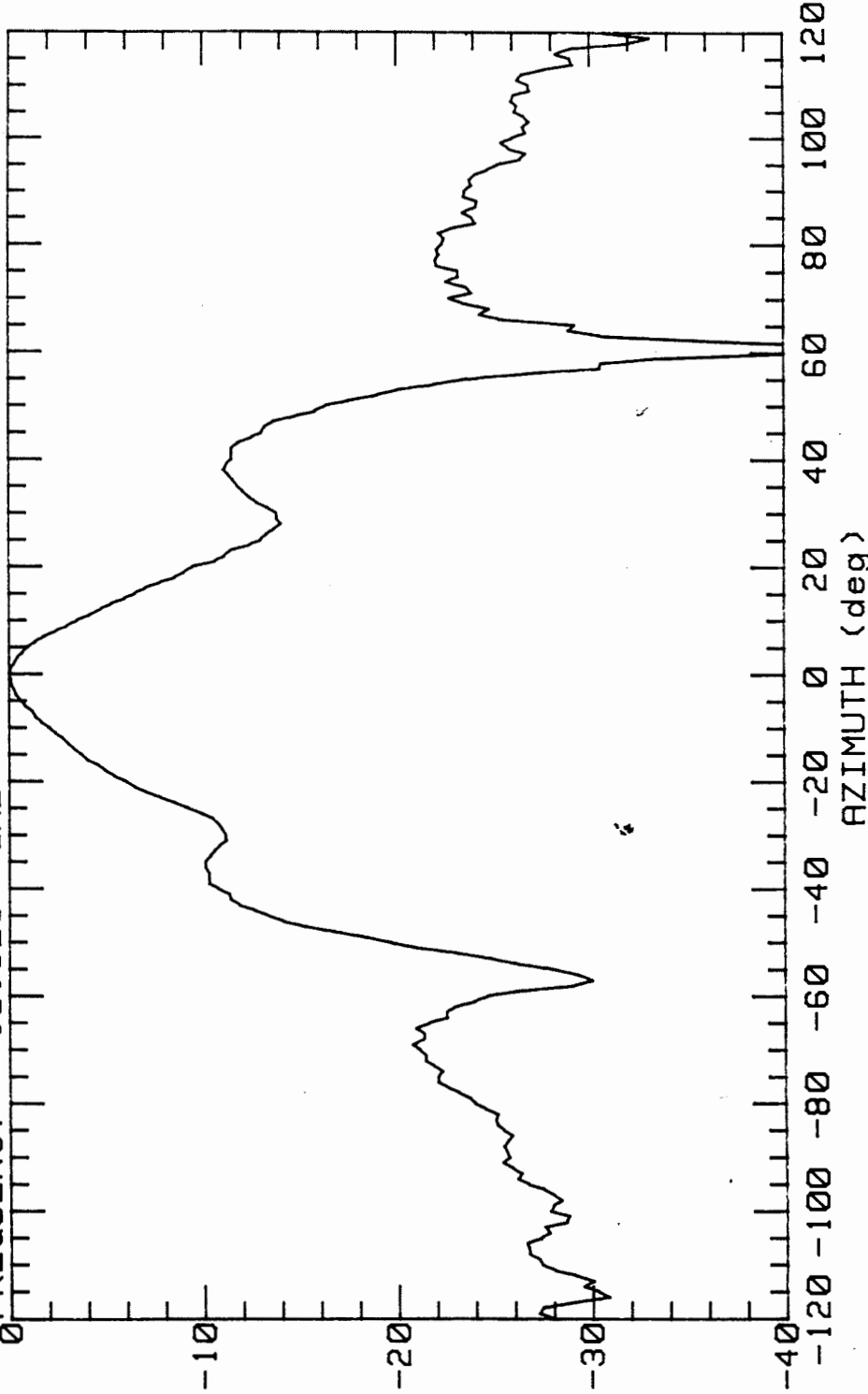
TRIBAR INDUSTRIES MUNI QUIP T3 #5806

Rx H

--4

6 INCH SPACING

FREQUENCY = 10.523 GHz



LOWER AZIMUTH = 0 deg

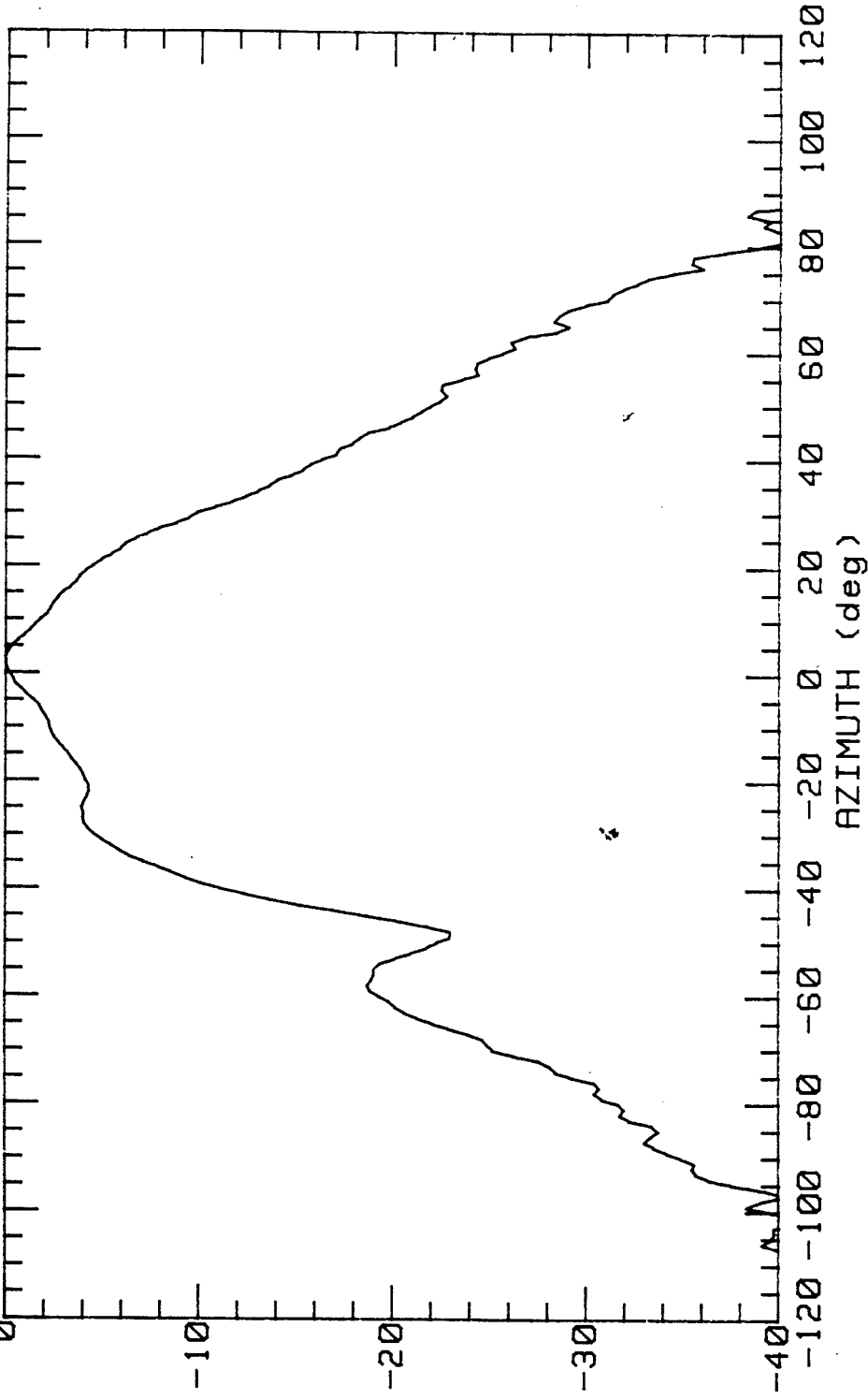
