COMMON SYSTEMS
TRANSMISSION MEASURING
MILLIWATT DISTRIBUTING CIRCUIT
USING 71F MILLIWATT REFERENCE GENERATOR

CHANGES

B. Changes in Apparatus (Components)

B.1 Fig. 1:

Superseded	Superseded By
1-R1 Resistor, RCL Electronics R287, 1870 ohms	254A Resistor, 1870 ohms
1-R2 Resistor, KS-14603 L3C, 234 ohms	KS-20289 L6C, 234 ohms
1-R3 Resistor, 227A, 562 ohms	KS-16313 L4F, 562 ohms
1-R4 Resistor, 227A, 249 ohms	KS-16313 L4F, 249 ohms
2-R7,R8 Resistor, 106C, 365 ohms	KS-16313 L4F, 364 ohms
1-R9 Resistor, 106C, 3360 ohms	KS-16313 L4F, 3440 ohms
1-R10 Resistor, 106A, 600 ohms	KS-20810 L1A, 600 ohms
1-R29 Resistor, KS-13491 L1, 2700 ohms	KS-20289 L6C, 2740 ohms
1-C1 Capacitor, KS-14338, 1uf	702C, 1uf
2-CR1,CR2 Diode, 433B	457F
1-CR3 Diode, 420M	459E
Removed	
2-R26,R27 Resistor, 263A, 42,200 ohms	

B.2 Fig. B:

Superseded	Superseded By
1-R11 Resistor, 227A, 42.4 ohms	KS-20810 L1A, 42.4 ohms
1-R12 Resistor, 227A, 63.4 ohms	KS-20810 L1A, 63.4 ohms
1-R13 Resistor, 227A, 127 ohms	KS-20810 L1A, 127 ohms
1-R14 Resistor, 227A, 255 ohms	KS-20810 L1A, 255 ohms

B.3 Fig. 3:

Superseded	Superseded By
1-R25 Resistor, KS-13490 L1, 750 ohms	KS-20616 L1A, 750 ohms
1-Z1 Network, 4181A	1-211A IC

B.4 Fig. 4:

Superseded	Superseded By
2-R19,R20, KS-16311 L1, 2910 ohms	KS-20616 L1A, 2910 ohms

B.5 Fig. 5:

Superseded	Superseded By
2-R21,R22 Resistor, KS-16311 L1, 2210 ohms	KS-20616 L1A, 2210 ohms
1-R23 Resistor, KS-16311 L1, 22,300 ohms	KS-20616 L1A, 22,300 ohms

D. Description of Changes

D.1 Diodes CR1 and CR2, type 433B, are replaced with type 457F. The 457F has a different temperature coefficient than the 433B. Resistor R1 was therefore changed to one of a different temperature coefficient to compensate for the temperature effects on generator amplitude stability. Options S and T are introduced to cover this change, Option T being rated Mfr Disc.

D.2 The 4181A distributing network in Fig. 3 is replaced by the WE 211A IC, which is more economical to produce. Option R is introduced to cover the 211A, and Option U, covering the 4181A, is rated Mfr Disc.

D.3 Other components listed in Part B (Changes in Apparatus) are replaced to help standardize the type of resistors and capacitors used in production. Options M and N are introduced to distinguish between those sets of resistor types and values necessary to retain the proper generator output impedance at the maintenance jack (J1).

D.4 CAD8 and CAD9 are added to show the interconnection of the distributing network (Fig. 3) to the 71G precision tone generator, SD-96618-01.

F. Changes in CD Sections

SECTION II

F.1 Add the following paragraphs:

3.06 The distributing network in Fig. 3 can also be used with the 71G precision tone generator (SD-96618-01) and serves the same functions as when used with the 71F milliwatt reference generator. When used with the 71G generator, output levels obtained from the distributing network are 0 and -16 dBm at several frequencies. A frequency of 10004 Hz can in some cases be used in place of the 1000 Hz obtained from the 71F generator.

3.07 The J94071J access panel circuit (SD-1C585-01), when used at the output of Fig. 3, provides an interface for No. 4 ESS transmission test line circuits.

SECTION III

F.2 Add to paragraph 3.02:

These networks can also be used with the 71G precision tone generator, SD-96618-01.

F.3 Add to paragraph 4.01:

(s) J94071G Precision Tone Generator Circuit, SD-96618-01.

(t) J94071J Access Panel Circuit, SD-1C585-01.

