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RADIO & TV ENGINEERING CO.

1416 Hollister Lane
Los Osos, CA 93402



Norwood J. Patterson, Owner
e-mail: npatterson805@charter.net

DATA and EQUIPMENT Used for Measurements KG6XDP TX at W. Jackman, Lancaster, CA

1. **Site 4009 W. Jackman**
Coordinates:
 34° 41' 59" N. Lat. NAD27
 118° 17' 28" W. Long.
See Exhibit L (Picture).
2. **Tower:**
 Rohn 25
 Triangular 12" cross section
 Height above insulator: 140 ft.
 Height above ground level: 145 ft.
 Insulator: Austin model A-4197-L
 See Exhibit L (Picture)
3. **Transmitter:**
 Broadcast Electronics (BE) model AM-1A,
 Audio amplifier and microphones.
4. **Bridge:**
 Delta CPBI s/n 826
5. **Line Terminating Unit (LTU):**
 REC model 1A1690 type "T" network with vacuum capacitor.
6. **Ground System:**
 120 #14 AGW copper wire insulated, placed on the ground level 145' long.
 All radials soldered at tower to a 2" copper strap around tower with 4 each
 8' ground rods staked at end of 145' to hold tight with a 2' reinforcing
 concrete bar.
 See Exhibit L (Picture).
7. **RF Bridge Meter:**
 Delta model 5 amp linear, model TCA-5.



8. **RF Antenna Meter:**
Weinschel RF Meter, 0 to 6 amps.
9. **Field Intensity Meters:**
Potomac FIM 41 s/n 888
Potomac FIM 41 s/n 882
Potomac FIM 41 s/n 812
10. **GPS Receivers:**
Trimble GEO3/BOB s/n 02475
Trimble GEO3/BOB s/n 02482
Magellan model 330 (no s/n).
11. **Bridge Antenna Z measurements (for P_o):**
GR 1606 s/n 3066
Generator: RX31-Potomac/s-n 428
Detector: SD 31-Potomac/s-n 441
Calibration Check Resistors:
GR 50 Ω s/n 1388 "900BT"
GR 200 Ω s/n 208 "900 BT"
GR 50 Ω s/n 19797 "874"
Weinschel 535M 50 Ω s/n 10074 "N"

KG6XDP Eqpt. Used to Measure-Lancaster

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED

145' / 44.2 m.

145 ft./44.2m. agl

Becon No
becon

Triangle Twr =
12 Inches

140 ft./42.8m.
above Ins.

Ground System 120 Radials

3 deg #14 Copper AGW
insulated

Wire, 4' round

Rods 8' Long at each corner of 2'x2'x2'
Copper Strap on wood Platform.

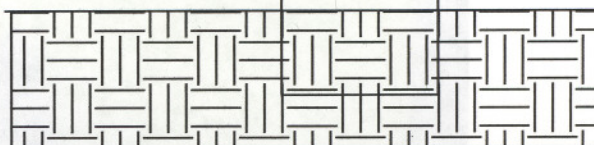
Po = 1 kW

Fc = 1.690 MHz

Various
amsl

Base 1
meter agl

Insulator
0.3m. (1ft.)



FCC: Po=1.00
kW, Fc=
1.690 MHz

Eng. N. J. Patterson

RRI Temp. K6XDP Calif.

SIZE	FSCM NO.	DWG NO.	Aug. 22, 04	REV
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SCALE

SHEET

08/22/04 04:55:31 PM

GR900® 50-Ohm Precision Terminations and Attenuators

Precision Resistive Terminations and Mismatches

Standard terminations are useful for calibration of bridges, slotted lines, admittance bridges, network analyzers, and reflectometers. The 50-ohm 900-W50 termination can also be used as a precision dummy load or as a termination in measurements of networks with more than one port. This termination, together with the 900-WNC Short Circuit and 900-LZ Air Lines, can form a calibration set for computer correction of measuring instruments. With an appropriate GR900 adaptor, it can be used as a low-SWR, precision type-N termination, or BNC, or C, etc.

Standard mismatches introduce reflections of known SWR in a 50-ohm transmission line and are therefore useful in the calibration of reflectometers, network analyzers, and SWR-measuring instruments.



