COMMENTATOR OPERATED O.B. EQUIPMENT EP11/1

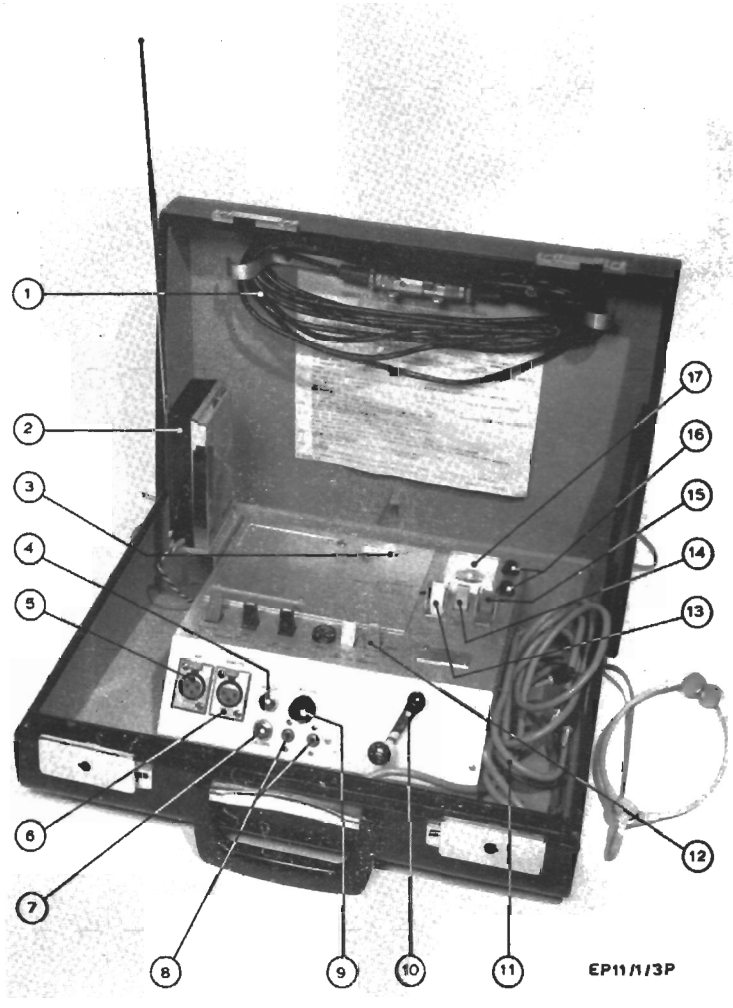


Fig. 1. General View of EP11/1

1. Microphone extension cable
2. Receiver
3. On-off switch
4. Replay jack
5. Lip microphone input
6. Effects microphone input
7. Record jack
8. Headphone jacks
9. Headphone volume control
10. Hand ringer
11. Output lead
12. Keys (left to right)
    Effects level
    Effects cut
    Replay cut
    Speak on control line
    Monitor
13. Tone/battery test key
14. Send level key
15. Line changeover key
16. Fuses
17. Battery voltmeter

Introduction

The EP11/1 is a portable equipment for use by a commentator on outside broadcasting. It comprises a carrying case fitted with an amplifier/receiver unit, a 20-ft microphone extension lead and two Danovox headsets.

The unit has two microphone inputs, one for a commentator's lip microphone and the other for an effects microphone. Both microphones may be carried inside the case.

The output plug, on a 12-ft lead, is connected to a socket at the O.B. point and provides communication with the studio centre over two lines, a music line and a control line. A hand-ringer is used to call the studio, and the microphone and a headset are used for telephone conversation.

Separate amplifiers for the lip and effects microphones and for a replay input from a tape recorder all feed into a common output amplifier. A compressor circuit in the lip microphone amplifier gives overload protection and a.g.c.; the effects level is controlled by a three-position key and also automatically by the commentator's voice. A monitoring amplifier is provided which can be switched to the output of the output amplifier or cue receiver or to the control line. The cue receiver has a separate battery. The remainder of the equipment can be operated from two alternative types of battery or from the mains. A 1-kHz oscillator is available for sending tone to line.

