MODEL 15-A TRANSMISSION TEST SET (NORTHEAST ELECTRONICS CORPORATION)

1. GENERAL

1.01 This section provides information on the operation and maintenance of the Model 15-A transmission test set.

1.02 The section consists of an instruction manual for this test set prepared by the Northeast Electronics Company, Concord, New Hampshire.

1.03 Accuracy checks and repair service for the 15-A transmission test set are available at Western Electric Distributing House locations under the "Red Ball" program.

Attachment:

Instruction manual for 15-A transmission test set.

OPERATING INSTRUCTIONS

MODEL TTS 15A TRANSMISSION TEST SET

NORTHEAST ELECTRONICS CORPORATION

AIRPORT ROAD

P. O. BOX 425 CONCORD, N. H. TEL. CAPITOL 5-6641

NORTHEAST ELECTRONICS CORPORATION

MODEL TTS 15A TRANSMISSION TEST SET

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ISSUED JULY 1961

OPERATING INSTRUCTIONS

MODEL TTS 15A TRANSMISSION TEST SET

1.0 GENERAL

1.01 The Model TTS 15A is a compact, transistorized, self-powered transmission measuring set. It contains an oscillator, a db meter, and a group of switches used to select the different measuring functions.

1.02 By means of the different switches in the Model TTS 15A the operator can perform the following functions:

1. Extend the circuit connected to the LINE terminals to the terminals marked EXT, thus providing a means for connecting a talk set to the line to be tested.

2. Connect the oscillator to the LINE terminals. In this connection eight constant level, fixed frequencies in the voice band can be transmitted. By means of switches either 600-ohm or 900-ohm termination can be provided and a hold coil can be connected to or removed from the LINE terminal. The SEND level is adjustable from 0 dbm down to -30 dbm.

3. Connect the db meter to the LINE terminals. This provides a means to measure from +8 to -30 dbm. An attenuator with six 5 db steps is provided to control the level measuring sensitivity; this provides a 5 db overlap between ranges. The db meter can be operated at 600 or 900 ohms impedance; a switch selects the desired impedance. A hold circuit can be connected to or removed from the LINE terminals. A locking type calibration control is provided for the db meter.

4. Provide an internal connection from the oscillator to the db meter for calibration purposes. This permits setting up any desired SEND level for the SEND function described under 2.

5. Connect the db meter to the LINE terminals and the oscillator to the EXT terminals to permit direct insertion loss measurements of four terminal networks such as transformers, pads, cord circuits, etc.

6. Transfer the LINE terminals to a termination consisting of 900 ohms in series with 2.0 mfd.

1.03 The set is suitable for measurement on any voice frequency trunks for which it has sufficient accuracy and range. In connection with another transmission measuring set at the distant end it permits straightaway transmission measurements between two locations. Looped measurements can also be made without additional measuring equipment. It may be used as a calibrated source of test power at any of its fixed frequencies, and it may be used as a measuring device in connection with a milliwatt reference testing power generator located at the distant end of the circuit. The basic accuracy of the set for both SEND and REC is ±0.25 db at room temperature for voice frequency; detailed information is given in Section 2.0, Performance and Features.

1.04 In locations in which considerable amounts of 60 cps power frequency appear across the circuit, an external filter, Model TTS 11 XF, can be supplied. This filter is connected in parallel with the LINE terminals on the TTS 15A and provides 25 to 30 db attenuation at 60 cps.

1.05 The set is contained in a metal box with a removable hinged lid. The overall dimensions are 6" x 8" x 5 7/8". Its weight is 7 1/4 pounds. The set is powered by two 9-volt Burgess C6X (or equivalent) batteries, which provide a battery life of 100 hours with intermittent use. The face view of the test set is shown in Fig. 1. The schematic is shown in Fig. 2 of this manual.

2.0 PERFORMANCE AND FEATURES

A. Oscillator Section

2.01 The oscillator section features and performance are:

Frequencies: Eight frequencies selected by a switch -- 300, 1000, 1300, 1500, 2000, 2300, 2700, and 3000 cps.

Frequency Accuracy: 2% from 50°to 100°F.

Distortion: Less than 1% at any harmonic.

Level Variation With Frequency: Less than ±0.10 db.

Output Level: Can be set by means of the SEND LEVEL adjustment and calibrated for any level between 0 dbm and -30 dbm.

