PORTABLE TEST PROGRAMME METER ME12/7

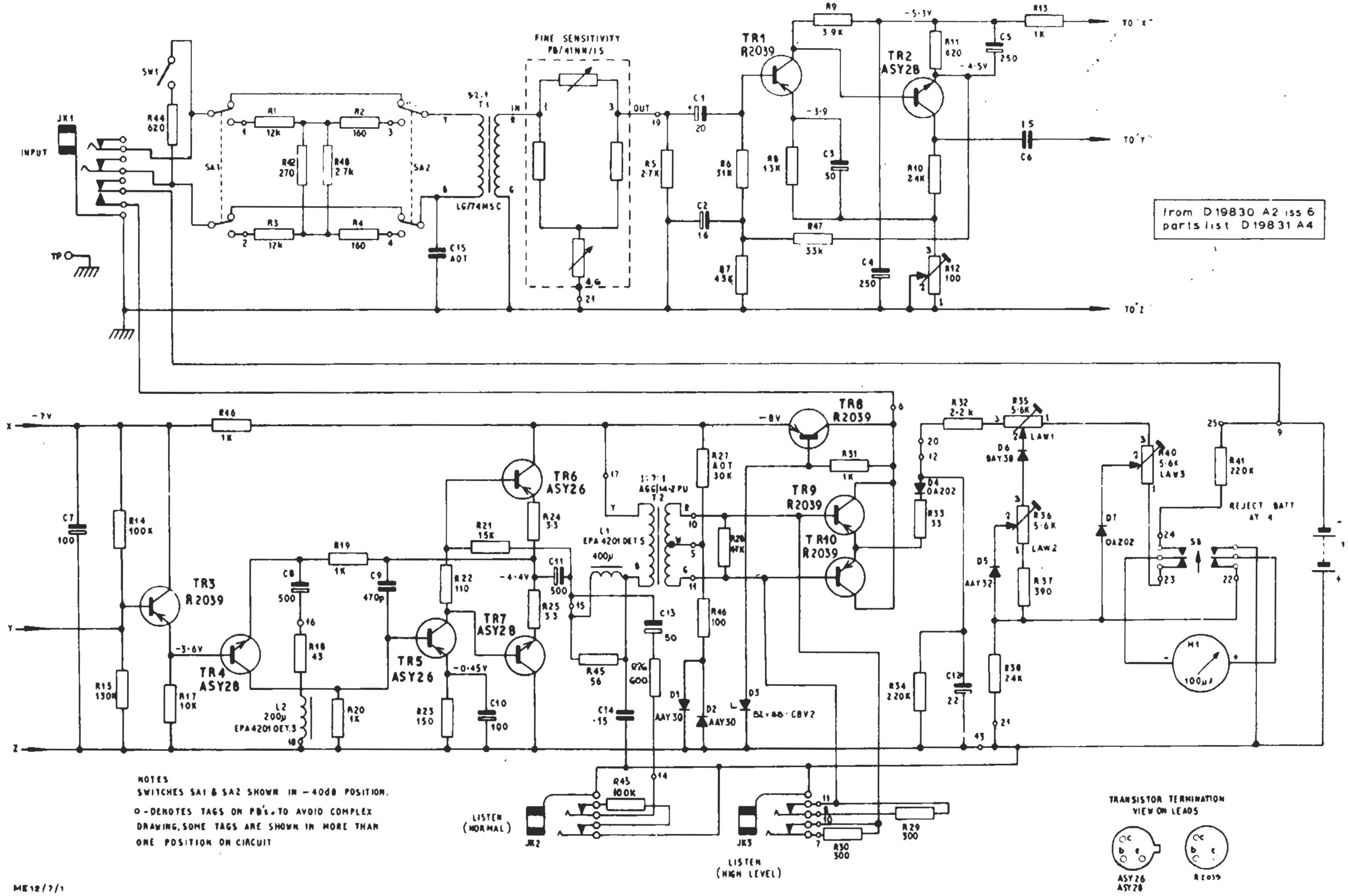

Fig. 1. Circuit of the ME12/7

Introduction

The ME12/7 is intended to replace the obsolete PPM/6. The unit contains its own dry-battery supply, and an indicating instrument with a conventional P.P.M. scale. Size and weight have been kept to a minimum, and as result the performance does not fully conform to that of standard P.P.M.s, but approximates to that of the ME12/5.

The unit is housed in a tinned-iron case fitted with a carrying strap. Lids are provided for the battery compartment and control panel.

General Specification

Input Volume	Range, −60 to +20 dB, in 2-dB steps.
Input Impedance	24 kilohms or 600 ohms, switched.
Listen Jacks: Normal	Output, about 0 dB, unbalanced. For high impedance headphones.
High Level	Output, about +15 dB, into high impedance loads, balanced. Output impedance, about 1,300 ohms.
	This jack carries a d.c. voltage; loads must be isolated.
Power Supply	Three 4·5-volt dry batteries. Drain, 3 to 16 mA.
Dimensions	4¼ by 10½ by 6¾ inches overall.
Weight	7 lb, including batteries.