The overall dimensions of the equipment in its case are 13 by $16\frac{1}{4}$ by $4\frac{1}{2}$ inches and the total weight is 15 lb.

General Description (Fig. 1)

The amplifier unit is assembled in a chassis measuring $9\frac{1}{2}$ by $8\frac{1}{2}$ by 3 inches, and is fixed in position in the case by four 4-B.A. screws. The unit has a sloping front on which are mounted two microphone input sockets, tape replay and record jacks, headphone jacks and volume control, and the ringing generator handle.

The top of the unit carries the following controls, starting from the left-hand side.

(a) Effects microphone level key which can be used to increase or decrease the output from the effects microphone amplifier by 12 dB.

(b) Effects microphone cut key.

(c) Replay cut key which shorts the input to the tape recorder replay amplifier on the EP11/1.

(d) Star indicator for incoming telephone calls.

(e) Nonlocking speak key which connects the output of the output amplifier to the control line.

(f) Monitor key by which the monitor amplifier input may be connected
1. to the monitor output of the output amplifier,
2. to the control line via the telephone unit, or
3. to the output of the receiver.

(g) Nonlocking send tone key which disconnects the lip microphone input and inserts a 1-kHz oscillator circuit before the input of the output amplifier so that tone at zero level may be sent to line. The opposite throw of this key connects the panel voltmeter across the receiver 9-volt battery.

(h) Sending level key which provides output levels of −6, 0 and +6 dB.

(i) Line changeover key which is used to interchange the music and control lines.

Also on the top panel are a battery voltmeter, a 250-mA fuse, a lid-operated on/off switch and the battery-compartment cover plate which is fitted with quick-release fasteners. The battery compartment is designed to take five U2 dry cells, or a Uher Dryfit battery, or a Uher mains unit.

On the left-hand side of the amplifier chassis is a modified a.m./f.m. Sony receiver, swivel-mounted on a swivel bracket. The mounting is designed to allow the receiver to be positioned for maximum signal pick-up by the internal ferrite rod aerial on the medium and long wavebands. A telescopic rod aerial is provided for use on the v.h.f. band.

The space on the right of the amplifier chassis is occupied by the output lead and plug, and a bracket in the lid is provided for the microphone extension lead.

Mounted inside the chassis is a printed circuit board carrying the commentator's microphone amplifier and compressor, the effects microphone amplifier, the output amplifier, monitoring amplifier, replay amplifier, and line-up tone oscillator. The input and output transformers for the amplifiers are mounted separately on the chassis.

A special feature of the design are the precautions which have been taken to minimise r.f. pick-up. All the points at which r.f. signals might enter the amplifiers have been fitted with decoupling capacitors, to the disposition and wiring of which particular attention has been paid.

Circuit Description (Figs. 2 and 3)

Lip Microphone Amplifier

The input from the lip microphone is taken via input transformer T1 to a triple-transistor amplifier stage, TR1 to TR3, which has an emitter-follower output and overall feedback via R5. From here the signal passes over the break contacts of the *Send Tone* key to the input of a second triple, TR5 to TR7, similar to the first. Across this input is bridged a field effect transistor TR4 used as a voltage variable resistor. The impedance presented by this transistor is controlled by a side-chain amplifier stage, TR8 and TR9.

With no signal input to the amplifier, TR4 is biased at about cut-off by a voltage derived from voltage stabiliser TR10. A thermistor, TH1, compensates for changes in the collector current of TR10 brought about by changes with varying temperature in the base-emitter voltage of TR10 and the voltage across D2, and a controlled voltage of 4·6 ±0·1 volts independent of the battery voltage is set up across TP1 and TP2 by suitable adjustment of R42. The bias requirements of individual f.e.t.s are obtained by adjustment of R36. Under these conditions TR4 presents a high impedance to the input circuit of TR5.