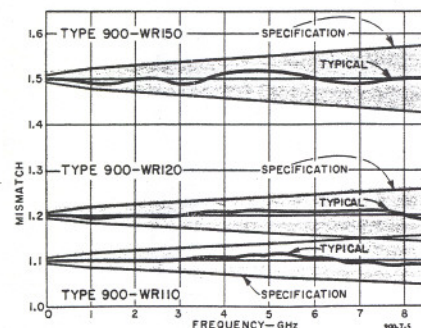
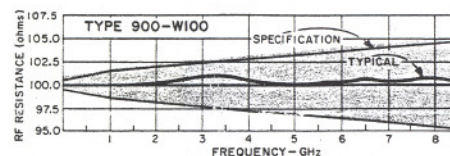
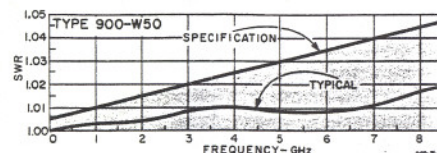
Frequency: Dc to 8.5 GHz.

	900	-W50	-W100	-W110	-W120	-W150
Dc						
Resistance:		50 Ω	100 Ω	45.45 Ω	41.67 Ω	33.33 Ω
Accuracy:		$\pm 0.3\%$	$\pm 0.5\%$	$\pm 0.5\%$	$\pm 0.5\%$	$\pm 0.5\%$
SWR, also see curves:		1.005 + 0.005 fGHz	—	1.1 nom	1.2 nom	1.5 nom
Plane			4 cm nom			
Position*:		—	—	—	—	—

Electrical: INPUT POWER: <1 W with negligible change, <5 W without damage. TEMPERATURE COEFFICIENT: <150 ppm/°C.

Mechanical: DIMENSIONS: 2 in. (51 mm) long x 1.06 in. (27 mm) dia. WEIGHT: 0.2 lb (0.1 kg) net.

Description	Catalog Number
Precision Resistive Terminations	
900-W50 50- Ω Standard Termination	0900-9953
900-W100 100- Ω Standard Termination	0900-9957
Precision Mismatches:	
900-WR110 Standard Mismatch, SWR 1.1	0900-9961
900-WR120 Standard Mismatch, SWR 1.2	0900-9963
900-WR150 Standard Mismatch, SWR 1.5	0900-9965



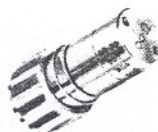
Open-Circuit Terminations

Open-circuit terminations are useful in establishing initial conditions of line length and signal phase, as shielding caps for open-circuited lines, and, at low frequencies, as capacitance standards.

Frequency: Dc to 8.5 GHz.

Plane Position*: For 900-WO, typically 0.26 cm, but varies with frequency within ± 0.012 cm of value shown on graph. For -WO4, 4.00 ± 0.01 cm (corresponds to 4-cm offset in 900-W100 and -W200 Standard Terminations).

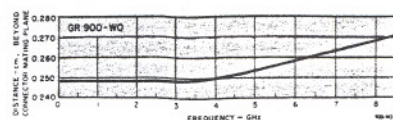
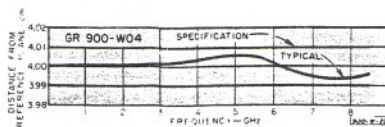
Electrical: CAPACITANCE: 0.172 \pm 0.008 pF for -WO, at low frequencies; 2.670 pF \pm 0.25% for -WO4, below 70 MHz.



900-WO4



900-WO

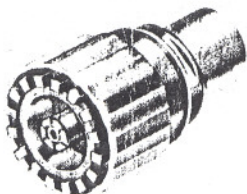


Precision Open-Circuit Terminations

900-WO, plane at 2.6 mm
900-WO4, plane at 4 cm

0900-9981
0900-9985

* Location of effective position of termination, measured toward "load", from reference plane of connector (where outer conductors butt together).



SPECIFICATIONS

Frequency Range: Dc to 8.5 GHz.

Dc Resistance: 200 ohms $\pm 0.3\%$.