UPPER AZIMUTH = 0 deg

ELEVATION POSITION = 0 deg



RADIATION PATTERN MEASUREMENT
TRIBAR INDUSTRIES MUNI QUIP T3 #5806 -4
2 INCH SPACING Rx V

FREQUENCY = 10.523 GHZ

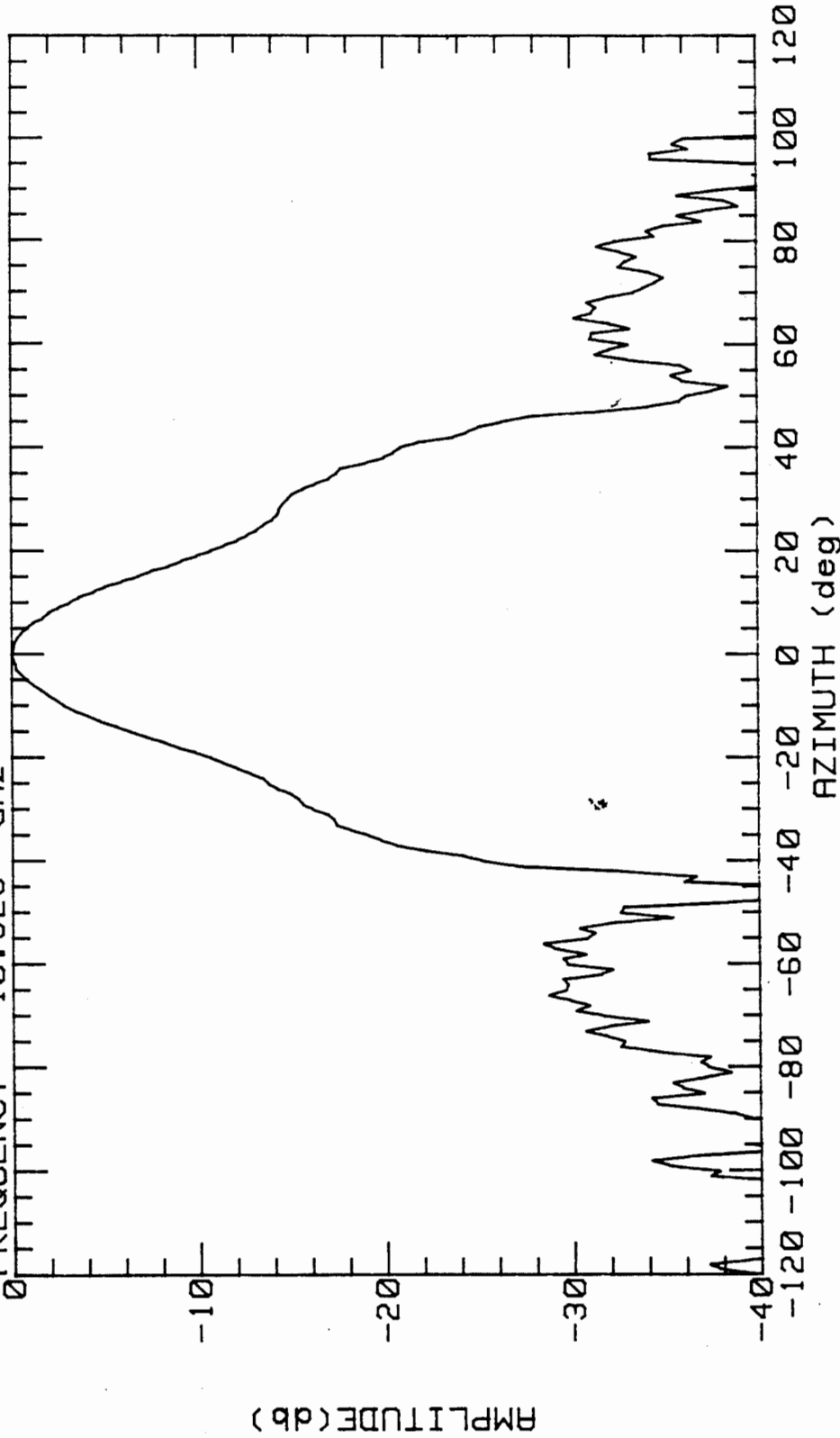