A signal applied to the lip microphone input is amplified by TR8 and when the negative-going crests of the waveform exceed the threshold formed by the base-emitter voltage of TR9 they cause conduction in TR9 which is otherwise cut off. As TR9 conducts, the positive excursion of the collector voltage permits C17 to discharge via TR9 and D1 so that the gate voltage of TR4 moves positively and causes TR4 drain-source impedance to fall, forming an attenuator with R12 as the series arm and thus reducing the gain of the amplifier chain.

The output signal level at which the limiting action begins is normally set at +3·5 dB by a preset control R27, and the gain of TR9 is adjusted by R32 so that an increase in output level of 30 dB is compressed to an increase of 4·5 dB in the output level. The recovery time is fixed by the values of C17 and R35.

The operation of the *Send Tone* key disconnects the microphone input and converts TR5—TR7 into a Wien-bridge oscillator with C7, C12, R9, R11 and R19 as the frequency-determining network. The oscillator output level is again controlled by TR4 and the side-chain amplifier stage, and is set by slight re-adjustment of R27. Compensation for any discrepancy between the setting of R27 required for the tone output and that for programme compression can be made by readjustment of R32. The *Send Tone* key also connects R23 into circuit to produce the correct level of tone passed to the output amplifier.

Effects Microphone Amplifier

Following the input transformer T2 there is a triple-transistor amplifier stage, TR11 to TR13, similar to that in the lip microphone amplifier. The gain of this stage may be varied by selection of the value of feedback resistance used in TR11 emitter circuit by means of the *Effects* key. This provides a range of ±12 dB from normal. The output from TR13 may be shorted out by the *Effects Cut* key.

TR13 is followed by a further amplifier stage, TR15, across the input to which is bridged an f.e.t., TR14. The output from TR15 is taken to the input of the output amplifier. TR14 controls the output of the effects amplifier in a similar way to that described for TR4 in the lip microphone amplifier. The d.c. bias for TR14 is set by adjustment of R38 and the gate potential is determined by the output across C27 from a trigger circuit, TR17 and TR18.

The input to the trigger circuit is taken, via an amplifying stage TR16, from the output of the lip microphone amplifier, and its value is adjusted by R65 so that with a level of −6 dB at the output socket, SKC, the trigger circuit just produces a square wave. The potential applied to the gate of TR14, and hence the impedance it presents to the input of TR15, is then set by adjustment of R73 so that a signal level of −78 dB at the input of the lip microphone amplifier reduces the output of the effects microphone amplifier by 10 dB.

Replay Amplifier

The replay amplifier is a single common-emitter stage, TR23, with its output tied to the input of the output amplifier. It requires a signal level at its input jack of −50 dB to produce zero level at the output socket. The input can be shorted by the *Replay Cut* key.

Output Amplifier

The outputs of the lip microphone amplifier, the effects microphone amplifier and the replay amplifier are tied to the input of the output amplifier.

TR24 and TR25 form a d.c.-coupled amplifier stage with feedback via R99. This is followed by

