

**DATA SET 603A-TYPE  
FOR TRANSMISSION OF MEDICAL ANALOG DATA  
THEORY OF OPERATION AND SUPPLEMENTARY INFORMATION**

**1. GENERAL**

**1.001** This addendum supplements Section 596-012-150, Issue 2. The attached pages must be inserted in the section in accordance with the filing instructions above.

**1.002** This addendum is issued to correct Figures 10 and 20 by moving the yellow and black spade-tipped telephone line cord leads from frame ground terminal 13 of TB1 and connecting them to spare terminal 20 of TB1. This gives added protection against installation or rearrangement wiring errors.

**Attached:**

**Page 13/14 dated June 1973, revised**

**Page 21 dated June 1973, revised**

**Page 22 dated June 1973, reissued**

**3. DESCRIPTION**

The following change applies to Part 3 of the section:

- (a) Figure 10—revised

**5. MAINTENANCE INFORMATION**

The following change applies to Part 5 of the section:

- (a) Figure 20—revised

**DATA SET 603A-TYPE**  
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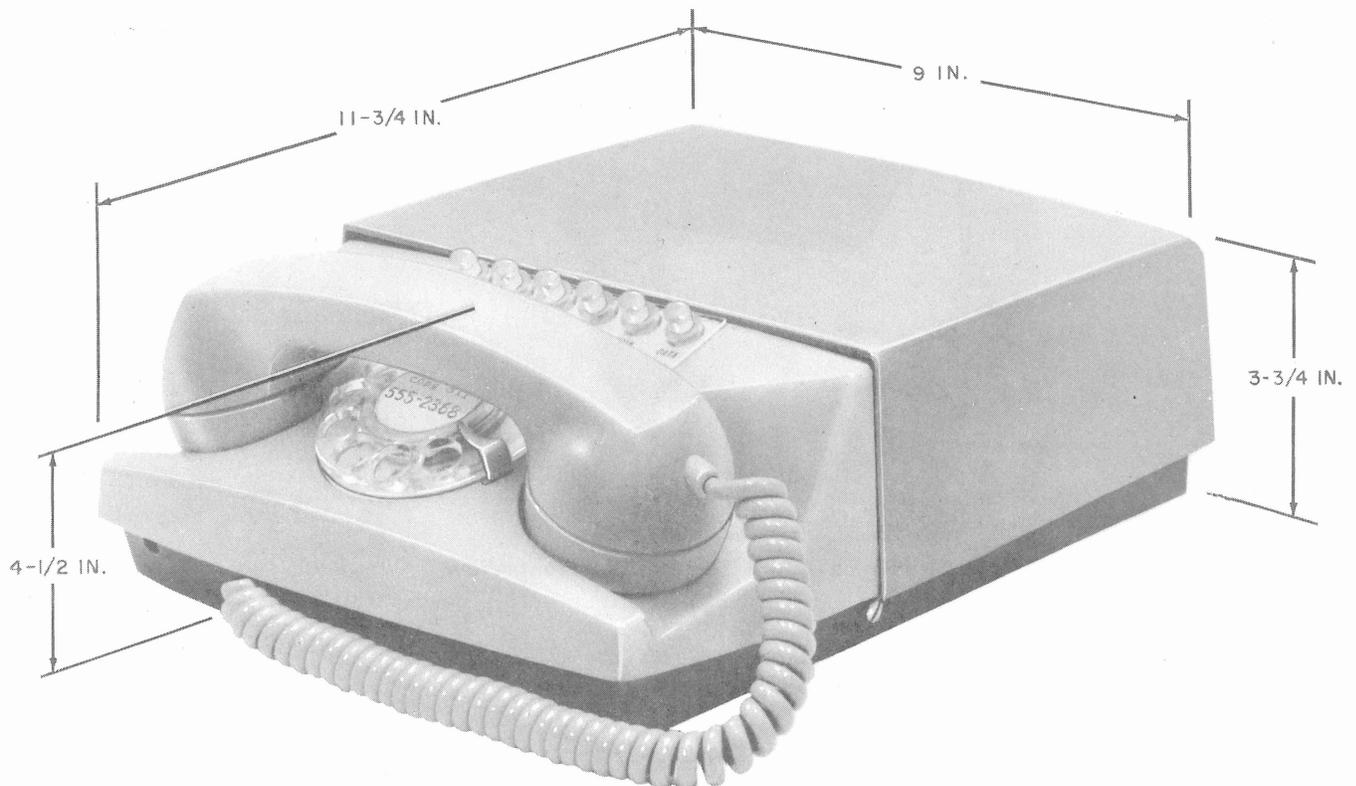
**1. GENERAL**

**1.01** Data Set 603A-type is a narrowband analog data transmitter designed primarily for the transmission of electrocardiographs over the switched telephone network.

**1.02** This section is reissued to include Data Set 603A2, and to show the reduced power output in compliance with FCC Tariff No. 263, which requires that the maximum output be no greater than -12 dBm at the serving central office. Also, minor changes were made throughout the section to comply with present format (eg, cps was changed to Hz).

**1.03** This practice contains detailed information necessary in the evaluation of the data set to determine if the data set can be used to meet specific customer requirements. It also permits emergency testing and troubleshooting, as well as providing information leading to an understanding of the overall operation and circuits of the data set.

**1.04** Data Set 603A1 is equipped with a rotary dial, while Data Set 603A2 is equipped with a TOUCH-TONE® dial, as illustrated in Fig. 1 and 2, respectively.



**Fig. 1—Data Set 603A1—Front View**

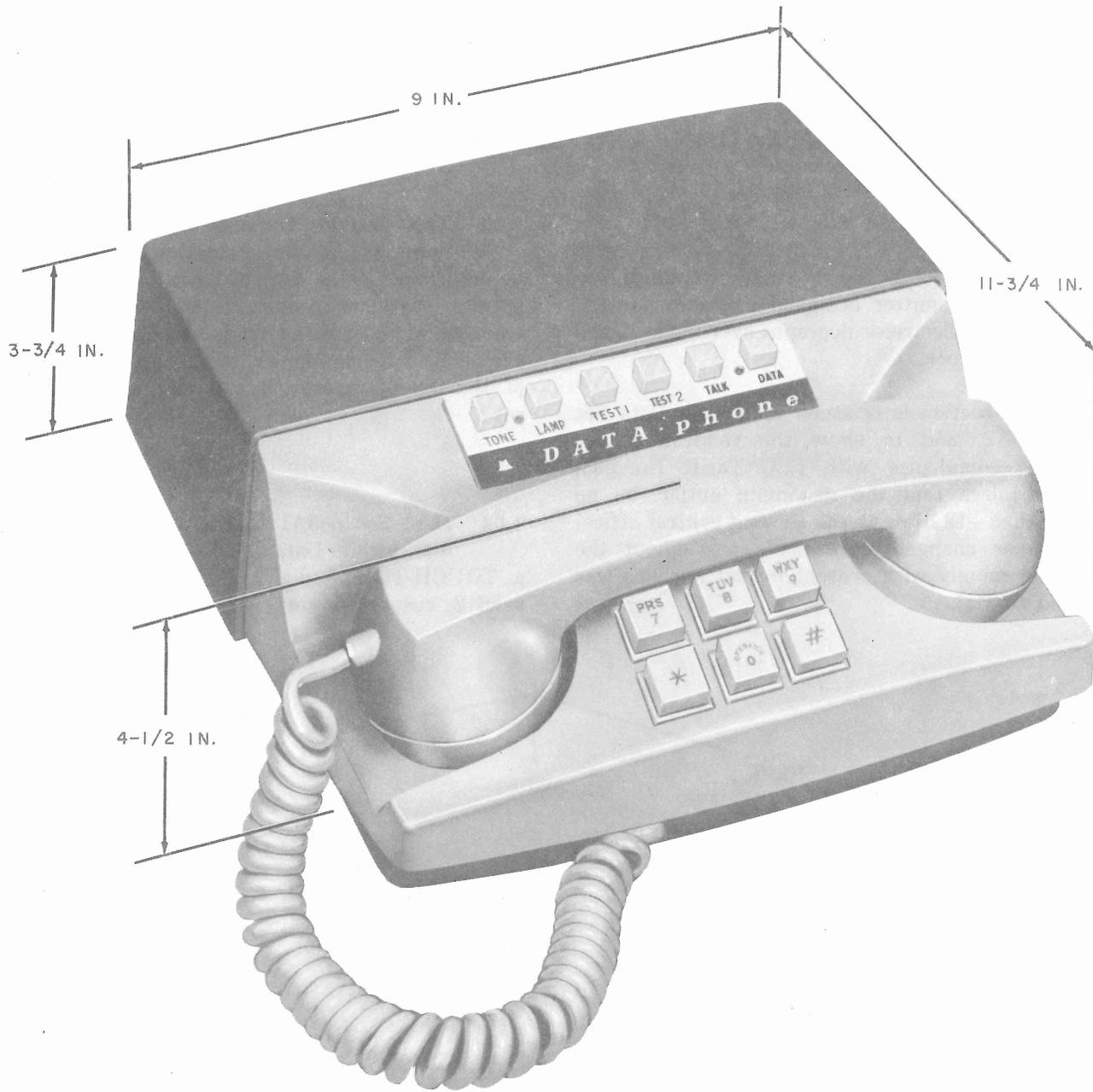


Fig. 2—Data Set 603A2—Front View

1.05 Information contained in this section is not required for normal maintenance. Information on the installation, option connections, and testing will be found in the applicable sections of the BSPs covering the 603A-type.

1.06 The 603A-type is an integrated unit combining a data transmitter, a line control unit, and a 6-button telephone set. This unit is housed in a 2-tone gray plastic case and weighs approximately 10 pounds.

1.07 The designation and function of the six control buttons on the set are shown in Fig. 3.

1.08 The set contains an FM transmitter for transmission of low-frequency (0 to 100 Hz) analog signals over voiceband telephone lines. The set accepts an input from the business machine, which will be primarily electrocardiographic equipment, and converts it to an FM line signal varying in frequency between 1726 Hz and 2250 Hz.

1.09 A reverse-channel receiver is provided, which may be used for coordination between the receiving and transmitting locations during data

transmission. The required signaling is accomplished by detecting the presence or absence of a 387-Hz tone that is transmitted from a Data Set 603B-type, which is the associated analog data receiver.

1.10 The telephone set is used to establish data calls and may be used as a normal telephone as well as for providing voice communications between transmitting and receiving points and to synchronize the start of data transmission at both stations.

1.11 A 25-pin interface connector is used to connect the data set to the business machine.

1.12 Operation of the business machine is not covered by this section.

1.13 The set is designed to operate correctly with an ambient temperature ranging from 40 to 120°F.

**2. EQUIPMENT ARRANGEMENTS**

2.01 Options available on Data Set 603A-type and the connections required to install the various options are shown in Table A.