LOWER AZIMUTH = 0 deg ELEVATION POSITION = 0 deg



RADIATION PATTERN MEASUREMENT
TRIBAR INDUSTRIES MUNI QUIP T3 #5806 -4
6 INCH SPACING Rx V

FREQUENCY = 10.523 GHz



LOWER AZIMUTH = 0 deg

UPPER AZIMUTH = 0 deg

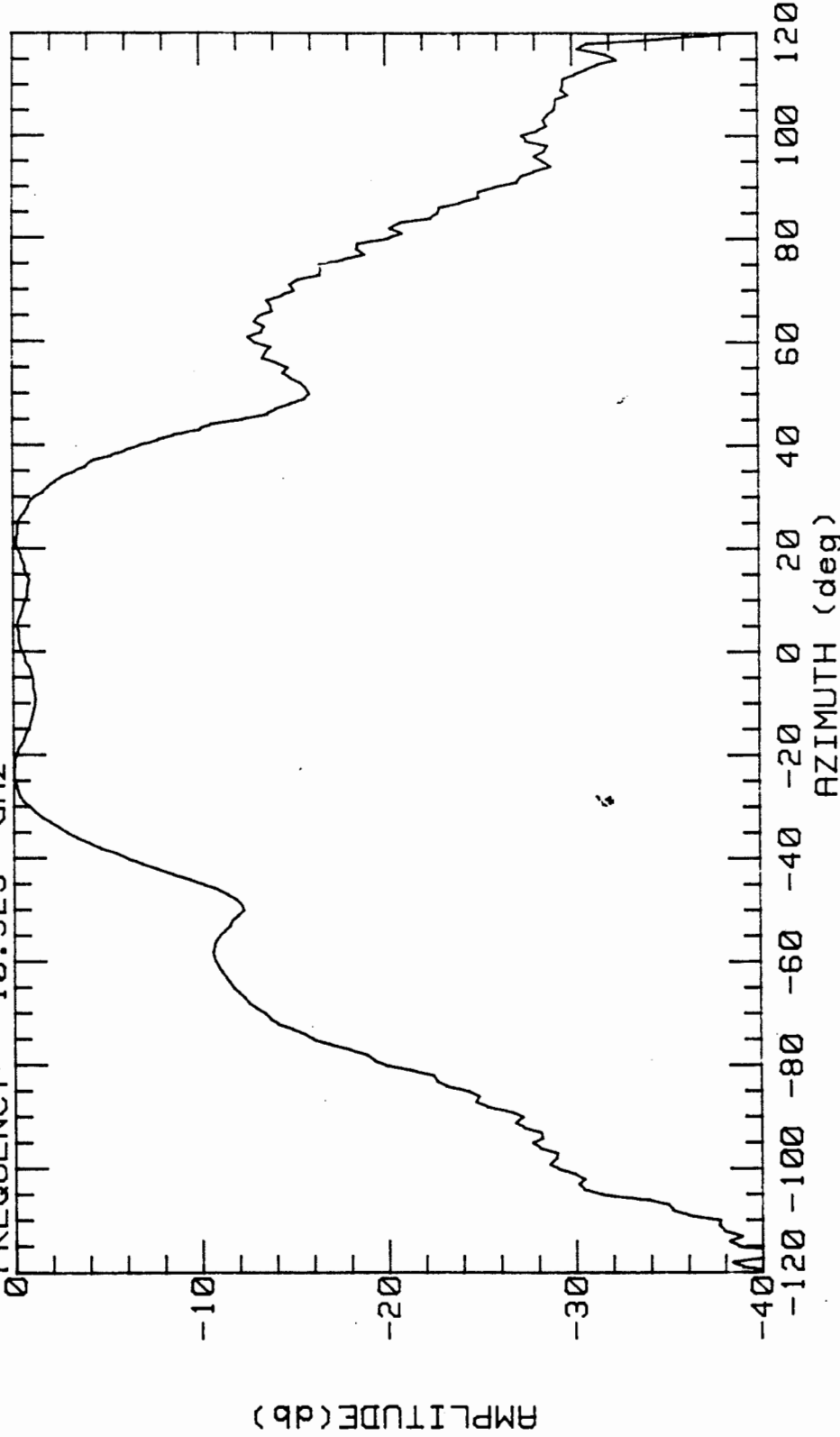


RADIATION PATTERN MEASUREMENT

TRIBAR INDUSTRIES MUNI QUIP T3 #55060 -27

2 INCH SPACING Rx H

