71A MILLIWATT REFERENCE GENERATOR
J94071A

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1. GENERAL

A. Description

1.01 This section describes the J94071A milliwatt reference generator (71A) and the associated distributing networks used to supply 1000-cycle transmission testing power at 600- and 900-ohm impedances. A block diagram of the generator and networks is shown in Fig. 1

1.02 Test power is supplied to as many as four outlets through the distributing networks which are required to build out each outlet to 600 or 900 ohms. These outlets are arranged in various combinations of adjustable distributing networks for 600- and 900-ohm connections at remote points of test. (Each outlet must be provided with a proper termination at all times.) In addition, a 600-ohm maintenance outlet jack is provided on the generator unit.

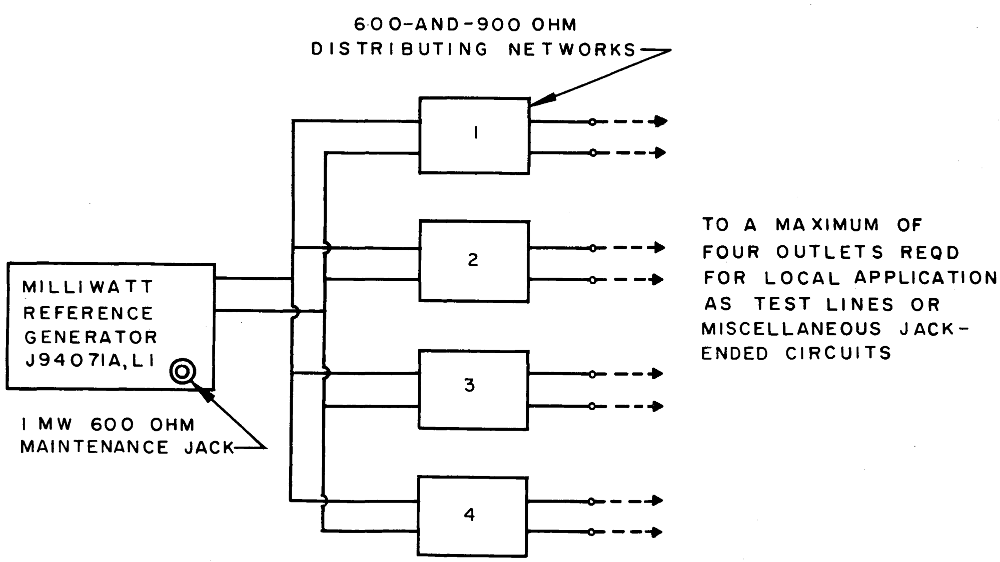


Fig. 1 — Single Milliwatt System Using 71A Generator

1.03 The output power at each outlet when properly terminated is 1 mw.

1.04 The basic generator consists of a transistorized oscillator. It is powered by the 48-volt central office talking battery and operates continuously.

B. Uses

1.05 The milliwatt generator is used for testing voice channels of transmission systems, trunks, lines, circuits, and networks. It is also used to provide a reference power for calibrating test equipment, including transmission measuring sets, amplifier-rectifiers, detectors, and meters whose db values are based on 1 mw.

1.06 The outlets of the milliwatt distributing system may appear in a number of test locations as required in any given office. Outlets are provided at such locations as testboards, patching bays, test frames, and equipment bays where 1000-cycle tests are made. In addition, milliwatt test lines are used to deliver 1000-cycle test power to trunks connected to them through the automatic switching equipment in dial offices or through a cord connection in manual switchboards.

C. Precautions

1.07 Improper termination of an outlet affects the accuracy of measurements in progress at other outlets supplied by the same panel. It is, therefore, important to avoid connecting a circuit whose impedance differs widely from that of the outlet, such as an open or short circuit. ***When making patches, open circuits should be avoided by plugging into the outlet appearance after the other end of the cord is terminated in the correct impedance. When removing the patches, they should be removed from the outlet appearances before disconnecting the circuit at the other end of the cord.*** The effect on all other outlets of any one outlet being nonterminated is 0.04 db.