F.4 Add to paragraph 6.06:

Refer to SD-96618-01 when using the 71G precision tone generator to feed the distributing networks in Fig. 3.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 4143-PK-TCA

COMMON SYSTEMS
TRANSMISSION MEASURING
MILLIWATT DISTRIBUTING CIRCUIT
USING 71F MILLIWATT REFERENCE GENERATOR

TABLE OF CONTENTS PAGE

SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 This circuit, by use of the 71F reference generator and the 71D and E distributing network panels, provides stable and accurate 1000-Hz testing power simultaneously at levels of +7, 0, and -16 dBm. This testing power is provided for voice channels of transmission systems, trunks, lines, circuits, and networks. When used with the 71H distributing network panel (SD-1C372-01), the 71F reference generator provides testing power of -10 dBV for wideband PICTUREPHONE® and data transmission circuits.

1.02 The 71F generator also provides a reference power for calibrating test equipment such as transmission measuring sets, amplifier-rectifier detectors, and meters with dB scales based on 1 milliwatt.

2. GENERAL DESCRIPTION OF OPERATION

2.01 The 71F generator is shown in Fig. 1 and 2. A distributing network, used for 600- and 900-ohm generator outlet impedances, is shown in Fig. 3. A distributing network used for 100- and 110-ohm generator output impedances is shown in Fig. 1 of SD-1C372-01.

2.02 The 71F reference generator can supply testing power for fifty 0-dBm outlets at 600 or 900 ohms, or the equivalent of sixty 0-dBm outlets in combinations of +7, 0, and -16 dBm. Artificial load resistors are provided to maintain a constant load on the generator, regardless of the output power being used. When used with the 71H network panel, each -10 dBV network load is equivalent to 1.5 0-dBm network; a maximum of 40 networks of -10 dBV being equivalent to 60 networks for 0 dBm.

2.03 The generator is powered by the central office battery, consuming about 85 mA, and operates continuously.

SECTION II - DETAILED DESCRIPTION

1. BASIC GENERATOR CIRCUIT

1.01 The generator circuit shown in Fig. 1 and 2 is a transistorized Hartley oscillator designed to operate at a nominal supply voltage of 48 volts dc. The frequency of oscillation is determined by the LC network, resonant at 1000 ±10 Hz, connected to the base of the transistor Q1. Resistor R1, connected between the emitter and the center tap of the inductor of the tuned LC circuit, limits the amount of positive feedback from the emitter to the tuned circuit. The value of R1 is chosen to obtain that critical amount of feedback which just permits the peak alternating base voltage to equal the direct collector-to-base voltage. When the base is at collector potential, limiting occurs, stabilizing the oscillating ampli-

tude. Capacitors C1 and C2 provide the necessary bypassing.

1.02 The amplitude of oscillation depends upon the direct voltage applied between the base and collector of the transistor Q1. This voltage is regulated by diodes CR1, CR2, and CR3, and can be varied by the MW ADJ potentiometer R5. R5 is adjusted in calibrating the output level and provides a range adjustment of approximately 0.7 dB. The procedure for calibrating the generator is given in the Bell System Practice covering the 71F generator.

1.03 Temperature compensation of the output level is provided by thermistor RT1. Resistor R2 limits the direct current through the transistor; resistor R6 limits the current through diode CR1. Resistors R3 and R4, together with R5 and RT1, form a voltage divider which determines the transistor base-to-collector voltage. Transistor Q2 or the resistance lamp RT2 limits the current through diodes CR2 and CR3, and minimizes current changes in CR2 and CR3 resulting from variations in the supply (office battery) voltage.

2. GENERATOR OUTPUT CIRCUIT

2.01 A low-impedance balanced output is obtained from transformer T1 in the emitter circuit. The secondary of T1 provides an output of 4.24 volts from terminals 1 and 6, and 1.89 volts from terminals 2 and 5. Each of these voltages feeds distributing networks from which +7 and 0 dBm into 600 or 900 ohms are obtained. A distributing network is shown in Fig. 3 and is further described in 3. of this section. Terminals 2 and 5 of transformer T1 also feed distributing networks on SD-1C372-01 from which output levels of -10 dBV are obtained.

2.02 Transformer T2 is also connected to the secondary of T1. The output from the secondary of T2 is fed to distributing networks from which an output level of -16 dBm into 600 or 900 ohms is obtained. The output impedance is determined by strapping on the distributing network as is described in 3. of this section.

2.03 The secondary of T1 also provides 1.55 volts from terminals 3 and 4. This voltage is used to feed distributing circuits with 18- and 106-type resistors when the 71F generator is used to replace the 2A sending panel as a source of testing power.