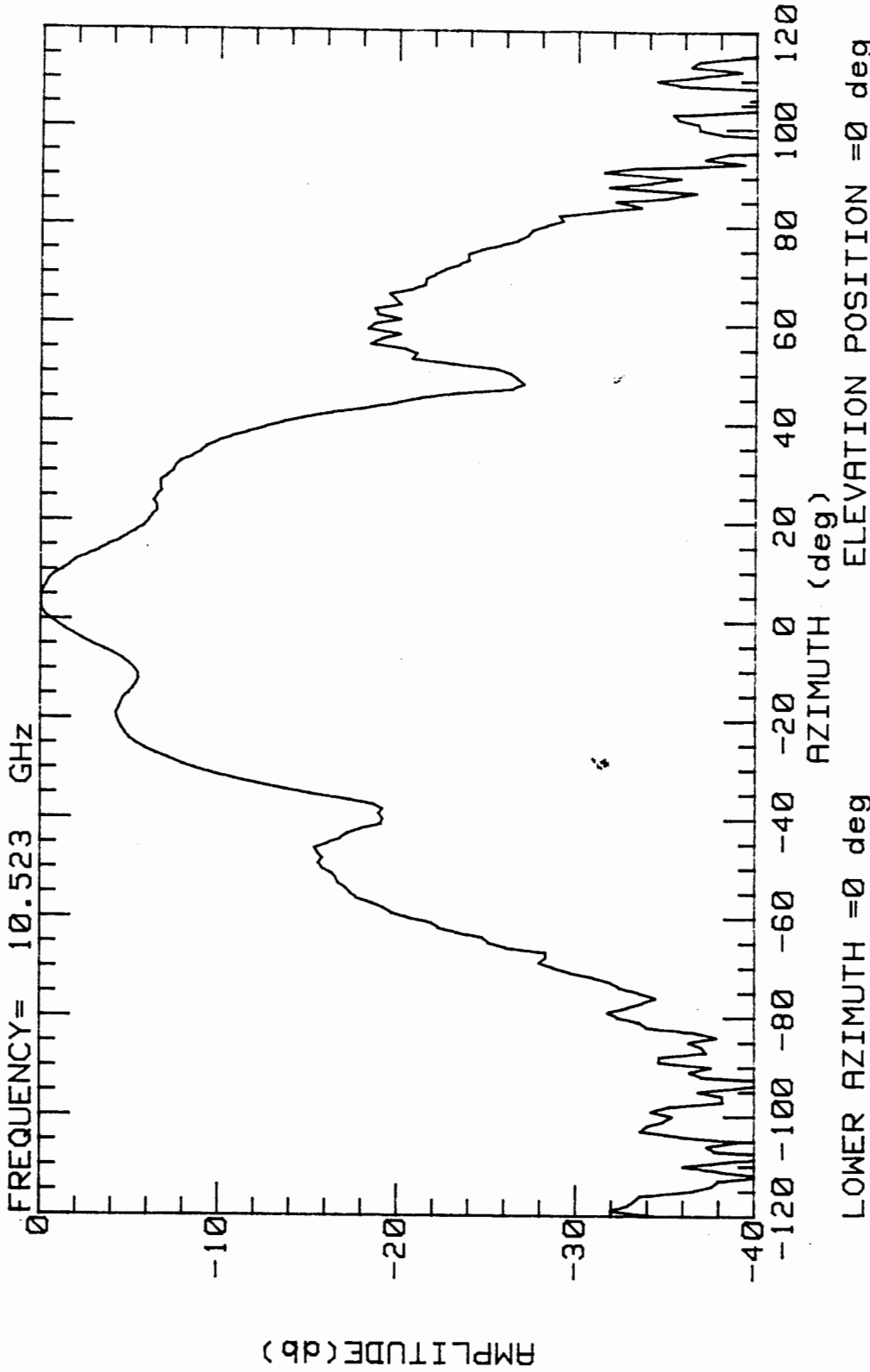
FREQUENCY = 10.523 GHz



LOWER AZIMUTH = 0 deg ELEVATION POSITION = 0 deg



RADIATION PATTERN MEASUREMENT
TRIBAR INDUSTRIES MUNI QUIP T3 #55060 ~27
6 INCH SPACING Rx H