Circuit (Fig. 1)

Signals applied to the input jack are passed by transformer T1 to a bridged-T attenuator that is adjustable up to 40 dB in 2-dB steps. The 2·5 kilohms impedance of this attenuator causes T1 primary to present an input impedance of 24 kilohms at the jack. This impedance is also introduced by a 40-dB balanced pad which can be switched between T1 and the input jack by SA. Shunt resistor R44 can be switched across the input jack to make the input impedance 600 ohms.

Output from the variable attenuator is passed through the two-stage feedback amplifier containing TR1 and TR2. Negative feedback from the collector circuit of TR2 to the emitter of TR1 is controlled by R12, which permits adjustment of the sensitivity of the unit.

Signals at TR2 collector are passed by emitter-follower TR3 to TR4. The output of TR4 collector is fed to the grounded-emitter amplifier TR5 which drives a complementary class B pair, TR6 and TR7. Negative feedback develops in the emitter circuit of TR4 because R18 and L2 form an impedance in this circuit, and owing to the feedback path via R19 from the output of TR6 and TR7. The collector load, R21, of TR5 presents a high impedance as a result of being connected to the output of TR6 and TR7, on the remote side of blocking capacitor C11.

The output of TR6 and TR7 is fed, via L1 (damped by R45), to the primary of T2. This transformer provides a balanced signal to TR9 and TR10, which are biased to cut-off and act as full-wave rectifiers. Their biasing is temperature compensated by D1 and D2. The rectified negative waves from TR9 and TR10 are passed by the low forward impedance of D4 to the time-constant capacitor C12. This capacitor discharges through the meter circuit (and also R34). The law of the meter indication relative to voltage across C12 is determined progressively at three points by the settings of R35, R36 and R40, and by the forward conduction characteristics of D6, D5 and D7. The meter itself is a 100-μA instrument to Equipment Department specification ED1476.

L2 and R18 in the emitter circuit of TR4, and L1, R45 and C14 at the output of TR6 and TR7, give the unit a frequency characteristic which drops above 20 kHz and a response to white noise that is similar to that of the ATM/1.

The ME12/7 has two *Listen* jacks. One, the *Normal* jack, provides an unbalanced output via C13 from TR6 and TR7. The other, the *High Level* jack, provides a balanced output from the secondary of T2. Both leads to the *High Level* jack carry the d.c. bias voltage applied through T2 secondary to TR9 and TR10. The output of each jack is in phase with the input to the unit.

The dry batteries which provide power are switched into use when a plug is inserted in the input signal jack, and they then feed a supply through voltage regulator TR8. Pushbutton SB enables an operator to check on the P.P.M. instrument itself whether the battery voltage is adequate.

Operation

The ME12/7 is used in the same way as a P.P.M. However, the unit does not respond exactly like a standard P.P.M. to some programme signals. (This is indicated by a yellow spot on the meter.) The discrepancy occurs in particular when the input contains short bursts of signal. During passages of a peaky nature, at high volumes the unit is likely to read low relative to a standard P.P.M., but at low volumes it may read high.

Periodic checks must be made with the *Battery Test* button, which should be pressed when a programme signal is making the meter peak to 6 or a tone is producing a reading of 4. If a reading below 4 is obtained while the button is pressed, fresh batteries must be inserted.

Any load plugged to the *High Level* jack must be in other respects isolated from the unit with respect to d.c., because any d.c. path (e.g., via an oscilloscope having an earth common with the ME12/7 source) or d.c. voltage introduced at the jack is likely to upset bias conditions within the ME12/7.

Maintenance

General

After component replacement or if performance is suspect, make whichever of the following checks and adjustments are appropriate.

For tests which require an a.f. input:

1. Connect the panel terminal to earth.
2. Set the input impedance switch to *Hi-Z*.
3. Use a signal source impedance of 600 ohms.
4. Check that the batteries (or substitute supply) are providing about 12 volts.

D.C. Voltages

Connect a 10-volt d.c. supply in place of the batteries and check that −7·8 to −8·6 volts is obtained at TR8 emitter. Increase the supply to 13·5 volts. The voltage at TR8 emitter should remain constant within 0·1 volt, although the supply current will rise (for example, from 7 to 11 mA, with no input signal).

With a supply of about 12 volts, check that voltages reasonably near the typical values marked on the circuit diagram (Fig. 1) are obtained.

Sensitivity

Turn the fine and coarse attenuators to −20 dB and −40 dB respectively. Apply a 1-kHz signal at precisely −68 dB to the input. The P.P.M. should read 2. If necessary, adjust R12.

When a reading of 2 is obtained, check the outputs at the *Normal* and *High Level* jacks on an ATM/1, in the AD mode, using its high impedance input. Levels of −10·5 ±1 dB and +5·3 ±1 dB should be obtained.