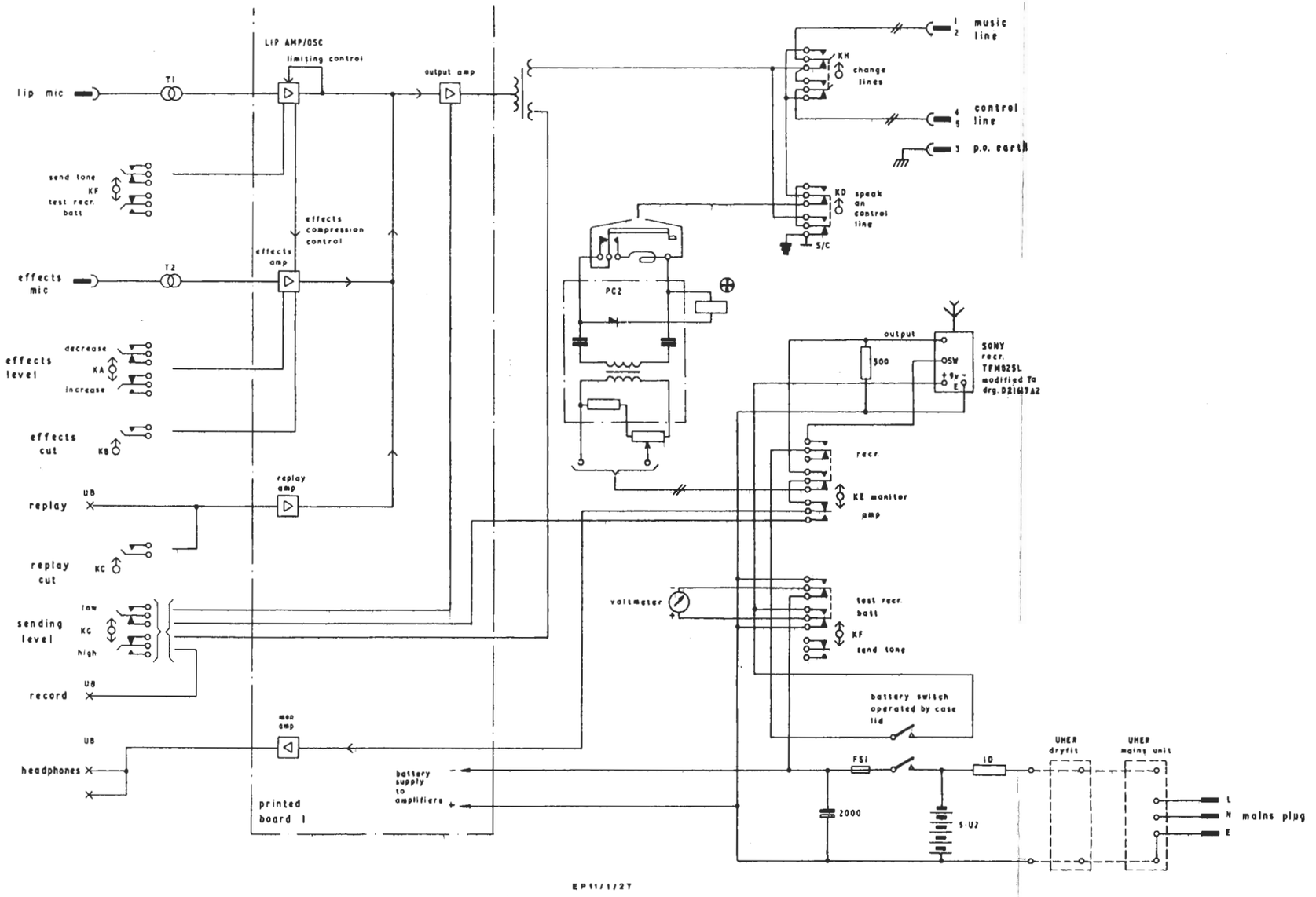
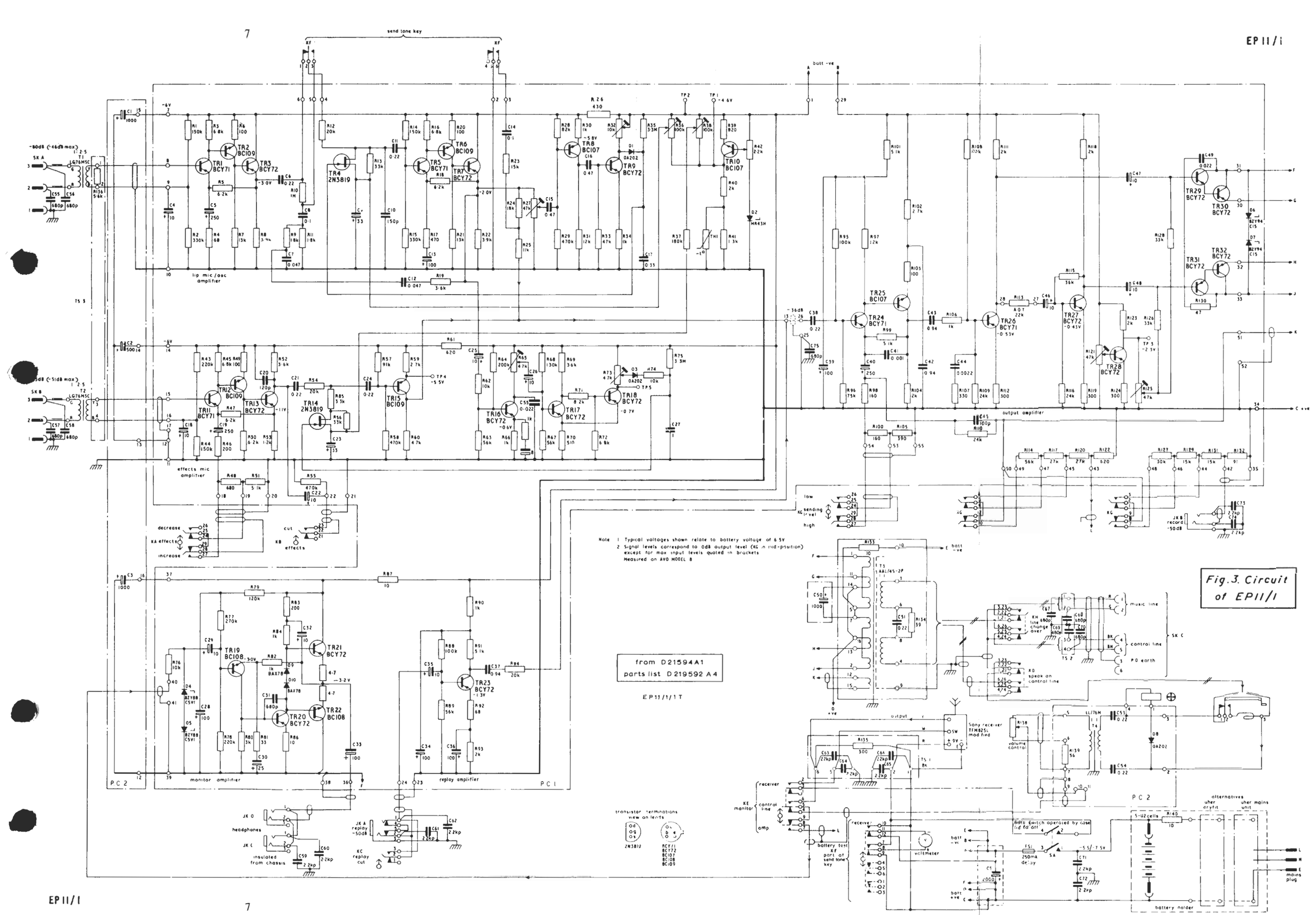