Output Impedance: The SEND and REC impedances in the TTS 15A can be switched to 600 or 900 ohms separately by two toggle switches, thus permitting measurements on such items as 600/900 ohm repeat coils, etc.

Send on LINE Terminals: Hold coil can be switched ON or OFF. LINE terminals can be switched with 500 ohms DC resistance to a 900-ohm +2.0 mfd termination.

Send on EXT Terminals: DC blocking and resistive hold circuit provided.

Other send frequencies can be provided. Substitution of another fixed frequency does not alter the basic operation of the set, and except for the change in value of two resistors, this manual remains applicable. The TTS 15A can be equipped with three additional frequencies on special order.

B. Receiving Section

2.02 The receiving section features and performance are:

Meter: 0.25 db divisions from +3 db to -3 db
0.5 db divisions from -3 db to -7 db
1.0 db divisions from -7 db to -10 db

Range of Measurements: +8 dbm to -30 dbm.

Frequency Response: Variations from 1000 cps response:

Not more than 0.1 db from 300-3000 cps
Not more than 0.25 db from 150-5,000 cps

Calibration: A calibration control is provided to set the meter precisely on 0 db when an accurate 0 dbm signal is applied to the LINE terminals or jack. After this adjustment, the 0 dbm point is accurate to ±0.10 db on all scales and the tracking of the scale will be within ±0.10 db.

Stability of Calibration: Changes referred to measurements at 70°F on representative set.

Temperature Errors: For readings between +3 db and -3 db ±0.25 db from 50° to 120°F; -0.4 db ±0.3 db from 50° to 20°F. (Meter can be recalibrated for consistent low temperature operation.)

Supply Voltage Errors: Not more than 0.1 db change for battery voltage range of 18 volts to 10 volts. Not more than 0.25 db change for range of 11 volts to 8 volts.

Input Impedance: 600 ohms or 900 ohms selected by a switch; balanced transformer with balanced DC blocking.

Receive on Line Terminals: Hold coil with 500 ohms DC resistance can be switched ON or OFF. Line terminals can be transferred to a 900 ohm +2.0 mfd termination.

C. Battery Check

2.03 The condition of the batteries can be checked by placing the FUNCTION switch in the SEND ADJ position. When full clockwise rotation of the SEND ADJ control fails to produce a reading of +1.5 db or higher, both batteries should be replaced.

2.04 The Burgess C6X (or equivalent) batteries provide a normal battery life of at least 100 hours with intermittent use.

3.0 DESCRIPTION

A. Controls

3.01 The following controls are provided on the TTS 15A.

1. Step attenuator with 5 db steps from +5 to -20 db for REC LEVEL control.
2. REC CAL control.
3. SEND FREQ selector switch.
4. SEND LEVEL adjustment.
5. FUNCTION switch for:
    a) Switching LINE terminals or jack to REC and EXT terminals to SEND.
    b) Switching LINE terminals to REC.
    c) Connecting LINE terminals directly to EXT terminals.
    d) Switching LINE terminals to SEND.
    e) Providing SEND ADJ provisions.
6. ON/OFF switch for the hold coil on the LINE terminals.
7. POWER ON/OFF switch.
8. Impedance Switches:
    a) Toggle switch to select 600-ohm or 900-ohm SEND impedances.
    b) Toggle switch to select 600-ohm or 900-ohm REC impedances.
9. Switch to transfer LINE terminals to a 900-ohm +2.0 mfd termination.

3.02 The following terminals are provided on the TTS 15A:

1. Two binding posts for LINE.
2. Type 310 jack for LINE.

3. Two binding posts for external equipment. These are also used to send while the REC section is connected to the LINE terminals.

4. A pin jack for the sleeve of the 310 jack.

5. A pin jack for case ground.

B. Schematic Diagram

3.03 The schematic diagram of the set is shown in Fig. 2. The detailed circuit description of the amplifier and oscillator section is contained in the following.

C. Receiving Section

3.04 As shown in Fig. 2 of this manual, the receiving section of this set consists of a tapped step-up transformer, T1, a meter driver amplifier, and a rectifier type AC meter.

3.05 The primary of transformer T1 has two balanced and tapped windings; this permits operation of 600 or 900 ohms and provides a balanced circuit which is blocked for DC by condenser C1. The secondary of transformer T1 is tapped at intervals which provide 5 db increments in voltage. The maximum step-up ratio of the transformer, as compared to its 600-ohm input windings, is slightly over 10:1.