603A2						
603A1						
DESIGNATION	TONE	LAMP	TEST 1	TEST 2	TALK	DATA
FUNCTION	PROVIDES AUDIBLE REVERSE CHANNEL INDICATION WHEN DEPRESSED.	PROVIDES VISUAL REVERSE CHANNEL INDICATION WHEN DEPRESSED	PROVIDES TEST CONNECTIONS REQUIRED TO FACILITATE REMOTE TESTING. (USED WITH TEST 2 BUTTON.)	PROVIDES TEST CONNECTIONS REQUIRED TO FACILITATE REMOTE TESTING. (USED WITH TEST 1 BUTTON.)	PLACES DATA SET IN TALK MODE THEREBY PROVIDING FOR NORMAL VOICE COMMUNICATIONS.	CLOSES REQUIRED CONTACTS TO PLACE DATA SET IN DATA MODE THEREBY PROVIDING FOR TRANSMISSION OF ANALOG DATA.

Fig. 3—Data Set 603A-Type—Control Button Designations and Functions

**TABLE A**  
**OPTION CONNECTIONS**

FEATURE OR OPTION		DESIG	AVAILABLE ON		CONNECTIONS ON TB1		QUANTITY
			603A1	603A2	FROM TERM.	TO TERM.	
Termination	600Ω	N	†	†	17	18	One Per Circuit
	900Ω	Q	*	*	17	16	
Reverse-Channel Indication	Lamp-Tone	T	*	*	1 7	2 14	As Required
	Contact	V	†	†	2 14	4 15	
Output Level	-12 dBm§	Z	†	†	8	9	One Per Circuit
	-3 dBm	Y	†	†	8	10	
	-6 dBm	X	*	*	8	11	
	-9 dBm	W	†	†	8	12	
Dial	Rotary	S	*	‡	—	—	—
	TOUCH-TONE	R	‡	*	—	—	—

\* Factory installed.

† Options which can be installed in field.

‡ Cannot be converted in field.

→§ 0 dBm for series 3 and lower; -12 dBm for series 4 and higher.←

**2.02** Data Set 603A-type accepts an input signal of 4 volts peak-to-peak or less. This is converted into an FM line signal varying in frequency between 1726 Hz and 2250 Hz. The set is designed for a balanced input but with SD1 common, SD2 may be driven as an unbalanced input.

**2.03** Although designed for use with electrocardiographic equipment, the set may be used with other equipment that provides a suitable input signal.

**2.04** Interface leads presented by the set to the business machine are two send data (SD) leads, two reverse-channel receive (RCR) leads, signal ground, and frame ground. A +20 volt and a -20 volt signal are provided for test purposes. Table B shows the interface lead assignment.

**2.05** A voltage signal of +2 volts between lead SD1 and lead SD2 corresponds to a frequency of 1726 Hz, while a -2 volts corresponds to a frequency of 2250 Hz.

**2.06** The impedance presented by the set between the SD1 lead and SD2 lead is 100K ±3K. With the SD1 lead grounded, the input impedance at SD2 is 50K ±3K.

**2.07** Impedance of the business machine should be 10K or less.

**TABLE B**

**INTERFACE CONNECTOR LEAD ASSIGNMENT**

PIN NO.	DESIG	LEAD ASSIGNMENT
1	FG	Frame Ground
2	SD1	Send Data 1
7	SG	Signal Ground
9	+20	+20 Volts (For Testing Only)
10	-20	-20 Volts (For Testing Only)
11	RCR1	Reverse-Channel Receive 1
12	RCR2	Reverse-Channel Receive 2
17	SD2	Send Data 2

**2.08** When option V is used, the two RCR leads provide a contact closure when the set is in the data mode and no reverse-channel signal is being received from the distant station.

### 3. DESCRIPTION

#### SYSTEM DESCRIPTION

**3.01** In order to obtain optimum transmission and to avoid interference during data transmission, the following system limitations apply to installations of Data Set 603A-type.

- (a) The set shall be used on individual lines only.
- (b) Extension telephones and extension data sets shall not be connected to the data transmission line. This also excludes auxiliary data sets which might cause interference.
- (c) To minimize inductive interference to the data signal on the telephone (data) line, the line should not be placed in the same run or raceway as the interface cable between the set and the business machine or lines carrying teletypewriter service.
- (d) Ensure that the data set and the business machine grounds are at the same potential.

If a common grounding system is not provided, a test using the 6A impulse counter can be made to detect any noise between the data set and the business machine caused by difference in ground potential. The test procedure is described in the practice entitled Data Set 603A-Type For Transmission of Medical Analog Data—Test Procedures (596-012-500). If the test requirements of the above practice are not met, the data set ground and the business machine ground must be bonded together. Local operating practices should specify the method of providing this bond.

- (e) The business machine interface connecting cord, which is supplied by the customer, should be kept as short as practical and should not exceed 50 feet in length. A short cord reduces the possibility of interference pickup.

#### COMPONENT DESCRIPTION

**3.02** To simplify the description of Data Set 603A-type, the set has been divided into four major units. These units are the power supply, the reverse-channel receiver, the transmitter, and the telephone and 6-button control unit. A block diagram showing the four major units is given in Fig. 4.

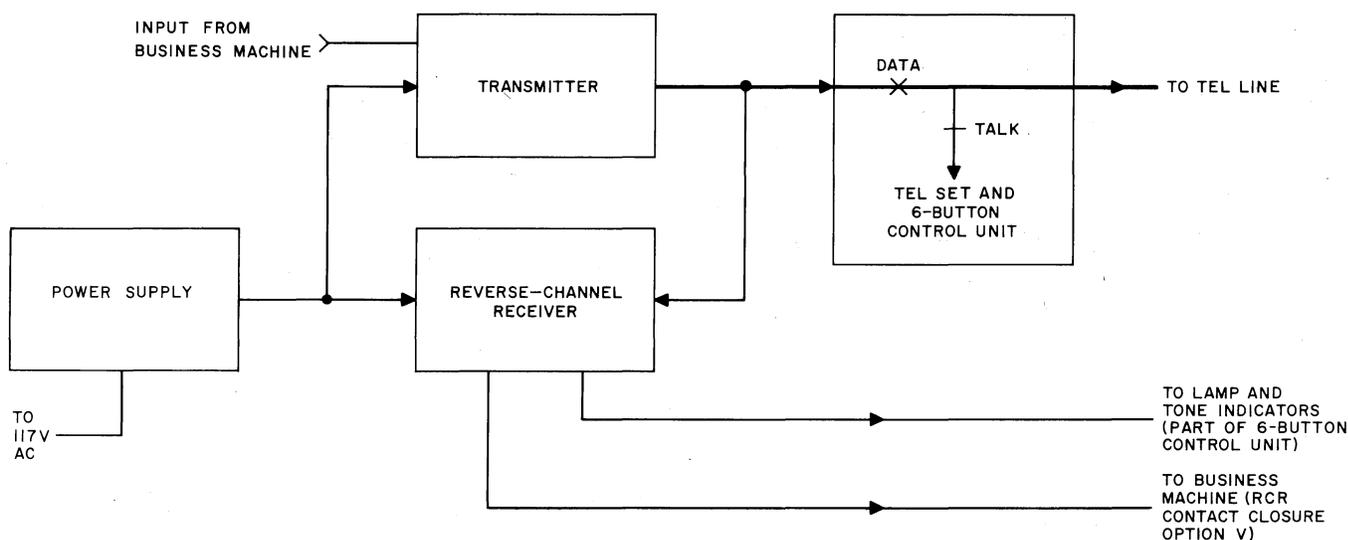


Fig. 4—Data Set 603A-Type—Block Diagram

## SECTION 596-012-150

**3.03** The power supply for the data set consists of an external transformer which is used to supply a nominal 20 volts ac to the data set. This voltage is converted into two 20-volt dc outputs by two half-wave rectifiers, one supplying a positive output, the other a negative output.

**3.04** Nominal 20-volt ac voltage from the external transformer is connected to the rectifiers on CP AU1. Two half-wave rectifiers and filters supply voltages of +15 to +21 volts and -15 to -24 volts. The voltage variations are due to line and load changes. These nominal 20-volt dc outputs supply power for operation of the other major units of the set.

**3.05** Relay K2 contact is used to enable the power supply and the contact is protected by a 185A network, designated Z3 in Fig. 5 and 10. Series 1 data sets do not contain the network. Series 2 data sets have the network connected between terminals 1 and 6 of TB1. Series 3 data sets contain a new circuit pack designated CP AU1, series 2. This new circuit pack includes a 185A network wired directly across relay K2 contact. It is not mandatory that series 1 data sets now in service be replaced. However, it is recommended that a 185A network be placed in these data sets during the next routine or repair visit and that the identification of the data set be changed to series 2.

**3.06** The reverse-channel receiver detects the presence or absence of the 387-Hz tone and provides a visual, audible, or electrical means of coordinating or receiving information from the associated analog data receiver during data transmission.

**3.07** The transmitter is composed of the data modulator circuits plus the required filters, transformer, and output attenuation pad. The

customer signal is used to frequency modulate the data set carrier to provide a signal suitable for transmission over the voice network.

**3.08** The 6-button control unit and telephone set provide the control functions required for operation of the other major units of the data set. This control unit has as its major components, the telephone apparatus network, two relays, a transformer, and the 6-control button unit.

### OPERATION

**3.09** Operation of the data set can be divided into three modes. These modes, which are briefly described in the following paragraphs, are the talk mode, the data mode, and the test mode.

**3.10** When the set is to be used as a telephone (ie, used in the talk mode), the handset is picked up and the TALK button depressed. This provides the necessary contacts to connect the telephone network across the line and block the operation of other circuits to assure that the set will remain in the talk mode.

**3.11** Operation of the DATA button actuates the contacts required to supply power to the various units, isolate the telephone network from the telephone line, and connect the transmitter and reverse-channel receiver circuits to the telephone line.

**3.12** The TEST 1 and TEST 2 buttons provide the contacts necessary to energize the modulator circuits, thereby causing the set to transmit three test frequencies which can be remotely measured to determine if the set is operating within the specified limits.

## CIRCUIT DESCRIPTION

### Power Supply

3.13 The external transformer supplies a nominal 20 volts through the operated contact of K2 to a pair of half-wave rectifiers which act as a power supply for this unit (Fig. 5). Diode CR2 and capacitor C2 form a half-wave rectifier which furnishes a -20 volt output. Diode CR3 and capacitor C1 form a half-wave rectifier which supplies a +20 volt output. The positive output from CR1 is applied directly to the loudspeaker or receiver unit HT1 and subsequently supplied with no capacitive filtering as the collector supply for transistor Q1. Power is also supplied directly to the data and reverse-channel receiver lamps.

### Reverse-Channel Receiver

3.14 Telephone line signals are applied to network Z2 through resistor R18 (Fig. 6). Network Z2 is a tuned transformer with an input impedance of 100 ohms at 387 Hz and essentially 0 ohms at other frequencies. The output winding of this transformer also has an impedance of approximately 100 ohms at resonance. The output is used to drive transistor Q6. Network Z1 consists of a pair of critically coupled tuned circuits and this network is used as the collector load for Q6. Z1 and Z2 provide the required frequency selectivity necessary to separate the 387-Hz reverse-channel signals from the data signals. Transistors Q14, Q13, and Q12, along with their associated components, make up a dc-coupled feedback amplifier which receives its bias from diode CR7 and resistor R17.

