Eddystone

NOISE MEASURING SET No. 31A

31 – 250MHz

Manufactured in England under licence from the U.K. Ministry of Posts and Telecommunications.

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The manufacturer reserves the right to modify the content of this publication to accommodate modifications, design improvements etc. Amendment Sheets will be incorporated where applicable at date of issue.

GENERAL DESCRIPTION

Eddystone Model 31A is a portable quasi-peak radio interference measuring set designed to meet the special requirements of British Post Office Specification W.6912. It is the commercial equivalent of Post Office Receiver Radio 31A and complies generally with the characteristics laid down in British Standard B.S. 727:1967. Frequency coverage extends from 31MHz to 250MHz and the overall measuring accuracy is sufficiently close to that of a standard CISPR receiver to guarantee a level of performance which is adequate for all but the most exacting applications. The receiver is primarily intended for use by field personnel engaged in the investigation of interference to normal VHF services, but it will be found equally suited to many industrial uses including acceptance testing on a wide range of electrical appliances.

Measurements can be taken of the voltage or field strength of CW signals or of impulsive noise with pulse repetition frequencies as low as 10-20Hz. The equipment is very simple to use, and long-term accuracy of a high order is assured by standardizing the overall gain against internally generated first-circuit noise before each reading is taken. Variation of gain with frequency is compensated by applying corrections from graphs which are individually calibrated for each receiver: separate graphs of aerial constants are also provided for use in field strength measurement.

Collapsible telescopic rod and dipole antennas, together with an insulated three-section mast, are included as part of the equipment and can be mounted on the carrying handle of the receiver to facilitate fully portable operation: the dipole incorporates a balun transformer as recommended in B.S. 727. All accessories, including associated cables etc., are stowed in a removable cover which forms part of the receiver case and serves to protect the controls and meter during transit. The whole outfit is constructed so as to be entirely suitable for field use, even under moderately inclement weather conditions.

Power is derived from a self-contained nickel-cadmium battery which allows twelve hours continuous operation before re-charging becomes necessary. A built-in charger is included, suitable for all standard 40-60Hz supplies, and a low-volt cut-out prevents damage to the battery through over - discharging. Charging current and battery state can be monitored on the panel meter.

GENERAL SPECIFICATION

Frequency Coverage		31-250MHz in three ranges (31-68MHz, 68-135MHz and 135-250MHz).
Intermediate Frequencies		1st IF :: 25MHz. 2nd IF :: 3MHz.
Reception Modes		CW - AM - FM
Detector		CISPR quasi-peak (charge time constant 1ms, discharge time constant 550ms).
Input Impedance		75Ω ± 40% (less than 20% reactive).
Aerials	Type 1	Dipole fitted with telescopic elements, adjustable to resonate at all frequencies 60 - 250MHz (includes balun and feeder).
	Type 2	Telescopic rod antenna, adjustable up to approximately 1.2 metres.
	Mast	An insulated 3-section mast is provided for use with either antenna.
Power Supply		Internal rechargeable nickel - cadmium battery of 2 Ampere-hour capacity. A built-in charger operates from 40-60Hz supplies of 100/125 volts and 200/250 volts. Over-discharge protection is provided.
Overall Case Dimensions		Width: 302mm (11.875in) Height: 206mm (8.125in) Depth: 256mm (10.0625in)
Weight		8.6kg (19lb)
Meter		Critically-damped with mechanical time constant of 100ms.
RF Connectors		BNC and RECMF sockets are provided.
Mains Connector		13-Amp flat-pin with self-contained fuse (2-Amps).

TYPICAL PERFORMANCE*

Sensitivity	CW field strength necessary to produce an indication 6dB above noise is less than 20μV/metre at any frequency when using aerial system supplied (less than 2μV at input socket).
IF Selectivity	120kHz B/W at -6dB, 200kHz B/W at -20dB
Frequency Stability	Of the order 1 part in $10^5/^oC$.
Screening	With aerial disconnected, indicated field strength falls by at least 55dB (31-70MHz), 45dB (70-150MHz) and 40dB (150-250MHz).
Image Rejection	Greater than 30dB at 31MHz and greater than 20dB in range 150-250MHz.
IF Rejection	Greater than 30dB.
Spurious Response	Sensitivity is at least 30dB down at any frequency more than 140kHz off-tune
Oscillator Radiation	Less than 1mV at aerial input over range 31-250MHz.
Measuring Range and Accuracy	110dB (±2dB) with sine-wave voltage.
Calibration Accuracy	Scales are accurate to within 2%.
Audio Output	Low-level output suitable for low/medium impedance telephones.
Overload Factor	20dB minimum.

(*) Not to be interpreted as a test specification.

CIRCUIT DESCRIPTION

The receiver employs a dual-conversion circuit covering the overall frequency band 31 - 250MHz in three switched ranges with a first intermediate frequency of 25MHz. Separate RF Tuning Units are used for each range, these having a nominal input impedance of 75Ω to permit direct connection to aerials and distribution feeders of the types normally encountered in VHF radio and television installations. Adequate image protection is provided by including low-pass input filters on the low frequency tuners and by the use of tuned bandpass coupling on the high frequency tuner.

The high degree of screening essential in a receiver of this type is provided by a tight-fitting outer cover of stiffened aluminium in conjunction with individual screening boxes for each of the internal units. Vital circuitry is therefore effectively double-screened giving a screening factor in excess of 55dB at 31MHz: protection is greater than 40dB at the highest frequency covered by the equipment.

Aerial input is taken via a 50dB RF Attenuator (switched in 10dB steps), and provision is made for introducing an internal fixed 30dB pad when greater RF loss is required. Two further switched attenuators are provided, these being wired between the output of the selected tuner and the input of the 25MHz IF Amplifier. The first of these is ganged to the 50dB RF Attenuator and the switching is arranged so that 20dB of IF attenuation (two 10dB steps) is introduced before the RF Attenuator becomes effective. The other IF Attenuator provides a loss of 10dB in 1dB steps. Total loss with all attenuators in circuit amounts to 110dB.

Output from the selected RF Tuning Unit is taken to a three-stage 25MHz IF Amplifier via a low-pass filter having a cut-off frequency of 27MHz. The last 25MHz stage feeds a diode ring modulator which serves as the 2nd Mixer producing a final IF of 3MHz: conversion injection is derived from a free-running oscillator tuned to 22MHz. Also fed by the last 25MHz Amplifier is an emitter follower which provides a low - level output for use when the receiver is operated in conjunction with a panoramic display unit for visual signal analysis.

Amplification at the final IF is provided by a four-stage bandpass coupled Amplifier which incorporates a manual gain control between the second and third stages. This control (labelled CAL) allows the operator to standardize the overall gain of the receiver before taking accurate measurements of voltage or field strength.

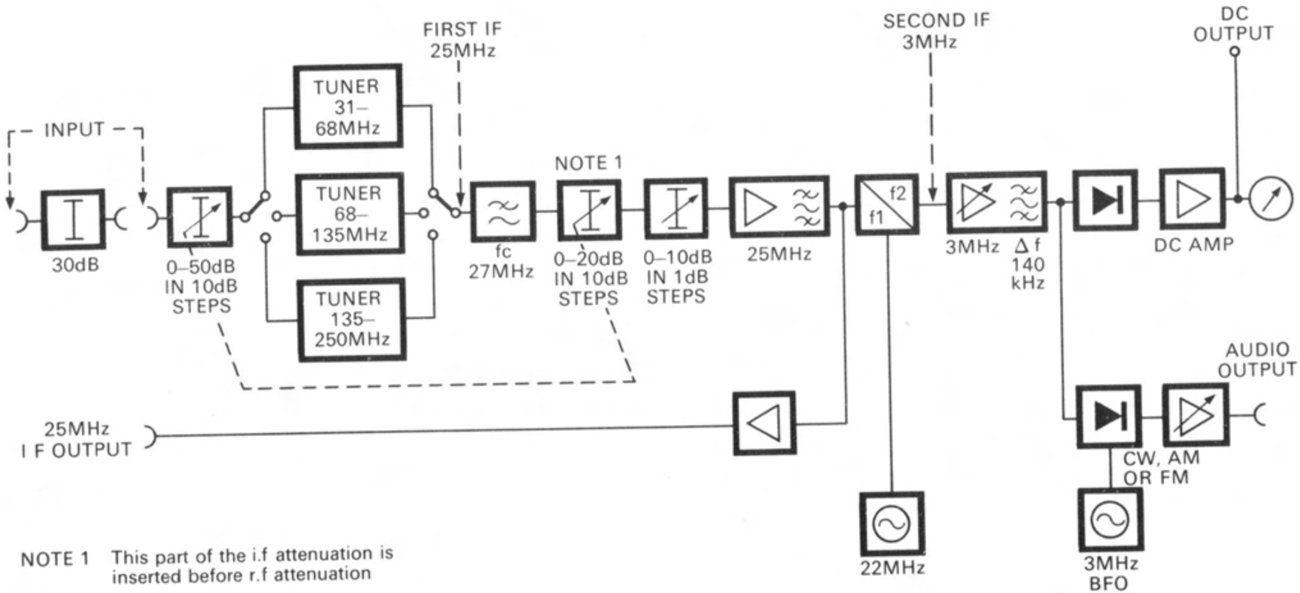


Fig. 1. Block Diagram of Noise Measuring Set No. 31A.

Circuit Description (contd.) Output from the 3MHz IF Amplifier is fed to an emitter follower, at which point in the circuit the signal route splits, one of the two paths feeding a second emitter follower which is transformer coupled to the quasi-peak Meter Detector. The other path is routed to the stages provided for audio monitoring: these comprise two cascaded 3MHz Amplifiers (which are used as a limiter for FM signals), an AM/FM Detector equipped with pre-tuned BFO for CW reception and finally a three-stage Audio Amplifier. The latter has an AF gain control and provides an output suitable for use with any low/medium impedance telephone headset.

On the indicating channel, output from the Meter Detector is taken to a six-transistor DC Amplifier with the meter connected in the emitter circuit of the final transistor pair. The Amplifier uses a balanced configuration in which the operating conditions can be adjusted by means of the potentiometer labelled DC BAL. This allows the meter needle to be set correctly before standardizing the overall gain by use of the CAL control. The meter is critically damped to give correct indications on pulse-type interference: output terminals are provided for connection to a pen recorder or other ancillary equipment.

Selection of the various circuit conditions which are required when operating the receiver is achieved by use of the FUNCTION SWITCH: this has seven positions as listed below. Operators should note that the output of the charger circuit is permanently connected to the battery and that provided an AC supply is présent, charging will continue at all settings of the FUNCTION SWITCH including the 'OFF' position.

'OFF'	Battery disconnected from receiver circuits.
'BATT CHARGE'	Meter indicates charge current. Receiver operates directly from battery, i.e. low-volt protection circuit is inoperative.
'CHECK BATT'	Meter indicates battery voltage. Receiver operates normally via low-volt protection circuit.
'DC BAL'	25MHz IF Amplifier disabled.*
'CHECK NOISE'	Appropriate RF Amplifier disabled.*
'MEASURE'	All stages operating normally.*
'LOW SENSITIVITY'	As 'MEASURE' but series resistor introduced in meter circuit to reduce deflection.

(*) Meter connected to o/p of DC Amplifier.

The low - volt battery protection circuit mentioned on the opposite page is included to safeguard the nickel-cadmium battery from the possibility of being over-discharged. In operation, the output of a transistor oscillator is rectified and used to control a series transistor which carries the full current taken by the receiver. When the battery voltage drops and falls within the limits 10.5V to 10.75V, output from the oscillator is reduced causing the series transistor to cut-off and so effectively disconnecting the battery from the load.

The charger circuit is a simple transformer/rectifier arrangement which provides a sufficiently high charging rate to restore the battery to a fully charged condition with a single over-night charge after normal daily use. See also page 26.

AERIALS FOR FIELD STRENGTH MEASUREMENT

General

All aerial accessories for use with Noise Measuring Set No. 31A, together with the AC mains charging lead, are housed in the removable front cover. The following items are provided:-

1. 3-section insulated collapsible mast.
2. Telescopic rod antenna fitted with integral BNC plug for direct connection to INPUT socket.
3. Two telescopic dipole elements and associated balun transformer.
4. Coaxial lead terminated with BNC plugs (aerial feeder).
5. Two coaxial 'U' links terminated with BNC plugs.
6. BNC plug/socket adaptor.

Telescopic Rod Antenna

Connect directly to INPUT socket when taking measurements on vertically polarized signals. Can also be mounted on mast for general interference tracing but measurements will not be accurate with this form of mounting. Length adjustable up to 1.2 metres max.

Dipole Antenna

Adjustable to resonate at all frequencies 60 - 250MHz. Suitable for taking field strength measurements on all horizontally polarized signals and useful for direction finding when tracing the source of any form of interference. The feeder is connected via a balun transformer and the dipole is mounted on the mast when in use.

USES OF THE NOISE MEASURING SET NO. 31A

1. Using the aerial systems supplied

(a) Tracing the location of an interference source (either noise or signal), by using simple direction finding or intensity comparison techniques.

(b) Measurement of the field strength of VHF transmissions in the range 31-250MHz, or the strength of harmonic radiation falling in this range.

(c) Measurement of the field strength produced by all forms of noise source in the range 31-250MHz.

2. Using other input sources

(a) Measurement of radio noise voltages on circuit conductors, e.g. the supply flex of a portable electrical appliance.

Special isolating networks are required for applications in this category.

(b) Measurement of the signal voltage of VHF transmissions and radiated noise picked up by existing commercial or domestic aerial systems in the range 31-250MHz.

(c) Other general uses of a diverse nature where an accurately calibrated selective voltmeter of high sensitivity is required, e.g. investigation of oscillator radiation in commercial VHF receiving stations, plotting polar diagrams or service areas of VHF communication networks, etc., etc.

3. Comparison with other equipment

(a) Detailed specifications for noise measuring equipment have been formulated by the International Special Committee on Radio Interference (CISPR), and these are closely adhered to in UK regulations which are based on the content of British Standard B.S. 727:1967 and other related standards.