1.08 When using test power from this generator as tone at workbenches or other similar locations, ***open- and short-circuit terminations should be avoided by using a pad of 15 db loss or more. To protect the outlet, blocking capacitors should be used where DC is encountered.***

1.09 Direct connection of an outlet to circuits with badly unbalanced ground conditions may also have adverse effects on measurements at other outlets. ***To avoid the effects of unbalanced ground conditions, a repeating coil should be used to connect such circuits.***

1.10 Office wiring loss varies with temperature. With a nominal office wiring loss of 0.45 db, a temperature change of 18 F will cause this loss to change by as much as 0.02 db. To help maintain adequate stability of the output power from outlets remote from the generator, it is advisable that the generator and outlets or test lines be installed so that wiring loss is at a minimum.

1.11 Because of the possibility of double connections, connecting circuits to the 71A should provide for multiple outlet appearances ***only*** at manual switchboards having ***adequate*** busy test features.

D. Adjusting Output Power

1.12 The procedure for adjusting the output power from the 71A milliwatt reference generator is given in Section E40.376.01 (A702.629.01), Chart 1. The method of adjusting the output power at individual outlets using the KS-16744, List 1 distributing networks is given in Section E30.223.13 (A204.474.13), Chart 13.

2. DESCRIPTION

A. Circuit

2.01 The generator circuit is shown in Fig. 2. The oscillator is of the Hartley type which employs a 2N43 transistor, Q1, as the active element. The frequency of oscillation is determined by the LC network, Z1. Resistor R1 determines the amount of feedback from the emitter to the LC network. The value of R1 is chosen to obtain that critical amount of feedback which permits the peak AC base voltage to equal the DC collector-to-base voltage. When the base is at collector potential, limiting occurs, thus stabilizing the oscillating amplitude. Connecting T1 between collector and emitter permits efficient power transfer to the load.