A level detector composed of diodes CR11 and CR12 and capacitors C5 and C7 turns on transistor Q15 when the amplified reverse-channel signal is present. This turns off transistor Q16, and the reverse-channel receiver (RCR) relay will be in the released condition. Resistors R41 and R42 hold transistor Q16 on when transistor Q15 is cut off by the absence of the reverse-channel signal. When Q16 is on, the RCR relay is operated. Operation of the RCR relay provides the necessary contact closures required to indicate the absence of the reverse-channel signal. The method of indication depends upon the operating mode of the set (ie, visual or audible indication) and the option (V or T) that has been installed in the set.

3.15 When the data set is equipped with option T, selection of visual or audible reverse-channel indication is accomplished by use of the TONE or LAMP key. When loss of the reverse-channel signal causes the RCR relay to operate, and the LAMP key is depressed, power is supplied from transformer T1 (Fig. 5), causing the LAMP key to light. If the TONE key is depressed, operation of the RCR relay places a ground on the emitter of transistor Q1. A square wave signal from Q2 (Fig. 8) is supplied to the base of Q1. This signal is amplified by Q1 and fed to the receiver unit HT1, producing an audible signal. The collector supply for transistor Q1 is the half-wave rectified voltage without capacitive filtering (Fig. 5). This insures rapid turnoff of the audible signal when power is removed from the rectifier. When option V is used, a contact closure is provided through the RCR1 and RCR2 leads.

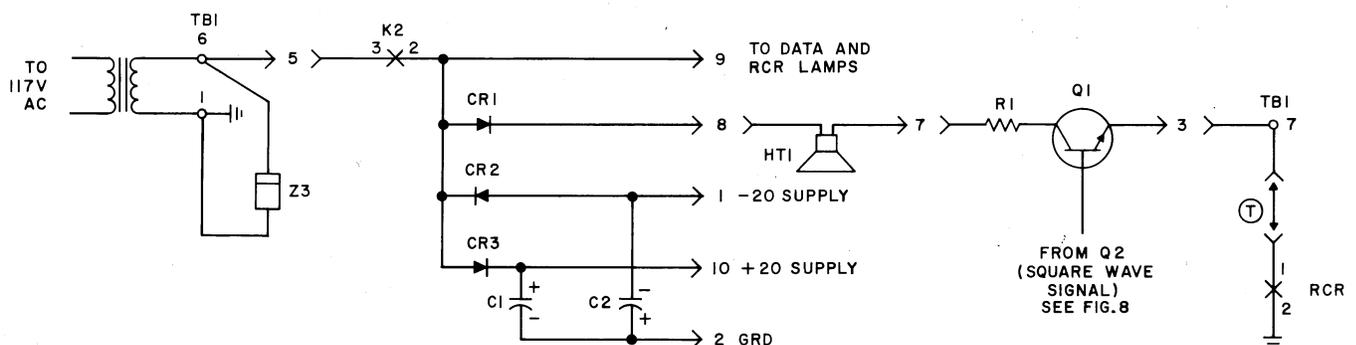


Fig. 5—Power Supply and Signal Generator—Schematic Diagram

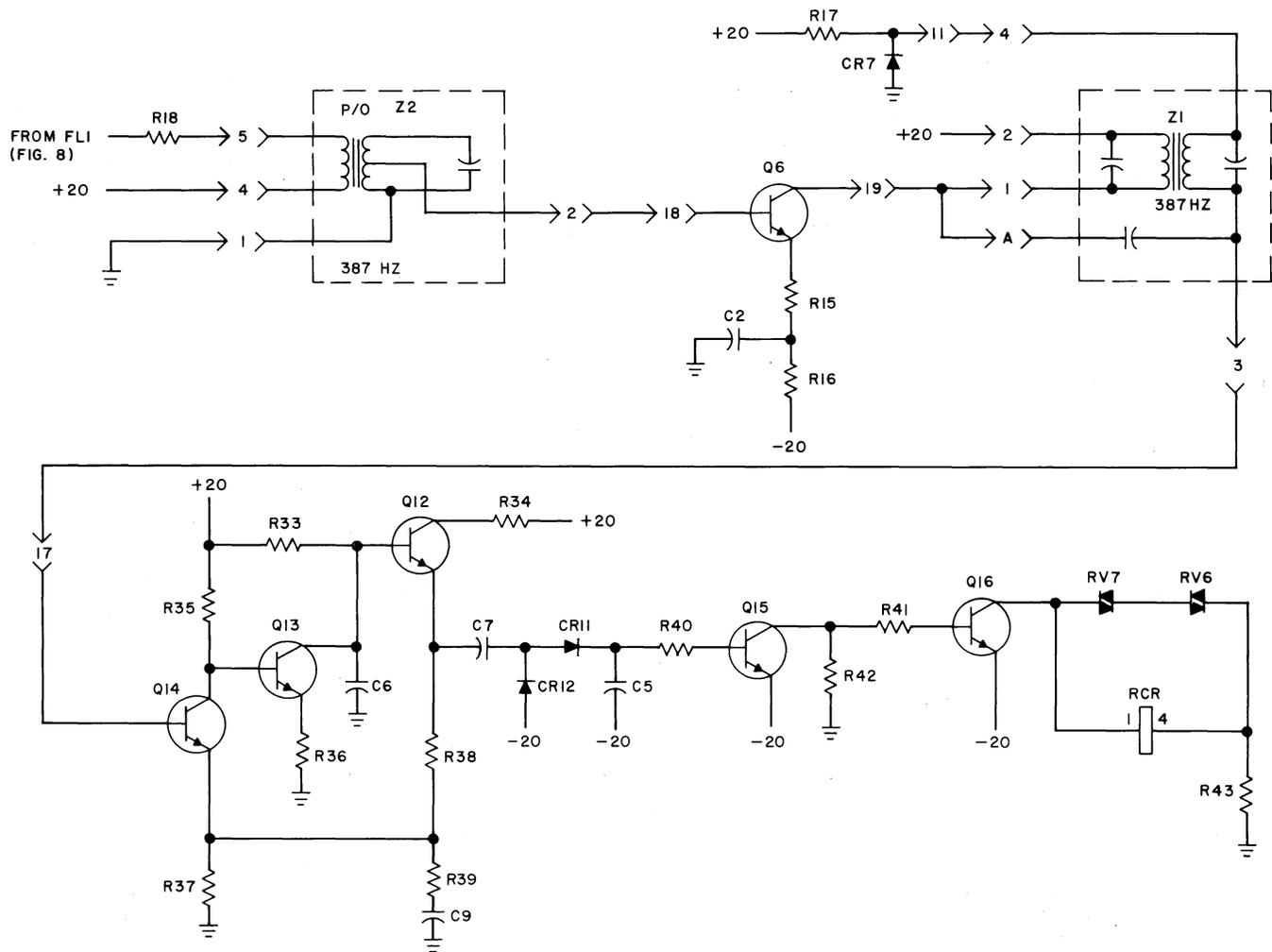


Fig. 6—Reverse-Channel Receiver—Schematic Diagram

**Line Control**

3.16 The line control circuit for the data set is composed of a telephone apparatus network, transformer T2, two K relays, and other miscellaneous components (Fig. 7). The circuit provides a means of placing the set in the desired operating mode (ie, talk mode or data mode).

3.17 When the data set is to be used as a telephone (ie, used in the talk mode), the handset is picked up and the TALK key is depressed. This closes the TALK key contacts and closes the contacts of the switchhook (SH), thereby placing the telephone network across the telephone line and shorting relays K1 and K2. The shorting path for the K relays is through the operated SH contact,

the operated contacts 3 and 4 of the TALK key, and the nonoperated contacts 1 and 2 of the DATA key. This prevents the relays from operating while the set is in the talk mode.

3.18 When the data set is to be operated in the data mode, the DATA key is depressed. The DATA key is a nonlocking key which releases all other keys on its return to the normal position. Depressing the key removes the shorting path across K1 and K2 relays that was established when the set was placed in the talk mode. This also shorts the telephone network through the operated contacts 1-3 of the DATA key. K1 and K2 relays operate from the central office current which is supplied through terminal 5 of TB1, through the K relays, transformer T2, the operated contacts

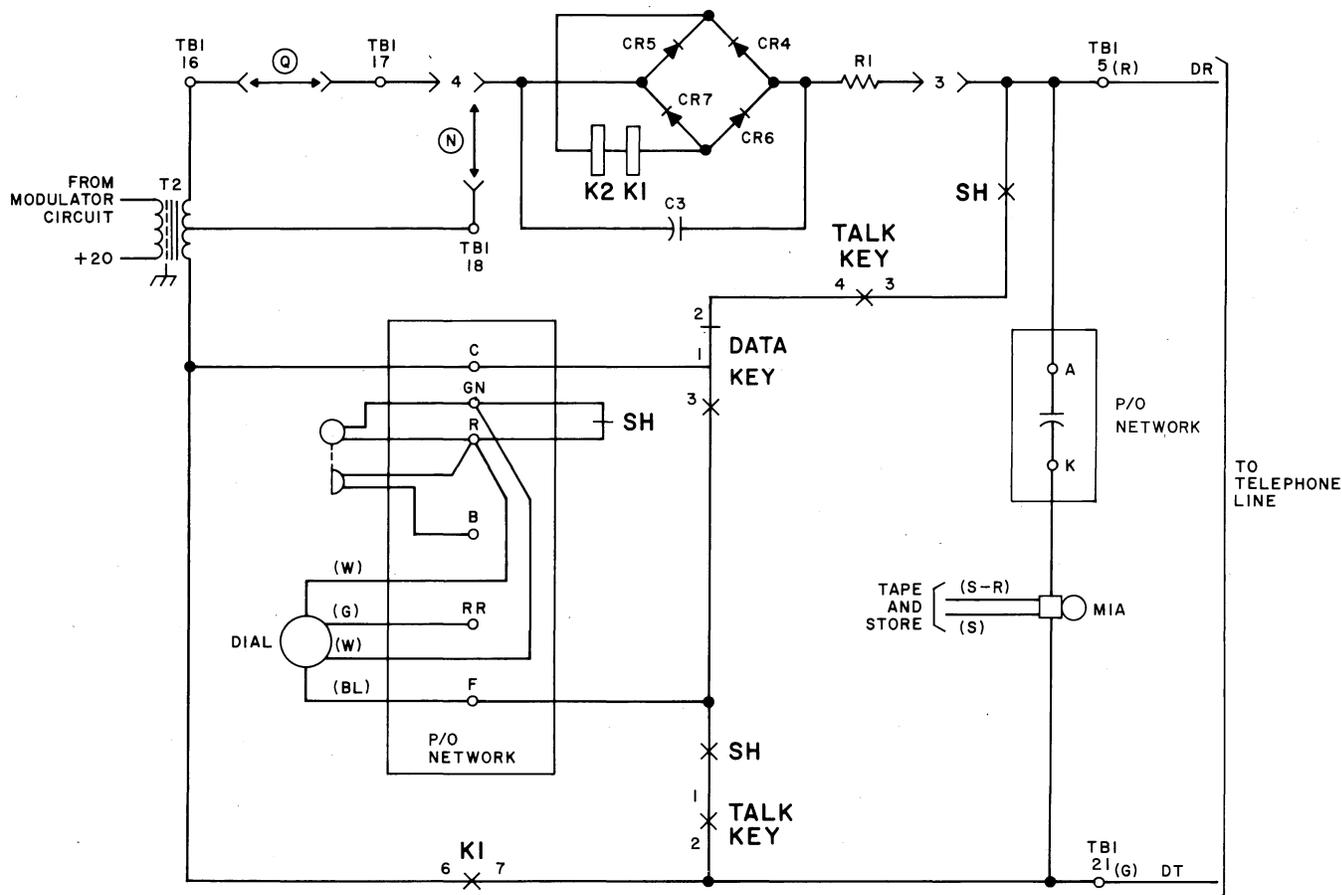


Fig. 7—Line Control—Schematic Diagram

1-3 of the DATA key, the SH, and the still operated contacts 1-2 of the TALK key, to terminal 21 of TBI. When the DATA key is released, the TALK key contacts open before the normally closed data key contact is closed. This insures that the previous short across the relays will not be reapplied. The K1 relay contact is used to provide a holding path for the K relays and to connect transformer T2 to the telephone line. The K2 relay contact applies ac power from the external transformer to the half-wave rectifiers and the RCR and DATA lamps (Fig. 5).