(b) Noise Measuring Set No. 31A has been produced to meet the need for a portable equipment for use in situations where the relatively high cost of a standard CISPR receiver is not entirely justified. Its standard of performance is more than adequate for the class of work likely to be undertaken and the degree of improvement obtained by substituting a standard CISPR receiver can be gauged from the Table on the opposite page.

TABLE 1. COMPARISON OF CISPR AND No. 31A SPECIFICATIONS

Item	CISPR	No. 31A
Input impedance	Not specified*	75Ω (for compatibility with standard VHF feeder systems)
Bandwidth at -6dB	120kHz	120kHz
Screening	60dB	55dB at 31MHz 40dB at 250MHz
Image Rejection	40dB	30dB at 31MHz 20dB at 250MHz
IF Rejection	40dB	30dB
Spurious	40dB	30dB
Overload Factor	43.5dB	20dB minimum
Pulse Response	Isolated pulse	20 p.p.s. Usable down to 10 p.p.s. with reasonable accy.
Time Constants:		
Detector charge	1ms	1ms
Detector discharge	550ms	550ms
Meter	100ms	100ms
Measuring Accuracy		
Sine waves	± 2dB	± 2dB
Field strength	± 3dB	± 4dB

(*) B.S. 727 : 1967 specifies 50Ω input impedance.

OPERATING INSTRUCTIONS

GENERAL INTRODUCTION

Principle of measurement Noise Measuring Set No. 31A functions as a selective voltmeter which is tunable over the range 31-250MHz: it is calibrated to measure the voltage at its input in terms of dB relative to 1μV.

In using the equipment for measuring purposes, its overall gain is first standardized against first circuit noise by adjusting the CAL control to produce a fixed deflection on the meter ('CAL'). This adjustment is carried out with the input disconnected and with both attenuators set at OdB. The signal to be measured is then applied at the input and the two attenuators are adjusted to restore the 'CAL' deflection previously obtained.

The level of the input signal in dB relative to 1μV is obtained directly by adding together the two attenuator readings and combining the result with a 'Receiver Constant' which compensates for variations in receiver gain with frequency. Constants are individually determined for each receiver and are recorded in the form of a graph attached to the inside of the removable front cover.

Accuracy of measurement When used to measure the voltage of a sine wave input, accuracy is of the order ± 2dB or better. Noise measurements are inherently more difficult to perform and accuracy is somewhat dependent on the skill of the operator in assessing an average reading from a series of observations on a noise source which may be discontinuous in nature and subject to fluctuation over a wide range of values. Further, it is well known that noise measurements are seldom repeatable with an accuracy of better than ± 3dB and on this basis an accuracy of the order ± 4dB can be considered about optimum for the Noise Measuring Set No. 31A.

Operator skills also enter into the measurement of field strength where errors of a similar order are likely to be encountered. The user should not be deterred by this, for in the great majority of cases measurements of this nature are carried out on a comparative basis as an indication of progress in noise suppression.

Slightly lower accuracy is achieved when working with very low signal inputs, i.e. where a total switched attenuation of 10dB or less is required for a normal 'CAL' indication. The amount of error is dependent on the type of signal and Table 2 on the following page gives correction factors for CW or modulated CW transmissions and for ignition-type interference. Correction factors quoted for the latter can be considered near enough correct for all practical purposes for all general forms of pulse-type noise.

TABLE 2. CORRECTION FACTORS FOR LOW-LEVEL SIGNALS

Total receiver attenuation (dB)	Correction factor to be deducted from measured level (dB)	
	CW/MCW signals	Ignition interference
2	6.5	1.4
3	5.0	1.0
4	4.0	0.6
5	3.2	0.4
6	2.5	0.2
7	2.0	0.1
8	1.5	-
9	1.0	-
10	0.5	-

PRELIMINARY CHECKS

Battery voltage Always check the battery voltage before using the equipment. Voltage is correct if meter needle registers in blue sector of scale when FUNCTION SWITCH is set to 'CHECK BATT'.

If reading is below the blue sector, or falls immediately to zero, battery should be re-charged as detailed on page 26.

It is recommended that the battery voltage is checked from time to time when using the equipment for a prolonged period of several hours operation. Where circumstances permit, the receiver can be used in the normal manner while the battery is on charge. Charging continues at all positions of the FUNCTION SWITCH.

Standardization of gain The overall gain must be standardized before using the receiver for taking measurements. The appropriate procedure is detailed below and operators should note that this operation can usually be omitted when the receiver is to be used only for general interference tracing.

(a) Disconnect aerial feeder at INPUT socket.

(b) Tune receiver to appropriate working frequency.

(c) Set both attenuators to OdB: select 'DC BAL' position of the FUNCTION SWITCH and set meter needle to 'DC BAL' mark by use of the DC BALANCE control.

Standardization of gain (contd.)

(d) Change FUNCTION SWITCH to 'MEASURE' and set meter needle to the 'CAL' mark by use of CALIBRATE control.

(e) Select 'CHECK NOISE' on FUNCTION SWITCH and check that meter deflection drops by 2-3dB (i.e. into green sector on scale).

This indication confirms that first circuit noise predominates above all other noise. If the meter deflection falls by less than the amount in (e), measurements are liable to an error as high as 3dB. If no fall is registered, the receiver should be withdrawn from service and returned to Eddystone Radio Ltd. for re-alignment.

(f) Set FUNCTION SWITCH back to 'MEASURE' and introduce 30dB of attenuation to protect the meter movement when the aerial input is re-connected.

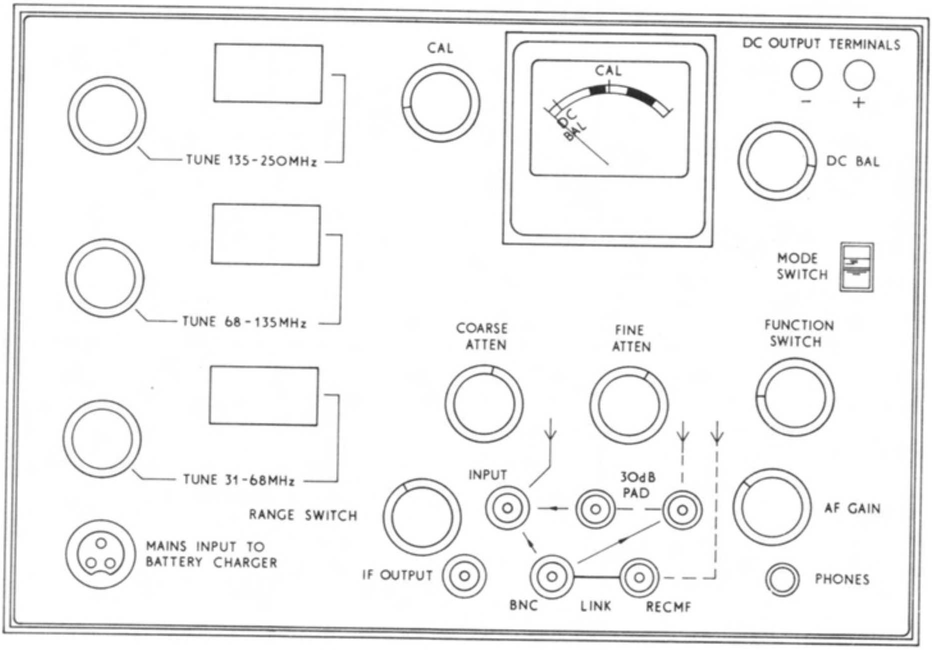


Fig. 2. Noise Measuring Set No. 31A. Panel Controls.

MEASUREMENTS

Voltage measurements

Measurements in this category include all cases where the receiver input is derived from a source other than the specially designed aerial system supplied with the equipment. Typical examples are measurement of RF signal level at the receiver end of a coaxial feeder and measurement of impulse noise on the supply lead to a fixed or portable appliance. It is important that where the source is not of 75Ω impedance, suitable matching networks are used at the receiver input. Corrections should be applied where necessary.

1. Measurement of radio signal voltages

(a) Switch on the receiver, connect to the signal source and tune receiver accurately to the appropriate frequency. Adjust attenuators to maintain usable meter deflection.

(b) Standardize the receiver gain as described on page 13.

(c) Re-connect to signal source, check tuning and adjust the attenuators to restore meter needle to 'CAL' mark.

(d) Calculate signal level as in example below (assuming Coarse Attenuator setting of 50dB, Fine Attenuator 7dB and Receiver Constant from graph of -2dB).

Signal level = (50 + 7 - 2) = 55dB above 1μV.

2. Measurement of impulse noise voltage

General The electrical constants of a normal power supply cable combine to make it a reasonably efficient filter at very high frequencies with the result that noise voltages on the line are attenuated to such a degree that radiation of interference is usually only significant on the length of lead in the immediate vicinity of the noise-producing appliance.

In view of this, most noise measurements are carried out either on the cable itself (within a few feet of the appliance), or in some cases directly at its supply terminals. Both methods of testing involve use of the measuring set in conjunction with simple auxiliary apparatus. Design guides for this type of equipment will be found in CISPR Publication No. 2 and in the British Standards B.S. 727:1967 and B.S. 800:1971.

Measurement of impulse noise (cont'd).

Procedure for noise measurement on power supply cables The usual device specified for this type of measurement is known generally as an 'MDS Clamp' (after its inventor - J Meyer de Stadelhofen). This takes the form of a ferrite current transformer which is usually combined in a single assembly with an associated ferrite isolator: a general impression of the basic form of construction can be seen in Fig. 3.

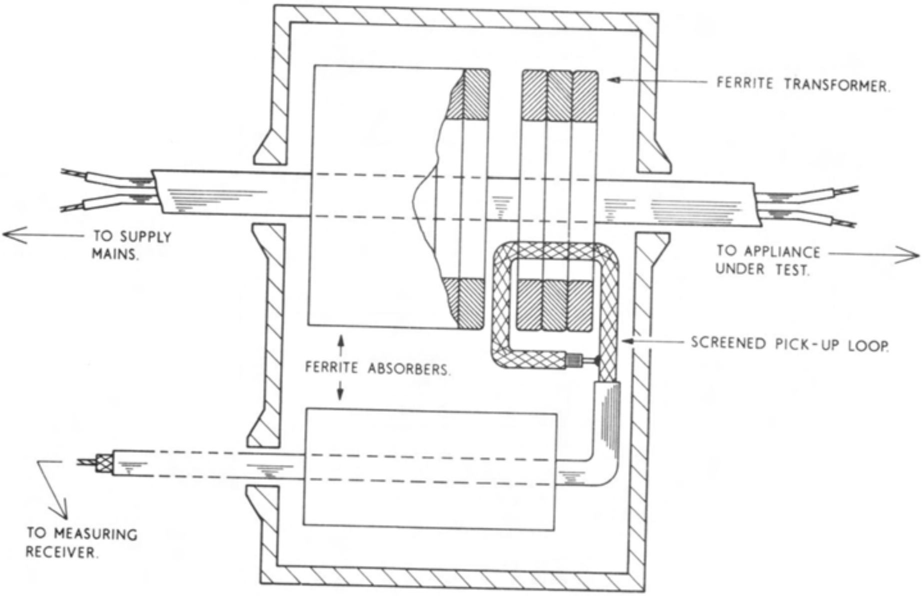


Fig. 3. Basic construction of ferrite transformer/isolator.

The current transformer takes the form of two or three ferrite rings through which are passed (1) the mains lead of the appliance, and (2) a screened single-turn pick-up loop. The ferrite isolator comprises several rings which are placed on the mains lead on the supply side of the current transformer: they serve to isolate the transformer from any RF noise which may be present on the supply cable. It is common for the ferrite rings to be fabricated in two halves (hence the term 'clamp') to facilitate attachment to the supply lead.

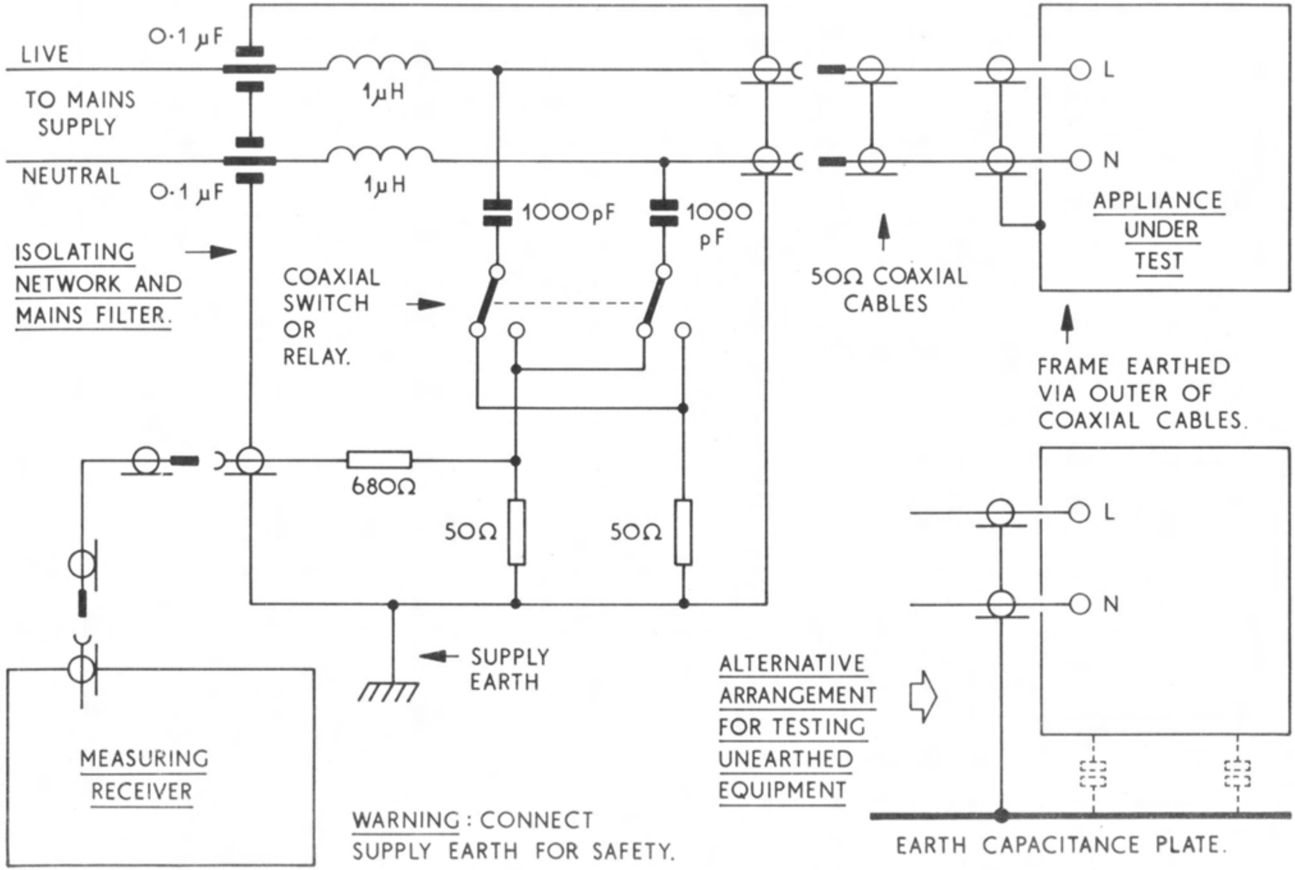


Fig. 4. Test set-up for measuring noise voltage at supply terminals.