Fig. 2. Block Diagram of EP11/1



Note 1 Typical voltages shown relate to battery voltage of 6 5V
2 Signal levels correspond to 0dB output level (KG in mid-position) except for max input levels quoted in brackets
Measured on AVO MODEL 8

Fig.3. Circuit of EP11/1

a driver stage TR26 and phase inverter TR27. TR26 and TR27 feed a pushpull output stage comprising two Darlington pairs TR29—TR30 and TR31—TR32. Feedback for this stage is provided by tertiary windings on the output transformer which are connected in the emitter circuits of the output transistors.

The output stage is biased by a voltage controlled by a shunt stabiliser TR28. The operating point of TR28 is set by adjustment of R121 so that the voltage measured at TP3 is constant within 0·1 volt for battery variations from 7·5 to 5·5 volts. The output-stage bias voltage is then set by adjustment of R125 to give a total standing collector current of 10 mA. The inputs to the output stage are balanced by adjusting the input to TR27 by varying R113 in the base circuit.

Overall feedback is provided by an additional winding on the output transformer, connected to resistance networks in the emitter circuit of TR24. The value of the feedback resistance in this emitter circuit is selected by the *Send Level* key, by means of which the output can be varied by ±6 dB on normal level. The signals for the amplifier monitoring circuit and the recording output are also taken from the voltage produced by this feedback winding, and additional contacts of the *Send Level* key vary the levels of these signals in step with the changes in the output level.

Connected between the collectors of the output transistors are two zener diodes D6 and D7 which act as limiters of the voltage which may be produced by ringing current from the Post Office line.