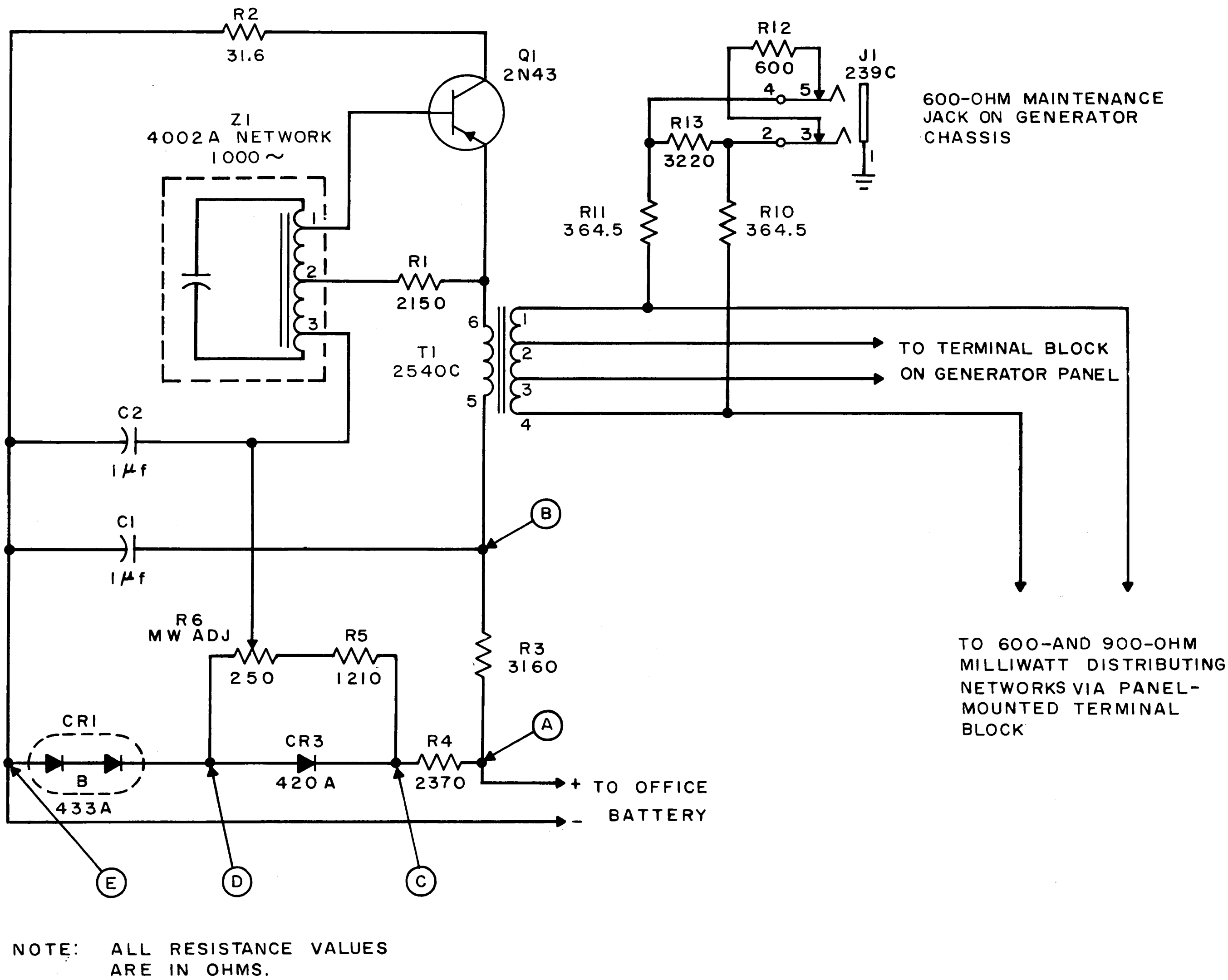
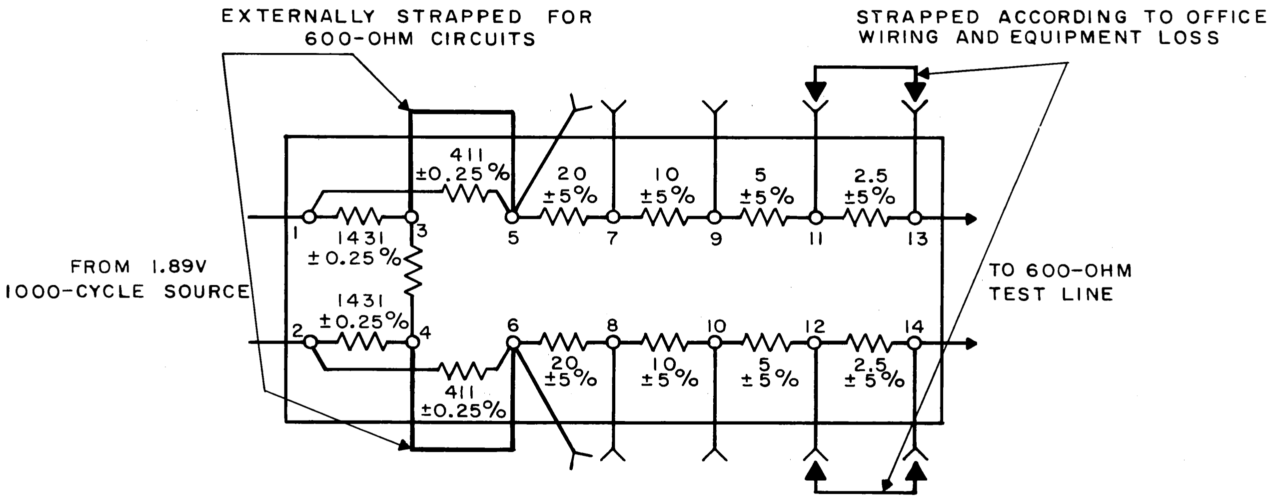


Fig. 2 – 71A Milliwatt Generator Circuit

2.02 The amplitude of oscillation is proportional to the DC voltage applied between base and collector of the transistor. The DC base-collector voltage is regulated by diodes CR1 and CR3. (In early models, two 420A diodes are used in place of a 433A. In this case, the diodes are designated CR1, CR2, and CR3.) R5 and R6 comprise a divider network across CR3 which permits changing the transistor base-collector voltage, and hence the output, by adjustment of potentiometer R6.

2.03 Additional regulation by R2 makes the oscillating amplitude almost completely insensitive to supply voltage changes. A decrease in supply voltage causes a small decrease in the voltage across the regulating diodes. However, a corresponding decrease in collector current causes a decrease in the voltage drop across R2, thus keeping the voltage between the base and collector of the transistor substantially constant. Resistor R4 limits the diode current, and R3 limits the transistor current.

2.04 Output taps are provided on the secondary of transformer T1. Terminals 1 and 4 supply 1.89 volts to the distributing networks for both 600- and 900-ohm outlets. Terminals 2 and 3, which are wired to the unit terminal block, supply 1.55 volts but normally are not



Note 1: All resistance values are in ohms.