Input Balance

Any disturbance of the input section components preceding T1 may upset the balance of the input circuit. To check this:

1. Set the input switch to *Hi-Z* and turn the attenuators to −20 and −40 dB.
2. Connect a centre tapped screened 600-ohm resistor across the input.
3. Using a tone source TS/10, feeding via an additional external variable attenuator, find the 10-kHz signal V1, relative to earth, required at the centre tap of the 600-ohm resistor to obtain −2·5 dB at the *Normal* jack.
4. Find the balanced 10-kHz signal V2 which must be applied across the 600-ohm resistor to obtain the same level at the *Normal* jack.

The ratio of V1 to V2 should exceed 65 dB. If necessary, adjust the value of C15.

Repeat the test with the coarse attenuator at 0. The ratio V1/V2 should exceed 30 dB.

Input Impedance

1. Turn both attenuators on the ME12/7 to 0. Feed the unit from a tone source TS/10 set to 1 kHz, via two similar resistors of 10 to 20 kilohms, one in each balanced lead.
2. Connect an ATM/1 across the output of the two resistors. Adjust the ATM/1 and TS/10 so that the ATM/1 indicates a precise level fed to the ME12/7.
3. Substitute a variable resistance box, range 50 kilohms, in place of the ME12/7 and adjust the box to obtain the same ATM/1 reading. The resistance box setting represents the ME12/7 input impedance and should be 24·2 kilohms ± 10 per cent.
4. Turn the coarse attenuator to −40 dB and repeat operations 1, 2 and 3 at 40 Hz, 1 kHz and 15 kHz. The input impedance of the ME12/7 should be 20 kilohms ± 10 per cent, 24 kilohms ± 10 per cent, and 21 kilohms ± 10 per cent respectively.
5. Check, with the coarse attenuator at −40 dB, that the input impedance at 1 kHz does not vary more than 2·5 kilohms over the range of the fine attenuator.

Attenuators

1. Connect a tone source TS/10, via a 600-ohm variable attenuator, to the ME12/7 input. Set the TS/10 to 1 kHz.
2. With maximum attenuation in the TS/10, turn the coarse and fine attenuators on the ME12/7 to −40 and −20 dB, and adjust the external variable attenuator so that an output of about −10 dB is indicated on an ATM/1 connected to the *Normal* jack of the ME12/7.
3. In 2-dB steps, increase the fine attenuator on the ME12/7 and decrease the attenuation in the TS/10. The output at the *Normal* jack should remain constant within ±0·2 dB.
4. Repeat operation 2. Then turn the coarse attenuator on the ME12/7 to 0 and switch out 40 dB on the TS/10. The output at the *Normal* jack should remain the same within ±0·2 dB. If necessary, reselect the value of R48 to obtain satisfactory coarse attenuator accuracy.

P.P.M. Calibration

1. Set the coarse and fine attenuators to 0 dB.
2. From a TS/10, apply −8 dB at 1 kHz to the input of the ME12/7.
3. Check that the ME12/7 reading is 2. If necessary, adjust R12.
4. Change the input level to 0 dB and adjust R35 to obtain a reading of 4.
5. Change the input level to +8 dB and adjust R36 to obtain a reading of 6.
6. Change the input level to +12 dB and adjust R40 to obtain a reading of 7.
7. Repeat the sequence of operations 3, 4, 5 and 6 until no further adjustments are necessary.

Frequency Response

1. Connect a TS/10 to the input of the ME12/7, and connect an ATM/1 (switched to AD) in parallel with the TS/10 output to measure small adjustments in the signal applied to the ME12/7.

2. Set the coarse and fine attenuators on the ME12/7 to 0.
3. Apply a 0 dB signal at 1 kHz from the TS/10, adjusted finely so that the ME12/7 reads 4.
4. Check, at 100 Hz and 5 kHz, that the input required to make the ME12/7 read 4 is within ±0·1 dB of that required at 1 kHz.
5. Check, at 20 Hz and 20 kHz, that the input required to make the ME12/7 read 4 is within ±0·5 dB of that required at 1 kHz.
6. Check, at 50 kHz, that the input required to make the ME12/7 read 4 is +11 ±3 dB relative to that required at 1 kHz.

Dynamic Performance

1. Set the coarse and fine attenuators to 0.
2. Set the input impedance to 600 ohms.
3. Apply the flick test to the ME12/7. That is, charge a capacitor of 5μF ±2 per cent to 2·75 volts and then switch the charged capacitor to the ME12/7 input. The pointer of the meter on the ME12/7 should flick to a reading between 3·5 and 4·5.
4. Repeat the flick test, but apply the charged capacitor to the ME12/7 with reversed polarity. The ME12/7 should again read between 3·5 and 4·5, and the reading should be within about 1 dB (one quarter of a meter division) of the reading obtained in operation 3.
5. Apply a 1-kHz tone to the ME12/7 at a level such that a reading of 7 is obtained. Switch off the tone abruptly and check that the time in which the reading falls to 1 is not less than 2 seconds.

Meter

1. Connect a supply of exactly 10 volts in place of the batteries.
2. Press the *Battery Test* button. The ME12/7 meter should read 4 within ±½ dB (one eighth of a division).
3. If a meter reading ouside tolerance is obtained in operation 2, check the value of R41 and the meter current for a reading of 4. These should be 220 kilohms ±2 per cent and 47·8 ±1 μA.

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