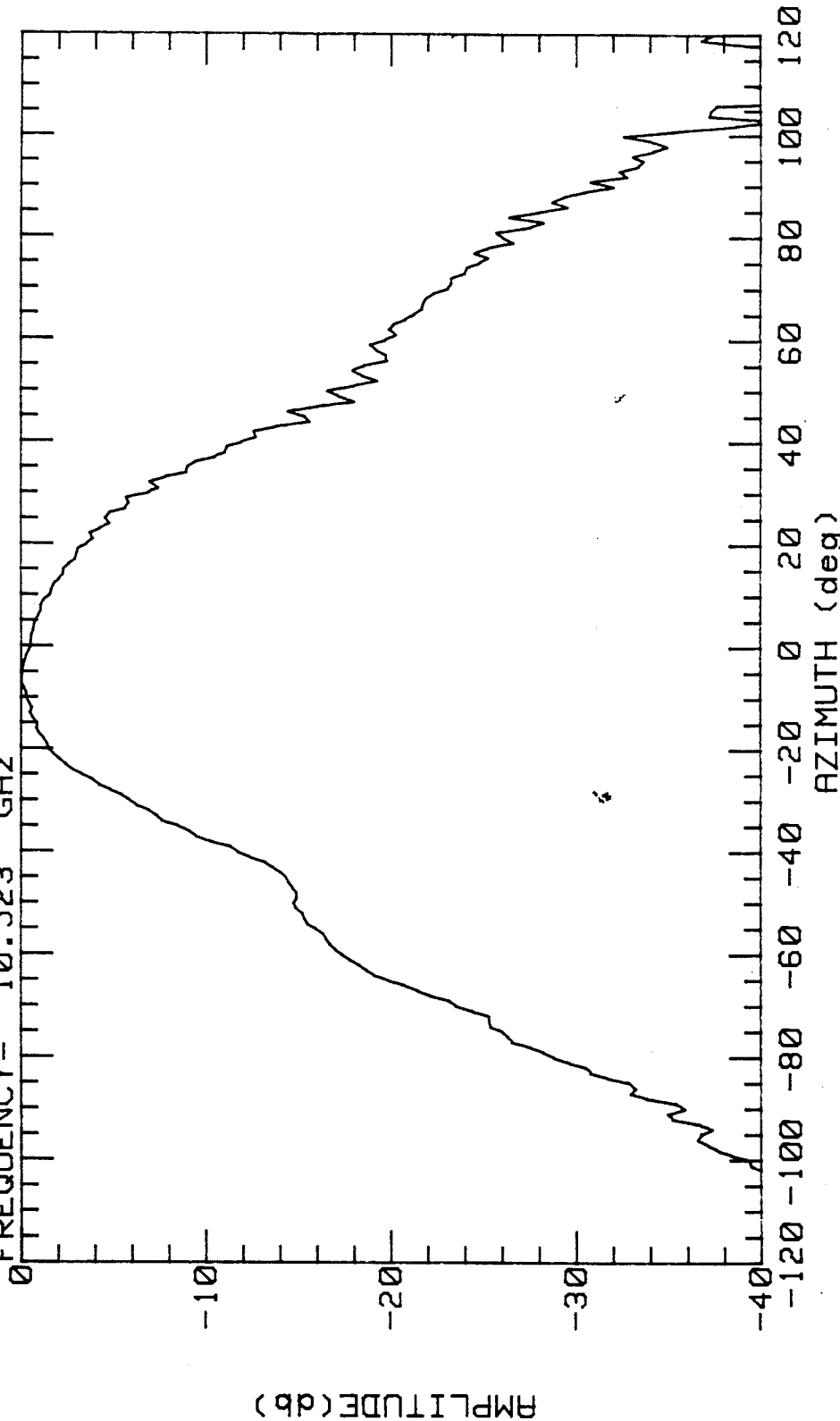




RADIATION PATTERN MEASUREMENT

TRIBAR INDUSTRIES MUNI QUIP T3 #55060 -27
2 INCH SPACING Rx V

FREQUENCY = 10.523 GHZ



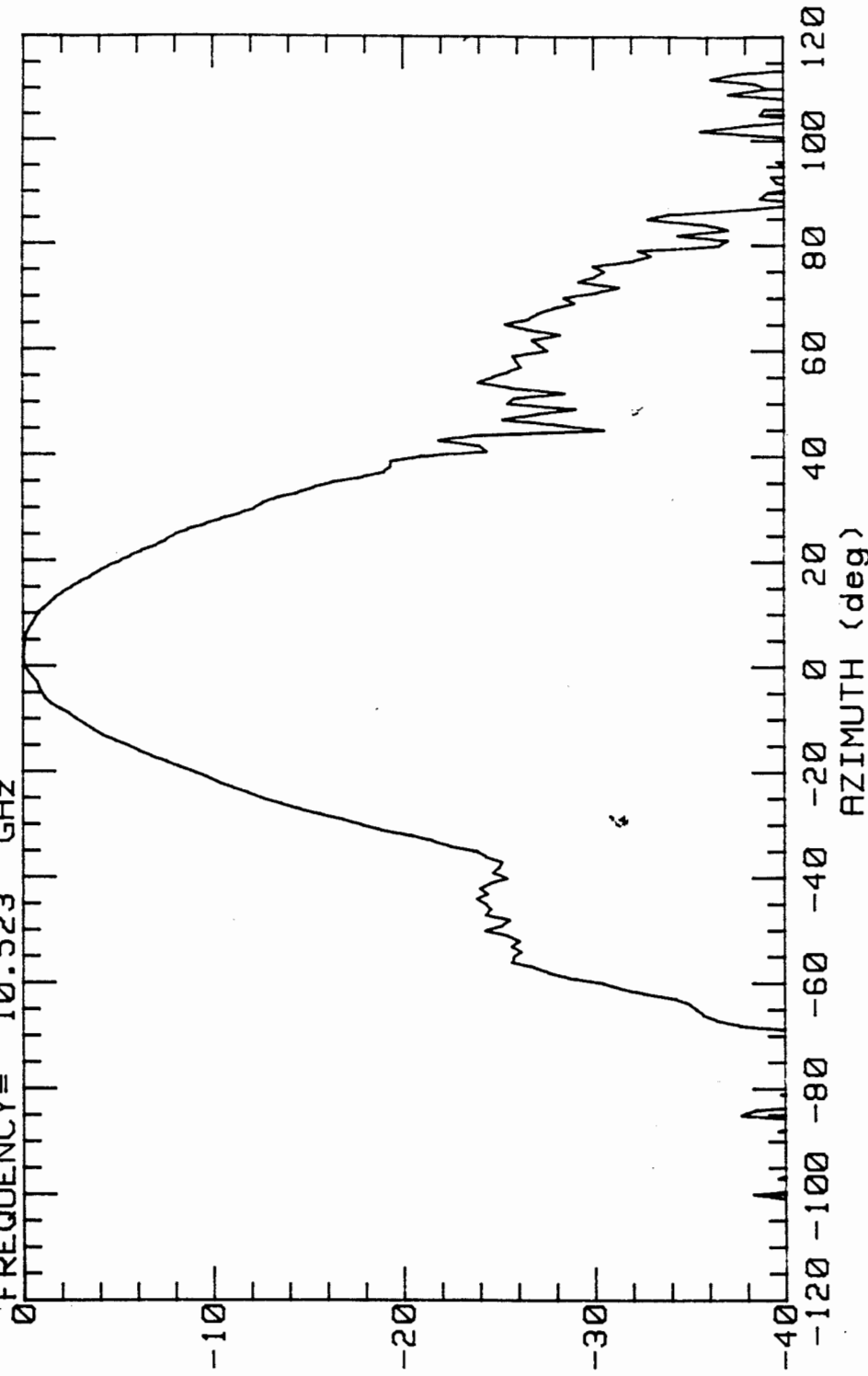