Noise measurement on power supply cables (contd).

The attenuation/frequency characteristic of the device must be determined (clamp attenuation factor), so that suitable corrections can be applied to readings obtained with the measuring set.

In use, the complete assembly is fitted on the supply cable and the pick-up loop is connected directly to the measuring set. Influence of the 'MDS Clamp' causes a standing-wave pattern to be set up on the cable and the assembly must always be positioned at a point of maximum before actual measurements are taken. When measurements are necessary at several frequencies, the clamp will need to be repositioned for each reading. The measuring set is operated in the same manner described for measurements on radio signals (page 14).

It is generally accepted that measurements of this nature are best expressed in terms of dB/pW (dB relative to 1 pico-watt). The No. 31A equipment has an input impedance of 75Ω and 1μV applied will be the equivalent of -19dB/pW. Calculation of interference power is therefore a simple procedure and is carried out as follows:-

Noise power in dB/pW = (Coarse Atten + Fine Atten) - (Receiver Constant + Clamp Atten) - 19.

Measurement at the supply terminals of an appliance A simple piece of auxiliary apparatus for measuring the noise voltage at the supply terminals of an appliance is shown in Fig. 4 on the previous page. The unit is based on information contained in B.S. 727:1967, circuit values being chosen to suit the frequency range covered by the No. 31A equipment using the standard value of artificial mains impedance (50Ω for frequencies above 30MHz).

The 0.1μF feed-through capacitors and 1μH radio frequency chokes serve as a filter to stabilise the mains impedance and to limit the effect of other mains-borne interference on the measurements being taken.

Insertion loss from both coaxial supply outlets to the input of the measuring set should be checked using a 50Ω source. The loss must not exceed 26dB and the actual figure should be recorded at various frequencies in the range to serve as a correction factor for use when taking measurements.

Operating procedure is essentially the same as that described on page 14, except that it is necessary to add the correction factor referred to above. It is normal practice to take readings of noise voltage on both poles of the supply.

High impedance probe Noise measurements on certain classes of appliance are best performed using a high-impedance probe. In B.S. 800:1971 for example, use of a 1500Ω probe is recommended for measurement at the load terminals of a solid-state control device. A simplified circuit for this type of arrangement is shown in Fig. 4 from which it can be seen that the input impedance of the measuring set is built-out to 1500Ω and connected to the line(s) via a blocking capacitor of suitable voltage rating.

Measuring technique is exactly the same as in the previous case, allowance being made for the impedance of the probe by adding the appropriate dB reading to the normal result: with a 1500Ω probe this would be 26dB.

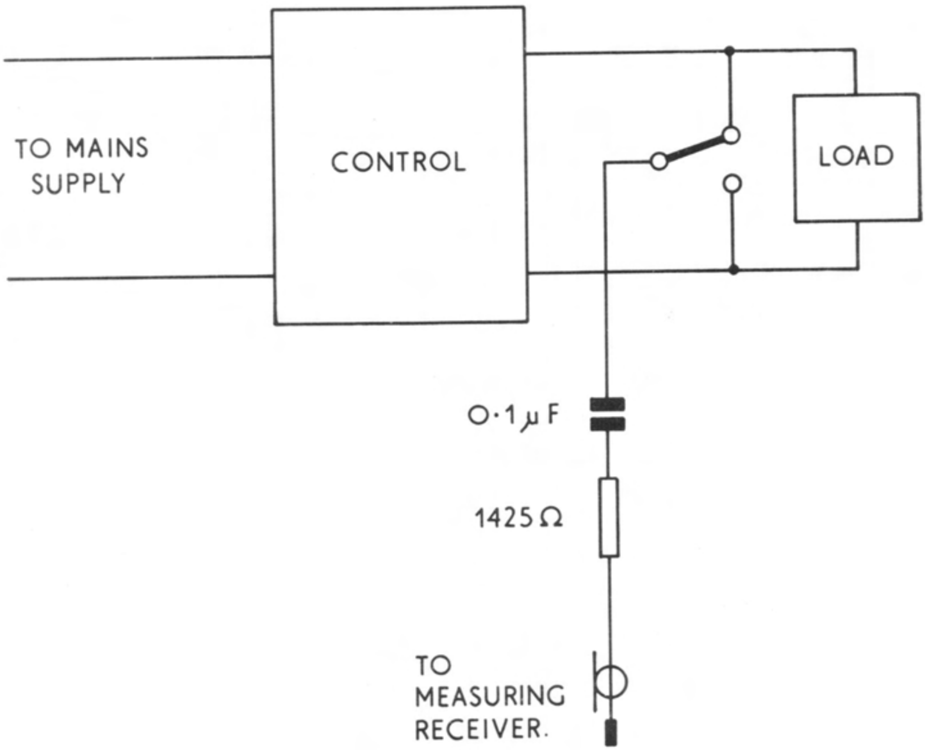


Fig. 5. High-impedance probe for noise measurement.

Field strength measurements

Measurement of field strength is often a convenient alternative to the methods of measurement outlined in the previous pages and, for this reason, the maximum allowable level of interference for certain classes of equipment is frequently specified in terms of dB relative to 1μV/metre. Testing is usually carried out at a fixed distance of 10 metres from the interference source using resonant dipole or rod antennas.

Aerial systems of both types are included with the No. 31A equipment which, by virtue of its complete portability, will be found extremely useful for measurements of this kind. Accuracy will be adequate for all normal purposes provided care is taken to observe the precautions listed below:-

(a) When using telephones to assist in identification of the wanted signal, these should be disconnected from the equipment before any reading is taken.

(b) The influence of hand/body capacity on the performance of the aerial should be noted and allowed for in maximizing the receiver response. In some cases it may be best to mount the aerial at some distance from the receiver and in this event due allowance should be made for the additional attenuation introduced by the extra length of feeder required. Accuracy of measurement will not be as high when using the vertical aerial in this manner since this has been calibrated with the case of the receiver acting as a partial ground plane.

(c) The operator should take special care not to position himself directly between the aerial and the noise source under test.

Aerial length It is important that the aerial in use is set to the correct length to resonate at the frequency of measurement. Table 3 gives the physical length of a quarter-wave for all frequencies in the range 60-250MHz, measurements below this range being made using the 60MHz setting. (This is in close agreement with British Standard B.S. 727:1967 which specifies a 50MHz antenna for the range 30-50MHz.)

The length obtained from Table 3 is the overall length for the rod antenna and the length of each element in the case of the dipole. A 20cm rule is provided on the back cover of this publication.

CAUTION: Operators should exercise care in using the receiver with aerials attached, to avoid the possibility of personal injury to eyes etc. when bending over the equipment to adjust controls.

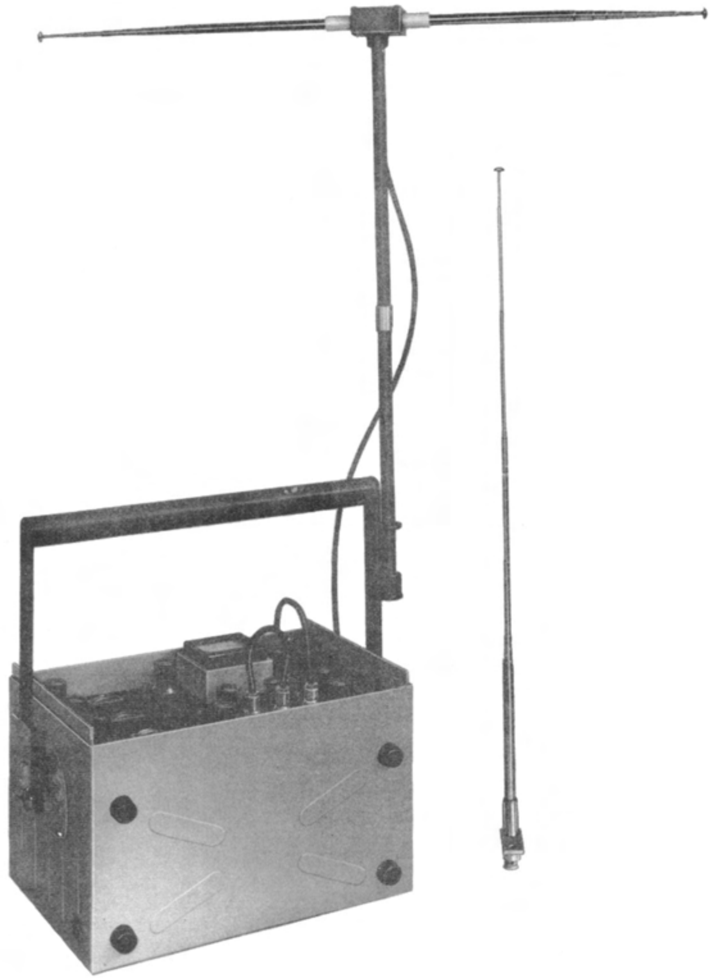


Fig. 6. No. 31A Equipment with dipole fitted for f/s checks.

TABLE 3 $\frac{1}{4}$-WAVE AERIAL LENGTHS FOR 30-250MHz

MHz	cm	MHz	cm	MHz	cm
30	116	110	65	190	37
40	116	120	60	200	36
50	116	130	55	210	34
60	116	140	51	220	33
70	102	150	47	230	31.5
80	88	160	45	240	30
90	77	170	42	250	29
100	70	180	39		

Aerial constants The No. 31A equipment is calibrated to provide readings of input voltage in terms of dB relative to 1μV, and it is therefore necessary to apply a correction factor in order to express the result in dB relative to 1μV/metre. A graph of constants for each aerial is provided in Fig. 7 on the opposite page. Field strength is calculated by adding the appropriate constant to the measured reading, e.g.:-

Field strength (dB relative to 1μV/metre) =

(Coarse Atten + Fine Atten) - Receiver Constant + Ae. Constant.

NOTE: The correction factors given in Fig. 7 apply only to the two aerials supplied with the No. 31A equipment. Measurements taken on other aerials should be expressed in terms of dB relative to 1μV (see page 15).

1. Measurement of horizontally polarized field strength

(a) Assemble the three-section aerial support mast and attach the balun unit to the top rod.

(b) Place the receiver on a level surface with the control panel in a horizontal or vertical position as convenient: adjust the handle to vertical setting and engage the mast in the socket provided.

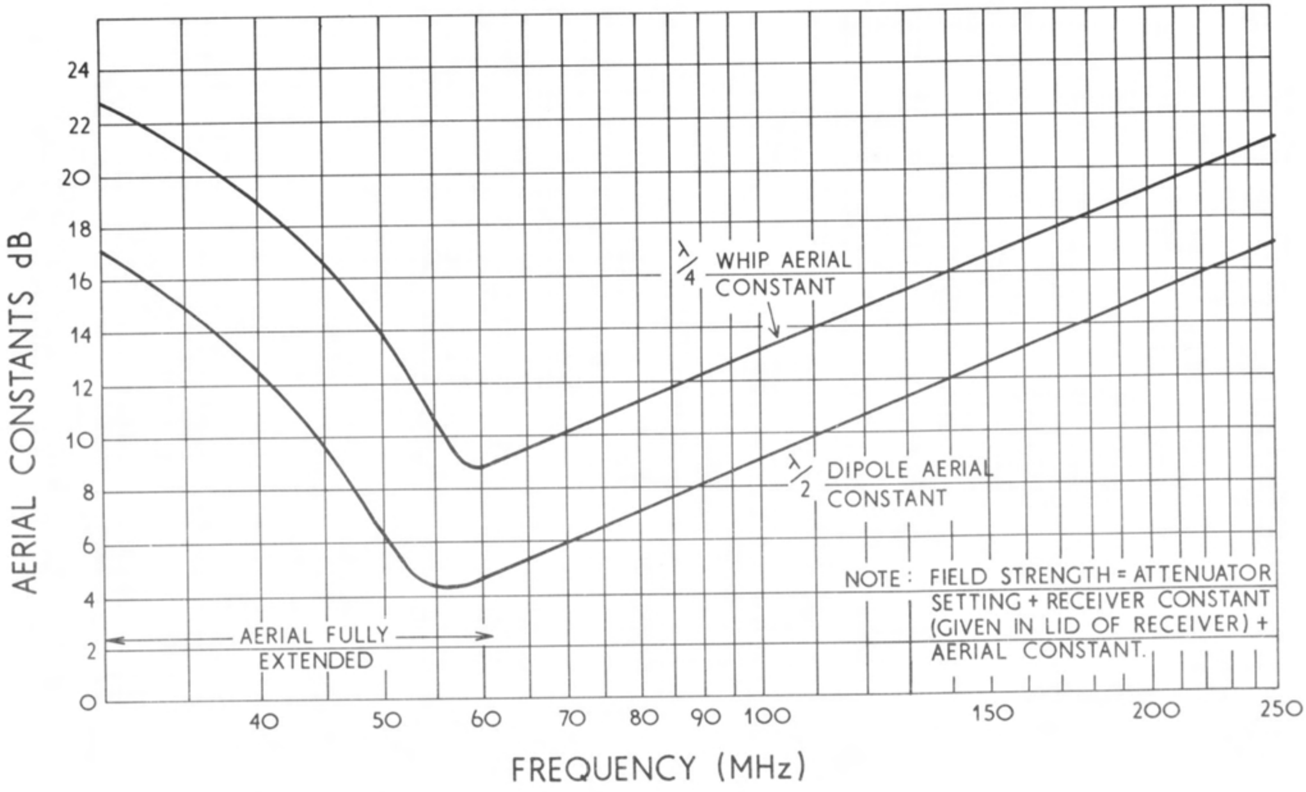


Fig. 7. Aerial correction factors for No. 31A aerials.