RF Resistance:

200.00 $\pm (1.00 + 2.00 \times f_{\text{GHz}})$ to 1 GHz;
200.00 $\pm (2.10 + 0.90 \times f_{\text{GHz}})$ 1 to 7 GHz;
200.00 ± 8.40 or $-(8.40 + 7.20 (f_{\text{GHz}} - 7))$
7 to 8.5 GHz.

Position at which resistance value applies: Beyond GR900 connector reference plane — (4.00 ± 0.05) cm to 2GHz; $(4.02 - 0.01 \times f_{\text{GHz}} \pm 0.05)$ cm, 2 to 8.5 GHz.

Leakage: Better than 130 dB below signal.

Maximum Power: 1 W with negligible change; 5 W without damage.

Temperature Coefficient: Less than 150 ppm/°C.

Dimensions: Length, 2 in. (51 mm); maximum diameter, 1-1/16 in. (27 mm).

Net Weight: 3 1/2 oz. (100 g).

CAUTION

THE CONTACT SURFACES OF THE INNER AND OUTER CONDUCTORS MUST BE PROTECTED, AS NICKS OR DENTS CAN IMPAIR ELECTRICAL PERFORMANCE.

Type 900-W200 STANDARD COAXIAL TERMINATION

200-OHMS

FEBRUARY 1966 *DC 200.00* Form 0900-0104A

GENERAL RADIO COMPANY
WEST CONCORD, MASSACHUSETTS

GR900 PRECISION COAXIAL COMPONENTS

DESCRIPTION

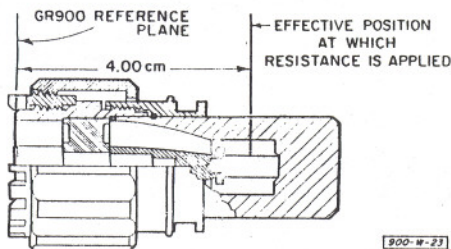
The Type 900-W200, 200-ohm Standard Termination introduces a 200-ohm resistive termination into a 50.0-ohm coaxial line. It is not a matched termination for a 200-ohm coaxial line.

The Type 900-W200 comprises a 50.0-ohm Type 900-BT Connector, a specially derived 50.0-ohm continuous transition, and a precision 200-ohm cylindrical resistor. The resistor is a highly stable, deposited-metal-film element.

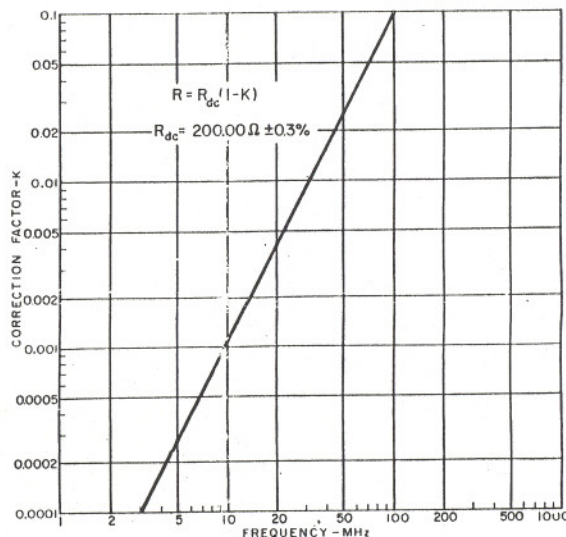
APPLICATIONS

The Type 900-W200 Termination is used as a 200-ohm standard for the calibration of bridges, slotted-line systems, and reflectometers.

It is particularly suited to the calibration of bridges and complex reflection-coefficient measuring instruments. The 4-cm position beyond the connector refer-

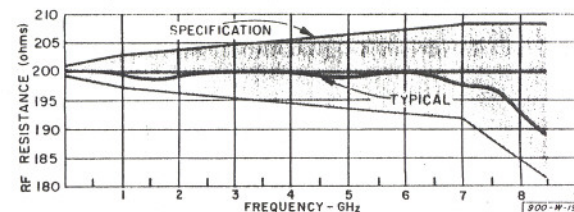


Cross section of the termination showing effective position at which resistance value applies.



