DOT GENERATOR AND BIAS MEASURING SET

CONTENTS PAGE

1. GENERAL

1.01 This section describes the combination Dot Generator and Bias Measuring Set used in the maintenance of high speed data systems and especially the Digital Subset. The set consists of a Dot Generator providing a source of square wave test signals and a Bias Detector to determine bias in the signal when received. The signal may be adjusted from approximately 400 to 4000 bits per second. This Issue 2 includes minor changes in the circuit schematic and in the calibration procedure.

1.02 The Dot Generator and Bias Detector portions of the test set are two separate circuits. They are merely installed in a single box for convenience. The over-all size of the instrument is approximately 6-3/4 by 5-1/4 by 2-3/4 inches. Fig. 1 shows the layout of the panel face.

1.03 The test set is used in conjunction with an external meter such as the KS-14510 Volt-Ohm-Milliammeter. When used with the above meter circuit bias may be read within 1% giving sufficient accuracy for the setting of slicing levels in the data transmitting equipment and providing an indication of the degree of distortion in a given system.

1.04 "Bias" as used with these circuits may be defined as the ratio of the excess positive bit length to the normal bit length. (See below for equation)

$$\text{Per cent Bias} = \frac{100\ [(\text{Positive Bit Length}) - (\text{Normal Bit Length})]}{(\text{Normal Bit Length})}$$

This is illustrated as shown in Fig. A.

2. CIRCUIT DETAILS

2.01 Fig. 2 is a schematic diagram of the test set. The left-hand portion of the circuit is the square wave generator and the right-hand portion is the bias detector.

(A) Dot Generator

2.02 In the square wave generator transistors T3 and T4 are used as a multivibrator to provide square waves. This part of the circuit operates as follows. Assume that T4 is conducting and T3 is cut off. The emitter of T4 is then held at a potential determined by the drop thru R1 and R2 and will be about − 9 volts.

2.03 The current thru T4 raises its collector voltage thus holding the base of T3 at such a potential as to keep it cut off. As C1 charges the voltage of the emitter of T3 rises until it equals that of the base and T3 starts to conduct. This conduction thru T3 takes part of the current from T4 causing its collector potential to drop and T3 to carry still more of the emitter current.

2.04 This accelerating shift causes the emitter of T3 to rapidly fall to a voltage about equal to the negative power supply and the emitter of T4 to fall below its base potential by the

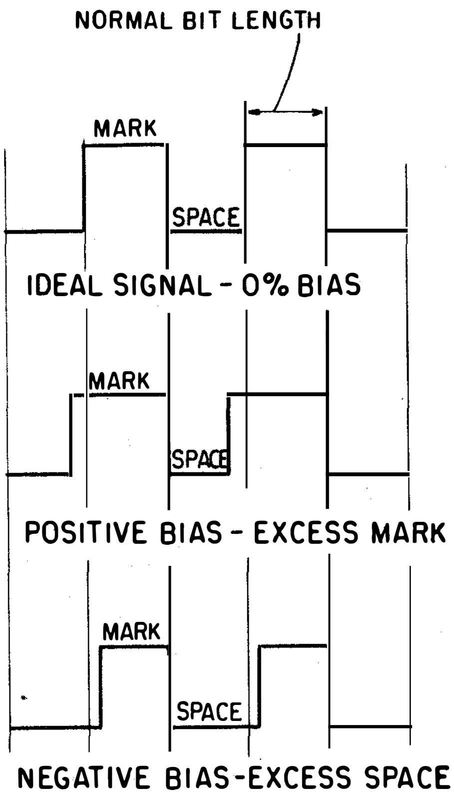

Fig. A

coupling thru C1. With T3 conducting the capacitor C1 will now charge in the opposite direction so as to build up the potential on T4 and allow T4 to start again conducting. When the emitter of T4 rises above its base the process reverses, T4 takes all the current again and the cycle is complete.

2.05 The Dot Bias potentiometer R5 adjusts the relative length of time each of the transistors T3 and T4 conducts. The time each is conducting depends on the time for the capacitor C1 to be charged by the current in the nonconducting transistor emitter circuit. Changing the ratio of the emitter resistors changes this charge time and the ratio of the time in the conducting and nonconducting state. The potentiometer is adjusted so that each of the transistors conducts for half the time in order to give an output signal of zero bias.