3.06 The amplifier driving the meter contains two cascaded emitter follower stages, Q5 and Q6. This type of circuit has a high input impedance, a low output impedance, and a high degree of gain stability against variations in operating parameters. The voltage gain of this type of amplifier is generally within about 0.2 db of unity gain. The base of the second transistor, Q5, is driven from the arm of a potentiometer, R5, in the first emitter circuit to provide a calibration adjustment. The bias current for the first transistor is supplied by a voltage divider consisting of R1 and R2 in parallel with condenser C2 and is applied to the base of Q5 through the secondary transformer of T1. This puts the bias source in series with the input circuit and increases the amplifier input impedance. See Fig. 3.

C. Oscillator and Buffer Amplifier Section

3.07 As shown in Fig. 4 of this manual, the bridged-T oscillator uses three transistor stages. The first two are direct coupled from the collector of Q1 to the base of Q2. The positive feedback path is completed from the emitter of Q2 back through a tungsten bulb used for level stabilization to the emitter of Q1. The emitter resistor of Q1 is variable for setting the correct amount of positive feedback necessary for stable operation. A negative feedback which is greater than the positive feedback is supplied to the base of Q1 through a null selective network and an emitter follower. The selective bridged-T null network decreases the negative feedback sufficiently to permit oscillation to occur at the desired frequency, which is determined by the values in the bridged-T circuit. This frequency-determining network consists of two selected value, parallel connected capacitances, C19, C23, and C20, C22, and two resistors selected by the frequency selector switch S3.

3.08 As shown in Fig. 4 of this manual, the buffer amplifier uses a single transistor in a common emitter circuit. The oscillator voltage obtained at the emitter of Q2 is connected to the base of Q4 through volume control R40. This arrangement permits adjustment for all levels from -30 to 0 db. The collector load of Q4 consists of two variable resistors with fixed shunts. These are used in connection with the 2-position impedance switch to select either a 600-ohm or a 900-ohm output impedance. This circuit is coupled to the output terminals through a DC blocking condenser, C8.

4.0 CALIBRATION

4.01 The calibration of the TTS 15A receiving section requires a 600-ohm or 900-ohm source of 1000 cps sine wave 1 mw power. Unless this power source is known to be accurate, it should be recalibrated to provide exactly one milliwatt of output power. The NEC Model TTS 4A Transmission Test Set or other equivalent device may be used for this purpose.

4.02 The FUNCTION switch on the TTS 15A is moved to the REC position, the IMP switch is moved to match the impedance of the power source, and the LINE terminals or jack are connected to the source. With the POWER switch in the ON position, and the REC LEVEL control at 0, if the meter reads less than 1.5 db, turn the FUNCTION switch to SEND ADJ and the SEND ADJ control fully clockwise. If the meter still reads less than 1.5 db, replace the batteries and repeat the preceding test.

4.03 If the meter reads low with correct battery voltage, as determined in paragraph 4.02, or if the meter reads high, loosen the locknut on the REC CAL potentiometer, readjust its screwdriver control to obtain a 0 db reading, tighten the locknut and make sure that the meter still reads precisely 0 db after tightening it.

4.04 The sending power is adjusted by using the receiving section for a reference. The FUNCTION switch is set to SEND ADJ, and the SEND and REC IMP switches are set at the send impedance to be used. If the send impedance is changed, the output level must be reset. No further calibration steps are required. As the variation in sending power over the frequency range is not more than 0.1 db, calibration at the individual frequencies usually is not required.

4.05 If the meter has been given a major overhaul involving component replacement, the tracking of the receiving section may be checked and adjusted as follows:

4.06 Procedure:

1. With no input signal, set the meter zero to the position indicated on the decal on the cover.

2. Connect the output terminals of a 600-ohm source of 1000 cps 1 mw sine wave power to the input of a precision attenuator and connect the LINE terminals of the TTS 15A to the output of the attenuator. Unless this power source is known to be accurate, it should be recalibrated to provide exactly one milliwatt of output power. The NEC Model TTS 4A Transmission Test Set or other equivalent device may be used for this purpose.