Correction factor K for Type 900-W200 resistive component at GR900 reference plane (above 5 MHz). Below 5 MHz, K is small enough to be considered negligible.

ence plane, at which the 200-ohm resistance is applied, coincides with the corresponding positions of the 0, ∞ and 100-ohm resistances of the Type 900-WN4 Short-Circuit Termination, the Type 900-WO4 Open-Circuit Termination, and the Type 900-W100 100-Ohm Standard Termination. Thus these four units



RF resistance (see chart).

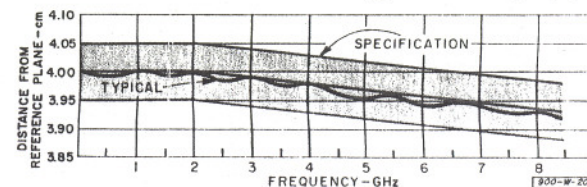
comprise a set of calibration standards.

When the Type 900-W200 is utilized to calibrate a low-frequency bridge, the reference plane (4 cm away from the GR900 connector mating plane), may not be the most convenient to use. This is particularly true for series (R, X) bridges.

The resistive component, R, of the impedance presented as a function of frequency at the connector reference plane, is given by

$$R = R_{dc} (1 - K)$$

where K is a correction factor (given in the graph).



Position at which resistance value applies (see chart).

POTOMAC INSTRUMENTS, INC

SILVER SPRING, MARYLAND

CERTIFICATE OF CALIBRATION

Field Intensity Meter Type FIM-41 Serial No. 888

This instrument was calibrated in an induction field of 220.0 millivolts per meter. At each measurement frequency the measured field was recorded and a correction factor K was computed: the indicated field must be multiplied by K to obtain the true field.

<u>KHz</u>	<u>K</u>	<u>MHz</u>	<u>K</u>	<u>KHz</u>	<u>K</u>	<u>MHz</u>	<u>K</u>
540	1.023	1.6	1.023	1100	1.000	3.5	1.014
600	1.009	1.9	1.014	1200	1.000	3.8	1.000
700	1.005	2.2	1.014	1300	1.000	4.1	1.005
800	1.000	2.5	1.009	1400	1.000	4.4	1.000
900	1.014	2.8	1.014	1500	1.000	4.7	1.005
1000	1.000	3.2	1.000	1600	1.000	5.0	1.005

Single Frequency of KHz only, K

The calibrating field is maintained equal to the National Bureau of Standards standard field within an accuracy of 1.0 per cent. NBS states that the absolute accuracy of its field is "believed to be within 3.0 percent."

The error at points on the meter scale other than the calibration point is less than 3.0 per cent. The attenuator ratios are correct within 2.0 per cent. These accuracies apply for battery voltages that are indicated by the instrument's battery check circuit to be useable. NEXT RECOMMENDED CALIBRATION DATE:

JUNE 2003

Calibrated by Frank Sandel Date 19 JUNE 2001

STATE OF MARYLAND

Personally appeared before me this 20TH day of JUNE 01, FRANK J. SANDEL, who testified under oath that the above calibration was made either by himself or under his direction and that the statements in the above certificate are true to the best of his knowledge and belief.

Albert E. Babbler
ALBERT E. BABBELER
NOTARY PUBLIC STATE OF MARYLAND
My Commission Expires June 1, 2005

POTOMAC INSTRUMENTS, INC

SILVER SPRING, MARYLAND

CERTIFICATE OF CALIBRATION

Field Intensity Meter Type FIM-41 Serial No. 882

This instrument was calibrated in an induction field of 220.0 millivolts per meter. At each measurement frequency the measured field was recorded and a correction factor K was computed: the indicated field must be multiplied by K to obtain the true field.

<u>KHz</u>	<u>K</u>	<u>MHz</u>	<u>K</u>	<u>KHz</u>	<u>K</u>	<u>MHz</u>	<u>K</u>
540	1.005	1.6	1.000	1100	1.000	3.5	1.000
600	1.000	1.9	1.000	1200	1.000	3.8	0.995
700	1.000	2.2	1.000	1300	1.000	4.1	1.005
800	1.000	2.5	1.000	1400	1.000	4.4	0.995
900	1.000	2.8	1.005	1500	1.000	4.7	1.000
1000	1.000	3.2	1.000	1600	1.000	5.0	1.000

Single Frequency of KHz only, K

The calibrating field is maintained equal to the National Bureau of Standards standard field within an accuracy of 1.0 per cent. NBS states that the absolute accuracy of its field is "believed to be within 3.0 percent."