Note 2: Idle circuit terminating resistor (SD-95100, Option LL) is removed from terminals 13 and 14 when network is put in service.

Fig. 3 – KS-16744, List 1 Distributing Network Arranged for 600-Ohm Circuit

used. The impedance looking toward the transformer from terminals 1 and 4 is approximately 6 ohms.

2.05 The single 600-ohm maintenance outlet provided on the generator unit is shown in Fig. 2. It is built out to 600 ohms by R10, R11, and R13, and terminated in 600 ohms by R12. Resistor R12 is lifted off the jack when a plug is inserted.

B. Distributing Networks

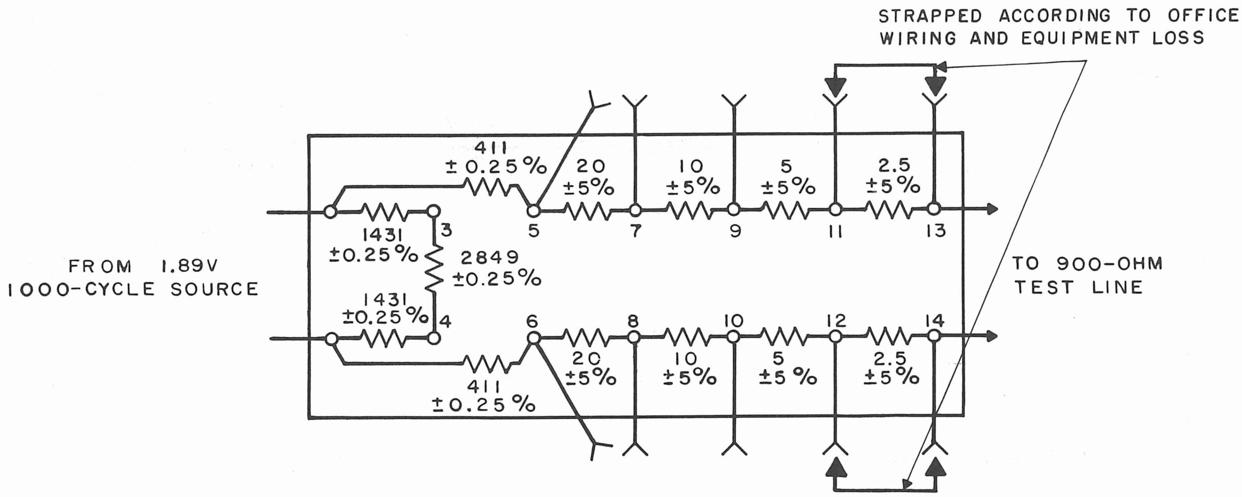
2.06 A KS-16744, List 1 distributing network is used to build out each of the four outlets to an impedance of either 600 or 900 ohms. It is designed to serve either impedance while connected to the same voltage source.

2.07 The distributing network is designed to compensate for office wiring and equipment loss between the generator and the outlet or test line appearance. Since this loss may differ with each outlet, a means of adjustment of each output is necessary. A loss of 0.03 db corresponds to about 125 pair-feet of 22-gauge wire or equivalent in 600-ohm circuits, and about the same length of 24-gauge wire or equivalent in 900-ohm circuits. Equipment such as blocking capacitors, shunt inductors, and pads which deviate from their specific loss are also causes for adjustment of individual outlets.

2.08 Office loss is often equivalent to an increase of in-series impedance. To compensate for wiring and equipment loss, resistors in the distributing network are strapped, thereby decreasing the amount of building-out resistance in the network. This is shown in Fig. 3 and 4. The range of adjustment is approximately 0.45 db for 600-ohm outlets, and 0.30 db for 900-ohm outlets. Other straps are required to convert the network from 900 to 600 ohms. Strapping procedures are given in Section E30.223.13 (A204.474.13).

C. Generator Panel

2.09 The 71A panel consists of a J94071A, List 1 generator unit; a maximum of four KS-16744, List 1 milliwatt distributing networks — J94071A, List 6 and/or 7 and wired per SD-95277-01, Fig. 6 and/or 7; and a J94071A, List 2 or 3 mounting plate for mounting on any style 19- or 23-inch bay.



Note 1: All resistance values are in ohms.

Note 2: Idle circuit terminating resistor (SD-95100, Option LL) is removed from terminals 13 and 14 when network is put in service.

