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POWER SYSTEMS
REMOTE TEST VOLTAGE
SUPPLY CIRCUIT
J87300

CHANGES

B. Changes in Apparatus

B.1 In CPS3

Superseded	Superseded By
R1 Resistor, 145A, 100 ohms, X Option	R1 Resistor, KS-20810,L1A, 316 ohms, W Option

D. Description of Circuit Changes

D.1 In CPS3 the R1 resistor is changed from 145A, 100 ohms, to KS-20810,L1A, 316 ohms. The original component is designated option "X" and is rated MD. The replacement component is designated option "W" and is rated AT&TCo Standard. This change is made to eliminate overheating of the switch transistors resulting in shutdown of the remote test voltage supply.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 2433-DHS
WECo 81430-BF-RB

POWER SYSTEMS
REMOTE TEST VOLTAGE
SUPPLY CIRCUIT
J87300

CHANGES

B. Changes in Apparatus

B.1 Superseded	Superseded By
CR5 of CPS4 and FS1, 460A Diode "Z" option	CR5 of CPS4 and FS1, 460M Diode "Y" option

D. Description of Circuit Changes

D.1 In CPS4 options "Y" and "Z" were added. Option "Z" indicates the existing wiring and component and was rated A&M. Option "Y" indicates the replacement of CR5, 460A, with 460M and the reorientation of the component for proper terminal alignment. Option "Y" is rated STD. This change was the result of component standardization.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 2433-DHS
WE DEPT 81430-BF-RB

POWER SYSTEMS
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CHANGES

B. Changes in Apparatus

B.1	Superseded	Superseded By
	Q1 & Q2 of CPS 6 & CPS 7 16F Transistor, "Z" option	Q1 & Q2 of CPS 6 & CPS 7 66F Transistor, "Y" option

D. Description of Circuit Changes

D.1 In CPS 6 & CPS 7 options "Y" and "Z" are added. Option "Z" indicates the existing use of 16F transistors and is rated A&M. Option "Y" indicates the use of 66F transistors and is rated STD.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 2433-RRG

WE 8143-LGK-ET

POWER SYSTEMS
REMOTE TEST VOLTAGE
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CHANGES

B. Changes in Apparatus

B.1 Superseded

CR1 Diode 446L
Fig. CPS 1 & FS 1
"Z" Option

Superseded By

CR1 Diode 446T
Fig. CPS 1 & FS 1
"Y" Option

B.2 Added

R4 145A 1MΩ Fig. CPS 1 & FS 1, "Y" option

D. Description of Changes

D.1 In CPS 1 options "Y" and "Z" were added. Option "Z" indicates the existing wiring and components and was rated Mfr Disc. Option "Y" indicates the reconnection of resistor R2 between base and emitter of Q1, the addition of R4 resistor between pins 8 and 12 of CPS 1 and the use of 446T diode in place of 446L. Option "Y" is rated STD. These changes improve self starting feature of converter without effecting current drain or any other circuit features.

BELL TELEPHONE LABORATORIES, INCORPORATED

BTL DEPT 2433-RRG

WE DEPT 8143-LGK-ET

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POWER SYSTEMS
REMOTE TEST VOLTAGE
SUPPLY CIRCUIT
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SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 This circuit converts voltage from nominal 48-volt negative battery to positive 200, 116, 100, 50 and 20 volts and negative 116 volts direct current. This circuit is intended for use as a test voltage supply for remote testing of subscriber lines.

2. GENERAL DESCRIPTION OF OPERATION

2.01 A central office battery of nominal -48 volts feeds a series transistor regulator whose output of approximately 40 volts supplies the input to a transistor core inverter whose output is a 8000 Hz square wave. Secondary windings are provided which, after rectification and filtering, produce positive 200, 116 and 20 volts dc and negative 116 volts dc. Regulation for line, load and temperature is achieved by a closed feedback loop from the 20 volts output to the series transistor regulator. The 100- and 50-volt outputs are derived from the +116 volt output by individual regulators. A relay connected across the 20-volt output provides a means of detecting failure of the supply.

2.02 The circuit is self protecting in the event of short circuits on the outputs. An external 3/4 ampere input fuse protects against internal shorts.