**3.19** Lightning protection is furnished by resistor R1 which is used to limit surge currents. Diodes CR4, CR5, CR6, and CR7 are used as a polarity guard to prevent the K relays from releasing when a surge current opposes the normal line current. Two zener diodes in the secondary of transformer T2 prevent peak voltages in the secondary from exceeding 8 volts.

### Data Modulator

**3.20** The modulator circuit (Fig. 8) is composed of a differential amplifier, a voltage-controlled multivibrator oscillator, networks Z1 and Z2, a group of level-adjusting resistors, and a low-pass filter FL1. Capacitor C1 has been added between the output of FL1 and ground to reduce high-frequency energy applied to the telephone line.

**3.21** Transistors Q7, Q8, Q9, Q10, and Q11 make up a differential amplifier that provides a high-impedance balanced load to the customer equipment and converts the balanced input to the single-ended signal needed to drive the multivibrator. Impedance between the inputs is maintained relatively constant by using two transistors on each side and shunting their high input impedances by resistors R25 and R26. The collector currents of Q8 and Q9 are fixed by the current source made up of transistor Q10, zener diode CR10, varistors RV3

SECTION 596-012-150

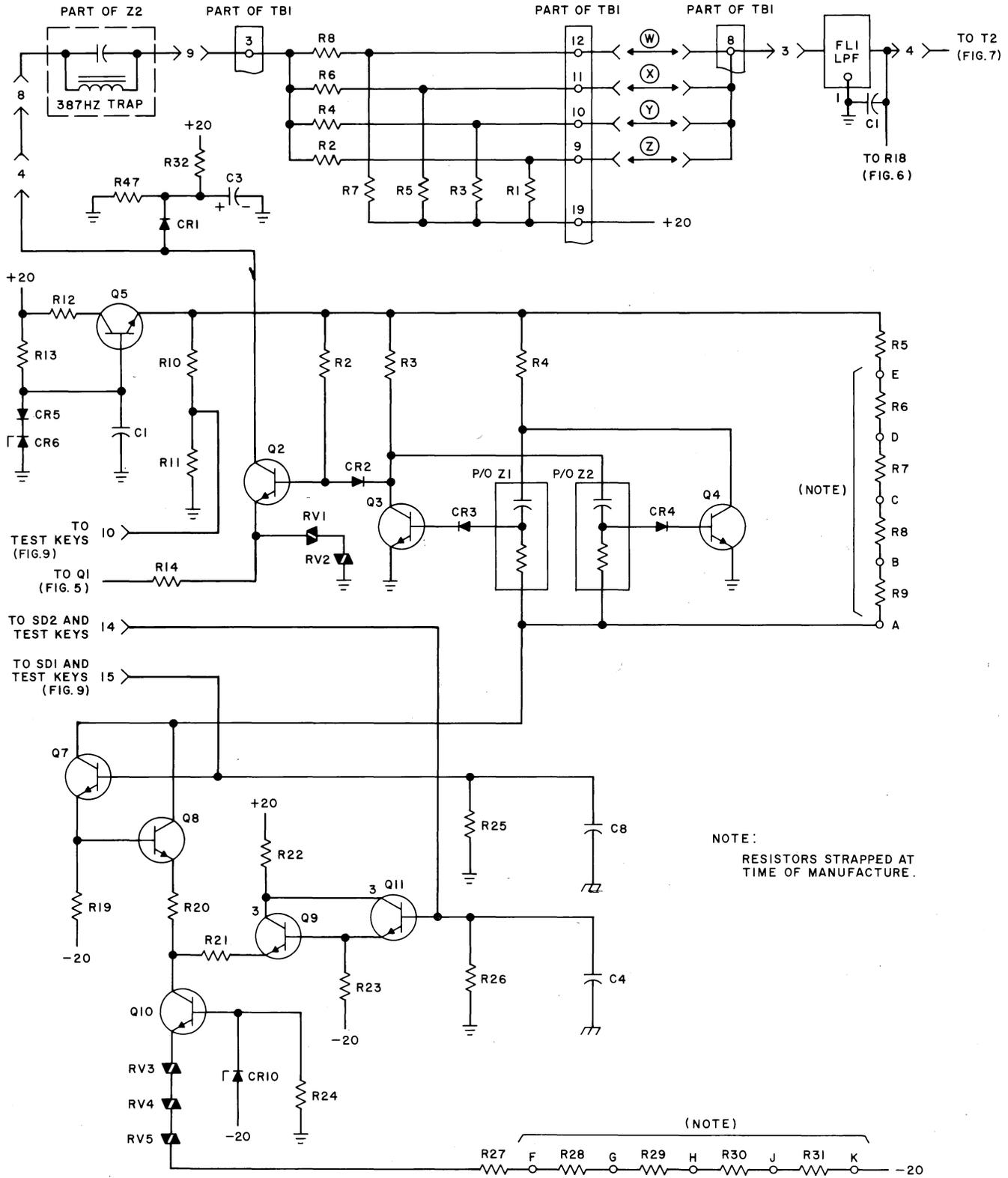


Fig. 8—Data Modulator—Schematic Diagram

through RV5, and resistors R24 and R27 through R31. The output from transistors Q7 and Q8 is used to control the frequency of the astable multivibrator which is made up of transistors Q3 and Q4. Diodes CR3 and CR4 are used to prevent reverse bias base-to-emitter breakdown in the transistors. Regulation of the positive supply voltage for the multivibrator and differential amplifier is accomplished by transistor Q5, diode CR5, and zener diode CR6. Transistor Q2 is used to isolate the multivibrator output circuit from the line and to provide a rectangular waveform. When transistor Q3 is off, diode CR2 is back-biased, isolating the multivibrator. Transistor Q2 is held on through resistor R2. When the multivibrator changes state, diode CR2 becomes forward-biased and transistor Q2 is held off. Varistors RV1 and RV2 are used to ensure proper turnoff of transistor Q2 and to provide a rectangular waveform to drive transistor Q1 which is part of the audible reverse-channel indicator amplifier. The output of transistor Q2 is applied to a tuned circuit in network Z2 and then to the four pairs of level-adjusting resistors which are made up of R1 through R8. The tuned circuit provided by Z2 reduces the data interference to the reverse-channel receiver. The level-adjusting resistors form voltage dividers which reduce the amplitude of the signal applied to the transmitting low-pass filter according to the level option that

has been selected (options W, X, Y, and Z). Filter FL1 is used to reduce the higher harmonics of the rectangular wave before applying it to the line. The output of the filter is coupled to the line through transformer T2 (Fig. 7).

**Note:** Resistors R1 and R2 in series 3 and lower data sets were 14,700 ohms and 2370 ohms, respectively. This produced an output of 0 dBm with option Z strapping. Resistors R1 and R2 in series 4 and higher data sets are 2740 ohms and 9530 ohms, respectively. This produces an output of -12 dBm with option Z strapping.

### Test Circuits

**3.22** Test circuits are provided to give a means of testing the data set from a remote location. Two test keys provide the necessary contacts required to transmit the test tones and thereby determine if the set is operating properly. The test circuit consists of the test key contacts (Fig. 9), and a voltage divider, made up of R10 and R11 (Fig. 8), and is connected to pin 10 of the test circuits.

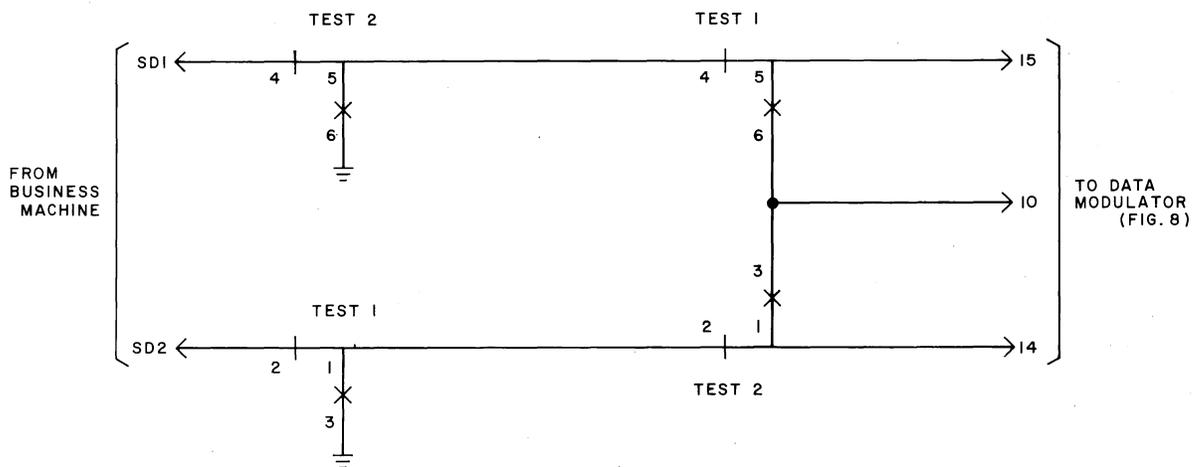


Fig. 9—Test Circuits—Schematic Diagram

## SECTION 596-012-150

**3.23** When a test key is depressed, both the SD1 and SD2 leads are disconnected from the interface. Operation of TEST 1 key grounds the SD2 lead and applies the output of the voltage divider through pin 10 to the SD1 lead. The voltage divider output is approximately +2 volts so the modulator frequency will be  $1720 \pm 35$  Hz. When TEST 1 key is released and TEST 2 key is depressed, the voltages on the SD1 and SD2 leads

are reversed and a higher frequency,  $2243 \pm 35$  Hz, is transmitted. With both TEST 1 and TEST 2 keys depressed, the SD1 lead is shorted to the SD2 lead and the frequencies transmitted will be  $1982 \pm 15$  Hz.

