

FIELD MAINTENANCE SUPPORT

50-Ohm Amplitude Calibrator

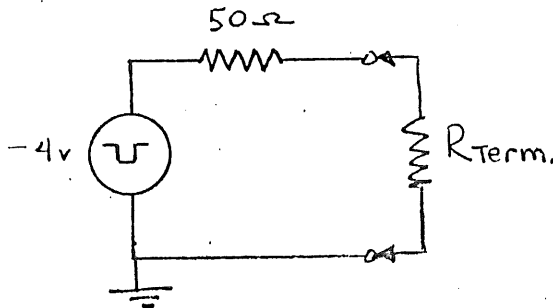
NOTE: THIS DEVICE IS TRACEABLE TO NBS. ALTHOUGH IT REQUIRES COMPLETE CALIBRATION ANNUALLY, THE GAIN MUST BE CHECKED EVERY 90 DAYS TO INSURE ACCURACY.

General:

The 50-ohm Amplitude Calibrator is basically a variable resistance that loads the 105 so that a relatively constant output voltage capable of supplying a 50-ohm load is obtained. This variable load consists of a transistor circuit referenced against a Zener diode. The regulator transistor draws current through a 6-volt lamp which is used to indicate when the regulator transistor is in operation.

Unfortunately the circuit does not have 100% regulation capabilities. The regulator will hold the output constant within $\pm 1\%$ before the circuit goes out of regulation. This 1% can be improved by holding the current in the regulator transistor to as nearly a constant value as possible. This point has been chosen as the current level at which the lamp passes from a visible glow to apparent darkness. The circuit actually is regulating long after the lamp extinguishes. It is very important to set the 105 to this point of operation if accuracies of $\pm .4\%$ are to be achieved. Also, a 15-minute warmup time should be allowed before using the calibrator. This allows the temperature of the regulator transistor to rise to the point where it is stable.

An initial divider has been included in the regulator (150-ohm series and 75-ohm shunt resistor) which drops the regulated -12 volts to -4 volts open circuit. This makes the calibrator look like a 50-ohm source in all calibrator settings. (This is a requirement for the calibrator used for setting gain of a 4S1.) Note then, that the output voltage will not be that indicated on the dial unless the calibrator is terminated in 50.0 ohms. The output error can be calculated by measuring the termination resistance and considering the source as having 50 ohms resistance.



50.0 ohm termination
gives $-4 \left(\frac{50}{100} \right) = -2.000V$

50.1 ohm termination
gives $-4 \left(\frac{50.1}{100.1} \right) = 2.002V$

50-Ohm Amplitude Calibrator (continued)

The 4S1 appears as 49 ohms to low frequencies (below 200 kc). The actual input voltage, in the 2 volt position, will be about 2% low. This is exactly as it should be, since the 4S1 is designed to indicate a voltage that came from a 50-ohm source and is terminated in a 50.0 load.

The 3S76, however, is a 50-ohm termination. Here the CRT indicates the actual voltage seen at the input terminals.

In calibrating the 3S76, the input DC resistance should be measured first. Then the input voltage corrected if the input resistance varies significantly from the nominal. Therefore, if the input was 50.1 ohm (+0.2%) the calibrator voltage is +.2%.

Normally, with input terminations that are within 0.2%, no corrections will be necessary. Since the 50-ohm terminations used in the 3S76 are $\pm 1\%$ resistors, it will be necessary to bear this correction in mind.

Inasmuch as active elements are involved in the regulator circuit, its calibration should be checked every 90 days. The following procedure for setting the regulator gain is included for this purpose. The resistance attenuator (1.2-0.012) accuracy should be certified annually. This item should be returned to Field Maintenance Support for recertification annually as indicated on the calibration sticker.

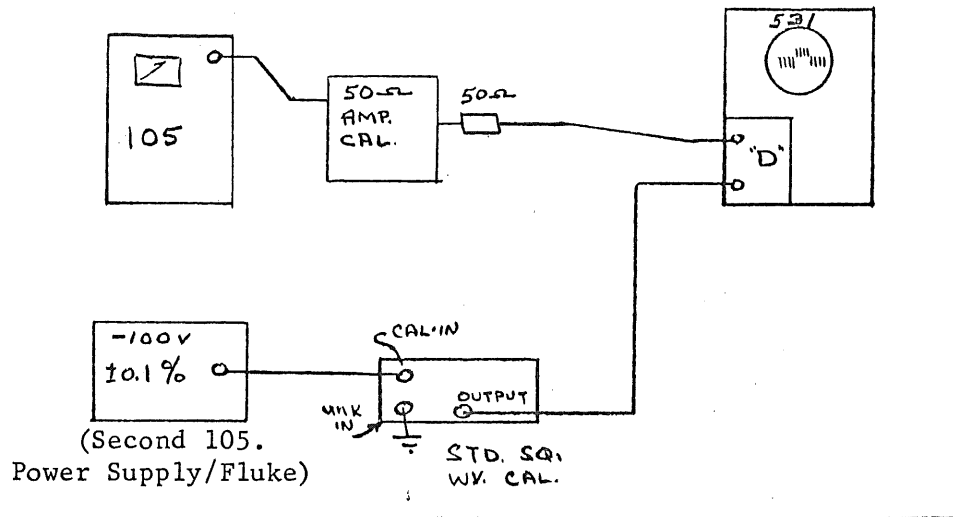
CALIBRATION PROCEDURE
for 50-ohm Amplitude Calibrators