3. Set the FUNCTION switch at REC and the REC IMP switch at 600.

4. Adjust the external REC CAL screwdriver control to provide a 0 db meter reading.

5. Increase the external oscillator attenuator setting by 10 db. The meter should read -10 db on the scale. If the meter reads higher, e.g. -9 db, increase the amplifier gain by a small amount by adjusting the REC CAL control. Then remove 10 db from the attenuator and make the meter read 0 db by adjustment of its mechanical zero screw. (If the meter had read lower than -10 db, e.g. -11 db, the amplifier gain should have been decreased by a small amount; 10 db should then be removed from the attenuator and 0 db should be obtained on the meter by adjustment of the mechanical zero.)

6. Repeat Steps 3 and 4 until the meter tracks at 0 and -10 db.

7. Adjust the precision attenuator in 1 db steps from 0 to 10 db. The meter should read the corresponding number of db within ±0.1 db at each point. If the requirements are not met, try a compromise mechanical zero setting, and if they still cannot be met, replace the meter.

8. When this requirement is met, note on the special sticker provided for this purpose the position of the needle with respect to the multiple dots (to the left of the scale arc) when the set is turned off.

9. Put a piece of black tape over the mechanical zero set screw to discourage further adjustment.

5.0 OPERATION

5.01 Initial Steps:

1. Unlatch and open cover. The cover can be detached from the case by sliding the cover up to the handle end of the case. When measurements are completed, it is recommended that the cover be replaced and closed, as a bracket on the cover will turn off the POWER switch when the cover is closed. This avoids leaving the set on when not in use and can substantially prolong battery life.

2. Turn POWER switch ON.

3. Connect line to be measured to LINE terminals or LINE jack.

4. Connect TEL SET to EXT terminals.

The instrument is now set up to send or receive signals on the LINE terminals, or to make calls on the line.

5.02 To Measure Tone:

1. Set REC IMP switch to desired impedance and REC level to +5.

2. Set FUNCTION switch to EXT position and call for tone with TEL SET.

3. Move HOLD switch to ON when tone is received.

4. Turn FUNCTION switch to REC position.

5. Turn REC LEVEL switch to obtain a convenient reading on the meter (between -3 and +3 marks if possible).

6. The measured level is the algebraic sum of the REC LEVEL dial setting and the meter reading. Black figures on the meter reading carry a minus (-) sign; red figures carry a plus (+) sign.

Examples:

REC LEVEL = -5; meter reads -2.5; level is -7.5

REC LEVEL = -5; meter reads +1.5; level is -3.5

REC LEVEL = +5; meter reads -2.5; level is +2.5

REC LEVEL = +5; meter reads +1.5; level is +6.5


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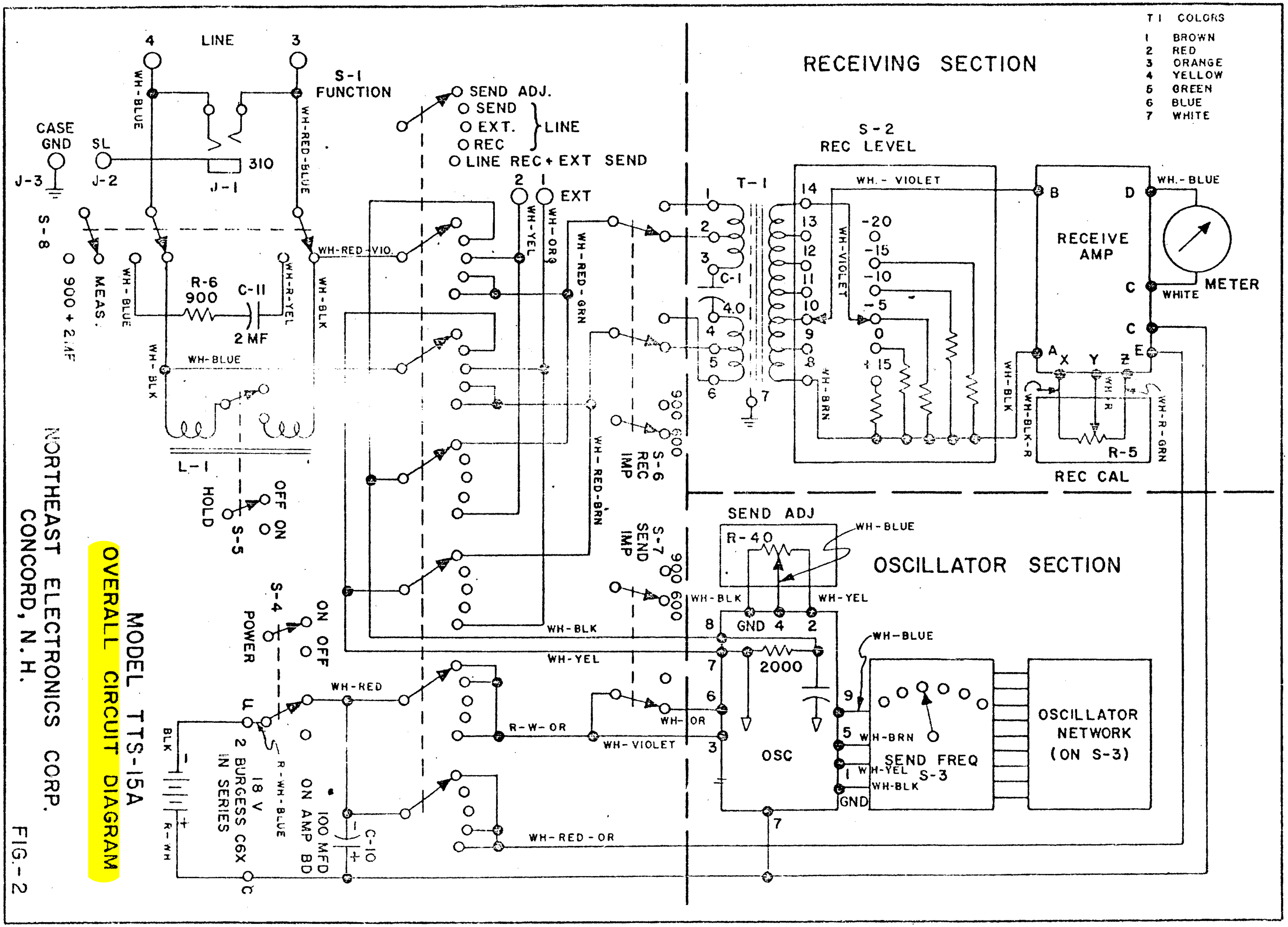
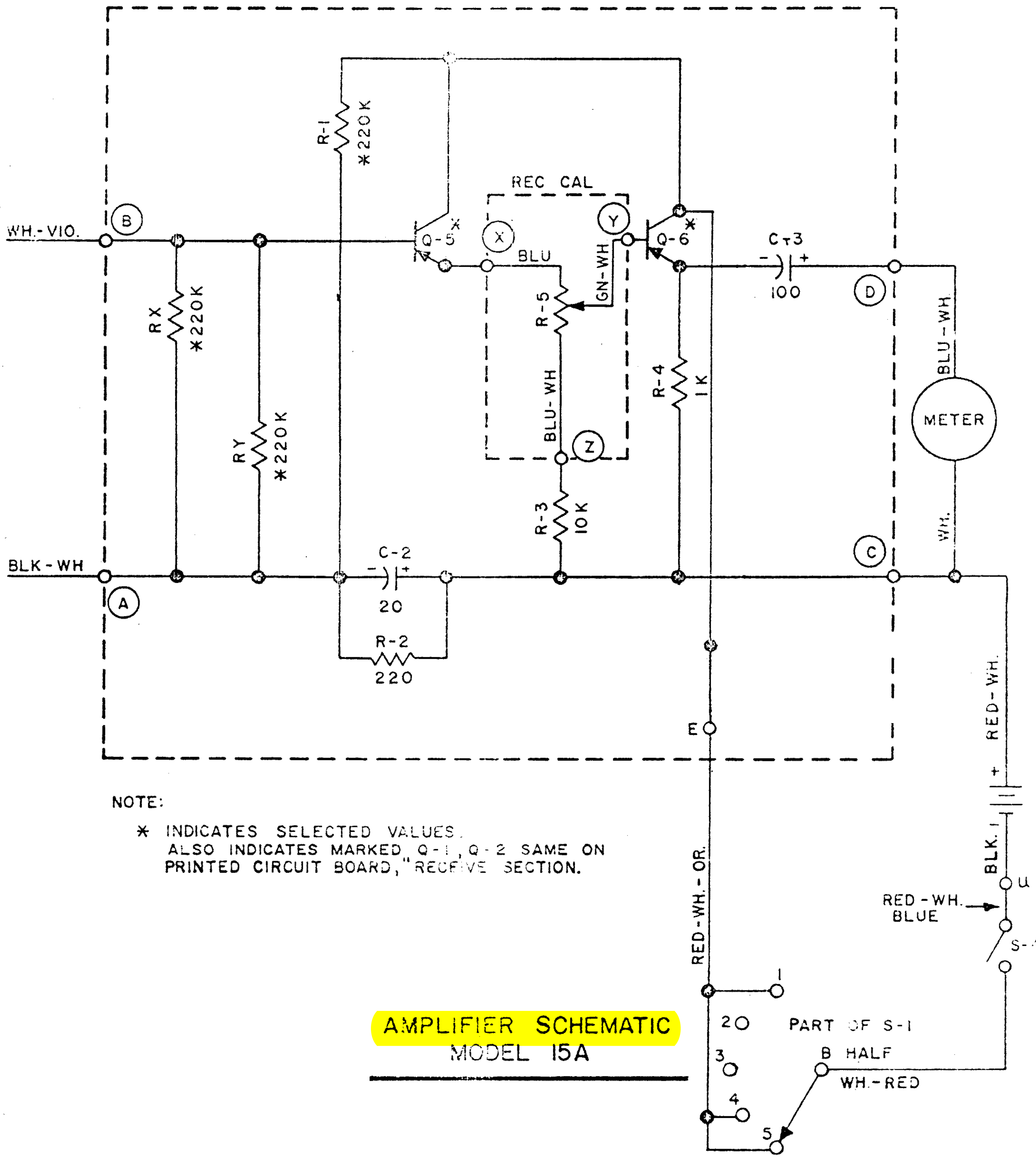
MODEL TTS-15A
SL
LINE
310
900 ÷ 2.0MF
TERM
ON
MEAS
HOLD
GND
EXT
ON
POWER
900
SEND IMP
600
REC IMP
900
600
SET SEND IMP AND REC IMP TO
SAME VALUE FOR SEND ADJ
SEND ADJ
SEND ADJ
LINE
LINE REC
+EXT SEND
REC CAL
300
1000
1300
1500
2000
2300
2700
3000
SEND FREQ
SEND
EXT
REC
FUNCTION
+5
0
-5
-10
-15
-20
REC LEVEL
-DB+