Fig. 4 – KS-16744, List 1 Distributing Network Arranged for 900-Ohm Circuit

2.10 One of the equipment arrangements of the 71A is shown in Fig. 5. Here the basic generator, contained in a metal case 1-1/2 by 4 by 6-1/2 inches, is shown assembled on a 19 by 1-3/4 inch mounting plate together with a terminal strip and four distributing networks. This figure shows the terminal strip on the apparatus side of the mounting plate for mounting the unit on a duct-type rack. For mounting on a bulb angle, channel, or other conventional type of 19-inch rack, sufficient slack has been provided in the local cable so that the terminal strip and its associated bracket may be released on the wiring side of the unit. In the other version, the components are mounted on a 23- by 2-inch plate.

2.11 Installations employing the 71A are equipped in accordance with local conditions. The variable factors are: office impedance, 600 or 900 ohms; and mounting plates, 19 by 1-3/4 inches or 23 by 2 inches.

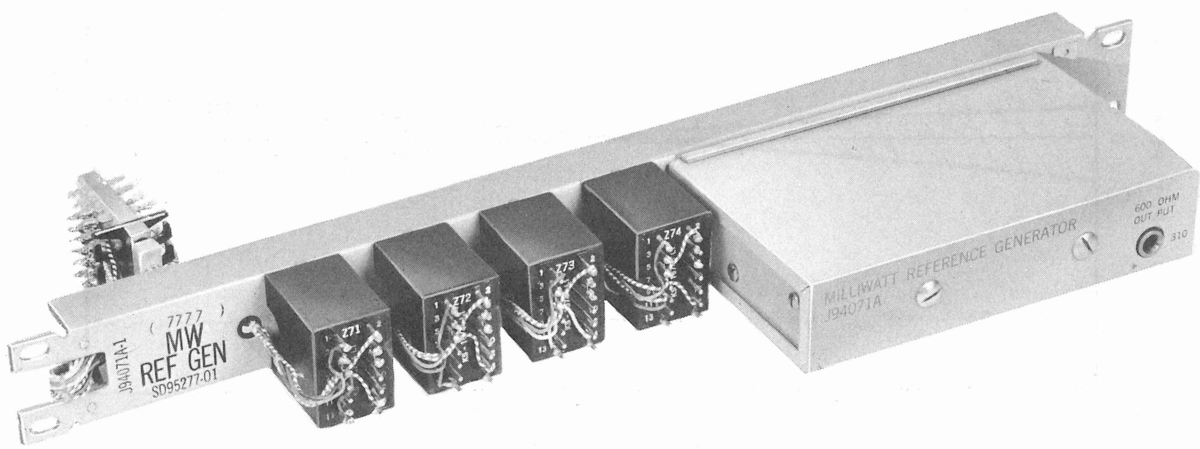


Fig. 5 – Typical 71A Generator Panel

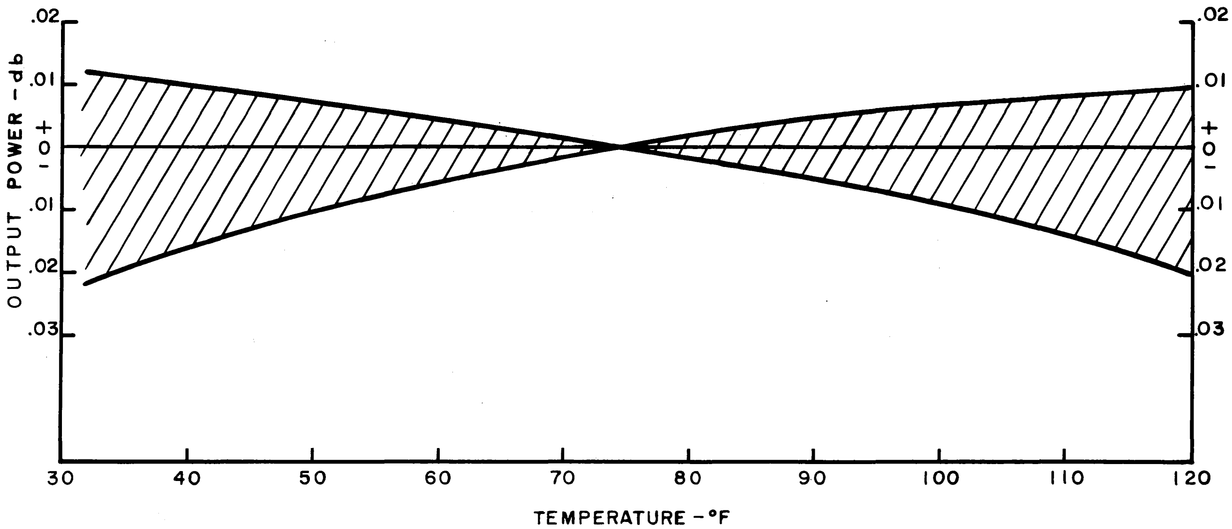


Fig. 6 – Output Power versus Temperature

3. TRANSMISSION PERFORMANCE

3.01 The output power from each outlet to its proper termination is 0 ±0.04 dbm. Under most conditions, the generator output is stable within ±0.02 db including effects of: (a) changes in temperature in the range from 32 to 120 F, (b) changes in battery voltage in the range from 44 to 52 volts, and (c) aging of components. Assuming a normal distribution of variations from all causes, the output power at any outlet is expected to be within ±0.05 dbm.