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Albert E. Brubaker
ALBERT E. BRUBAKER
NOTARY PUBLIC STATE OF MARYLAND
My Commission Expires June 1, 2005

TYPE 1001-A STANDARD-SIGNAL GENERATOR

1000-P2 40-Ohm Series Unit must be connected between the generator and the patch cord. Since the cable is terminated, the output voltage is one-half the voltage indicated by the panel settings.

At the highest frequencies (15 - 50 Mc), if coaxial connections cannot be maintained up to the receiver input terminals, errors in sensitivity measurements can result due to the reactance of the connecting leads. A method for introducing a measured amount of power into the receiver input terminals, in spite of appreciable lead reactance, is described in RCA APPLICATION NOTE number AN 132 of May 17, 1948, entitled, "Receiver Sensitivity and Gain Measurements at High Frequencies". In this method, when the receiver tuning capacitor and an externally added series capacitor are both tuned for maximum receiver output, the receiver presents an effective input resistance which matches the dummy antenna resistance, and the input power may then be calculated.

3.3 LOOP ANTENNA - LOW IMPEDANCE METHOD

When the receiver under test is equipped with a loop antenna, it may be tested either with a transmitting test loop connected to the standard-signal generator or by introducing the test signal into the receiver loop through a very low impedance generator.

The Type 1000-P3 Voltage Divider (not supplied as standard equipment with the Type 1001-A Generator) was designed to facilitate the injection of a test signal in series with the receiver loop. The voltage divider is shown schematically in Figure 7. Its 50-ohm impedance at one end of the unit effectively terminates the Type 874-R21 50-Ohm Coaxial Patch Cord and its one-ohm impedance at the other end of the unit is sufficiently low for insertion in series with the receiver's loop antenna without disturbing its normal operation. The voltage appearing at the one-ohm, or loop end of the voltage divider is one hundredth of the voltage indicated by the panel control settings (remember to use the Type 1000-P2 40-Ohm Series Unit at all but the 100 MV MULTI-

PLIER settings). CAUTION: This method is not recommended for use with the ac-dc type of receiver where one side of the power line is connected directly to the receiver chassis. There is considerable shock hazard if the signal generator is operated ungrounded; there is also the danger that the attenuator cards may be burned out.

3.4 LOOP ANTENNA - TEST LOOP METHOD

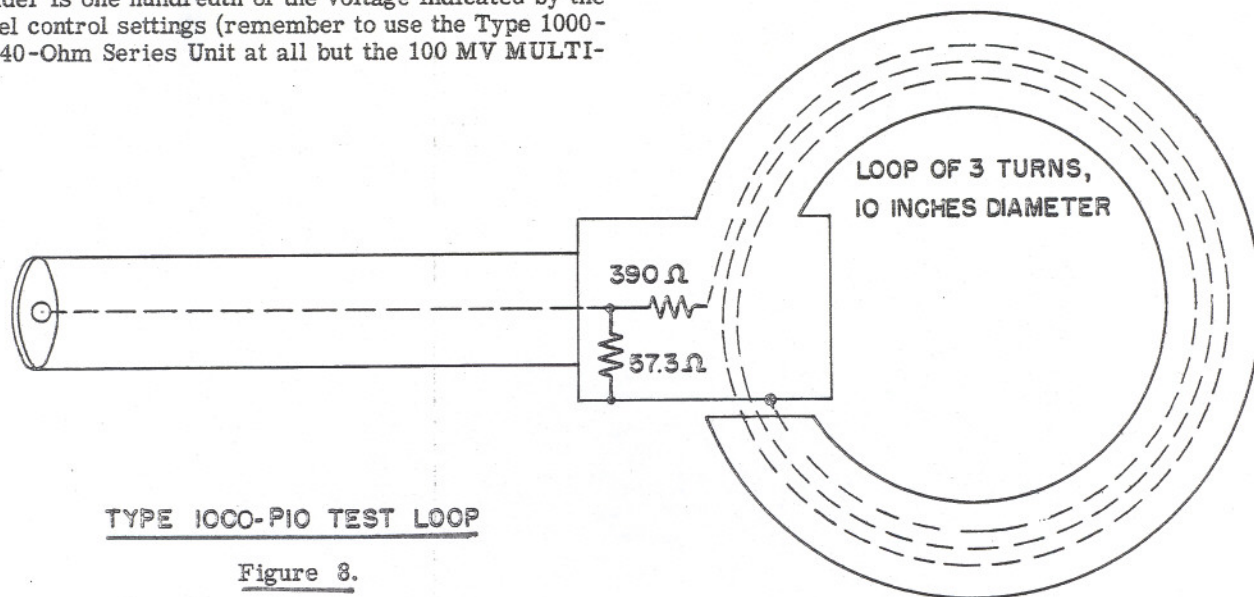
The Type 1000-P10 Test Loop (not supplied as standard equipment with the Type 1001-A Generator) provides a convenient means for measuring loop-antenna receivers in accordance with the preferred method outlined in the I.R.E. Standards mentioned above.*