Monitor Amplifier

The monitor amplifier is a conventional circuit with a complementary pushpull output feeding two paralleled 60-ohm headsets. The amplifier has a gain of 39 ±3 dB at 1 kHz but a bass-cut circuit C30-R81 introduces an attenuation at 50 Hz of about 10 dB. Across the input are two zener diodes D4 and D5 which limit the ringing-current voltage when the amplifier is connected to the control line.

Operation of the *Monitor* key connects the monitoring amplifier input to

(a) the output amplifier output,
(b) the control line, or
(c) the cue receiver.

The level from the control line into the monitoring amplifier may be adjusted by volume control R138.

Receiver

The receiver is a commercial model tunable to v.h.f. f.m. signals and to the medium and long wavebands. It has been modified as follows:

1. The internal loudspeaker is removed and the output is attenuated before being connected via the *Monitor* key to the monitoring amplifier.
2. The on/off switch on the internal volume control is disconnected, and the receiver battery circuit is completed by a pair of contacts on the main lid-operated switch, in series with another pair of contacts on the *Monitor* key KE.
3. A resistor is added in series with the internal volume control so that it is not possible to mute the output of this control.

Power Supply

The battery compartment is designed to accept any one of three possible types of power supply. These are

1. five U2 cells,
2. a Uher Dryfit rechargeable battery,
3. a Uher mains unit.

The amplifier unit is designed to operate with a supply of 5·5 to 7·5 volts. The supply is taken to a rocker switch which is operated to *Off* by the case lid and via a 250-mA antisurge fuse to a 2,000-μF capacitor and the amplifier supply rails. The supply voltage is monitored by a voltmeter which may be switched, by the opposite throw of the *Send Tone* key, to check the voltage of the receiver battery.

Telephone and Switching Circuits

The music line is termined on pins 1 and 2 of a 6-pin Cannon socket, and the control line on pins 4 and 5. Both lines are connected to travellers on the *Change Lines* key KH so that with the key normal the music line is taken to the output amplifier output and the control line is taken via the *Speak on Control Line* key KD to the telephone circuit.

Operation of the *Change Lines* key changes over the two lines. Operation of the *Speak on Control Line* key connects the output amplifier output to the control line as well as to the music line, and disconnects the monitoring circuit from the control line.

Incoming ringing tone operates the star indicator. With all keys normal, incoming calls from the studio centre are received on the headset, and may be answered by operating the *Speak on Control Line* key and using the lip microphone.

Operating Instructions

Power Supplies

1. The equipment operates from five U2 batteries, or from a Uher Dry Fit pack or from a Uher mains unit; the receiver contains its own PP3 battery. Intructions for inserting these are on the underside of the battery-compartment cover.
2. To switch on, operate the rocker switch. To conserve batteries, switch off when not in use.
3. To check the receiver battery, operate the ivory key rearwards.

Setting Up and Testing

4. Insert the 6-pin connector into an appropriate socket at the venue.
5. Ring the control room by the hand generator and listen for a reply on headphones. If no reply, change lines by operating the red key, and recall the control room.
6. Ringing calls from the control room will make the star indicator flicker.
7. To speak on the control line, cut the effects microphone (maroon key), operate the yellow key and use the lip microphone.
8. To send tone, operate the ivory key forwards.
9. To change the sending level, operate the grey key to *H* (*High*) or *L* (*Low*) as directed by the control room.
10. Test the lip microphone level with control room, using a voice level similar to that expected to be used on the commentary.
11. Test the effects microphone level, and adjust it to suit the O.B. Set the blue key to *Increase* for quiet crowds, e.g., cricket or to *Decrease* for noisy situations, e.g., football.
12. The lip microphone circuit is self-limiting to prevent distortion, and is arranged to automatically reduce the effects level when the commentator is speaking normally.

Monitoring

13. Monitoring is by headphones only and is selected by the green key.
14. Cue programme or feedback is controlled by the volume control when the green key is central.
15. To check outgoing programme, operate the green key to *Amp*.
16. To use the radio receiver, operate the green key to *Recr*.