MODEL TTS-15A
OVERALL CIRCUIT DIAGRAM
NORTHEAST ELECTRONICS CORP.
CONCORD, N.H.
FIG. - 2

Q-5 AND Q-6 ARE 2N1374.



NOTE:

∗ INDICATES SELECTED VALUES.
ALSO INDICATES MARKED Q-1, Q-2 SAME ON PRINTED CIRCUIT BOARD, "RECEIVE" SECTION.

AMPLIFIER SCHEMATIC
MODEL 15A

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FIG.-3

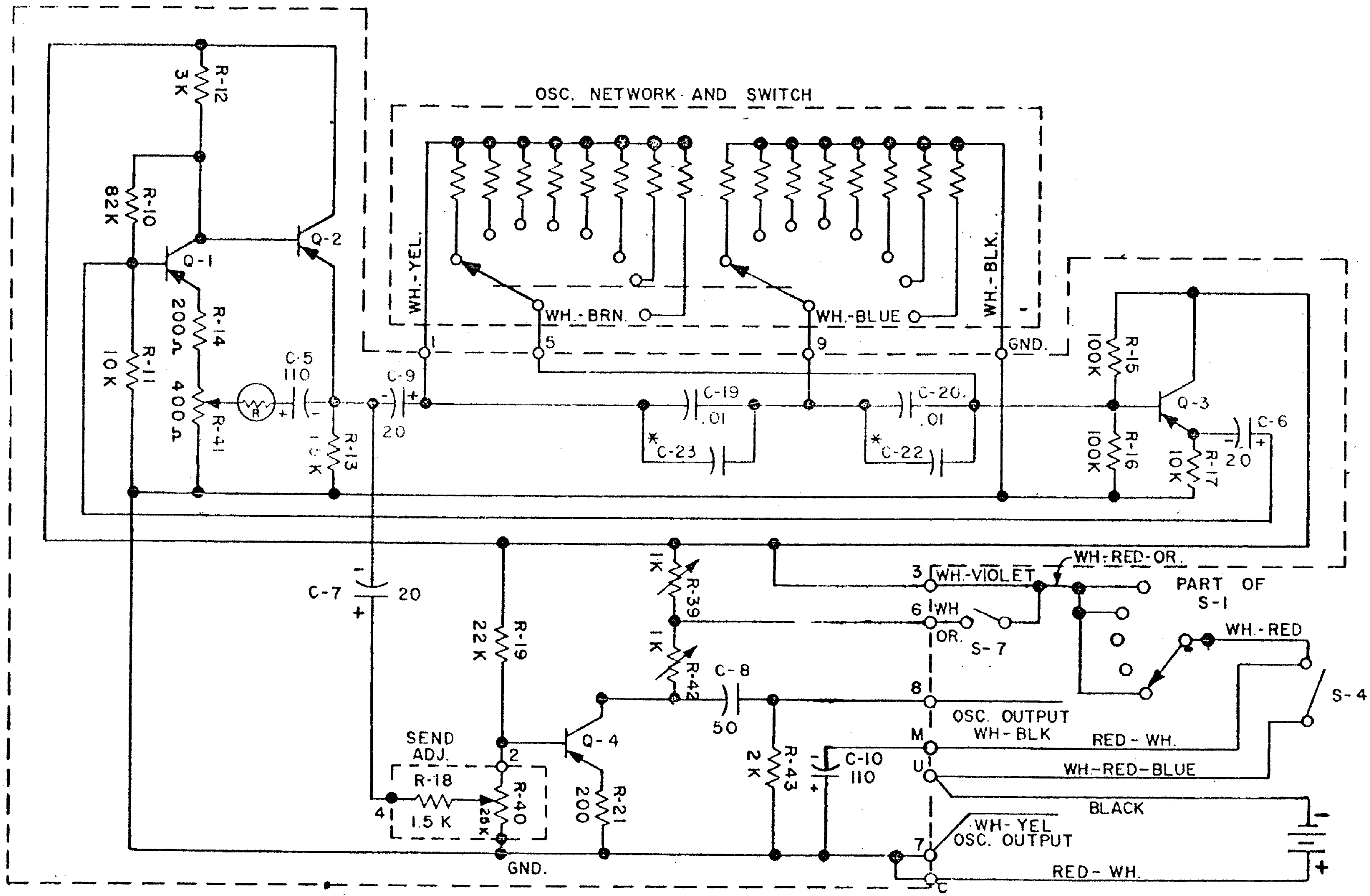

FIG.-4

NOTE:
ALL TRANSISTORS ARE 2N1374 OR EQUIVALENT.
* C-22 & C-23 ARE SELECTED VALUES.

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MODEL TTS-15 A
SCHEMATIC
BRIDGED - T OSCILLATOR
AND BUFFER AMPLIFIER

MODEL TTS 15A TRANSMISSION TEST SET

TABLE OF REPLACEABLE PARTS

Circuit Ref		Description	Mfr* & Mfr's Designation
C1	Capacitor:	fixed, paper, 4 mfd, 150 vdc	K, 121P40591R5S2
C2	Capacitor:	fixed, electrolytic, 20 mfd, 25 vdc	G, APD-046
C3	Capacitor:	fixed, electrolytic, 100 mfd, 20 vdc	G, APD-095
C5	Capacitor:	fixed, electrolytic, 100 mfd, 20 vdc	G, APD-095
C6	Capacitor:	fixed, electrolytic, 20 mfd, 25 vdc	G, APD-046
C7	Capacitor:	fixed, electrolytic, 20 mfd, 25 vdc	G, APD-046
C8	Capacitor:	fixed, paper, non-polarized, 50 mfd 75 vdc	K, DFP50M75
C9	Capacitor:	fixed, electrolytic, 20 mfd, 25 vdc	G, APD-046
C10	Capacitor:	fixed, electrolytic, 100 mfd, 20 vdc	G, APD-095
C19	Capacitor:	fixed, paper, .01 mfd, 100 vdc	K, 194P10351
C20	Capacitor:	fixed, paper, .01 mfd, 100 vdc	K, 194P10351
R1	Resistor:	fixed, composition, 220 K, ±5%, 1/2 w	A, EB2245
R2	Resistor:	fixed, composition, 220 K, ±5%, 1/2 w	A, EB2245
R3	Resistor:	fixed, composition, 10 K, ±5%, 1/2 w	A, EB1035
R4	Resistor:	fixed composition, 1 K, ±5%, 1/2 w	A, EB1025
R5	Resistor:	variable, carbon, 1 K, ±5%, 1/2 w	A, CU1021
R6	Resistor:	wirewound, non-inductive, 900 ohm, ±1% 3 w	L, 451E9011
R10	Resistor:	fixed, composition, 82 K, ±5%, 1/2 w	A, EB8235
R11	Resistor:	fixed, composition, 10 K, ±5%, 1/2 w	A, EB1035
R12	Resistor:	fixed, composition, 3 K, ±5%, 1/2 w	A, EB3025
R13	Resistor:	fixed, composition, 1.5 K, ±5%, 1/2 w	A, EB1525
R14	Resistor:	fixed, composition, 200 ohms, ±5%, 1/2 w	A, EB2015
R15	Resistor:	fixed, composition, 100 K, ±5%, 1/2 w	A, EB1045