**3.24** The overall Data Set 603A-type is shown functionally in Fig. 10.

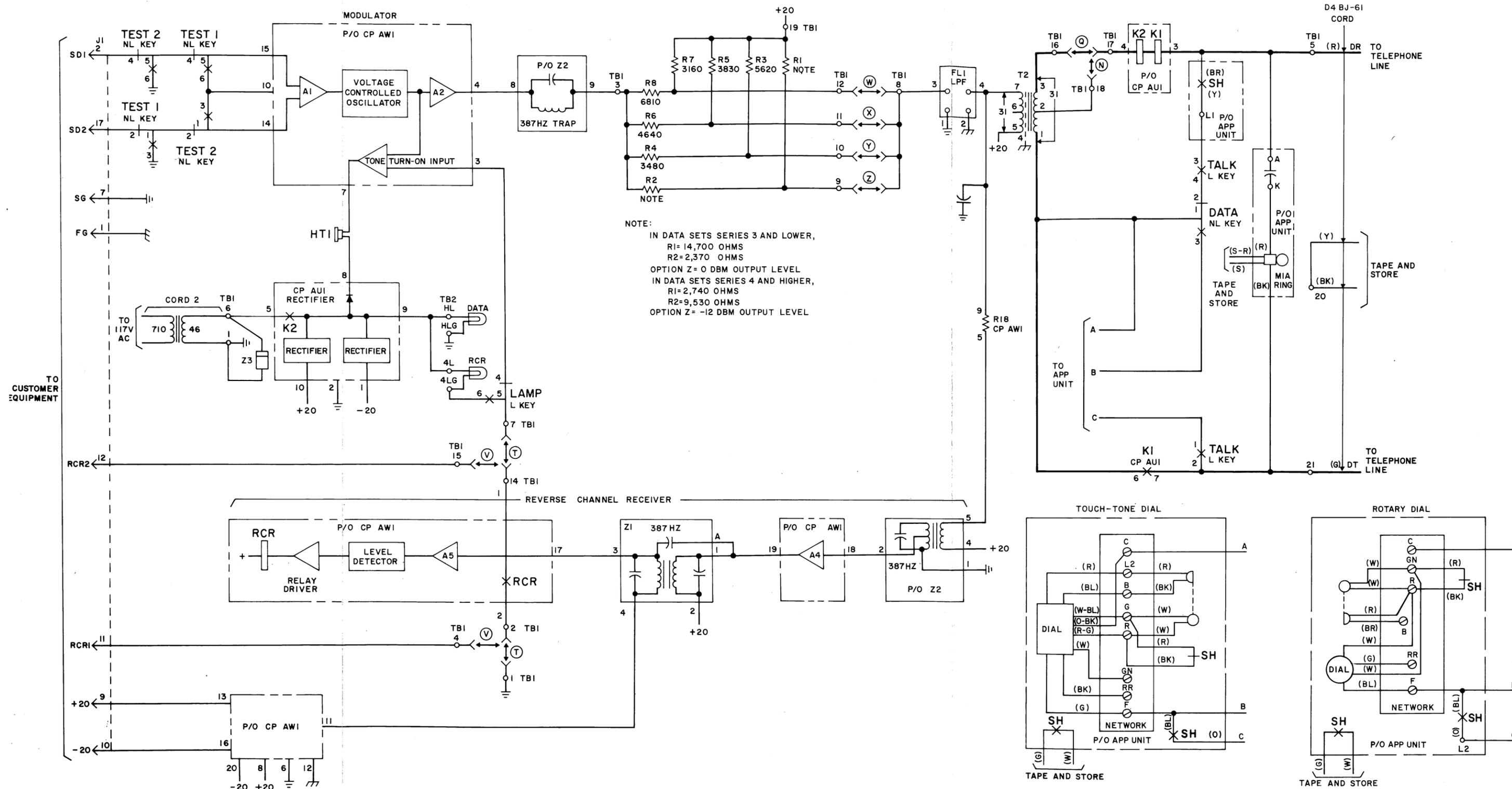


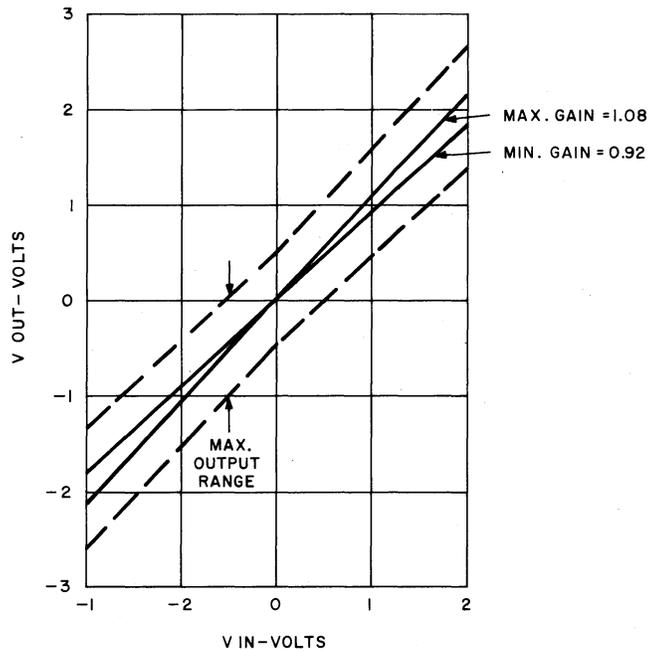
Fig. 10—Data Set 603A-Type—Functional Diagram

**4. PERFORMANCE DATA**

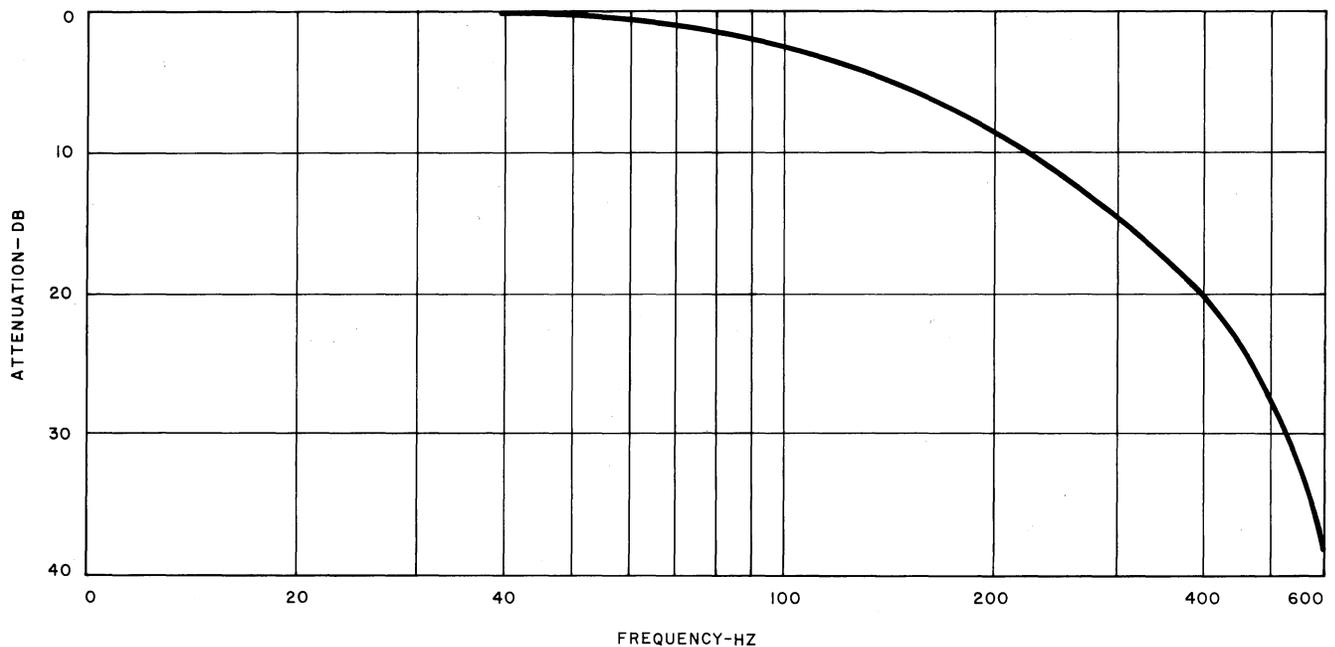
**4.01** In order to give information concerning the fidelity of transmission to be expected with Data Set 603A-type, some of the baseband channel characteristics are presented. These include static characteristics, amplitude and phase characteristics, noise performance, and harmonic distortion. For this information to be meaningful, the 603A-type transmitter and 603B-type receiver are considered as a single data system.

**4.02** The nominal gain of the system is 1.0 (ie, the output voltage should equal the input voltage). Manufacturing tolerances, line voltage variations, and temperature changes can add so that the gain is between 0.92 and 1.08 and the output voltage for 0 volts input is between +0.47 and -0.47 volt. If temperature variations are ignored, these numbers become 0.95, 1.05, +0.37 volt and -0.37 volt, respectively. Static characteristics of the 603A-type (Fig. 11), show the maximum and minimum slopes of the transfer characteristics and the region of possible output voltages versus input voltages. Note that there is a much larger uncertainty in the value of the output voltage for a given input than there is for the change in output for a change in input.

**4.03** The expected frequency response for a 603A-603B Medical Data System is shown in Fig. 12. Measurements over other facilities and through a line simulator with various delay and slope settings have little effect on this curve. This is accomplished by using a relatively narrow bandwidth line signal.



**Fig. 11—Data Sets 603A-603B—Static Characteristics**



**Fig. 12—Data Sets 603A-603B—Frequency Response**

SECTION 596-012-150

4.04 Phase characteristics of the 603A-603B system are shown in Fig. 13 and 14. Figure 14 shows a set of curves for test calls over the DDD network that were originated and terminated in

Holmdel, N.J. and looped back at the city indicated on the curve. For all cases, the phase is nearly linear in the regions of interest; however, the slope varies due to the differences in delays encountered.