SECTION II - DETAILED DESCRIPTION

1. TRANSISTOR CORE INVERTER-FS 1

1.01 Power transistors in the two CP 3 switches alternately switch the output voltage of series transistor regulator Q1 between halves of T1 transformer primary winding (2-3-4). The primary voltage is transformed and appears at the terminals of feedback windings (1-2) and 4-5). The two feedback voltages are 180 degrees out of phase and will hold one CP 3 turned on and the other CP 3 off until T1 saturates. Saturation of T1 causes all the transformer voltages to reverse. The CP 3 that was off will turn on and the other CP 3 will now turn off. The frequency of oscillation is determined by the volt-time capability of T1 and the input voltage to the transistor core inverter. It is nominally 8000 Hz.

1.02 Assume one switch is in the conducting state (saturated). The voltage across C1 of CP 1 is applied across the center tap (terminal 3) and terminal 2 of the primary winding of T1, positive at terminal 3. Voltages are induced in the other half of the primary winding, terminals 3 and 4, (positive at 4) and in the feedback windings, terminals 1 and 2 and 4 and 5, (positive at 2 and 5). Current flows from terminal 2 through the conducting switch and collector to emitter of Q1 to -48 volt battery. The induced voltage across terminals 1 and 2 has driven the conducting switch into saturation by driving current from terminal 2 through the base to emitter junction of Q1, R1 (on CP 3) and back to terminal 1. The induced voltage across terminals 4 and 5 holds the other switch in the off state by driving current from terminal 5 through R1 and CR1 (on the other CP 3) and back to terminal 4, thus reverse biasing the base to emitter junction of Q1 of the off switch by the amount of the forward voltage drop across CR2. When T1 saturates, the voltage across the primary and feedback windings drops essentially to zero. The drive to the on switch is therefore removed and the voltage across C1 of the switch that was on effectively reverse biases Q1 which turns it off quickly. The voltage on C1 of the switch that was off discharges through R1 and the base to emitter junction of Q1 driving it into conduction quickly. The residual inductance of T1 drives emitter to collector current through the switch that turned on bringing T1 out of saturation and repeating the above cycle in the opposite direction.

1.03 Capacitor C1 (APP FIG. 1) provides a low impedance to suppress switching spikes that would be fed back to the associated equipment.

2. OUTPUT VOLTAGES

200-Volt Output

2.01 The voltage produced across terminals 6 and 7 of T1 is a square wave of approximately 400 volts peak-to-peak. This voltage is then full-wave rectified and filtered by CP 4 to produce nominal +200 volts.

20-Volt Output

2.02 The voltage produced across terminals 8 and 9 of T1 is a square wave of approximately 40 volts peak-to-peak. This voltage is then full wave rectified and filtered by CP 4 to produce nominal +20 volts.

2.03 The 20-volt output is regulated by adjusting the voltage input to the transistor core oscillator. CP 2 samples the 20-volt output and compares it to the constant voltage across a reference diode and produces an output current signal at terminal 11 of CP 2. The output of CP 2 drives CP 1, which in turn drives the base of Q1. The resulting collector to emitter voltage of Q1 subtracts from the battery voltage and the difference is the input voltage to the transistor core inverter.

2.04 Assume the nominal 20-volt output voltage increases. A portion of this voltage increase appears at the base of Q1 of CP 2 and decreases its drive. The resulting decreased collector current of Q1 of CP 2 provides less base drive to Q1 of CP 1, decreasing its emitter current. The decreased base drive to Q1 increases its collector to emitter voltage drop. Therefore, less voltage appears at the input to the transistor core inverter and the output voltage decreases in accordance with the turns ratio of T1.

+116 and -116 Volt Output

2.05 The voltage across terminals 10 and 12 of T1 is a square wave of approximately 464 volts peak-to-peak. CP 5 provides full-wave rectification and filtering to produce ±116 volts to the center tap (terminal 11 of T1).

100-Volt Output

2.06 The 100-volt output is derived from the +116 volt output by means of series regulator CP 7.

50-Volt Output

2.07 The 50-volt output is derived from the +116 volt output by means of CP 6, an open loop shunt regulator.

Alarm

2.08 Relay K1 in CP 4 provides a visual alarm and a loop closure which can be used on a job basis to initiate an external low voltage alarm in the event of a short circuit on either the 200, +116, 20 or -116 volt outputs. When the circuit is operating normally, K1 is operated and contacts 2 and 3 are open. If a short circuit occurs on any of the above outputs, K1 releases and contacts 2 and 3 close. The closure of contact 2 causes DS1 (LV ALM) on the front panel of the test voltage supply to light. Closure of contact 3 provides the loop closure referred to previously.