The Type 1000-P10 Test Loop is an electrostatically shielded, three-turn coil of ten inches diameter. Figure 8 shows a schematic of the loop and its coupling circuit. The three-turn loop is connected to a four-foot coaxial cable by a 390-ohm resistor to assure constant loop current for a given input voltage up to 3 Mc. The 50-ohm cable is effectively terminated by the 50-ohm shunt combination of a 57.3-ohm shunt resistor and the 390-ohm series resistor. The input to the cable utilizes a Type 874-C Cable Connector.

Figure 9 shows the proper arrangement of apparatus for testing a loop-antenna radio-receiver with a standard-signal generator and the Type 1000-P10 Test Loop.

Note that the loops are arranged coaxially. The separation between the loops should be at least twice the greatest dimension of the larger loop.

*See also "Measurement of Loop-Antenna Receivers", W. O. Swinyard, Proc. I.R.E., p. 382, July 1941.



TYPE 1000-P10 TEST LOOP

Figure 8.

GENERAL RADIO COMPANY

The equivalent electric field intensity in microvolts per meter at the center of the receiving loop antenna is:

$$E = \frac{71,250}{(50 + R_o)S^3} E_o$$

Where E_o is the open-circuit output voltage of the standard-signal generator in microvolts, R_o (ohms) is the output impedance of the standard-signal generator, and S (inches) is the separation between the test loop and the receiving loop, as shown in Figure 9.

It is usually convenient to select the separation between loops so that the field intensity is readily expressed in terms of the signal generator voltage, E_o . For example, when using the Type 1001-A Standard-Signal Generator with its 50-ohm output impedance, the field intensity in microvolts per meter at the receiver loop antenna is one-tenth of the open-circuit output voltage of the generator if the two loops are approximately one-half meter apart. Thus, when the signal generator open-circuit output voltage as indicated on the panel controls is 100 microvolts, the field intensity at the receiver loop is ten microvolts per meter.

Table I lists the loop spacing required under various generator impedance (R_o) conditions to obtain a convenient factor for determining the field intensity (E) at the receiving loop antenna in terms of the signal generator open-circuit output voltage, E_o .

The separation "S" between loops is the distance between the outer periphery of the test loop and the center of the receiving loop. The separation "X" between loop centers is somewhat less, as shown in Table I.

TABLE I

R_o	E_o/E	S (inches)	X (inches)
0 Ω	5	19.3	18.7
	10	24.2	23.7
	20	30.6	30.2
	50	40.9	40.5
	100	52.2	52.0
10 Ω	10	22.8	22.2
	20	28.8	28.4
	50	39.0	38.6
	100	49.2	49.0
37.5 Ω	10	20.1	19.4
	20	25.4	24.8
	50	34.4	34.0
	100	43.3	43.0
	200	54.6	54.3
50 Ω	10	19.3	18.7
	20	24.2	23.7
	50	32.9	32.5
	100	40.9	40.5
	200	52.2	52.0
75 Ω	20	22.5	22.0
	50	30.6	30.2
	100	38.5	38.1
	200	48.5	48.2