Measurement of horizontally polarized field strength (contd.)

(c) Screw the two dipole elements into the balun unit and adjust each rod to the length indicated in Table 3. Connect the balun output to the receiver input using the coaxial lead supplied.

(d) Switch on and tune the receiver to the appropriate frequency, using headphones to identify the wanted signal. Take out the input plug and standardize the overall gain, using the procedure given on page 13. Re-connect the input plug.

(e) Check the tuning and then rotate the dipole to the position of maximum signal.

(f) Adjust attenuators as necessary to cause meter deflection to fall on the 'CAL' mark and calculate field strength as shown on page 22.

2. Measurement of vertically polarized field strength

(a) Place the receiver on a level surface with its control panel uppermost. Lower the handle as far as possible.

(b) Plug the telescopic rod aerial directly into the input socket and adjust its length to approximately one quarter wave at the measuring frequency (see Table 3).

(c) Switch on and tune the receiver to the appropriate frequency, using headphones to identify the wanted signal. Remove the aerial and standardize the overall gain, using the procedure given on page 13. Re-connect the aerial and adjust its length to correspond exactly with the frequency shown by the receiver scale. Check receiver tuning.

(d) Adjust attenuators as necessary to cause meter deflection to fall on the 'CAL' mark and calculate field strength as shown on page 22.

'U' LINKS and BNC ADAPTOR

The two 'U' links provided are for connecting the input socket to (1) the 30dB fixed RF attenuator, and (2) the internal link which allows direct connection of aerial feeders terminated with RECMF-type plugs. The BNC adaptor is used to provide a socket connection when the vertical aerial is mast-mounted.

INTERFERENCE TRACING

In many investigations, the source of interference will be immediately apparent and the operator can proceed directly to establish the level of the disturbance with a view to determining whether it exceeds the prescribed value considered to be acceptable for the type of appliance involved. Other cases however, will not be quite so straightforward and it will then be necessary to seek out the interference source before actual measurement is possible.

The No. 31A equipment, being simple to operate and completely portable is ideally suited for applications of this type. Either of the two basic tracing techniques can be employed, i.e. intensity comparison and simple direction finding, or in some cases a combination of both. The audio output which is available allows telephones to be used for signal identification, but operators should disconnect these before bearings or readings of relative level are taken.

When tracing interference, it is usually unnecessary either to standardize the overall gain of the receiver or to adjust the aerials to their normal resonant length. In fact, handling of the set will be much easier if the minimum length of aerial capable of providing the required sensitivity is used. In this connection, it is important to note that when using the dipole, both elements must always be extended by an equal amount or there will be a risk of error in the bearings taken.

It is recommended that when using the vertical aerial for tracing, it should always be mounted on the bottom section of the mast with the handle suitably positioned. This will preclude the possibility of damage to the receiver input socket in the event of the aerial being inadvertently knocked against an obstruction: the connecting feeder should be of minimum length.

Overall gain must be standardized, and aerials correctly resonated, whenever it is necessary to carry out comparative checks on two or more different frequencies.

Direction finding This form of interference tracing is carried out with the dipole which has a horizontal polar diagram closely resembling a 'figure-of-eight'. Rotation of the aerial gives two positions of maximum signal and two of minimum, so that there will be an ambiguity of 180-degrees in all bearings taken. The ambiguity can be resolved by taking bearings from two different positions and plotting the appropriate position lines on a map.

INTERFERENCE TRACING (contd.)

Intensity comparison   Either aerial can be employed for this technique, in which the field pattern is determined by making a series of observations within the area in which the disturbance is detectable. Care should be taken to avoid approaching too closely, any local obstruction which may be self-resonant at the frequency on which the tests are being carried out. Re-radiation from such obstructions may be particularly troublesome when tracing interference in the confines of a building and the operator should therefore be on his guard to discount any dubious observation which may be noted. When using the dipole in this manner, always ensure that it is orientated for maximum pick-up before taking a reading of comparative strength.

BATTERY CHARGING

The internal nickel-cadmium battery should provide some 12-hours of continuous operation when fully charged, and with normal daily use will be fully charged after a single over-night charge. Over-charging should be avoided and it is therefore recommended that the charger is fed from an AC outlet controlled by a suitable time switch.

In circumstances where the battery has been discharged to the point at which the internal battery protection circuit has come into operation, a longer period of charge will be required to attain full capacity.

To charge the battery, merely connect the AC supply to the panel socket provided and set the FUNCTION SWITCH to 'BATT CHARGE' to obtain a reading of the charge current on the panel meter. Correct charging rate is indicated when the meter deflection falls in the blue sector.

MAINTENANCE

GENERAL

Noise Measuring Set No.31A is a purpose-built instrument designed to withstand the rigorous conditions of field use. It should require very little routine maintenance apart from regular inspection of the aerial accessories etc. housed in the lid.

This part of the handbook includes detailed checks which can be applied from time to time to determine that the performance specification of the equipment is maintained in service. These tests can also be employed for fault-finding in the event of the receiver developing a fault during normal use. Replacement units and all major spares can be supplied for user-servicing (see Appendix 'D'). Unserviceable receivers can be returned to the factory if this course of action is preferred.

INTERNAL CONSTRUCTION

Reference to Figs 8 and 9 will show that the receiver utilizes unit construction throughout, with all units attached directly or indirectly to the rear of the front panel. A protecting rail is fitted to support the lower part of the receiver when removed from its case. All units are labelled for ease of identification: interconnecting coaxial leads are coded alphabetically, and all others numerically.

ACCESSIBILITY OF UNITS FOR SERVICING

Access can be gained to the interior of the following units without the need for removing them from the main assembly.

Det/Audio & Meter/Batt Protection Unit: Disengage coaxial plug 'P' and 15-way free-socket SK21 - Remove four screws and slide off outer cover. Re-connect earth tag before carrying out tests.

3MHz IF Unit: Take out four screws and slide cover plate to rear to remove. Re-connect earth tag and replace both front screws before carrying out tests.

25MHz IF Unit: Take out four screws and slide cover upwards to remove.

REMOVAL OF UNITS

RF Tuning Units

1. Disconnect two coaxial plugs.
2. Unsolder two -ve supply leads (black wires).
3. Unsolder earth connection (red wire).
4. Slacken two screws in flexible coupler to free tuning gang.
5. Remove four screws which retain insulated mounting plate at rear of tuning drive - support unit and lift clear.

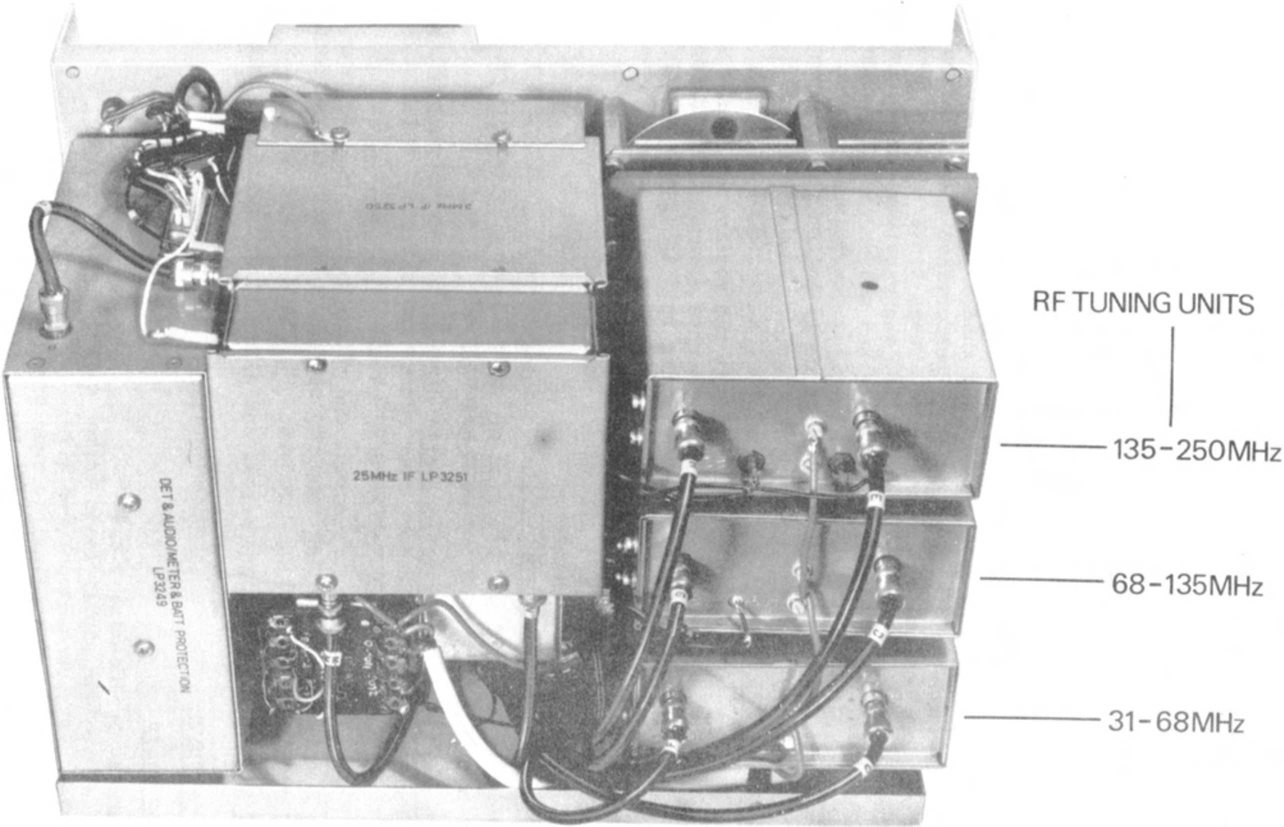


Fig. 8. Top view of Noise Measuring Set showing unit location.

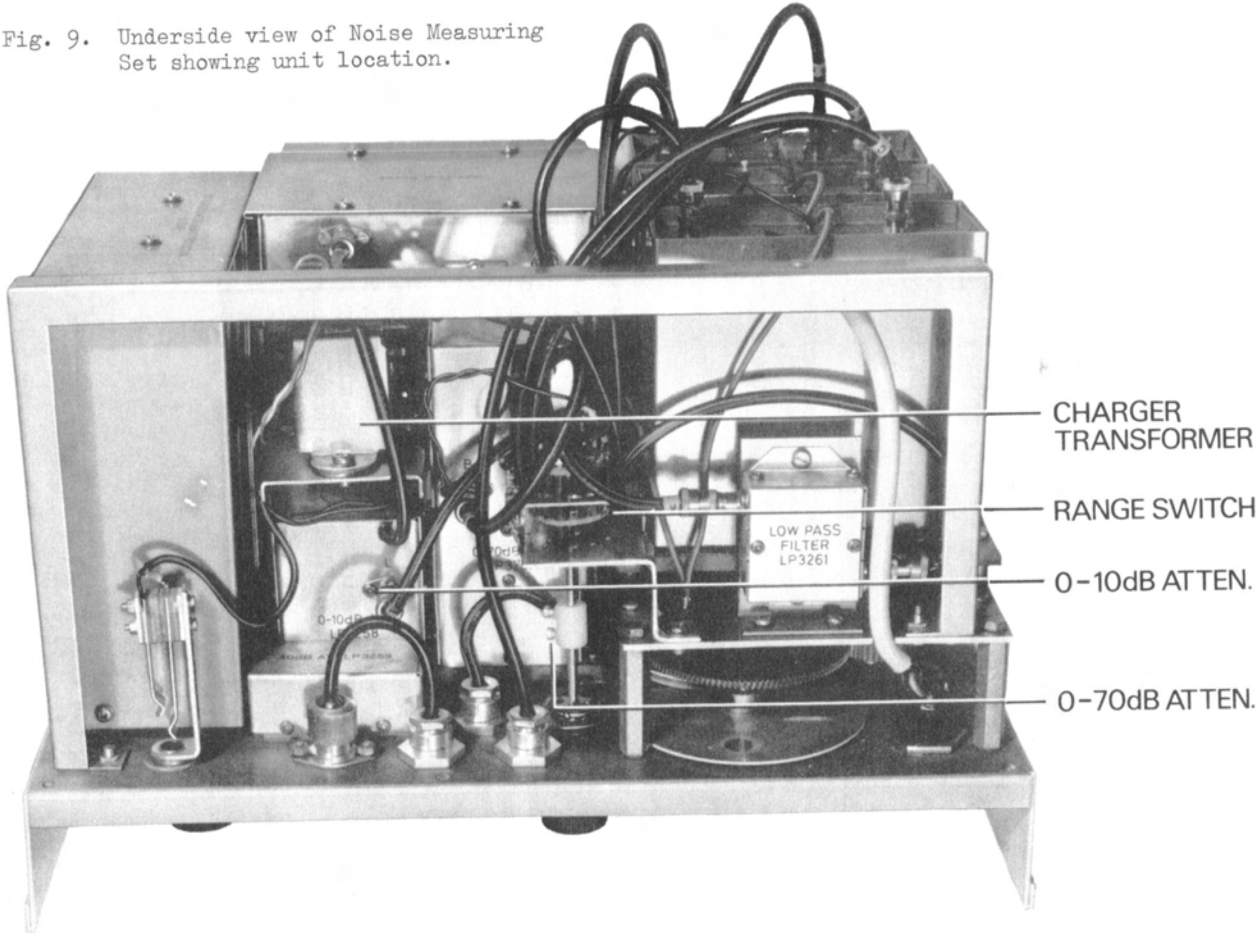


Fig. 9. Underside view of Noise Measuring Set showing unit location.