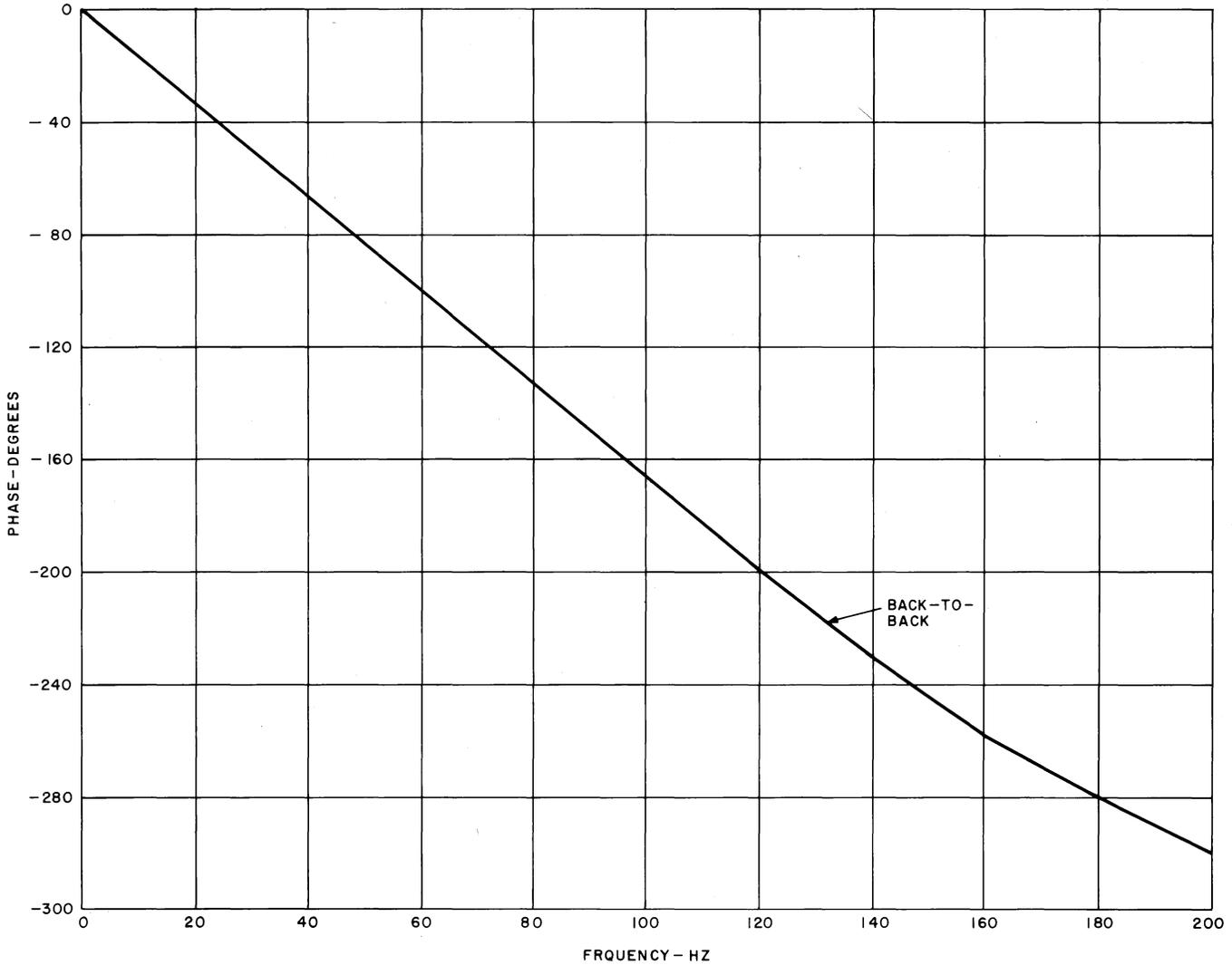


Fig. 13—Data Sets 603A-603B—Phase Characteristics

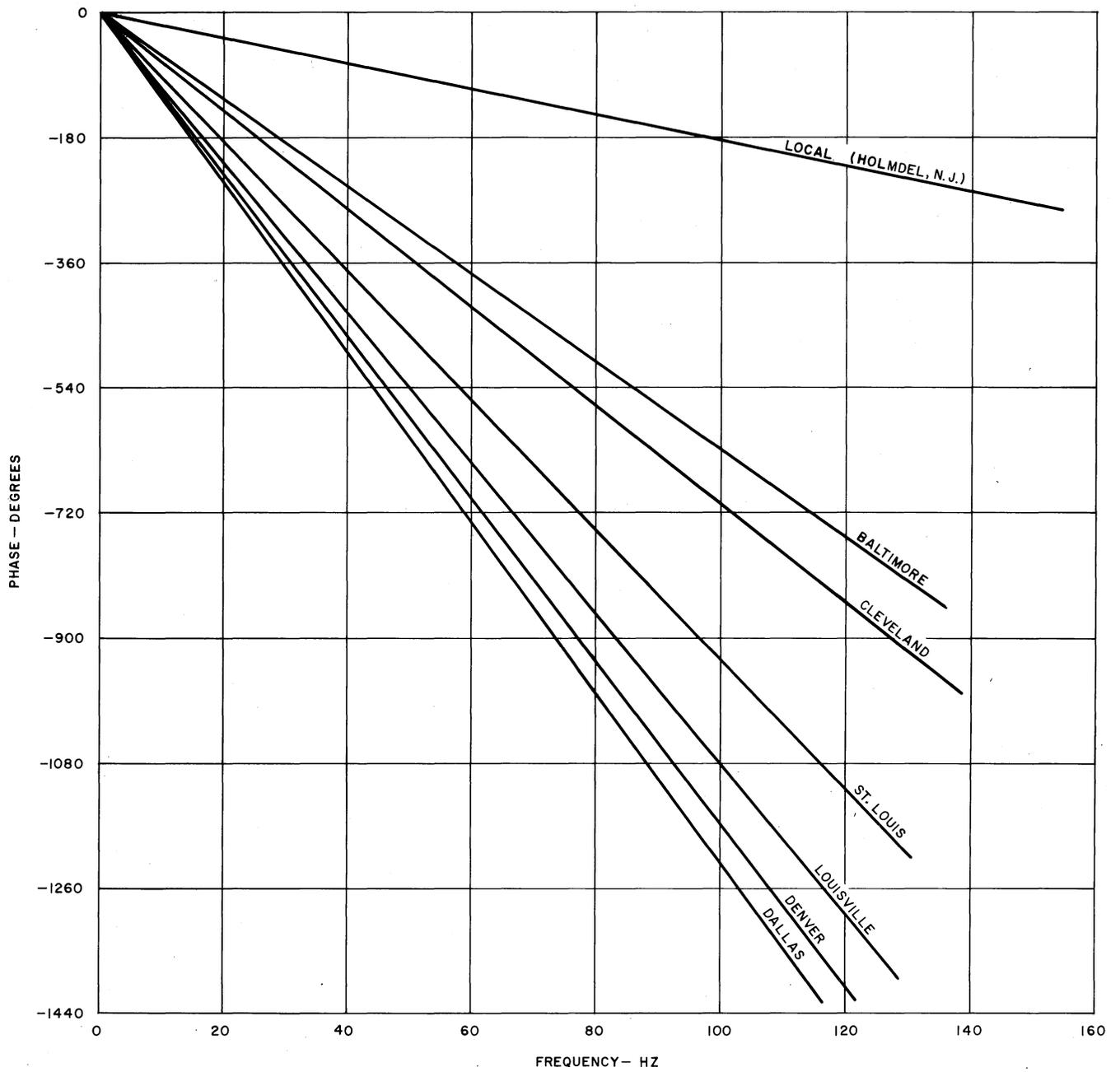


Fig. 14—Data Sets 603A-603B—Phase Characteristics by Location

**4.05** The harmonic content that can be expected in the output of the 603B is shown in Fig. 15. This distortion is the result of delay and amplitude distortion in the carrier band (2 kHz) of an FM system such as the 603A-603B system. The curves for a local call show that the second and third harmonics remain at least 40 dB below the fundamental.

**4.06** Some typical EKG traces transmitted over various telephone lines are shown in Fig. 16. The upper trace is the local copy obtained from the transmitting EKG. The other traces are the received traces over a local loop, a loop between Holmdel, New Jersey and Dallas, Texas and back, and a loop between Holmdel, New Jersey and Denver, Colorado and back. The local call produced a trace which has no apparent degradation. The trace received over the Dallas loop is quite acceptable except for the noise that is present. Note that the Denver call exhibits a large amount of "baseline wobble." This is caused by unwanted modulation of the local oscillators in the L Carrier System, which causes frequency modulation of the carrier input to the 603B. This often occurs on loop calls and is the worst transmission impairment encountered for this type of service. Although this impairment is easily recognized by a cardiologist as not belonging to the EKG, it is severe enough to destroy information. A computer trying to diagnose this trace might have some difficulty in distinguishing between the transmission impairment and any cardiac impairment.