3.02 Typical curves showing the effects of temperature and supply-voltage changes on the generator are shown in Fig. 6 and 7. The output power, shown within the shaded area of these curves, is determined by the manufacturing tolerances of circuit components and the setting of the MW ADJ potentiometer. All the extreme variations in level shown will not usually be found with any one generator.

3.03 The frequency of the 71A generator is 1000 cycles ±1 per cent under the environmental conditions stated in 3.01.

3.04 The output impedance of each outlet is within 1 per cent of its nominal value irrespective of the number of outlets in use, provided the adjustable distributing networks are properly strapped.

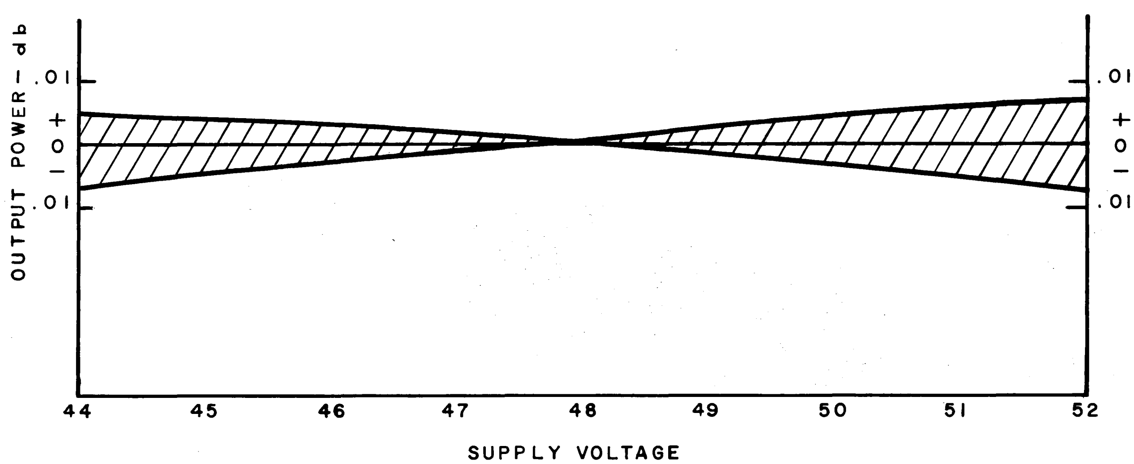


Fig. 7 – Output Power versus Supply Voltage

3.05 The effect of any one outlet being nonterminated on all other outlets of the same panel is +0.04 db if open, −0.04 db if shorted. Therefore, ***it is important that the number of outlets in use when the generator is calibrated be equipped and terminated at all times.***

3.06 The harmonic content of the output power in terms of the fundamental (1000-cycle) value is such that each harmonic is at least 40 db below the fundamental.

4. OPERATING FEATURES

4.01 A 600-ohm jack-ended outlet is provided on the generator unit. This is a maintenance outlet which is used when the output power from the generator is adjusted by the MW ADJ potentiometer. It may also be used for calibrating test equipment or other purposes for which a 600-ohm outlet is required. The output power from this jack is 1 mw at 1000 cycles and may be patch-connected using a 310-type plug-ended cord.