Operating Radio Receiver

17. Raise the receiver to the vertical position.
18. Set the switch on the rear to the required waveband.
19. Set the receiver volume control initially to *5*.
20. Power the receiver by operating the green key to *Recr*.
21. For medium and longwave reception, rotate the receiver to obtain the loudest signal.
22. For f.m. reception, extend the telescopic aerial and rotate it to obtain the best results.

Recording Facilities

23. To record, use the *Record* jack to feed a Uher recording machine.
24. To play a recording to line, use the *Replay* jack.

Use with Uher Tape Recorder

When the EP11/1 is used with a Uher recorder, special precautions may be necessary to avoid earth loops causing mains hum if both equipments are operated from Uher power units.

Test Procedure

General

Adjustment of the preset variable resistors mentioned in the circuit description is carried out during initial testing of the amplifier board, and the presets are then sealed. If the unit develops a fault which requires realignment of these circuits, it is recommended that it be returned to Equipment Department.

The overall performance of the unit can be checked by the following measurements.

Test Apparatus

Audio-frequency tone source
Test meter ATM/1
Oscilloscope
Total harmonic distortion test set
Decade resistance box

Test Conditions

Applicable unless otherwise stated.

Music line termination	600 ohms
Control line termination	600 ohms
Lip chain source impedance	300 ohms

Effects chain source impedance	300 ohms
Effects key setting	*Increase*
Other key settings	Normal
Test meter impedance	High
Nominal supply voltage	6·5 volts

'Send Tone' and 'Sending Level' Keys

1. Operate the *Send Tone* key.
2. Measure the tone output level and frequency on the music line. The output level should be 0 ±1 dB and the frequency 1000 ±100 Hz.
3. Check for waveform distortion with the oscilloscope across the music line output.
4. Operate the *Sending Level* key to *High* and *Low*. The corresponding increase and decrease in level should be 6 ±0·5 dB.

Lip Microphone Chain

1. Apply tone in series with 300 ohms to the lip microphone input socket.
2. Adjust the tone source output to make the level at the music line output (SKC tags 1 and 2) 0 dB at 1 kHz. The tone source output level should then be −78·5 ±2 dB.
3. Keeping the output level of the tone source constant, vary the frequency, and check that the level at the music line output is 0 ±2 dB at 15 kHz and between −1 and −4 dB at 50 Hz.
4. Now apply tone directly to the microphone input socket and adjust the level at the music line output to +3·5 dB.
5. Increase the input level by 30 dB and check that the music line output level is +8 ±1 dB.

Effects Microphone Chain

1. Apply tone in series with 300 ohms to the effects microphone socket.
2. Adjust the tone source level to make the music line output level 0 dB. The tone source level should then be −80 ±2 dB when measured with the T.P.M. section of the ATM/1.
3. Operate the *Effects* key to *Increase* and *Decrease*. The corresponding changes in music line output level should be +12 and −12 ±1 dB.
4. Operate the *Effects Cut* key. The residual output on the music line should be not greater than −40 dB, measured with the T.P.M. peaked to *6*.
5. Keeping the tone source level constant, vary the frequency, and check that the level at the music line output relative to that at 1 kHz is 0 ±2 dB at 15 kHz and between −1 and −4 dB at 50 Hz.
6. Connect the oscilloscope across the music line output.
7. Apply 10-kHz tone to the effects microphone input and adjnst the input level to give an output level of 0 dB.
8. Note the amplitude of the waveform on the oscilloscope.
9. Apply tone at 500 Hz from a second source to the lip microphone input and adjust the input level to −80 dB.
10. Again note the amplitude of the 10-kHz tone, which should now be one-third of its original value.

Replay Chain

1. Apply tone in series with 300 ohms to the *Replay* jack and adjust the input level to make the output to the music line 0 dB. Check that the tone source level is −50 ±1 dB.
2. Operate the *Replay Cut* key. The residual output on the music line should be not greater than −38 dB measured with the T.P.M. peaked to *6*.
3. Keeping the tone source level constant, vary the frequency. Check that the music line output level relative to that at 1 kHz is 0 ±2 dB at 15 kHz and between −1 and −3 dB at 50 Hz.