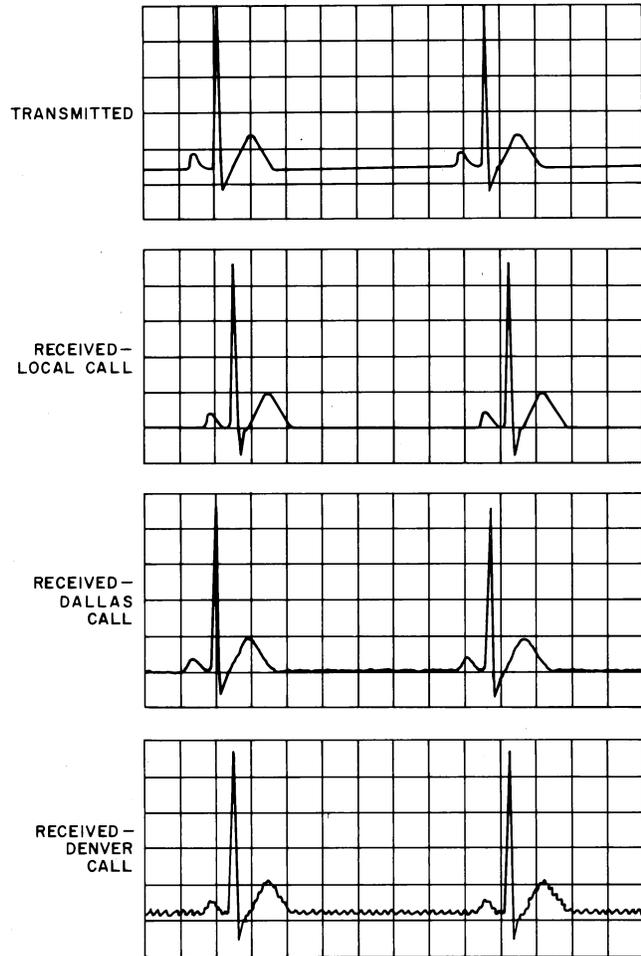


Fig. 16—Typical EKG Transmissions

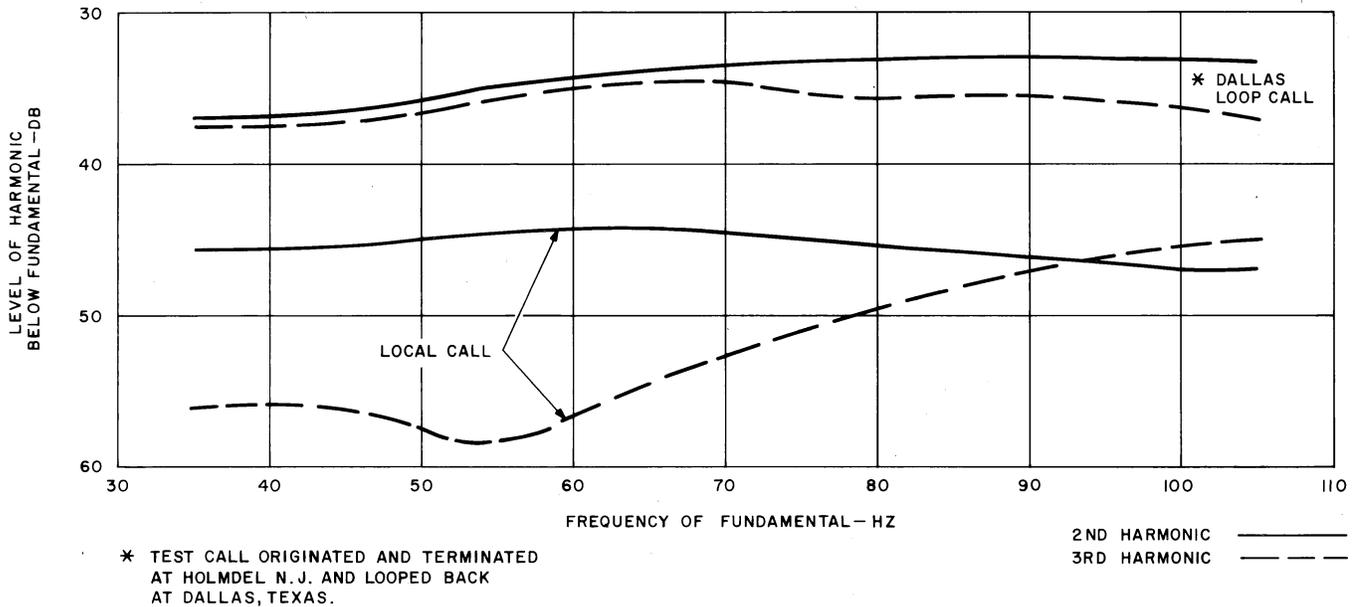
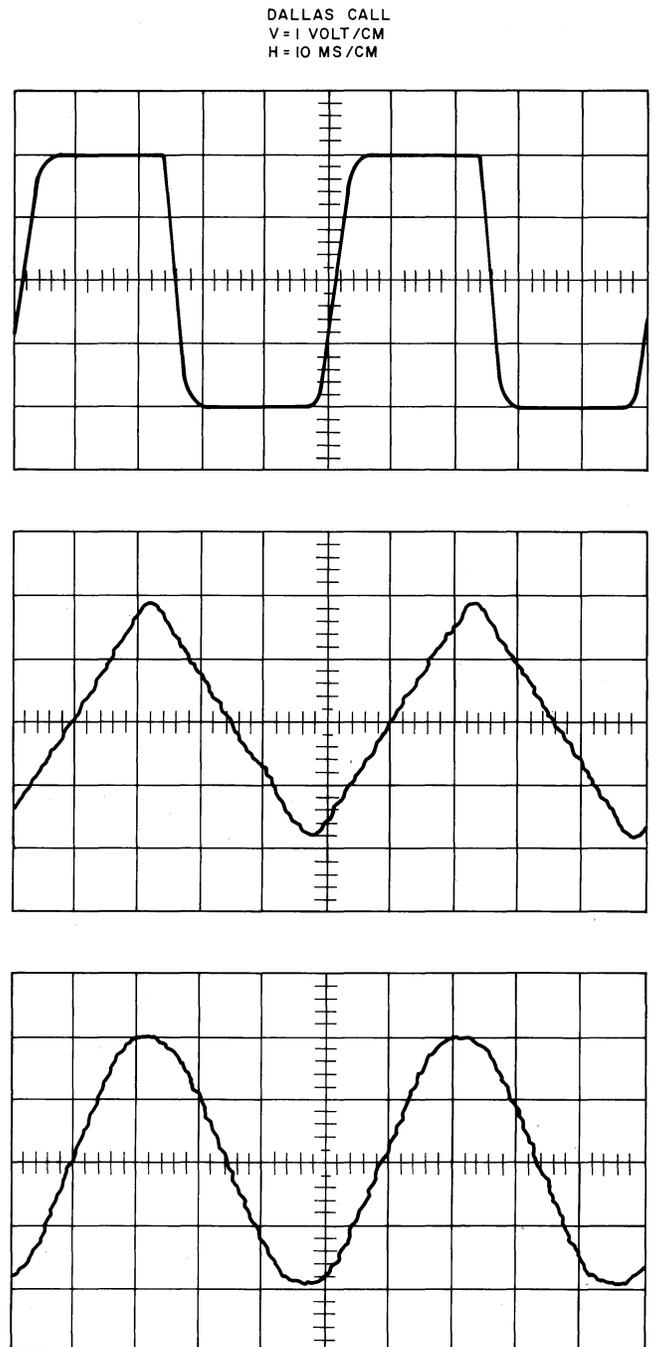
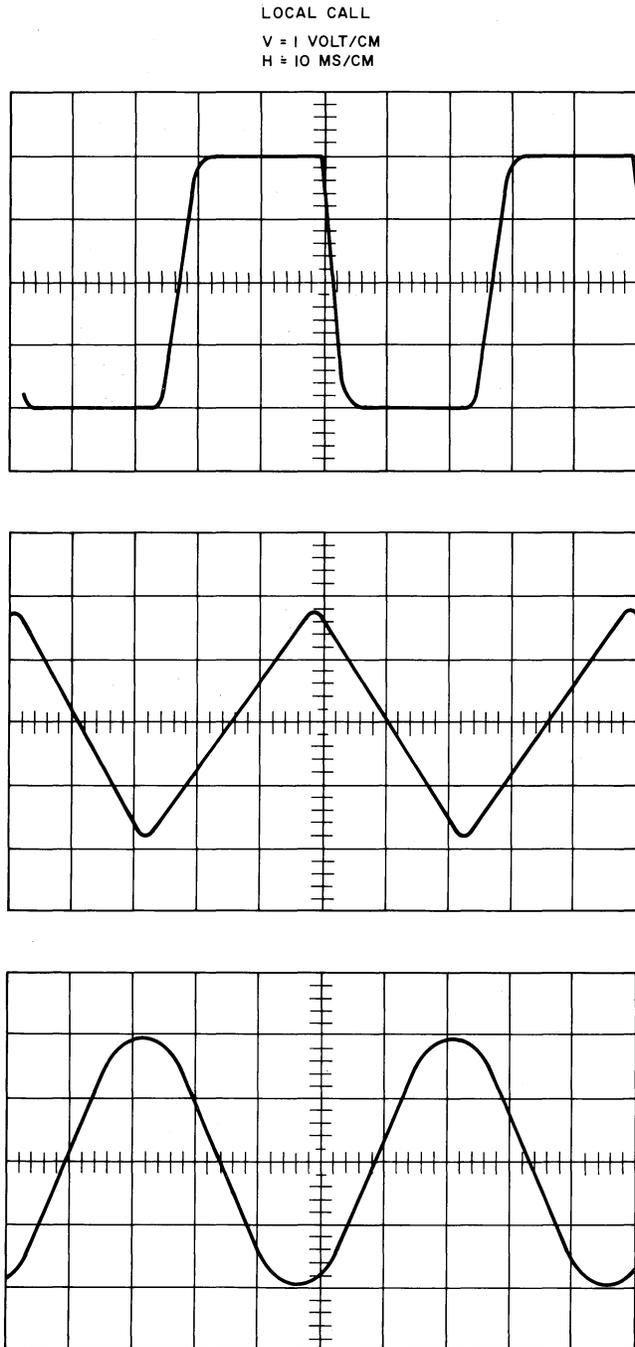


Fig. 15—Data Sets 603A-603B—Harmonic Distortion Curves

**4.07** Response of the 603A-603B system to square, triangular, and sine wave inputs of 4 volts peak-to-peak at 20 Hz is shown in Fig. 17. The square wave response has no overshoot and a rise time of about 5 ms, which is consistent with the 100 Hz system bandwidth. The triangular and sine waves show some evidence of harmonic distortion.

In the triangular wave, this is seen as a slight departure from a straight line for the sides.

**4.08** The test signal response taken over a loop call to Dallas, Texas is shown in Fig. 18. This figure shows that there is little change in the waveform due to the change in line facilities, except for the added noise.



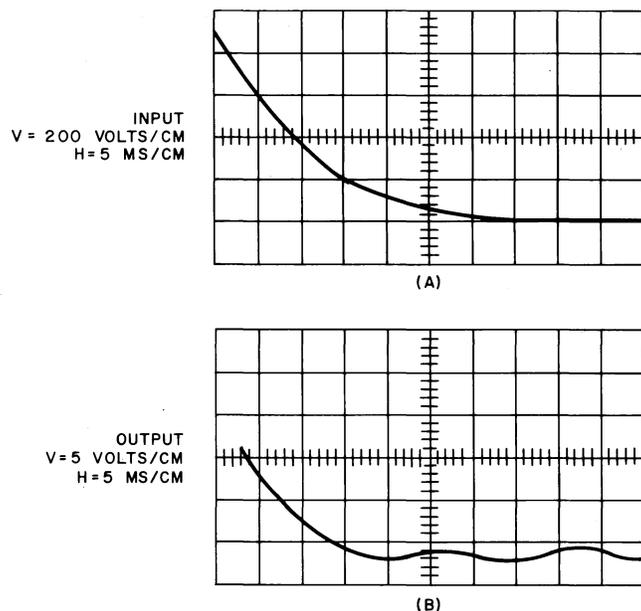
**Fig. 17—Test Signal Response—Local Call**

**Fig. 18—Test Signal Response—Dallas Call**

**4.09** Curve B of Fig. 19 shows the voltage produced at the input leads of the 603A-type transmitter when a simulated lightning surge, curve A, is applied to the telephone line. Although this is not strictly a measure of transmission performance, it is of interest to the potential users of the system. In use, the 603A is connected between a phone line and an EKG machine. The patient is in intimate contact with the leads from the EKG machine and any surge from the data set could conceivably cause harm to the patient. Even though the transmission from the data set to the patient is small (the path is backward through the EKG amplifier), it is desirable to keep these surges small. The curves show that for an 880-volt peak surge at the telephone line, the open circuit voltage at the input to the 603A is about 12 volts peak. The peak short-circuit current under these conditions is 2 mA. Since protector blocks normally limit surges to under 600 volts, the maximum voltage at the interface of the data set will be less than 10 volts.

## 5. MAINTENANCE INFORMATION

**5.01** The 603A-type does not require any routine maintenance.



**Fig. 19—Lightning Surge Response**

**5.02** For cover removal and replacement procedures, refer to the practice entitled Data Set 603A-Type For Transmission of Medical Analog Data—Maintenance (596-012-300).

**5.03** For installation testing and tests required at the customer premises when clearing trouble conditions, refer to the practice entitled Data Set 603A-Type For Transmission Of Medical Analog Data—Test Procedures (596-012-500).

**5.04** For detailed testing of the 603-type, refer to the following text and test layout (Fig. 20). This figure shows the test connections and layout or hookup that will be required to test the data set as outlined in the following paragraphs. The entire test or some parts of this test may be required when trying to determine the cause of trouble in a malfunctioning data set.

**5.05** In order to perform the following tests on the 603A-type, options N, V, and Z must first be installed. When an option is to be installed, refer to the practice entitled Data Set 603A-Type For Transmission Of Medical Analog Data—Installation (596-012-200) or Table A of this section.

**5.06** The switches in Fig. 20 are shown in the reset position. Any operation from that initial position places the switch in the operated position. All tests should be performed in sequence as some tests depend upon the previous switch settings.

## CONTINUITY TESTS

**5.07** Continuity tests and color code checks shall be made on all wiring except when a lack of continuity or incorrect association of apparatus will cause a failure of some other test. Sufficient continuity tests shall be made in all cases to ensure that the electrical association of apparatus and equipment is in accordance with the apparatus and equipment designations.

**5.08** All terminals and all apparatus cases for which ground is specified shall be checked to ensure that ground is present.



## SECTION 596-012-150

### TEST EQUIPMENT

**5.09** The following test equipment (or equivalent) (one each) will be required for the tests:

- Daven Attenuator, Type VT-795G, Range 0-111 dB
- Harrison 800A-2 Power Supply
- Hewlett Packard 405B DC Digital Voltmeter
- Hewlett Packard 523D Counter
- Hewlett Packard 200DC Oscillator
- Hewlett Packard 400L AC VTVM
- WECO 107B Frequency Generator
- General Radio Variac
- AC Voltmeter, Range 0-150 Volts, Accuracy  $\pm 2$  Percent

**5.10** Connect the test equipment to the data set as shown in Fig. 20.

### TALK CIRCUIT TESTS

**5.11** Adjust the variac until the ac voltmeter reads 115 volts. Operate switches S1, S4, and S9, and adjust R1 so that the voltage across L1 is  $60 \pm 2$  volts rms. With the handset of the 603A-type on hook, depress the TALK key and momentarily operate switch S11. Operation of S11 should cause ringing; resetting of switch S11 should cause the ringing to cease.