3MHz/25MHz IF Assembly

The two IF Units are assembled to form one single unit before installation in the main assembly: they must be removed in this form.

1. Disconnect coaxial plugs 'M', 'N' & 'P'.
2. Disconnect pull-off connectors at unit terminations Nos 24 & 36.
3. Remove knob from CAL control.
4. Take out two screws on top of 3MHz IF Unit near panel.
5. Slacken two screws near coaxial sockets 'M' and 'N'.
6. Support units and slide clear of main assembly.

Det/Audio & Meter/Battery Protection Unit

1. Remove outer cover as per previous instruction (page 27).
2. Remove control knobs from FUNCTION SWITCH, DC BAL and AF GAIN.
3. Remove four nuts holding front plate of unit to insulated pillars at rear of front panel.
4. Support unit and slide to rear to remove.

0-10dB & 0-70dB Attenuators

These two units must be removed as a combined assembly.

1. Remove 3MHz/25MHz IF Assembly as described above.
2. Remove battery and foam pad (for access in (8) below).
3. Disconnect coaxial plugs 'B' & 'L' on Attenuator Units.
4. Disconnect coaxial plugs 'M' & 'N' on 25MHz IF Unit.
5. Disconnect coaxial plug 'K' on Low Pass Filter.
6. Unscrew INPUT socket and free from front panel.
7. Remove both ATTENUATOR control knobs.
8. Remove two screws (access through battery compartment) and lift the mains transformer to clear space at rear of attenuator assembly.
9. Remove four screws which retain insulated front plate to panel bracket - support unit and slide to rear to remove.

Battery

Remove 3MHz/25MHz IF Assembly for access to battery box.

Meter

1. Remove 3MHz/25MHz IF Assembly.
2. Remove battery.
3. Remove foam pad from front of battery box to expose the four screws which retain the meter housing.
4. Disconnect meter leads and remove screws in (3) above. Meter housing is now free and should be supported to prevent damage.
5. Extract meter from housing by removing four x 4BA hex. nuts.

PERFORMANCE TESTING

VOLTAGE ANALYSIS

A complete summary of voltage values for all transistors will be found in Appendix 'A' on pages 48/49.

TEST EQUIPMENT

The following equipment in the Marconi Instruments range is recommended for performance testing and adjustment of Noise Measuring Set No. 31A.

TF144H/4 SIGNAL GENERATOR

Freq. range: 10kHz-72MHz.
Int. Calibrator: 400kHz/2MHz.

TF1066B/6 SIGNAL GENERATOR

Freq. range: 10MHz-470MHz.
Int. Calibrator: 1MHz/10MHz.

TF2416 COUNTER

Freq. measurement to 50MHz.
10mV sensitivity.

TF1101 R-C OSCILLATOR

Freq. range: 20Hz-200kHz.
60dB step attenuator.

TF2210 OSCILLOSCOPE

DC to 100MHz bandwidth.
6cm x 10cm display.

TF2163S UHF ATTENUATOR

0-142dB in 1dB steps.
50Ω impedance.
VSWR: 1.1 to 200MHz.

54411-021 MATCHING PAD

75Ω to 50Ω.
BNC connectors.
VSWR: 1.04 to 1GHz.

TF2500 AF POWER METER

Seven power ranges.
Wide impedance range.

PERFORMANCE TESTS

DETECTOR/AUDIO & METER/BATTERY PROTECTION UNIT - LP3249

Audio Sensitivity (TR25/TR26/TR27)

1. Remove cover from LP3249 unit.
2. Connect audio generator to P/C Terminal No. 47. (see fig. 10).
3. Connect audio power output meter (matched to 600Ω) to telephone socket or P/C Terminals 48 & 49 (No. 48 = earth).*
4. Tune audio generator to 1kHz.
5. Set FUNCTION SWITCH to 'MEASURE', MODE SWITCH to 'AM' and AF GAIN to maximum.
6. Increase output from generator until power output meter indicates 3mW.
7. Check that input to No. 47 for output in (6) is of the order 50mV.

(*) Actual o/p Z is nominally 1kΩ: a 600Ω termination is used for convenience only.

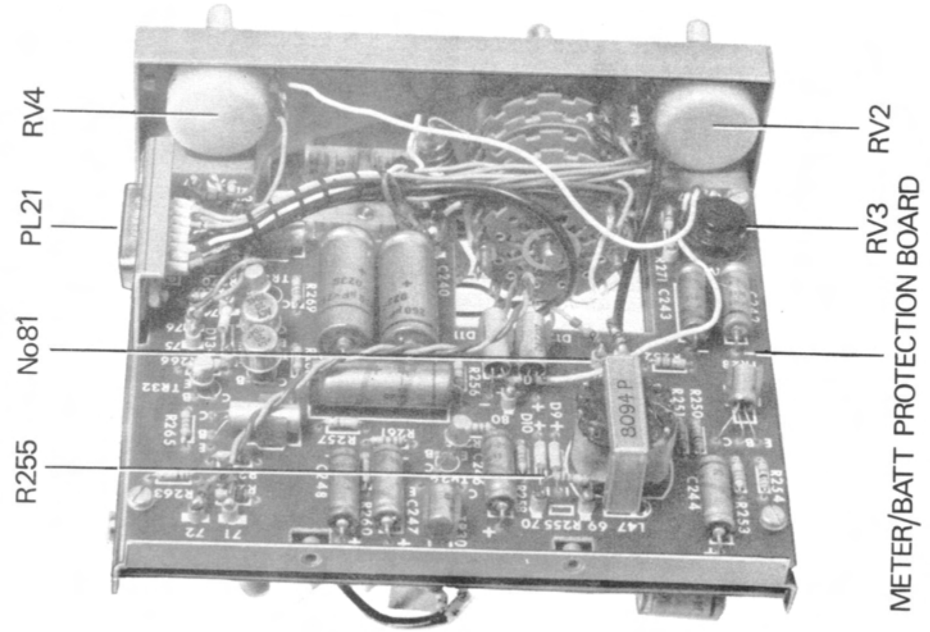


Fig. 10. Internal views of Det/Audio & Meter/Battery Protection Unit.

3MHz Sensitivity (TR20/TR21 & Meter Amplifier)

1. Disconnect coaxial plug 'P' (PL20).
2. Set FUNCTION SWITCH to 'DC BAL' and adjust DC BAL CONTROL so that meter reads on DC BAL mark.
3. Switch to 'MEASURE'.
4. Connect signal generator to socket 'P' (SK20).
5. Tune generator to provide an unmodulated 3MHz signal.
6. Increase output from generator until meter reads on 'cal' mark.
7. Check that generator output is of the order 30-40mV.

Meter Amplifier (TR31-TR36)

This part of the circuit can be assumed to be operating correctly if the DC BAL CONTROL functions normally.

3MHz Sensitivity (TR20/TR24 & Audio Amplifier)

1. Disconnect coaxial plug 'P' (PL20).
2. Set FUNCTION to 'MEASURE', MODE to 'AM' and AF GAIN to maximum.
3. Connect signal generator to socket 'P' (SK20) and power output meter to PHONES socket (adjust impedance match to 600Ω).
4. Tune generator to provide a 1kHz 30% modulated signal at 3MHz.
5. Increase output from generator until power output meter reads 3mW.
6. Check that generator output is of the order 8-10mV.

Beat Frequency Oscillator (TR22)

Drive level measured with a valve voltmeter connected between P/C Term. No. 43 and earth should be of the order 70mV (FUNCTION at 'MEASURE' and MODE at 'CW').

Battery Protection Circuit (TR28/TR29/TR30)

Replacement of components in this circuit may necessitate alteration of the value for R255. This resistor is mounted on P/C tags Nos 69 & 70. The procedure for determining the new value is as follows:-

1. Disconnect internal battery and operate receiver from a stabilised DC power supply with variable output in the range 9 - 12.5V.
2. Connect testmeter to monitor voltage between P/C Terminal No. 81 (negative) and earth.
3. Adjust power unit to supply 12.5V to receiver.

Battery Protection Circuit (contd.)

4. Set FUNCTION SWITCH to 'CHECK BATT'.
5. Reduce supply voltage slowly and note voltage at which panel meter reading falls to zero. Drop-out should occur in the range 10.5V to 10.7V (not 10.75V as stated on circuit).
6. If circuit trips above or below this range, the value of R255 should be altered to obtain correct operation - value should lie in the range 1.5Ω to 150Ω.

3MHz IF UNIT - LP3250

3MHz Sensitivity (TR16-TR19 & Meter Path)

1. Remove cover and disconnect existing lead from P/C Terminal No. 31.
2. Connect signal generator to P/C Terminal No. 31.
3. Set FUNCTION SWITCH to 'DC BAL' and adjust DC BAL CONTROL so that meter reads on DC BAL mark.
4. Switch to 'MEASURE' and set CAL CONTROL fully clockwise.
5. Tune generator to provide unmodulated signal at 3MHz and adjust its output level to cause meter to read on 'cal' mark.
6. Check that generator output lies in the range 30-80µV.
7. Check range of adjustment provided by CAL CONTROL (see opposite).

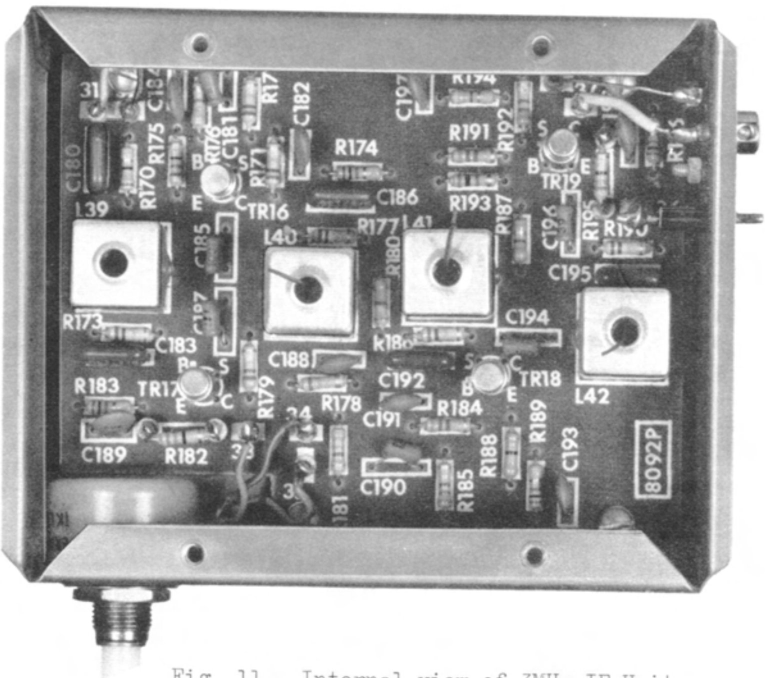


Fig. 11. Internal view of 3MHz IF Unit.

RV1 Adjustment Range (CAL CONTROL)

1. Proceed as in 3MHz sensitivity check on opposite page.
2. Set CAL CONTROL fully anti-clockwise.
3. Increase generator output to restore 'cal' reading on meter.
4. Note Increase in generator output and check that this is of the order 10dB.
5. Re-connect lead to P/C Terminal No. 31.

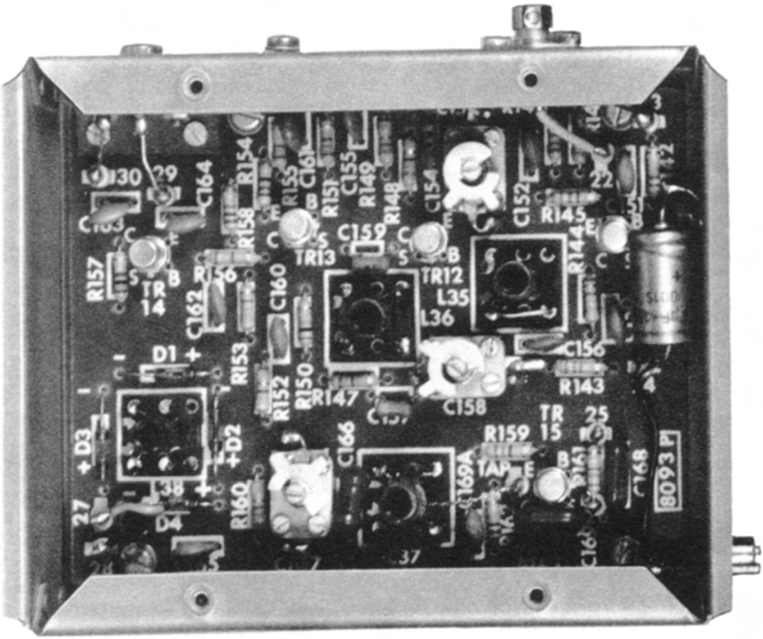


Fig. 12. Internal view of 25MHz IF Unit.

25MHZ IF UNIT - LP3251

25MHz Sensitivity (TR11-TR13, 3MHz IF & Meter Path)

1. Disconnect PL16 (coaxial lead 'M') from SK16.
2. Connect generator to SK16.
3. Set FUNCTION SWITCH to 'DC BAL' and adjust DC BAL CONTROL to cause meter to read on DC BAL mark.
4. Switch to 'MEASURE' and set CAL CONTROL fully clockwise.
5. Tune generator to provide unmodulated signal at 25MHz and adjust its output level to cause meter to fall on CAL mark.
6. Check that generator output is of the order 10μV.

Image Response

1. Proceed as in (1) to (6) on previous page and note exact generator output.
2. Tune generator to image frequency (19MHz) and increase output to sufficient level to give reading on meter.
3. Tune generator for peak meter deflection.
4. Adjust generator output level to give 'cal' reading on meter.
5. Check that difference in attenuator readings of (1) and (4) above is of the order 45-60dB.

2nd Oscillator (TR15)

The level of oscillator injection from this stage should be checked if previous tests indicate normal sensitivity at 3MHz but low sensitivity at 25MHz. Valve voltmeter connected between positive ends of D2/D4 and earth should read approximately 200mV.