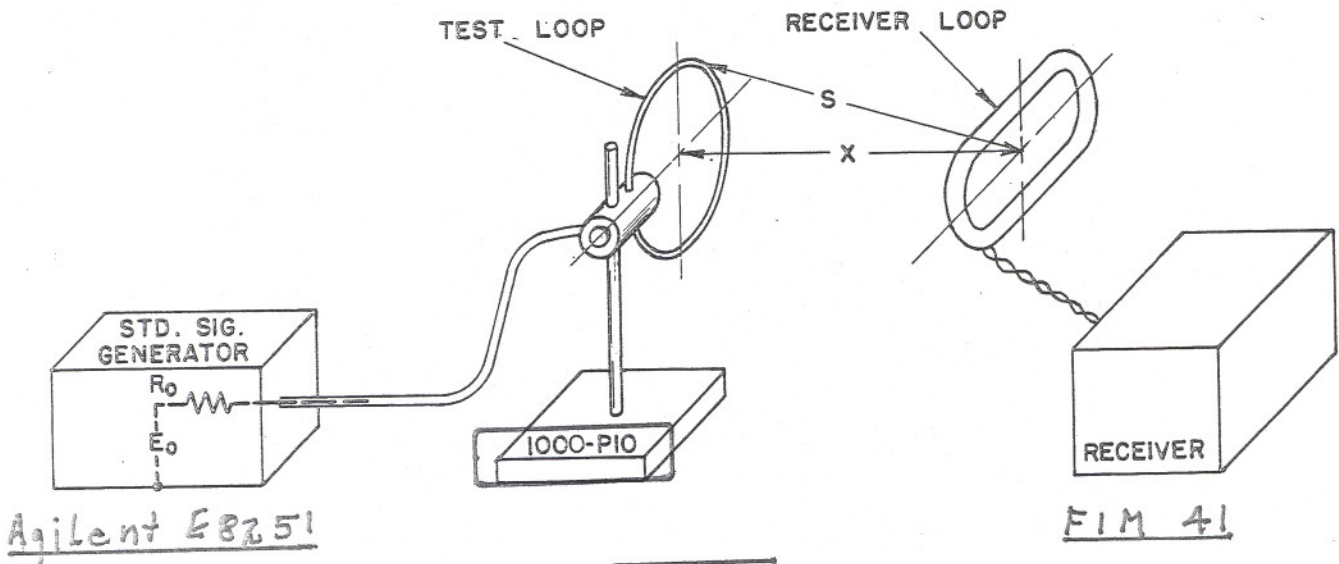


Figure 9.

Radio/Tv Engineering Co.
Memo: FIM Calibration 1/15/04



Note

Included this document with all radial measurements.

Attached are the calibration certificates for each of the Potomac FIM, two models of the 41 and one model 21 and 71 (Dipole antenna for 71).

Prior to use of the FIM's, I check the calibration in our Laboratory, using a shielded area 20x30 ft. and create a known field in the FM antenna. For this I use a standard signal generator (Agilent-HP) model E8251A. The signal generator is used with a General Radio calibrated loop antenna model P1-10. See attached information on creating a known field within the FIM loop antenna.

The results of this test confirm that the calibration is within manufacturer's specifications.

The generator has the following specs:

The GR type 1000-P10 3-turn test loop antenna calibration is good to 3 MHz. The accuracy is 5% with careful attention given to the signal generator and setup.

The field strength in volts per meter, 19 inches from the loop, is $1/10^{\text{th}}$ the signal generator output in volts, with a 50 ohm generator. The generator I use is an Agilent (HP) model E8251A which has a frequency range of 250 kHz to 20 GHz.

The signal generator calibration is traceable to U.S. NIST. The last calibration by Agilent is dated July 18, 2002. I further check the output accuracy:

1. Frequency with an Agilent counter power meter model Agilent 53150A, frequency range of 10 Hz to 20 GHz, power ± 1 dB, which is locked to WWV via 60 KHz radio signals. An accuracy of better than 1×10^{-11} is maintained with our master oscillator.
2. Power is further checked before each use, using an HP power meter, Model HP435B with sensors:
 1. HP 8481A (.01 to 18 GHz)
 2. HP 8484A (.01 to 18 GHz)
 3. HP 8482 (100Kz to 4.2 GHz)Accuracy Obtained $\pm 1\%$.

We always strive for the very highest accuracy possible.


Norwood J. Patterson
Owner