**5.12** Reset switch S1 and operate switch S11. Set the attenuator to approximately 20 dB and the oscillator frequency to 1000 Hz. With the handset off-hook, check for sidetone. Operate S2 and a tone should be heard in the handset. Depressing the switchhook should cause the tone to cease. Depressing the DATA key should also remove the tone. Press the TALK key and place the handset on hook.

### REVERSE-CHANNEL RECEIVER TESTS

**5.13** Set the oscillator frequency to 387 Hz and adjust its amplitude to 0 dBm. Place the set in the data mode by lifting the handset, pressing the DATA key and replacing the handset. Only the DATA lamp should light and it should remain

lighted when the handset is replaced. Pressing the TALK key should not extinguish the lamp.

**5.14** Set switch S6 to position 3. Operate switch S12 and gradually increase the attenuator setting until the digital voltmeter reading starts to decrease from its previous value of about 2 volts. Record the attenuator setting. The value should be greater than 50 dB.

**5.15** Remove option V and install option T.

**5.16** Set the attenuator to 100 dB. A tone, which increases in frequency when the TEST 2 key is pressed and decreases in frequency when the TEST 1 key is pressed, should be heard. When the LAMP key is pressed, the tone will not be heard but the LAMP key shall light.

**5.17** Set the attenuator to 48 dB. Vary the oscillator frequency above and below the 387-Hz setting and record the frequencies at which the LAMP key begins to flicker. The lamp should not flicker until a frequency less than 380 Hz is set or a frequency greater than 394 Hz is reached. Reset the oscillator to 387 Hz.

### POWER SUPPLY TEST

**5.18** Place switch S6 in position 1 and record the digital voltmeter reading. This reading should be  $18.3 \pm 1.1$  volts.

**5.19** Place switch S6 in position 2 and record the digital voltmeter reading. This reading should be  $21.4 \pm 1.3$  volts.

### TRANSMITTER TEST

**5.20** Set switch S4 to the operated position and switch S6 to position 4. Set power supply to +2.00 volts. Reset switch S12 and record the ac VTVM reading. This reading should be  $-12 \pm 1.5$  dBm for data sets marked series 4 or higher, and  $0 \pm 1.5$  dBm for data sets marked series 3 or lower. [Refer to the section entitled Data Set 603A-Type for Transmission of Medial Analog Data—Installation (596-012-200) for information on external padding that may be required for sets marked series 3 or lower].

**5.21** Remove option Z and install option Y. Record the VTVM reading. This reading shall be  $-3 \pm 1.5$  dBm.

**5.22** Remove option Y and install option W. Record the VTVM reading. This shall be  $-9 \pm 1.5$  dBm.

**5.23** Remove option W and install option X. Record the VTVM reading. This reading shall be  $-6 \pm 1.5$  dBm.

**5.24** Remove option N and install option Q. Place the set in the data mode. The VTVM reading will be approximately the same as the previous reading.

**5.25** Record the counter frequency. This shall be  $1988 \pm 13$  Hz.

**5.26** Operate switches S7 and S8 and record the counter reading. The counter shall read  $2248 \pm 20$  Hz.

**5.27** Reset switch S8 and record the counter reading. The counter shall read  $1724 \pm 20$  Hz.

**5.28** Subtract the reading recorded in 5.27 from the counter reading obtained in 5.26. The difference shall be  $524 \pm 15$  Hz.

#### TEST CIRCUITS TEST

**5.29** Reset switch S7 and press the TEST 1 key. Record the counter reading. This reading shall be  $1720 \pm 35$  Hz.

**5.30** Depress the TEST 2 key and record the counter reading. The counter shall read  $2243 \pm 35$  Hz.

**5.31** Simultaneously depress and hold both the TEST 1 and TEST 2 keys and record the counter reading. The counter shall read  $1982 \pm 15$  Hz.

**5.32** Add the counter reading obtained in 5.29 and 5.30. Divide the total by 2. This shall be equal to the reading obtained in 5.31 within  $\pm 5$  Hz.

#### SIGNAL AND FRAME GROUND TEST

**5.33** Set switches S10 and S12 to the operated position. Set switch S6 to position 5. Record the reading of the digital voltmeter. The voltmeter shall read  $1.0 \pm 0.2$  volt.

**5.34** Set switch S3 to the operated position and reset switches S4 and S10. Adjust the oscillator frequency to 1000 Hz and set the amplitude to  $1.5 \pm 0.1$  volt.

**5.35** Operate switch S5 and record the ac VTVM reading. The VTVM shall read less than 1.1 volts.

**5.36** Reset all switches. If the data set has passed all of the preceding tests, it may be considered to be operating properly.

**5.37** For detailed maintenance of the circuit packs, refer to the Bell System Repair Specifications (BSRS) 480.022.

**5.38** Component placement on the circuit packs is shown in Fig. 21 and 22.

#### 6. REFERENCES

**6.01** Sources of additional information on Data Set 603A-type are listed as follows:

- (a) CD-1D075-01
- (b) Bell System Repair Specification (BSRS) 480.022
- (c) SD-1D075-01

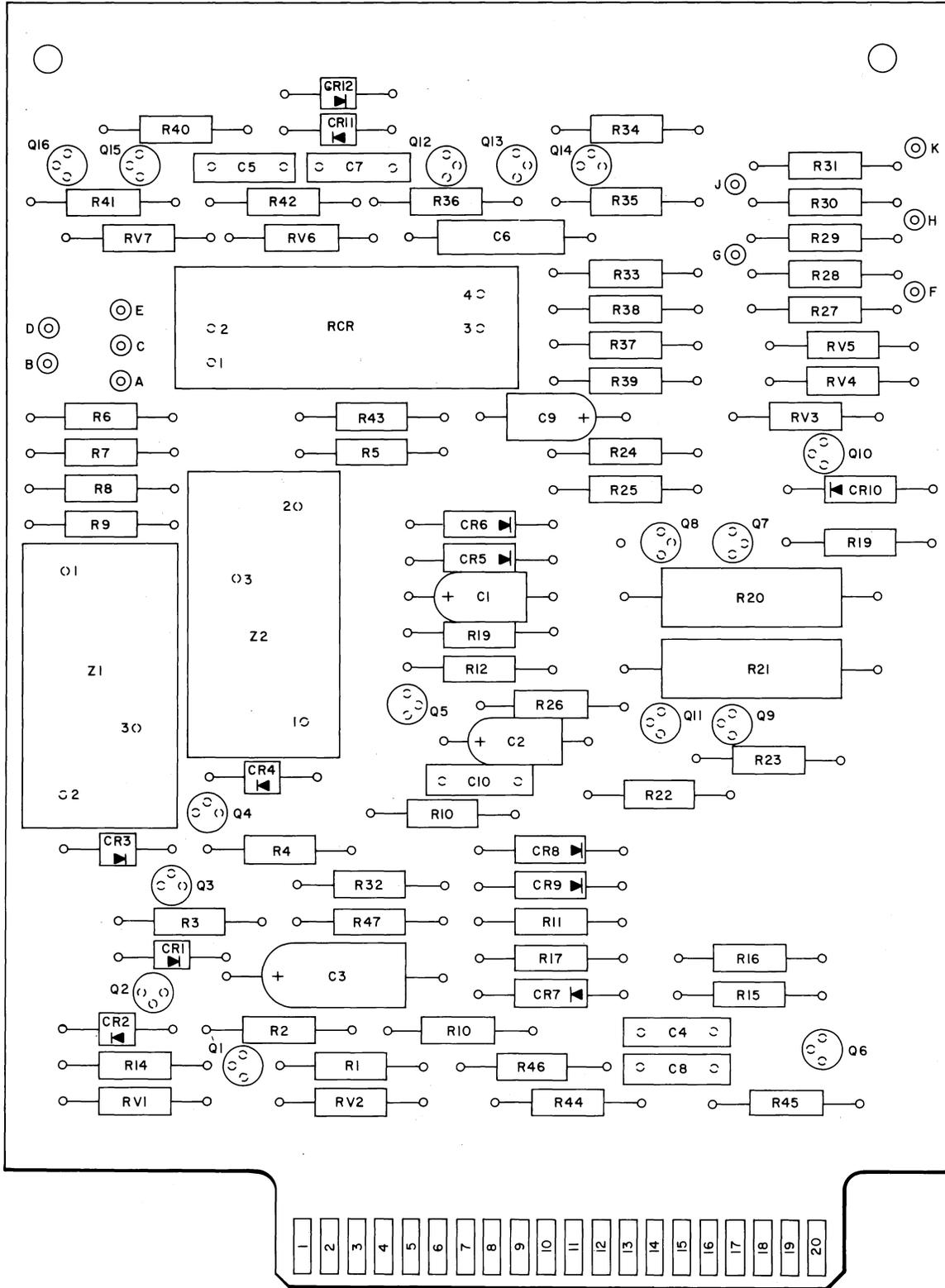


Fig. 21—CP AW1 Component Placement

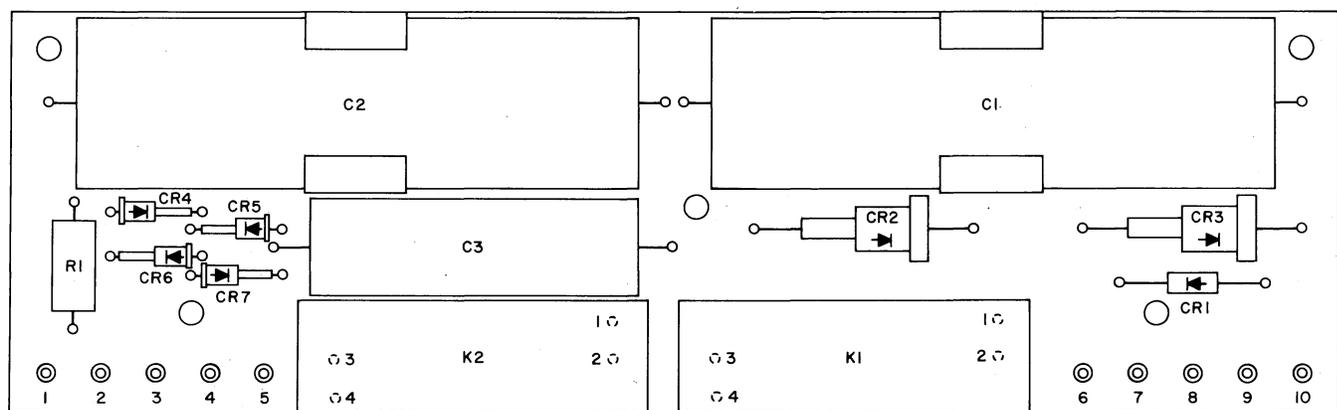


Fig. 22—CP AU1 Component Placement