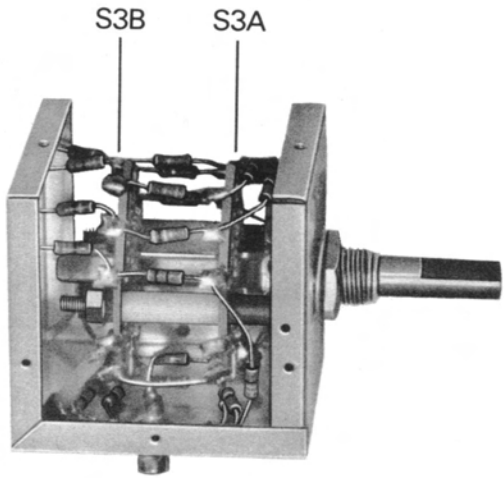


Fig. 13. Internal view of 0-10dB Attenuator Unit.

0-10dB ATTENUATOR - LP3258

1. Disconnect coaxial plug 'L' (PL15).
2. Connect generator to socket 'L' (SK15) via external attenuator (75Ω matching).
3. Set 0-10dB Attenuator to '10dB' position and external attenuator to 0dB.
4. Set FUNCTION SWITCH to 'DC BAL' and adjust DC BAL CONTROL so that meter reads on DC BAL mark.
5. Switch to 'MEASURE' and set CAL control fully clockwise.
6. Tune generator to 25MHz and adjust output level so that meter reads on 'cal' mark.
7. Decrease setting of 0-10dB Attenuator in 1dB steps and restore 'cal' reading at each position by adjusting external attenuator.
8. Check that accuracy is within 0.5dB at each setting.

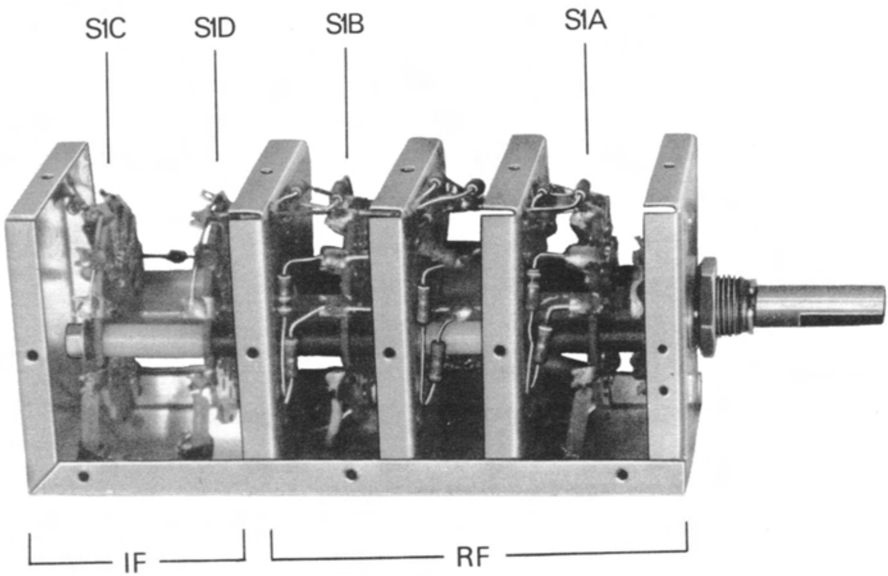


Fig. 14. Internal view of 0-70dB Attenuator Unit.

0-70dB ATTENUATOR - LP3257

1. Adjust receiver for normal operation with overall gain standardized at a tune frequency of 230MHz.
2. Connect generator to INPUT socket via an external attenuator matched to 75Ω. (pad connected between attenuator and receiver input).
3. Set 0-70dB Attenuator to '70dB' position and external attenuator to 0dB.
4. Tune generator to 230MHz and adjust output level so that meter reads On 'cal' mark.
5. Decrease setting of 0-70dB Attenuator in 10dB steps and restore the 'cal' reading at each position by adjusting the external attenuator.
6. Check that accuracy is within 1.5dB at each setting.
7. Repeat check at tune frequencies of 100MHz and 32MHz.

RF TUNING UNITS (Overall receiver check)

The following tests should be performed on each range using the basic procedures outlined below:-

Sensitivity

1. Adjust receiver for normal operation with overall gain standardized at test frequency.
2. Set 0-70dB Attenuator to '0dB' and 0-10dB Attenuator to '6dB'.
3. Connect generator to input socket and adjust to provide unmodulated signal at test frequency. Ensure close match to 75Ω input.
4. Adjust generator output level to produce 'cal' reading on meter.
5. Check that generator output does not exceed 2μV.

Image Response

1. Proceed as in (1) to (5) above and note exact generator output.
2. Tune generator to image frequency (test frequency + 50MHz).
3. Increase generator output to restore 'cal' reading.
4. Check that increase in generator output from level in (1) above is not less than 20dB and is of the order 30dB at 31MHz.

Calibration Accuracy

Scale calibration should be checked at 5MHz intervals using a 1MHz or 5MHz crystal-controlled harmonic generator. Accuracy should be within 2% on all ranges. Check can be performed by use of TF1066 generator if scale accuracy is first checked against internal calibrator.

Receiver Constant

1. Adjust receiver for normal operation with overall gain standardized at test frequency.
2. Set 0-70dB Attenuator to '40dB' and 0-10dB Attenuator to '0dB'.
3. Connect generator to input socket and tune to test frequency.
4. Set attenuator on generator to 40dB above 1µV.
5. Adjust 0-10dB Attenuator until meter reads on 'cal' mark.
6. Note setting of 0-10dB Attenuator. This is a measure of the receiver constant which should coincide with the figure given by the graph supplied with the receiver.

Noise Drop

1. Standardize overall receiver gain at test frequency.
2. Switch to 'CHECK NOISE' and observe drop in meter reading below CAL mark.
3. Meter should drop into green sector on scale. Reading can be below green sector at some frequencies but must never be above. Return receiver to factory if noise drop is not to specification.

Pulse Response

Specialized test equipment is required to carry out this functional check - return receiver to factory if substandard performance is suspected. Fig. 15 shows a typical CISPR detector characteristic.

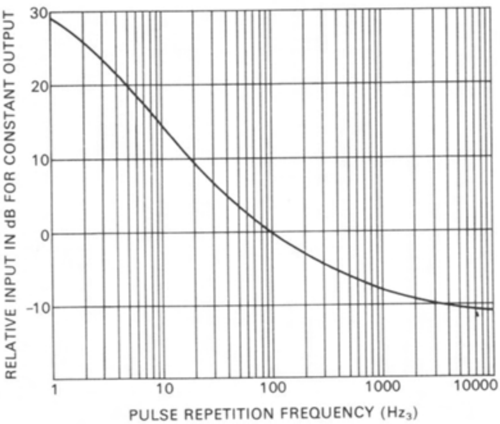


Fig. 15 Pulse response of CISPR quasi-peak detector.