- I. Terminate 50-ohm Amplitude Calibrator in 50.0-ohm load known to be accurate within $\pm 0.1\%$. (Available from Field Maintenance Support.)

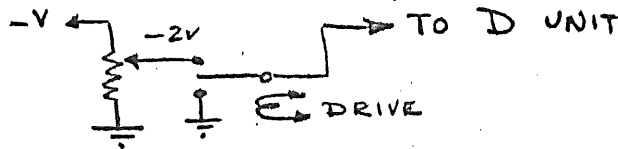
- II. Balance D unit at 10 kc. Feed a 10 kc square wave from the 105 simultaneously to both inputs of the D unit and adjust DIFF. BAL. for best cancellation. All but the leading edges should cancel, which indicates good balance at 10 kc.

- III. Connect the following equipment as shown in the diagram:

1. Tektronix Type 105
2. Tektronix Type 531 or equivalent
3. Tektronix D Plug-in
4. Tektronix Standard Square Wave Calibrator*
5. -100 V source*
6. 50-ohm Terminator, .1% (FMS)

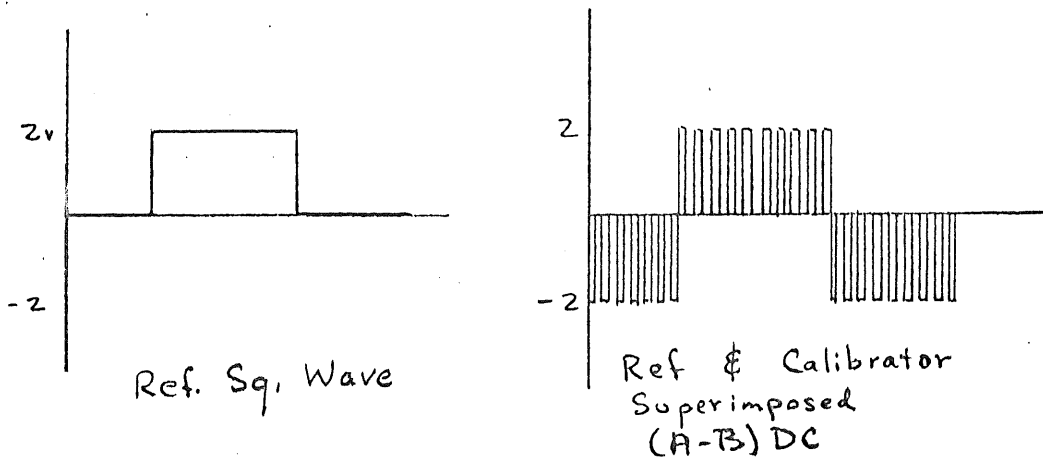


*Alternate methods of obtaining a -2 volt-reference square wave chopped to ground may be used. That is as shown, where -2 volts is set with Fluke meter or other .05% accurate infinite impedance voltmeter.



50-ohm Amplitude Calibrator (continued)

- IV. Accurately ($\pm 0.05\%$) set the -2 volt reference either by measuring the -100 volts or by measuring the -2 volts directly with an infinite impedance voltmeter. (For the -100 volt approach, the variable power supply of another 105 set to -100 volts with a Fluke meter may be used.
- V. With the D unit set at 1 volt/cm and the calibrator set at 2 volts, a positive-going square wave, $-(-2v)$, of the chopper drive frequency should be seen with the faster 10 kc amplitude calibrator waveform superimposed on it.



- VI. By increasing the D unit gain to 2 mv/cm, each cm corresponds to 0.1%. The zero reference line of the top and bottom portions of the composite waveform can be adjusted with the calibrator gain control (inside the box) until each lies on the zero reference line. Here the calibrator is set to exactly 2.00 volts. If the top of the bottom half and the bottom of the upper half are separated by 1 cm, the calibrator is 0.1% off from the reference, etc. Allow at least 15 minutes for the calibrator to warm up before setting the gain as the regulator transistor must stabilize at its operating temperature.

/s/ Albert Crane

Albert Crane
Measurement Standards
Domestic Operations Quality Assurance

FIELD MAINTENANCE SUPPORT

50 Ohm Amplitude Calibrator