2.06 The potentiometer R7 controls the frequency of the signal by changing the amount capacitor C1 must charge to cause a reversal, of conducting conditions of T3 and T4, that is the charge required to drop the emitter voltage to the base potential. This control therefore permits setting the frequency or bit rate of the signal by means of the calibrated dial on the potentiometer.

2.07 The output of the multivibrator is fed from the collector of transistor T4 thru capacitor C2 to the base of transistor T2. The network R8, R9 and the associated varistor is used to equalize the charging of C2 in the positive and negative halves of the multivibrator cycle. This insures sufficient base current in T2 during the time it is conducting.

2.08 Transistors T1 and T2 act as an amplifier and output circuit. When a ***negative*** signal is applied to the base of T2 the transistor conducts and lowers the base of T1 to nearly 0 volts. In this condition a very small current thru R11 serves to keep T1 cut off. The output at the DOT GEN OUTPUT jacks is then also about zero.

2.09 When the input to T2 from the multivibrator is ***positive,*** T2 is cut off. In this condition the current thru R10 and R13 causes the base of T1 to become negative and T1 to conduct. This negative level is controlled by the LEVEL CONTROL potentiometer R13 and so controls the negative magnitude of the output signal.

(B) Bias Detector

2.10 The Bias Detector circuit (right side of Fig. 1) serves to measure the signal bias or the difference in length of the positive and negative portions of the signal.

2.11 When a square-wave signal is applied to the input terminals and the positive peak voltage is accumulated on capacitor C3 and the negative peak voltage on capacitor C4. The polarities of the two varistors are such as to prevent conduction which would discharge the capacitors as the wave reverses polarity.

3. METHOD OF OPERATION

3.01 The test set as normally used provides a symmetrical square wave as a signal source which is applied to the transmitting data terminal, passed thru the modulator, over the transmission line, thru the demodulator of the receiving terminal and to the Bias Detector section of another test set to measure the signal bias inserted by the equipment. Loop measurements with a signal test set may also be made on local equipment or when two identical line facilities are available.

3.02 Operating procedure for the set is as follows:

(A) Calibration of Dot Generator

(1) Connect the 20V DC INPUT jacks to a negative 20-volt dc supply. The supply in the Digital Subset may be used when available.

(2) Set the BIT RATE to the desired value by means of the scale on the calibrated frequency control potentiometer. The test set will operate from approximately 400 to 4000 bits per second.

(3) Connect the KS-14510 meter to the METER jacks. Set the meter to the 0-60 microampere range.

(4) Connect the DOT GEN OUTPUT jacks to the Bias Detector INPUT jacks.

(5) Set the Balance-Calibrate switch to the BAL position.

(6) Adjust the bias of the square-wave signal using the Dot Bias Potentiometer until the meter reads zero.

(7) Set the Balance-Calibrate switch to CAL and adjust the amplitude of the Dot Generator signal to the desired value by means of the OUTPUT LEVEL control. This voltage may be adjusted from zero up to a swing of about zero to −13.5 volts. (0 volts for a mark and −13.5 volts for a space.) To set the Dot Generator output to swing from zero to −12 volts, as required for the input of the modulator of the Digital Subset, adjust the Output Level control to obtain a meter deflection of 10 on the 0-12 volt scale, ***with the meter set to the 0-60 micro-ampere*** range. Other signal voltages may be obtained by adjusting the Output Level control for proportional meter deflections.

(B) Measurement — Subset Slicing Level

(1) Connect the DOT GEN OUTPUT jacks to the transmitter input of the data subset.

(2) At the receiving end connect the data subset receiver output to the test set INPUT jacks with the meter connected to the METER jacks.

(3) With the meter on the 0-60 microampere scale, adjust the slicing levels in the data receiver so that the meter indicates zero when the Balance-Calibrate switch is in the BAL position.

(C) Measurement — Per cent Bias

To determine per cent bias (although not required for correct adjustment of the data subset), the actual per cent bias of the signal may be determined as follows.

(1) Calibrate the set as in Part (A).