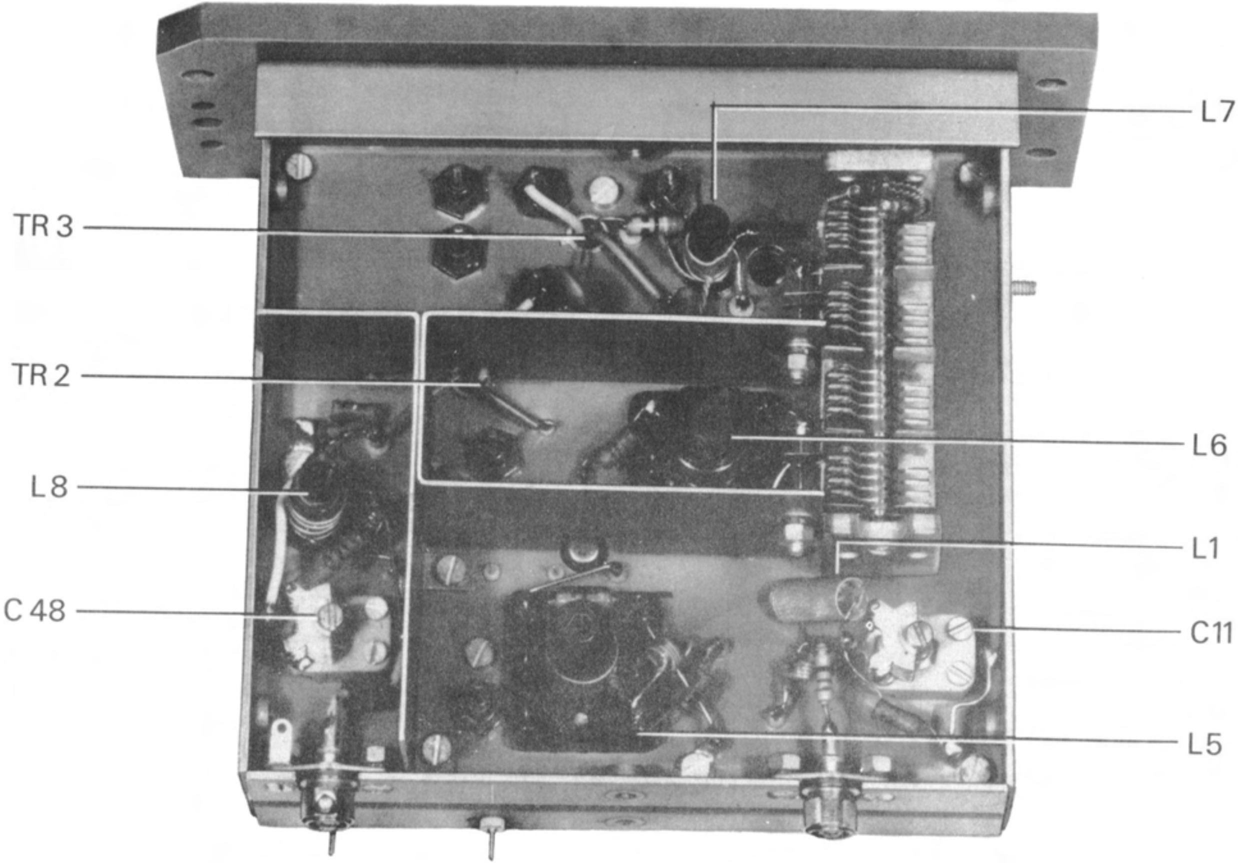


Fig. 16. Top view of Range 1 Tuning Unit (31-68MHz) : LP3252

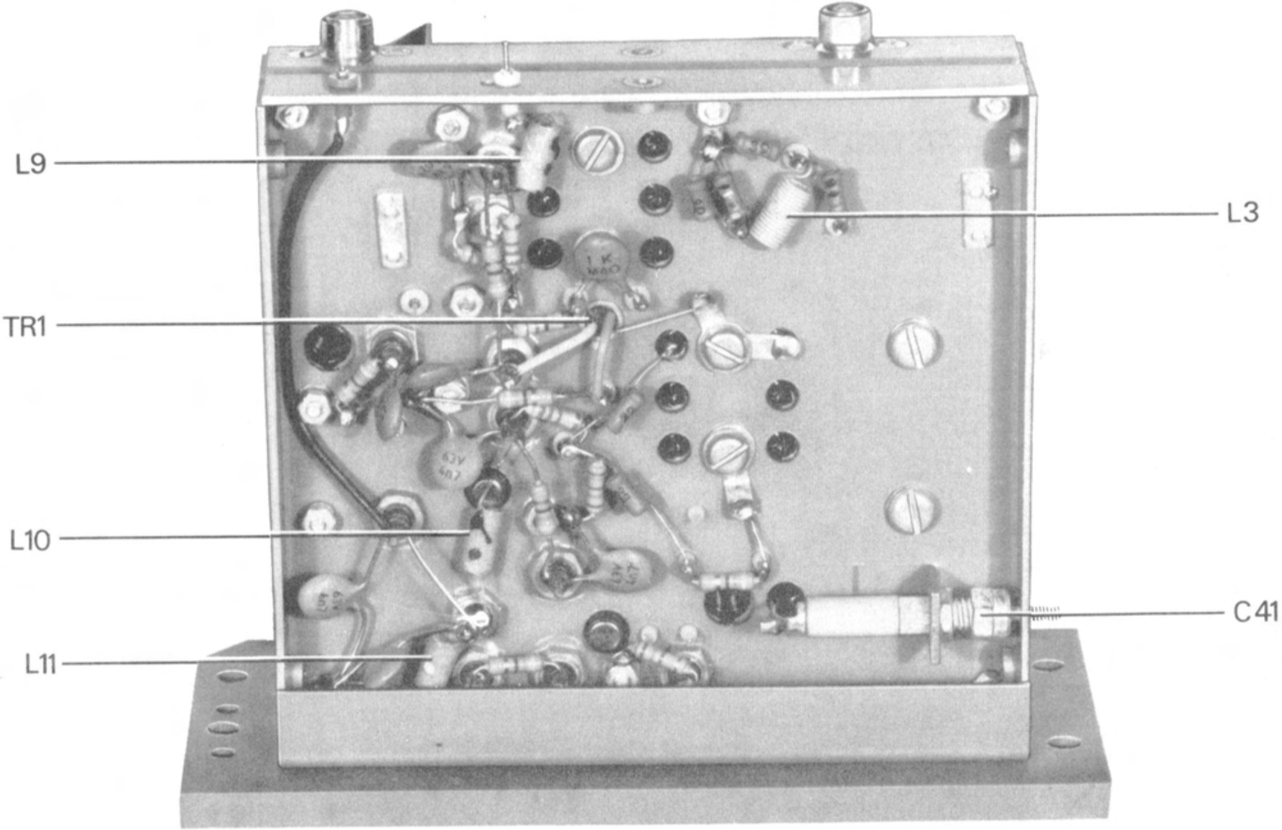


Fig. 17. Underside view of Range 1 Tuning Unit (31-68MHz) : LP3252

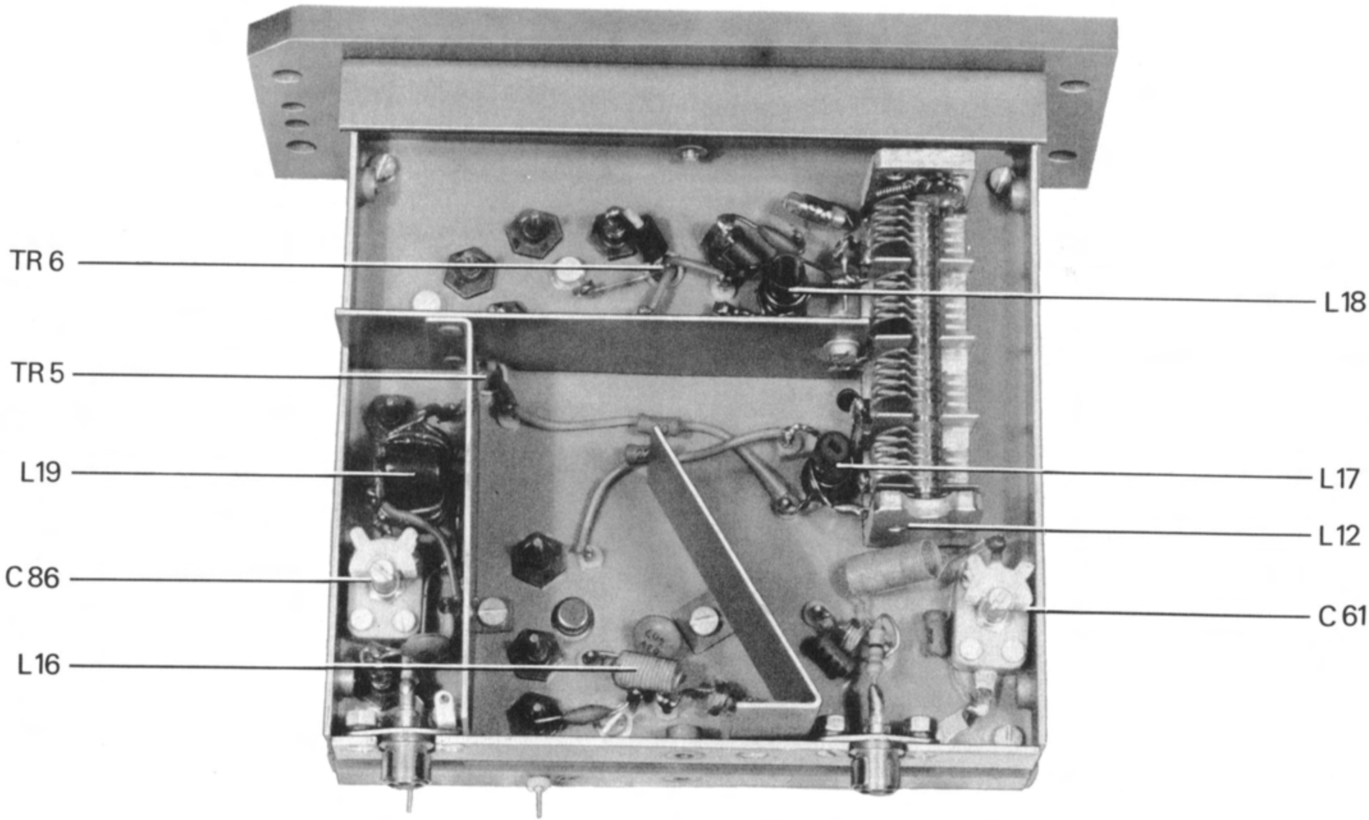


Fig. 18. Top view of Range 2 Tuning Unit (68-135MHz) : LP3253

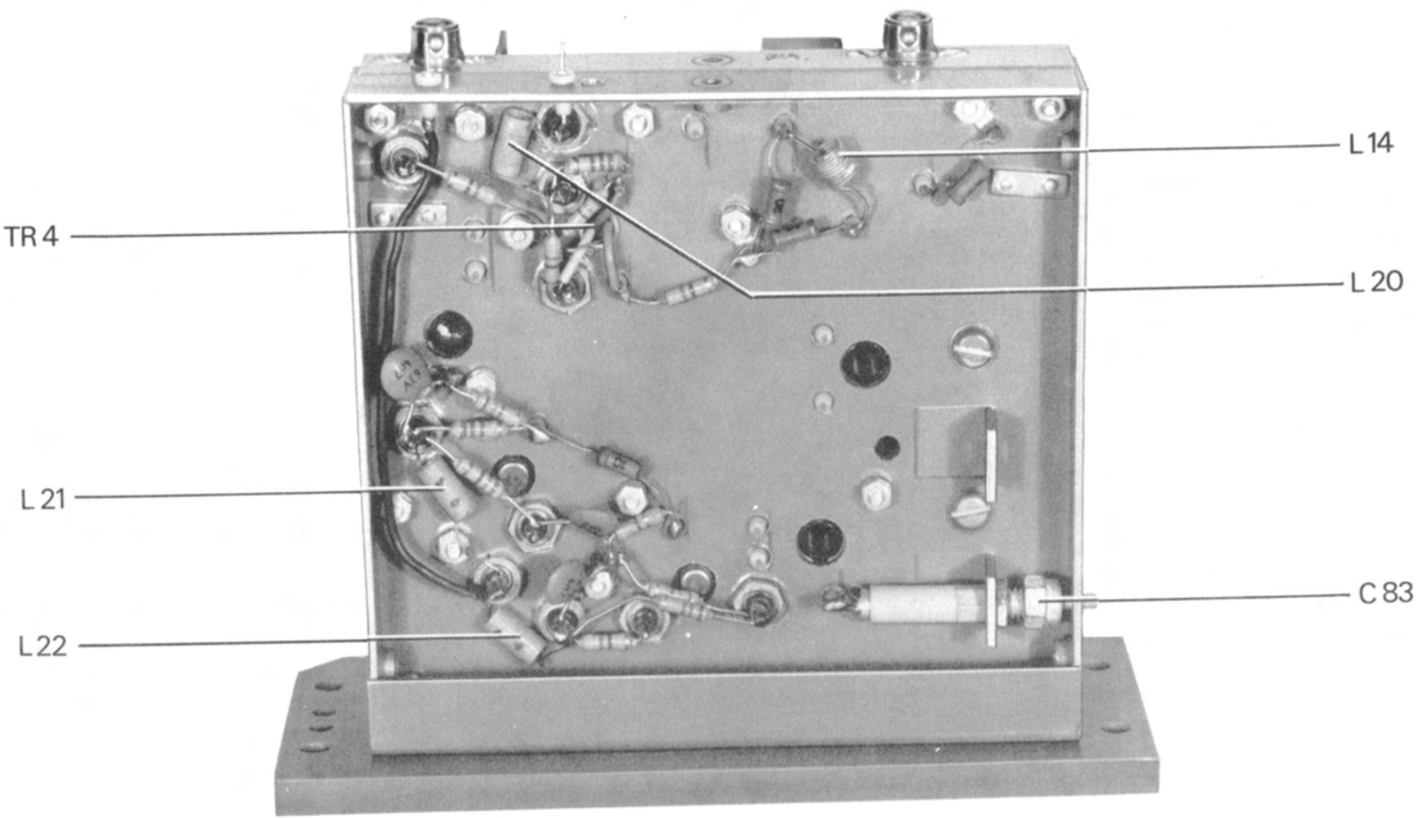


Fig. 19. Underside view of Range 2 Tuning Unit (68-135MHz) : LP3253

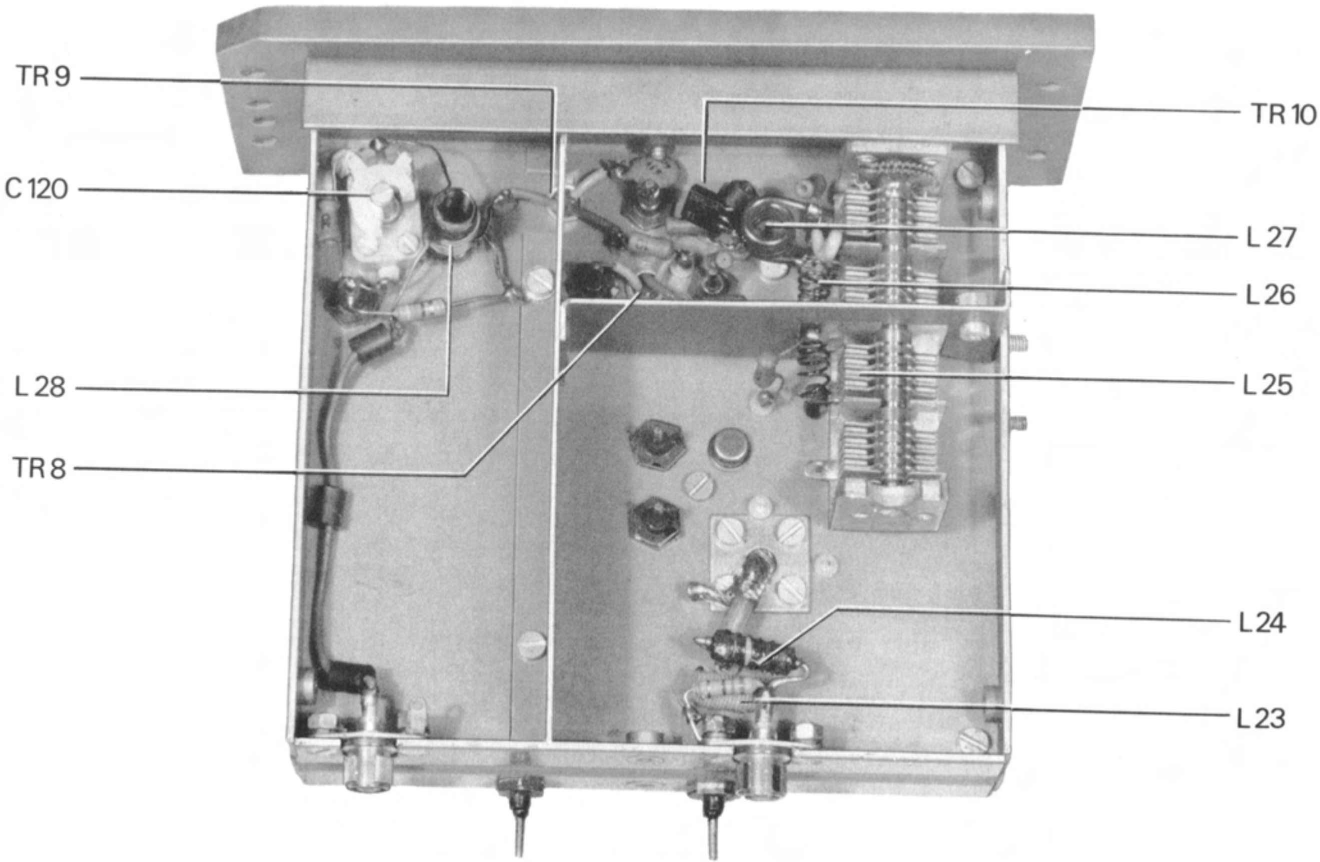


Fig. 20. Top view of Range 3 Tuning Unit (135-250MHz) : LP3254

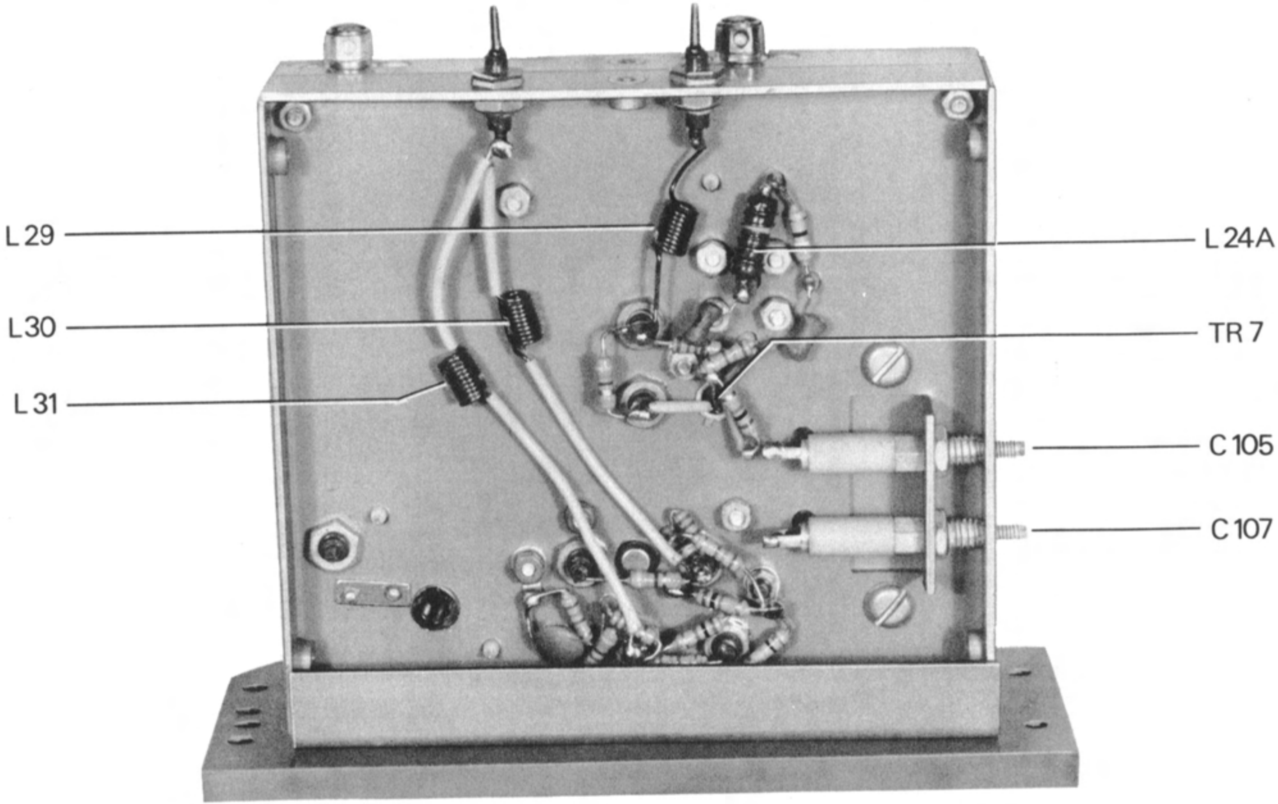


Fig. 21. Underside view of Range 3 Tuning Unit (135-250MHz) : LP3254

RE-ALIGNMENT

DET/AUDIO & METER/BATTERY PROTECTION UNIT

Detector Alignment

1. Remove unit cover and re-connect 15-way connector.
2. Connect signal generator to SK20 (coaxial lead 'P').
3. Set FUNCTION SWITCH to 'MEASURE', MODE to 'AM' and AF GAIN at mid-position.
4. Arrange signal generator to provide a 3MHz signal with 50% modulation at 1kHz. The accuracy of the generator should be checked with calibrator or frequency counter.
5. Connect oscilloscope to PHONES socket and adjust timebase etc. to display receiver output. Take special care to ensure that overloading is avoided and that the c.r.t. display shows a clear sine wave trace.
6. Adjust cores in L45 and L46 (on inner peak) for maximum amplitude of c.r.t. display.
7. Change MODE to 'CW' and adjust C211 for zero beat (BFO adjustment).
8. Change MODE to 'FM' and connect voltmeter to P/C Terminal No. 59.
9. Check discriminator symmetry over the range 2.9-3.1MHz and correct response if necessary by minor adjustment of L46.
10. Voltage at P/C Terminal No. 59 should be of the order +1.4V with generator at 2.9MHz, -1.4V at 3.1MHz (input level 15mV nominal).