2.04 The 71F generator is provided with one jack-ended outlet on the generator unit. This jack is also shown in Fig. 1. Resistors R7, R8, R9, R26, and R27 build out the outlet impedance to 600 ohms. R10 serves to terminate the outlet when it is not in use. This outlet appearance on the generator unit, primarily a maintenance outlet, is used when calibrating the output level from the generator. However, it may also be used as an additional outlet for routine tests.

2.05 Resistors R11 through R18 (Fig. A) and resistors R11 through R14 (Fig. B) serve as artificial load resistors to maintain a load on the generator equivalent to approximately sixty 0-ohm outlets. The connection of these artificial load resistors is determined by the amount of power being supplied to the outlets in use. These resistors provide loading in units equivalent to one 0-dBm outlet. The number of 0-dBm outlets that each artificial load resistor represents is given in parentheses next to that resistor in Fig. A or B. When possible, the artificial load should be connected so that the total generator load is equivalent to exactly sixty 0-dBm outlets. Each +7 dBm outlet supplied is considered as five 0-dBm outlets. Each -10 dBV outlet supplied per SD-1C372-01 is considered as 1.5 0-dBm outlets. The power required for the -16 dBm outlets may be neglected when computing the generator load. An example for computing the artificial load is as follows:

(a) Number of networks on 71D or 71E panels (Fig. 3) connected to pair T5R5 of Fig. 2 = 10

(b) Number of networks on 71D or 71E panels (Fig. 3) connected to pair T3R3 of Fig. 2: 5 [Multiply this number by 5 to get (for this example) 25].

(c) Number of networks on 71H panels (FS1 of SD-1C372-01) connected to pair T5R5 of Fig. 2: 8 [Multiply this number by 1.5 to get (for this example) 12].

(d) Number of distributing circuits per SD-95000-01 or SD-95000-02 connected to pair TR of Fig. 2 =7.

The total equivalent 0-dBm loads in use on generator is thus 54.

Subtract the total computed above from 60, 60 - 54 = 6. The artificial load totaling six should thus be connected. When using Fig. A, only resistors R11 and R14 should be connected; when using Fig. B only R14 should be connected. The total generator load using Fig. A is equivalent to sixty 0-dBm outlets and to fifty-nine 0-dBm outlets using Fig. B. Table C is a guide to other artificial load combinations.

2.06 No provision has been made for blocking direct current from the generator output circuit. External dc blocking should be provided in offices where direct voltages appear on connecting circuits or circuits to be tested.

3. DISTRIBUTING NETWORK PANELS (71D and E)

3.01 On the 71D and E network panels are mounted either five or ten milliwatt distributing networks. A distributing network,

shown in Fig. 3, is designed to build out the output impedance of the 71F generator to 600 or 900 ohms. A network is assigned to each outlet and is connected between the generator and the outlet appearance. A possible exception is when outlet jacks are multipled at manual switchboards having busy test features. The distributing network for obtaining -10 dBV builds out the generator impedance to 100 to 110 ohms. This network, mounted on a 71H network panel, is described in CD-1C372-01. The distributing network of Fig. 3, mounted on the 71D and 71E panels, is described below.

3.02 The distributing network is used for 600- or 900-ohm outlets. For 900-ohm applications, the network is used without the D option shown in Fig. 3. For 600-ohm applications, terminals 3 and 5 and terminals 4 and 6 of the network are strapped per option D.

3.03 The distributing network is also provided with a means of compensating for central office wiring and equipment loss. This is accomplished by reducing the amount of resistance in the network between the generator and outlet appearance. Specific values of resistance can be strapped out in 5-ohm steps (option C of Fig. 3), which correspond to changes of 0.02 dB in 900-ohm outlets and 0.03 dB in 600-ohm outlets. The total resistance which may be strapped out is 75 ohms. This provides a range of adjustment in 900-ohm applications of approximately 0.3 dB and in 600-ohm applications of approximately 0.45 dB. The procedure for this distributing network adjustment and the adjustment of output power at individual outlets is given in BSP Section 103-335-513.

3.04 The distributing networks are usually provided in groups of five, with one or two such groups mounted on a 71D or E panel. All the networks on any one panel normally are of the same level and impedance.