Record Input

1. Reset the input level to the *Replay* jack to give a music line output level at 1 kHz of 0 dB.
2. Measure the level at the *Record* output jack, which should be −50 ±1 dB.
3. Operate the *Sending Level* key in each direction. The record output level should remain at −50 ±1 dB.

Output Impedance

1. Remove the 600-ohm termination from the music line output.
2. Apply tone to the lip microphone input to give an output level of −20 dB.
3. Connect the resistance box to the music line output.
4. Adjust the resistance box to give a drop in output level of 6 dB. The resistance required should be 70 ±12 ohms.

5. Repeat the test for the other positions of the *Sending Level* key. The resistance should remain at 70 ±12 ohms.
6. Restore the 600-ohm termination to the music line output.

Harmonic Distortion

1. Connect the oscilloscope to the music line output.
2. Apply tone to the effects microphone input, and adjust the level until clipping is just observed on the oscilloscope.
3. Measure the output level, which should be at least +14 dB.
4. Repeat with the *Sending Level* key in the *High* position. The music line output level at which clipping is just observed on the oscilloscope should be now at least +17 dB.
5. Restore the *Sending Level* key to normal.
6. Adjust the input level to give an output level of +10 dB.
7. Measure the total harmonic distortion, which should not exceed the following.

At 1 kHz	1%
At 60 Hz	2%
At 5 kHz	2%

8. Apply tone at 1 kHz to the lip microphone input and adjust the input level to give an output level of 0 dB.
9. Measure the total harmonic distortion, which should not exceed 0·3 per cent.
10. Increase the input level to give an output level of +8 dB.
11. Measure the total harmonic distortion, which should not exceed 1·5 per cent.
12. Apply tone at 1 kHz at the *Replay* input jack to give an output level of +10 dB.
13. Measure the total harmonic distortion, which should not exceed 2·0 per cent.

Monitor Amplifier

1. Apply 1-kHz tone to the control line output (SKC pins 4 and 5), and adjust the level at this point to 0 dB.
2. With both headsets plugged in, check the volume from the monitor amplifier and the range of the monitor volume control.
3. With 1-kHz 0-dB tone at the music line output (SKC pins 1 and 2), operate the *Monitor* key to *Amp* and check that the volume from the monitor amplifier is the same as in the first test.
4. Operate the *Monitor* key to *Receiver* and check that the receiver operates on all wavebands and delivers adequate volume to the monitor amplifier.

Control Line

1. With 1-kHz 0-dB tone at the music line output, operate the *Speak On Control Line* key and check that the tone appears on the control line output at the same level.
2. Remove the tone and connect the field telephone to the control line terminals.
3. Check that the field telephone generator operates the star-indicator and the internal generator rings the field telephone bell.

Crosstalk

1. Connect the ATM/1 across the music line output.
2. Connect the oscilloscope to the ATM/1 *Listen* jack.
3. Operate the *Effects Cut* and *Repro Cut* keys.
4. With no signal applied, display the noise output on the oscilloscope.
5. Apply 1-kHz tone at +10 dB to the control line terminals and increase the monitor volume until severe overloading is heard on the headset.
6. Examine the music line output for traces of 1-kHz tone. The amplitude of the tone should not exceed peak noise. This also applies if the frequency of the tone is varied over the range 200 Hz to 15 kHz.
7. Operate the *Change Lines* key and interchange the positions of the tone source and ATM/1.
8. Repeat the test.

NOTE:—Disturbance of the correct disposition of the wires in the output cable may cause an increase in crosstalk.

Voltage and Current Measurements

(*a*) *Voltages*

Voltages measured with an Avometer Model 8 between the transistor emitters and the positive supply rail are marked on Fig. 3.

(*b*) *Current Consumption*

The total current consumption under various conditions of load and with a 6·5-volt supply is shown below.

No input	30 mA
Output 0 dB at 1 kHz	30 mA
Output +16 dB at 1 kHz	38 mA
Output +16 dB and monitor output 0 dB	50 mA

WWM(X) 6/70