(2) Connect the signal to be measured to the test set INPUT jacks and the meter to the METER jacks.

(3) With the meter on the 0-60 microampere scale read the meter with the BAL-CAL switch first in the Balance position and then on the Calibrate position.

(4) $\%\ \text{Bias} = \dfrac{100\ \text{(Meter r'd'g in BAL pos.)}}{\text{(Meter reading in CAL pos.)}}$

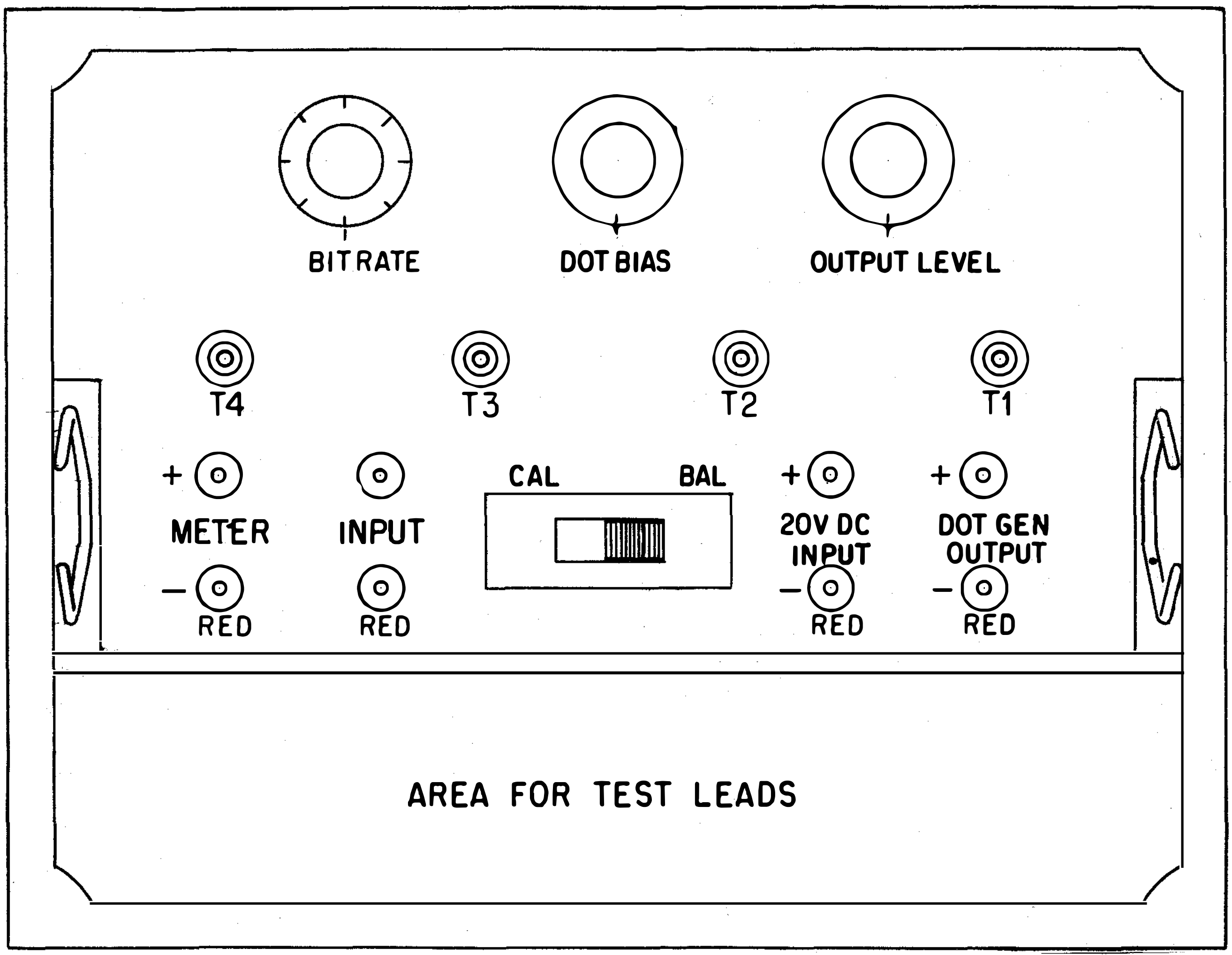

Fig. 1 — Panel of Dot Generator and Measuring Set

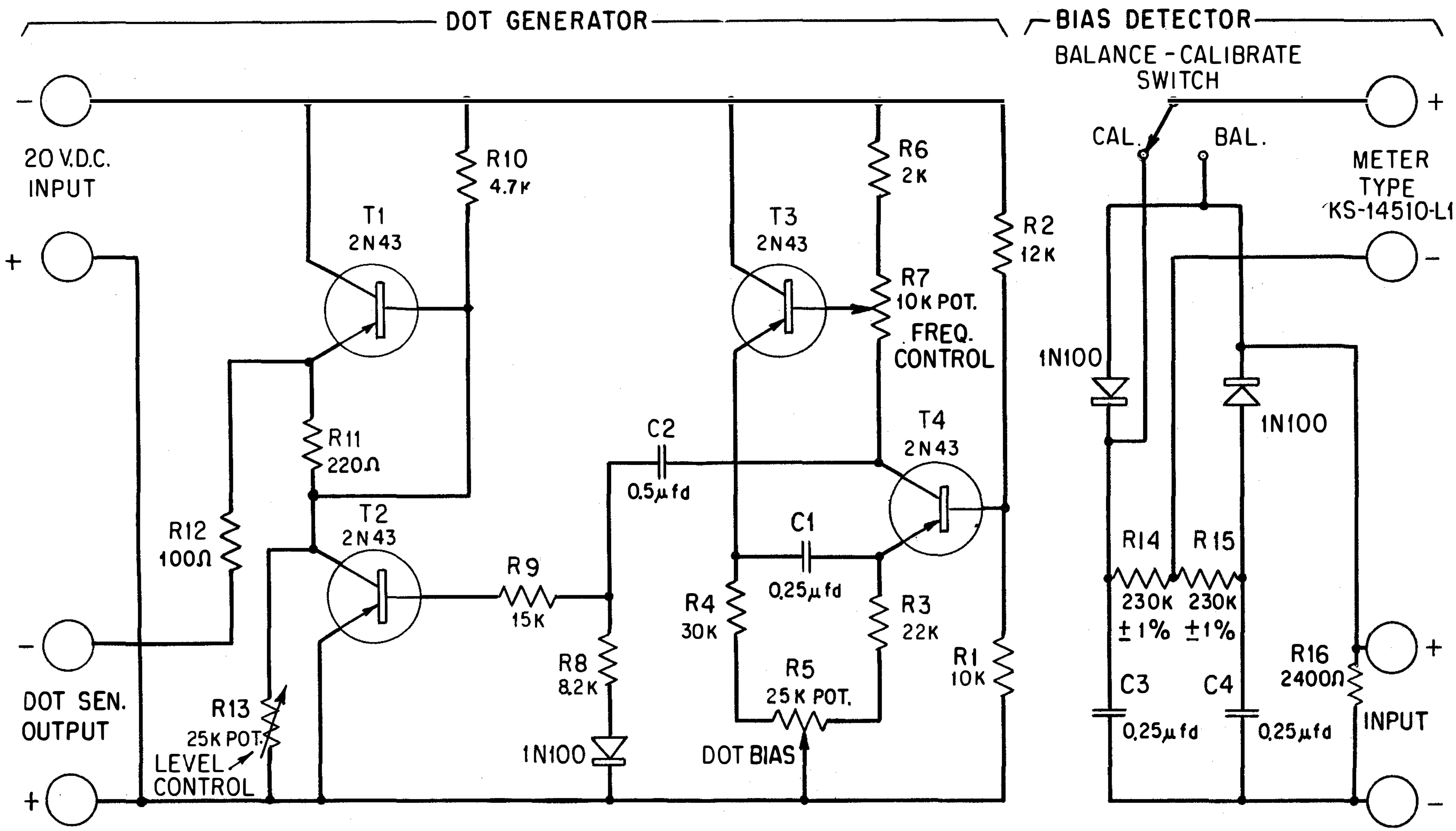

Fig. 2 — Dot Test Set