LOWER AZIMUTH = 0 deg ELEVATION POSITION = 0 deg



RADIATION PATTERN MEASUREMENT

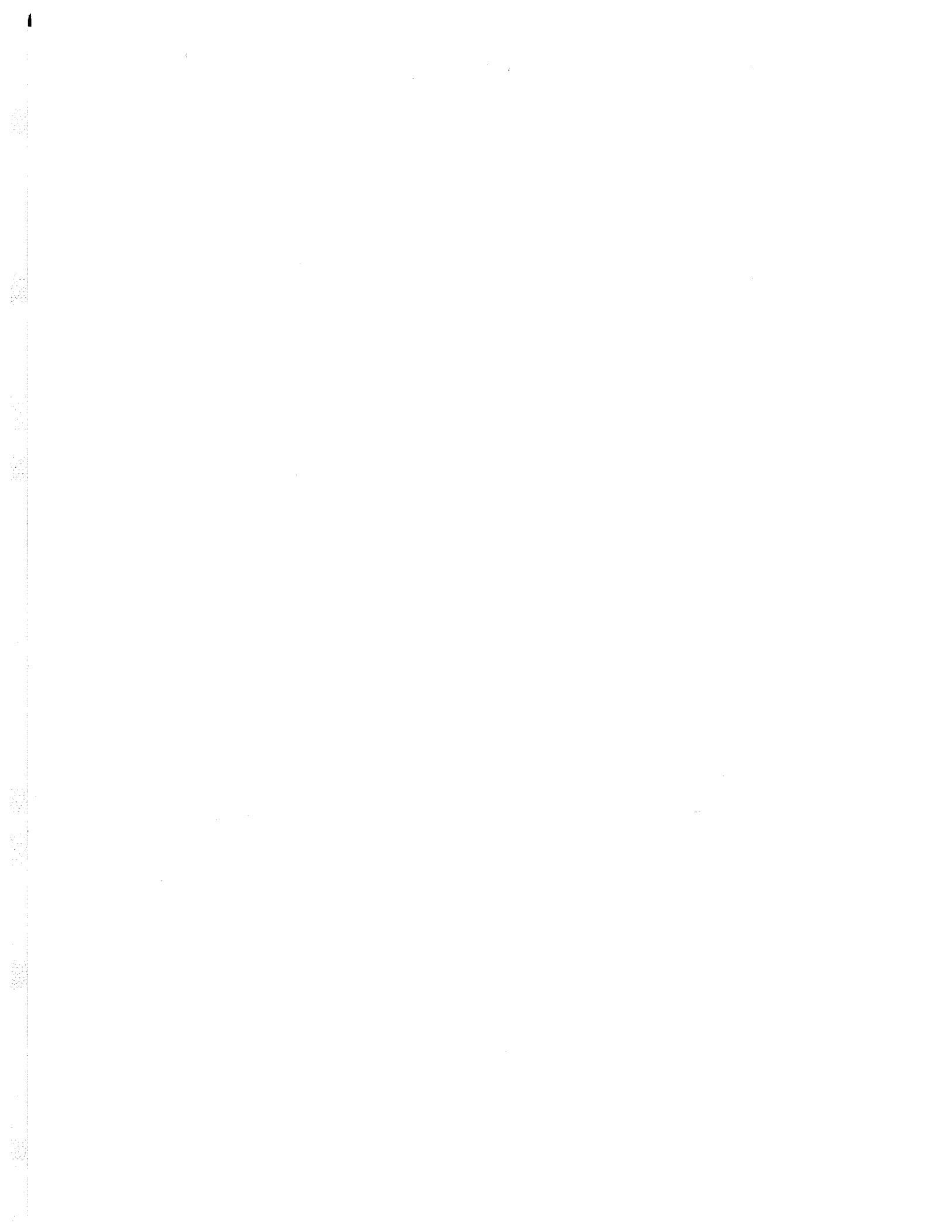
TRIBAR INDUSTRIES MUNI QUIP T3 #55060 Rx V -27
6 INCH SPACING