4.02 The distributing networks may be adjusted to compensate for office wiring and equipment loss. This is explained in 2.08.

5. MAINTENANCE

5.01 Because semiconductor devices are used in the generator, and because the power supply is the central office battery, the performance of the milliwatt generator is expected to be reliable and it should require only a minimum of maintenance.

5.02 There are no adjustments for frequency deviation.

5.03 The 71A generator output power is adjustable over a range of approximately 0.80 db by a screwdriver-operated potentiometer. The potentiometer shaft normally is covered to discourage unwarranted changes in the setting of the potentiometer.

> ***Note:*** Changes in the potentiometer setting should be made only when accurate means of measuring the output are available and in accordance with Section E40.376.01 (A702.629.01), Chart 1.

5.04 Because of the expected stability of the generator, the apparent need for a change of setting of the potentiometer may well indicate a trouble condition external to the unit. The correct output at each individual outlet should be verified when required, in accordance with Section E30.223 (A204.474).

> ***Note:*** When the measurement of an outlet shows excessive deviation from the required output power, this should be a cause to investigate first the external or connecting circuits for trouble.

Factors which may result in a deviation from 1 mw at any outlet are:

(a) Inaccurate calibration.

(b) Addition or removal of outlets (change of load).

(c) Distributing network or connecting circuit trouble conditions primarily affecting one outlet.

(d) Open or shorted terminations or faulty patching procedures affecting one or more of the other outlets.

(e) Ground on one side of an outlet.

(f) Circuit or component failure resulting in excessive deviation from 1 mw at all outlets.

(g) Component aging internal to the generator.

During the measurement used as the basis for resetting the MW ADJ potentiometer, it is recommended that all outlets, test lines, connecting circuits, etc, be made busy or safeguarded from causing a change of output as covered in Section F21.113.1 (E12.104).

5.05 The distributing networks and the connecting circuits, which make up the total load on the generator, influence the setting of the potentiometer. By design this load should be constant and not appreciably affected by normal use of any outlet. A sudden change of a few hundredths db in output at the maintenance outlet would be a cause for an investigation for trouble in one of the outlet circuits. This should include a check for open or shorted terminations, and improper strapping of the distributing networks as covered in the appropriate sections of E30.223 (A204.474).

5.06 Aging of components, particularly the avalanche breakdown diodes which regulate the transistor DC supply voltage, may result in a gradual change in the output voltage and require a different setting of the potentiometer. It is expected that, at most, a change of 0.03 db will take place only during an elapsed interval of months, perhaps years, thereby not warranting frequent potentiometer adjustment. In an unusual case, the range of the potentiometer may not be adequate for precise adjustment, thus requiring the replacement of the generator. Verification of this requires an accurate DC voltmeter as explained in 5.08.

5.07 When a trouble condition is indicated which might result from component failure, or a lack of sufficient adjustable range due to unknown causes is encountered, steps should be taken which include a shutdown of the milliwatt system, verification of proper load conditions, and investigation of DC voltages in the generator unit. To restore service after clearance of external trouble or the replacement of the generator, it will be necessary to repeat the line-up adjustment and checking tests given in Section E40.376.01 (A702.629.01), Chart 1.

5.08 The following DC voltages are normally present in the generator circuit. These voltages are listed ***only*** as a guide for determining whether or not trouble exists within the generator, and may be measured after removing the chassis cover. If voltage measurements indicate failure or one or more components in the generator circuit, the generator unit ***should be replaced.*** The test points are shown in Fig. 2.

BETWEEN TEST POINTS	BATTERY VOLTAGE		
	44V	48V	52V
B and A	30 ±2V	34 ±2V	38 ±2V
C and A	25.5 ±2	29.5 ±2	33.5 ±2
D and C	6.0 ±0.6	6.0 ±0.6	6.0 ± 0.6
E and D	–	12.45 ±0.25	–

The meter used for all measurements should have a sensitivity of 1000 ohms or more per volt. The meter used for measuring the last item in the table should have a precision of at least ±0.25 volt.

6. LIST OF DRAWINGS AND SPECIFICATIONS FOR REFERENCE

(A) Drawings (not attached)

TITLE	DWG. NO.
Circuit	SD-95277-01, Fig. 1
Equipment	J94071A-( )

(B) Specification (not attached)

TITLE	SPECIFICATION
71-Type Milliwatt Reference Generators	J94071 (AA387.049)