TABLE OF REPLACEABLE PARTS

Circuit Ref	Description	Mfr* & Mfr's Designation
R16	Resistor: fixed, composition, 100 K, ±5%, 1/2 w	A, EB1045
R17	Resistor: fixed, composition, 10 K, ±5%, 1/2 w	A, EB1035
R18	Resistor: fixed, composition, 1.5 K, ±5%, 1/2 w	A, EB1525
R19	Resistor: fixed, composition, 22 K, ±5%, 1/2 w	A, EB2235
R21	Resistor: fixed, composition, 200 ohms, ±5%,1/2 w	A, EB2015
R37	Resistor: fixed, composition, 1.2 K, ±5%, 1/2 w	A, EB1225
R38	Resistor: fixed, composition, 1.8 K, ±5%, 1/2 w	A, EB1825
R39	Resistor: variable, wirewound, 5 K	I, 11214
R40	Resistor: variable, carbon, 2.5 K	A, CU2521
R41	Resistor: variable, wirewound, 400 ohms	E, CM22425
R42	Resistor: variable, wirewound, 5 K	I, 11214
R43	Resistor: fixed, composition, 2 K, ±5%, 2 w	A, HB2025
R	Lamp: tungsten (used as resistor) 4 w, 120 vac	F, T4-1/2
J1	Jack:	M, C-12B
J2	Jack: (LINE) binding posts, brass, nickel plated	J, #137
J3	Jack: (LINE) binding posts, brass, nickel plated	J, #137
J4	Jack: (EXT) binding posts, brass, nickel plated	J, #137
J5	Jack: (EXT) binding posts, brass, nickel plated	J, #137
	Sleeve Jacks: pin type, (2 per set)	J, #241
S1	Switch: rotary, 6 position, 6 pole (FUNCTION)	D, PA1021
S2	Switch: rotary, 11 position, 2 pole, (REC LEVEL)	D, PA1009
S3	Switch: rotary, 6 position, 2 pole, (OSC FREQ)	D, PA1015
S4	Switch: toggle, SPST, (POWER)	J, #510
S5	Switch: slide, SPST, (HOLD)	J, #510

TABLE OF REPLACEABLE PARTS

Circuit Ref	Description	Mfr* & Mfr's Designation
S6	Switch: slide, 4 pole D.T. (IMPEDANCE)	J, 513
S7	Switch: toggle, D.P.D.T.	J, 513
S8	Switch: toggle, D.P.D.T.	J, 513
T1	Transformer: receive	NEC-NES 1930
L1	Inductor: series, 3.17 henry	B, 2740J
Q1	Transistor	M, 2N1374 or equivalent
Q2	Transistor	M, 2N1374 or equivalent
Q3	Transistor	M, 2N1374 or equivalent
Q4	Transistor	M, 2N1374 or equivalent
Q5	Transistor	M, 2N1374 or equivalent
Q6	Transistor	M, 2N1374 or equivalent
	Battery: 9 volt (2 per set)	C, C6X
	Knobs: for rotary switches S1, S2, S3	H, S-647-3L-BB
	Knob: for REC LEVEL control	I, 2242
M	Meter: special	NEC-Model 15 A-1124-E12/P4.2

* See "List of Manufacturers" Code Letters for Replaceable Parts Table on Page 4.

LIST OF MANUFACTURERS CODE LETTERS FOR REPLACEABLE PARTS TABLE

Code Letter	Manufacturer
A	Allen-Bradley Company
B	Automatic Electric Company
C	Burgess Battery Company
D	Centralab
E	Clarostat Manufacturing Company
F	Herzog Miniature Lamp Works, Inc.
G	International Electrical Industries
H	Kurz-Kasch, Inc.
I	The Muter Company
J	H. H. Smith Company
K	Sprague Electric Company
L	Sylvania
M	Texas Instruments, Inc.
NEC	Northeast Electronics Corporation