2.09 The 50-volt and 100-volt outputs are protected against short circuits by current-limiting voltage regulators.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 DC Input Voltage

Normal Operation	-48 to -50 volts or -50 to -52 volts
Emergency Operation	-42.75 to -52.5 volts
Trouble Operation	-42.75 to -55 volts
Transient Operation	-60 volts

1.02 Ambient Temperature: The ambient temperature in the vicinity of the converter shall not be less than 32°F nor greater than 115°F for continuous and reliable operation.

1.03 Output Voltages and Regulation: The output voltages fall within the ranges given in column (2) below. The regulation due to normal input voltage variations, load and temperature is within the ranges given in column (3) and column (2). The regulation due to emergency or trouble input voltage variations, load and temperature is within the ranges given in column (2). If input voltage transients exceed 55 volts, the output voltages may not remain within ranges given in column (2) during the duration of the transient.

(1) Nominal Voltage	(2) Voltage Range Min.	Max.	(3) Regulation
200	200	225	±5.0 volts
+116	116	118	±1.0 volts
100	99	101	±0.5 volts
50	49	51	±0.5 volts
20	19	21	±0.5 volts
-116	-116	-118	±1.0 volts

1.04 DC Output Current: In order to meet the voltage regulations listed in paragraph 1.03, the load currents shall not exceed the values shown below:

(1) Nominal Voltage	(2) Max. Load (milliamperes)
200	70
+116	15
100	1
50	1
20	24
-116	15

1.05 Overload: The converter will withstand without damage a short circuit on any output.

1.06 Frequency: The transistor core inverter switches at a frequency of approximately 8000 Hz.

1.07 Output Ripple: The output ripple will not exceed 2 percent peak-to-peak of the value of any output voltage. In addition, commutation spikes will not exceed 20 percent of the value of any output voltage.

1.08 Noise Introduced on the Battery: The noise introduced on a battery of 180 ampere-hour capacity will not exceed 35 dBrn (C-message weighting).

1.09 DC Input Current: The dc input current will not exceed 0.650 amperes under the load conditions of paragraph 1.04 when the loads are applied one at a time.

2. FUNCTIONAL DESIGNATIONS

None.

3. FUNCTIONS

3.01 This circuit is designed to perform the following functions:

(a) To provide nominal regulated dc voltages of 200, +116, 100, 50, 20 and -116 from a negative 48-volt vattery.

(b) To provide a visual alarm if the output voltage fails.

(c) To provide potentiometers to set the +116, 100- and 50-volt outputs and to compensate for variations due to aging and long term drift.

(d) To provide protection against internal shorts by means of an external input fuse.

(e) To provide protection of the circuit from short circuits on any output by limiting the short circuit current.

(f) To provide a means for disconnecting the ground lead of the ±116V, 100V, and 50-volt outputs from the input ground lead.

(g) To provide a means for connecting an external low voltage alarm on a job basis if required.

4. CONNECTING CIRCUITS

4.01 This supply circuit will function with the following circuits.

(a) SD-1B023-01 - TSPS No. 1 System Applications

(b) SD-99311-01 - Remote Test Circuit Applications

5. ADJUSTMENTS

Output Voltages

5.01 Output voltage may be measured at output terminal strip TS1 with a voltmeter of at least 20,000 ohms/volt sensitivity. Adjustment of the +116, 100- and 50-volt outputs may be made by means of the appropriate VOLTS ADJ potentiometer. If adjustment is required, the +116 volt output should be adjusted first. In all cases voltage is increased by turning the appropriate potentiometer clockwise to raise the voltage and counterclockwise to lower the voltage. No means of separately adjusting the 200, 20, and -116 volt outputs is provided. These will satisfy the required limits when the +116 volt output is properly adjusted.

6. TESTING REQUIREMENTS

6.01 The Manufacturing Testing Requirements are covered in specification X-77600.

SECTION IV - REASONS FOR REISSUE

D. Description of Changes

D.1 In FS 1 lead designated "TO CONNECTING CIRCUIT" from terminal 8 of CP 4 to terminal 51 of TS 1 (+GRD) was removed; lead from terminal 14 of CP7 to connecting circuit was redesignated as GRD and notation "SEE NOTE 303" was added.

D.2 In CAD 1, leads from terminal 51 of TS 1 to terminal 8 of CP 4 and to the connecting circuit (+GRD) were removed. A new GRD lead was added from terminal 31 of TS1 to the connecting circuit.

D.3 On sheet A1, sheet index was corrected.

D.4 On sheet B1, designation "TO CONNECTING CIRCUIT" was added to leads 1 and 2 from terminals 3 and 4 of CP 4.