3.05 A test power level +0.5 dBm can be obtained from a 0-dBm outlet by connecting the resistors shown in Fig. 4 or 5 to the distributing network which serves that outlet. Resistors R19 and R20 of Fig. 4 are connected as shown to the network in Fig. 3 (when the network is used for 900 ohms) to obtain +0.5 dBm from the network into 900 ohms. Resistors R21, R22, and R23 of Fig. 5 are connected to the network as shown in Fig. 3 (when the network is strapped for 600 ohms) to obtain +0.5 dBm from the network into 600 ohms. In such applications, the impedance of the 0.5-dBm outlet as seen from the termination is decreased from 900 to 795 ohms, and from 600 to 535 ohms.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

SUPPLY VOLTAGE

1.01 The 71F generator operates over the range of the central office battery from 44 to 52 volts and is on continuously.

CURRENT DRAIN

1.02 The current drain of the 71F generator is 85 ±10 mA over the range of the central office battery.

AMBIENT TEMPERATURE

1.03 The 71F generator operates over an ambient temperature range from 40° to 120°F.

OUTPUT

1.04 The 71F generator supplies 1000-Hz test power to a maximum of fifty 0-dBm outlets or the equivalent of sixty 0-dBm outlets in combinations of +7, 0, and -16 dBm outlets at 600 and/or 900 ohms. Test power of -10 dBV 100 or 110 ohms is obtained when the generator is used with SD-1C372-01.

1.05 The output frequency of the 71F generator is 1000 Hz fixed. There is no means of frequency adjustment.

1.06 The 71F generator output level is stable to ±0.03 dB, and the output frequency within ±1 percent under the environmental conditions stated in 1.01 and 1.03.

2. FUNCTIONAL DESIGNATIONS

None.

3. FUNCTIONS

3.01 The 71F generator provides stable and accurate 1000-Hz testing power at levels of +7, 0, and -16 dBm, at 600 and 900 ohms, and -10 dBV at 100 or 110 ohms.

3.02 The 71D and E network panels serve to build out the impedance of the 71F generator to 600 and 900 ohms and also provide a means of adjustment for office wiring and equipment loss.

4. CONNECTING CIRCUITS

4.01 Various circuits which may connect to the output of the 71F generator are as follows.

(a) Transmission Measuring Circuits (VF Channel Patch Bays) - SD-59432-01.

(b) Noise Measuring Circuit (VF Channel Patch Bays) - SD-59433-01.

(c) Maintenance Circuit (TASI) - SD-59972-01.

(d) Test Line Circuit (4W Intertoll) - SD-68095-01.

(e) Announcement Systems No. 5A - SD-68445-01.

(f) Automatic Transmission T and C Circuit (See Note 105) - SD-68446-01.

(g) Jack Circuit Toll Test Unit No. 5A - SD-68544-01.

(h) Sending Jack Circuits - SD-95101-01.

(i) Sending Pad Circuits - SD-95147-01.

(j) Repeater Measuring Circuit (V1 and V3) - SD-95162-01.

(k) 1000-Hz Outlets, Receive Jacks, and Controls - SD-95162-02.

(l) Announcement System No. 6A - SD-95608-01.

(m) Transmission and Noise Check Circuit (See Note 105) - SD-95698-01.

(n) Transmission and Noise Measuring Circuit (Testboards) - SD-95900-01.

(o) Test and Monitor Circuit (For Signaling) - SD-96519-01.

(p) N2 Carrier Telephone Application Schematic - SD-97118-01.

(q) Transmission Test Line Circuits - SD-98100-01.

(r) Miscellaneous Jack Circuits.

5. MANUFACTURING TESTING REQUIREMENTS

5.01 The manufacturing testing requirements are specified in X-77166.

6. CONNECTING INFORMATION

6.01 A distributing network is required for each outlet in use. The number of distributing networks or distributing network panels which may be connected to the generator is, therefore, determined by the number and combination of +7, 0, and -16 dBm outlets required. Any number and combination of +7, 0, and -16 dBm outlets may be connected which does not exceed the equivalent of sixty 0-dBm outlets. (See 2.05.)

6.02 Any circuit connecting to an outlet of the 71F generator should provide a termination for that outlet at all times, either by the circuit under test or a resistor, except at the possible momentary interval of the plugging-in at a jack, when the outlet is equipped with a pad of 15 dB or more loss, or when the circuit is connected to an outlet of -16 dBm.

6.03 On drawings covering circuits connecting to an outlet of the 71F generator, the impedance and level required by the connecting circuit should be clearly designated to avoid errors in these connections.

6.04 Connecting circuits should be balanced with respect to ground and also should provide a reasonable matching impedance at 1000 Hz. Transformers or blocking capacitors should be used when the connecting circuit applies direct current on the tip and ring connections in excess of 100 microamperes. (See 2.06.)