FREQUENCY = 10.523 GHz



LOWER AZIMUTH = 0 deg ELEVATION POSITION = 0 deg

APPENDIX C



TEST EQUIPMENT REPORT

Test Comp./Part: <i>Ottawa Police Radio Units</i>		Page 1 of 2	
Test Technologist: <i>L. ALLAN</i>		Date: <i>Aug 23 97</i>	
Facility: <i>OTTAWA</i>		Recalib.	
Manufacturer	Description	Model	Serial #
<i>HEWLETT-PACKARD</i>	<i>SPECTRUM ANALYZER</i>	<i>HP8560A</i>	<i>28167645 2747705489</i>
<i>HEWLETT-PACKARD</i>	<i>NETWORK ANALYZER</i>	<i>8580A</i>	<i>01554</i>
<i>WELN: CNEE</i>	<i>ATTENUATION 10 DB</i>	<i>175027</i>	<i>N/A</i>
<i>WELN: CNEE</i>	<i>ATTENUATOR 10DB</i>	<i>R169E</i>	<i>N/A</i>
<i>HEWLETT-PACKARD</i>	<i>POWER METER</i>	<i>43213</i>	<i>2130A035</i>
<i>HEWLETT-PACKARD</i>	<i>IMPEDANCE METER</i>	<i>2437A</i>	<i>18756</i>
<i>HEWLETT-PACKARD</i>	<i>DIRECT COUPLER</i>	<i>116911</i>	<i>02765</i>
<i>SCIENTIFIC ATLANTA</i>	<i>HPARMONIC MIXER</i>	<i>14-5</i>	<i>1048000</i>
<i>SCIENTIFIC ATLANTA</i>	<i>HARMONIC MIXER</i>	<i>14-5</i>	<i>483</i>
<i>HEWLETT-PACKARD</i>	<i>AMPLIFIER</i>	<i>X281A</i>	<i>12368</i>
Customer No.:	<i>10010</i>	MPBT No.:	<i>1104</i>

TEST EQUIPMENT REPORT

Test Comp./Part: Ottawa Police Range Guns		Facility: OTTAWA			Page 2 of 2
Test Technologist: L. ALLAN					Date: Nov 23 91
Manufacturer	Description	Model	Serial #	Calib.	Recalib.
PRD	TUNER	303	238		
HARRISON LAB. INC	PULLER SUPPLY	56510	318		
SCIENTIFIC INSTRUMENTS	PATELINA TEST TUNER	PANA-31	29		
ARC	STANDARD GUN TUNER		3		
PRD	TUNER	303	456		
HUBBETT PROBABER	PROBBER	2200	26		
SCIENTIFIC INSTRUMENTS	RECEIVER	1070	187388		
HUBBETT PROBABER	COMPUTER	236	2430002482		
Customer No.: 70670				MPBT No.: 126	

APPENDIX D

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