6.05 When the 71F generator is used to feed either the 71D or 71E network panel, together with the 71H network panel, the artificial load on the generator must be determined according to Table C. Each network on the 71H is considered as 1.5 networks of either the 71D or 71E panels.

6.06 Refer to SD-1C372-01 for connecting information when using the -10 dBV networks on the 71H panel.

7. SYSTEM CONSIDERATIONS (ENGINEERING GUIDES)

7.01 A guide for restricting the size of milliwatt systems to specific areas in order to simplify administration thereof, and to provide adequate stability of testing power, is outlined below. Application of the guide is not intended to be rigid, but is rather to indicate intent. Exceptions to it may be practicable in individual cases, particularly where reliable administration of the milliwatt system can be attained. In general, it is desirable that the areas indicated have exclusive use of a milliwatt system.

(a) Toll testboard area, including:

(1) Toll testboard.

(2) Circuit patching bay.

(3) ATTC and associated test frame (if under the direct control of the plant organization responsible for the system serving the toll testboard).

(4) Equipment bays, including echo suppressors and signaling units (if under the direct control of the plant organization responsible for the system serving the toll testboard).

(b) Switching area, including:

(1) Dialable milliwatt test lines.

(2) Code 10# test lines and their equivalents.

(3) Manual and automatic test frames (if under the direct control of switching equipment personnel).

(c) Manual switchboards.

d) Voice-frequency patching bays within a well-defined area. Where several groups of patching bays are widely separated in the office or if they are under the control of two or more plant organizations, each group of bays would have its own supply.

(e) Carrier equipment area. If voice-frequency patching bays are located within or adjacent to these areas, they may use a common supply with the equipment area. In any case, however, the outlets from any one source should be restricted to a well-defined area.

(f) Private line testboard if not under the direct control of the toll testboard area.

(g) Program area.

(h) Telegraph test area.

(i) Any equipment area which is not located within or adjacent to or under the direct control of one of the areas listed above. Such an area might contain one or more of the following groups of equipment:

(1) Echo suppressor bays.

(2) Repeater bays.

(3) Signaling bays.

(4) Announcement systems.

(5) Service observing equipment.

(6) ATTC and associated test frames.

(7) Manual and/or automatic test frames.

7.02 In each of the above locations the outlets from any one source should be restricted to a well-defined area, under the control of a single plant organization.

7.03 In addition to area restrictions, it is desirable that the following general limitations be observed:

(a) Outlets from any one system should all be on the same floor and in the same building area.

(b) All of the outlets from any one system should be under the direct control of a single operating company and single plant organization.

(c) Separate switching systems in a single building or building area should not share the same milliwatt system unless these switching systems are maintained as a single unit by a single organization, and provided the above restrictions apply.

SECTION IV - REASONS FOR REISSUE

B. Changes in Apparatus (Components)

B.1 Fig. 1:

Superseded	Superseded By
KS-16744,L1 Network	4181A Network
KS-13490,L1, Resistor R25 750 Ohms	KS-20616,L1A Resistor, 750 Ohms

B.2 Fig. 1:

Removed	Replaced By
1-221A R6 Resistor, 287 Ohms	263A Resistor
2-221A R26 and R27 Resistors, 42,200 Ohms	263A Resistor
1-221A R24 Resistor, 2610 Ohms	263A Resistor

B.3 Artificial Load Circuits:

Superseded	Superseded By
Fig. A	Fig. B

B.4 CAD 1:

Superseded	Superseded By
KS-14554,L1 Connector	KS-14554,L7 Connector

D. Description of Changes

D.1 A designation is added to pair T5R5 in Fig. 2 to allow connecting Fig. 2 to the 100-ohm or 110-ohm distributing network on SD-1C372-01. This distributing network is required for the 71F generator to provide test tone on wideband PICTUREPHONE and data transmission circuits. Ten such networks are mounted on a panel and coded J94071H. Note 112 is added to aid in adjusting the artificial load connections when using FS1 of SD-1C372-01.

D.2 Fig. B is added to simplify artificial load connections to Fig. 2. Fig. A, previously shown as part of Fig. 2, is rated Mfr Disc. Table C is changed to cover the addition of Fig. B.

D.3 Designations are added to CAD 1 reflecting the change described in D.1. Corrections are also made to CAD Fig. 1, 6, and 7.

D.4 All resistors previously shown as type 221A are replaced by type 263A. Type

221A resistors now being manufactured do not have the same electrical characteristics as those shown on previous issues of this drawing and, therefore, are not shown lined out.

D.5 Note 111 is reworded to clarify the requirement of a separate wire pair for leads E and F between Fig. 1 and 2.

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