IF ALIGNMENT

3MHz IF Unit

1. Remove cover and disconnect existing lead from P/C Terminal No. 31.
2. Connect signal generator to P/C Terminal No. 31.
3. Set FUNCTION SWITCH to 'DC BAL' and adjust DC BAL CONTROL to balance meter.
4. Switch to 'MEASURE' and set CAL CONTROL fully clockwise.
5. Arrange generator to provide an unmodulated 3MHz signal with level set for 'cal' reading on meter. The accuracy of the generator should be checked with calibrator or frequency counter.
6. Adjust cores in L39, L40, L41 & L42 for peak reading on meter. Reduce output level to maintain 'cal' reading.

IF ALIGNMENT - 3MHz IF Unit (contd.)

7. Increase generator output by 6dB. Off-tune above and below 3MHz to restore 'cal' reading and note overall IF bandwidth.

8. Increase generator output to +20dB above level in (6) above. Off-tune to restore 'cal' reading and note overall bandwidth.

9. If bandwidth in (7) and (8) above is less than 120kHz and 200kHz respectively, stagger tune L39/40 and L41/42 to achieve correct response.

10. Check 3MHz sensitivity - see page 34.

25MHz IF Unit

1. Disconnect PL16 (coaxial lead 'M') from SK16.

2. Connect signal generator to SK16.

3. Set FUNCTION SWITCH to 'DC BAL' and adjust the DC BAL CONTROL to balance meter.

4. Switch to 'MEASURE' and set CAL CONTROL fully clockwise.

5. Arrange generator to provide an unmodulated 25MHz input with level set for 'cal' reading on meter. Generator scale accuracy must be checked against calibrater or frequency counter.

6. Tune C167 for peak deflection of meter (2nd Oscillator adjustment).

7. Tune C158 for peak deflection of meter (25MHz IF adjustment).

8. Alter generator to 19MHz, increase output level and locate image response.

9. Tune C153 for minimum meter deflection.

10. Check sensitivity etc. - see page 35.

RF ALIGNMENT

Despite the apparent simplicity of the front-end circuits, re-alignment of the RF Tuning Units requires an involved procedure calling for a high degree of skill and intimate knowledge of the absolute parameters of the equipment as a whole. Re-alignment should not be necessary, except perhaps when a transistor or other critical component has been changed. In this event, the equipment should be returned to the factory where the necessary instruments, test jigs etc. are immediately available.

A P P E N D I X 'A'

V O L T A G E   A N A L Y S I S

In the event of the receiver failing to operate normally, voltage analysis should be carried out in the sequence given below. Voltages quoted here were taken with a standard 20,000Ω/V testmeter (AVO Model 8): 10% variation should be allowed on all readings to cover battery state and normal semiconductor spreads. All voltages are NEGATIVE w.r.t. earth. The Note 'TRANSISTOR VOLTAGES' on the circuit diagram should read VOLTAGES ARE QUOTED WITH RECEIVER GAIN STANDARDIZED. It is not essential to standardize gain for normal analysis.

1. Switch to 'CHECK BATT' and ensure that meter reads in blue sector.
2. Check supply voltage availability at unit terminations below:-

DET/AUDIO & METER/BATT PROTECTION UNIT:-

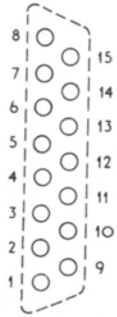
SK21/1 :: -12V (FUNCTION SWITCH at any position other than 'OFF' or 'BATT CHARGE').

SK21/2 :: -12V (Any position other than 'OFF', 'BATT CHARGE' or 'CHECK NOISE').

SK21/3 :: -12V (As SK21/1).

SK21/4 :: -12V (Direct from battery).

SK21/9 :: -11.5V (Any position other than 'OFF' or 'DC BAL').



SK21 viewed on wiring side

3MHz IF UNIT:- Pin No. 36 :: -12V (As SK21/1 above).

25MHz IF UNIT:- Pin No. 24 :: -11.5V (As SK21/9 above).

RF TUNING UNIT No. 1 (Range Switch to 31-68MHz)

Pin No. 16 :: -12V (via SK21/3). Pin No. 17 :: -12V (via SK21/2).

RF TUNING UNIT No. 2 (Range Switch to 68-135MHz)

Pin No. 18 :: -12V (via SK21/3). Pin No. 19 :: -12V (via SK21/2).

RF TUNING UNIT No. 3 (Range Switch to 135-250MHz)

Pin No. 20 :: -12V (via SK21/3). Pin No. 21 :: -12V (via SK21/2).

3. Detailed checking of transistor voltages necessitates removal of the unit covers, or removal of the entire unit in the case of the three RF Tuners. Time can therefore be saved by using standard signal tracing techniques to identify which unit(s) is/are faulty. Voltage analysis can then be resumed, using the Table of Voltages on the following page as a guide.

T A B L E   O F   V O L T A G E S

Unit	Ref	Emitter	Base	Collector
RF Tuning Unit No. 1	TR1	9.3V	10.1V	2.1V
	TR2	9.45V	10.1V	2.0V
	TR3	9.45V	10.0V	2.1V
RF Tuning Unit No. 2	TR4	9.3V	10.0V	2.1V
	TR5	9.5V	10.2V	3.45V
	TR6	10.4V	11.0V	1.15V
RF Tuning Unit No. 3	TR7	9.4V	10.2V	2.0V
	TR8	9.4V	9.9V	2.3V
	TR9	9.35V	9.28V	3.0V
	TR10	7.4V	8.0V	0V
25MHz IF Unit	TR11	2.9V	3.1V	6.95V
	TR12	6.7V	7.0V	10.5V
	TR13	3.25V	3.5V	7.6V
	TR14	7.3V	7.6V	11.0V
	TR15	3.5V	3.4V	5.55V
3MHz IF Unit	TR16	4.9V	5.0V	10.5V
	TR17	2.4V	2.5V	8.65V
	TR18	4.55V	4.8V	10.0V
	TR19	5.4V	5.6V	9.4V
Det/Audio Board	TR20	4.9V	5.1V	11.3V
	TR21	4.15V	4.9V	8.2V
	TR22	5.1V	4.32V	6.9V
	TR23	4.55V	4.82V	9.75V
	TR24	4.85V	5.0V	10.0V
	TR25	6.7V	3.0V	10.2V
	TR26	4.8V	4.5V	7.05V
	TR27	1.15V	1.3V	5.4V
Meter/Batt Protection Board	TR28	0.9V	8.1V	10.5V
	TR29	15.0V	14.2V	14.8V
	TR30	12.2V	12.5V	12.3V
	TR31	0.3V	0.36V	7.0V
	TR32	9.1V	7.0V	1.0V
	TR33	0.9V	1.0V	6.85V
	TR34	0.85V	1.0V	6.85V
	TR35	9.1V	7.3V	1.0V
	TR36	0.3V	0.35V	7.3V

APPENDIX 'B'

SEMICONDUCTOR COMPLEMENT

Ref	Type	Mfr	Circuit Function
TR1	2N918	Mullard	RF Amplifier } RF Tuning Unit No 1
TR2	2N918	Mullard	Mixer } RF Tuning Unit No 1
TR3	2N918	Mullard	1st Oscillator } RF Tuning Unit No 1
TR4	2N918	Mullard	RF Amplifier } RF Tuning Unit No 2
TR5	2N918	Mullard	Mixer } RF Tuning Unit No 2
TR6	2N918	Mullard	1st Oscillator } RF Tuning Unit No 2
TR7	2N918	Mullard	1st RF Amplifier } RF Tuning Unit No 3
TR8	2N918	Mullard	2nd RF Amplifier } RF Tuning Unit No 3
TR9	2N918	Mullard	Mixer } RF Tuning Unit No 3
TR10	2N4254	Texas	1st Oscillator } RF Tuning Unit No 3
TR11	AFZ12	Mullard	1st 25MHz IF Amplifier
TR12	AFZ12	Mullard	2nd 25MHz IF Amplifier
TR13	AFZ12	Mullard	3rd 25MHz IF Amplifier
TR14	AFZ12	Mullard	Emitter Follower (IF Output)
TR15	AFZ12	Mullard	2nd Oscillator (22MHz)
TR16	AFZ12	Mullard	1st 3MHz IF Amplifier
TR17	AFZ12	Mullard	2nd 3MHz IF Amplifier
TR18	AFZ12	Mullard	3rd 3MHz IF Amplifier
TR19	AFZ12	Mullard	4th 3MHz IF Amplifier
TR20	AFZ12	Mullard	Emitter Follower
TR21	BFX88	Mullard	Meter Det. Driver
TR22	AFZ12	Mullard	Beat Frequency Oscillator
TR23	AFZ12	Mullard	3MHz Amplifier/Limiter
TR24	AFZ12	Mullard	3MHz Amplifier/Limiter
TR25	ACY20	Mullard	1st AF Amplifier
TR26	ACY20	Mullard	2nd AF Amplifier
TR27	ACY20	Mullard	AF Output Amplifier (headset)
TR28	CV9259	Mullard	Batt. Protection Oscillator
TR29	CV7328	Texas	Batt. Protection Switch Driver
TR30	CV9259	Mullard	Batt. Protection Switch
TR31	CV7347	Mullard	} Meter Amplifier
TR32	CV7328	Texas	} Meter Amplifier
TR33	ACY20	Mullard	} Meter Amplifier
TR34	ACY20	Mullard	} Meter Amplifier
TR35	CV7328	Texas	} Meter Amplifier
TR36	CV7347	Mullard	} Meter Amplifier

Ref	Type	Mfr	Circuit Function
D1 D2 D3 D4	4 x CG651H	A.E.I.	2nd Mixer
D5	-	-	Reference not allocated
D6	BAX13	Mullard	Meter Detector
D7 D8	2 x CG651H	A.E.I.	Audio Det/Discriminator
D9 D10	2 x CV7128	Mullard	Batt Protection Rectifier
D11	OAZ200	Mullard	Zener Regulator
D12	OAZ207	Mullard	Zener Regulator
D13	CV7128	Mullard	Meter Protection
D14	BZY88C4V7	Mullard	Zener Regulator
D15	BZY88C6V8	Mullard	Zener Regulator
D16 D17	2 x CV7040	Mullard	Battery Charge Rectifier

N O T E

Late production receivers have Mullard BFX89 transistors fitted in place of the 2N918's in RF Tuning Unit No. 3 (TR7, 8 & 9).

APPENDIX 'C'

COMPONENT VALUES TOLERANCES AND RATINGS

Location Code

A 30dB Attenuator LP3259.
B 0-70dB Attenuator LP3257.
C RF Tuning Unit No. 1 (31-68MHz) LP3252.
D RF Tuning Unit No. 2 (68-135MHz) LP3253.
E RF Tuning Unit No. 3 (135-250MHz) LP3254.
F Low Pass Filter LP3261.
G 0-10dB Attenuator LP3258.
H* 25MHz IF Unit LP3251 (PCB LP3247/4).
I* 3MHz IF Unit LP3250 (PCB LP3247/3).
J* PCB LP3247/2 Detector & Audio/Meter &
K* PCB LP3247/1 Batt. Protection Unit LP3249.
L Miscellaneous items located on chassis frame.

(*) Components within unit but not mounted directly on PCB are coded H-, I-, J- & K-.

CAPACITORS

Ref	Value	Type	Tol	Wkg V	Loc
C1	4.7pF	Tubular Ceramic	0.5pF	200V	B
C2		Capacitors C2-C9 may be fitted in 0-70dB Attenuator (values selected during test).			
C3					
C4					
C5					
C6					
C7					
C8					
C9					
C10	22pF	Tubular Ceramic	5%	200V	C
C11	2-12pF	Air Trimmer C32-01	-	-	C
C12	68pF	Tubular Ceramic	5%	200V	C
C13	39pF	Tubular Ceramic	5%	200V	C
C14	39pF	Tubular Ceramic	5%	200V	C
C15	4.7pF	Tubular Ceramic	0.5pF	200V	C
C16	68pF	Tubular Ceramic	5%	200V	C
C17	0.001μF	Disk Ceramic	20%	500V	C
C18	0.0047μF	Plate Ceramic	+80% -20%	30V	C
C19	0.001μF	Tub. Cer. Feed Thru'	+80% -20%	500V	C

Ref	Value	Type	Tol	Wkg V	Loc
C20	0.001μF	Disk Ceramic	20%	500V	C
C21	0.0047μF	Plate Ceramic	+80% -20%	30V	C
C22	0.001μF	Tub. Cer. Feed Thru'	+80% -20%	500V	C
C23	32pF	Tubular Ceramic	5%	200V	C
C24	4-14pF	Part gang - C21-4	-	-	C
C25	4-14pF	Part gang - C21-4	-	-	C
C26	22pF	Tubular Ceramic	5%	200V	C
C27	0.0047μF	Plate Ceramic	+80% -20%	30V	C
C28	0.001μF	Tub. Cer. Feed Thru'	+80% -20%	500V	C
C29	0.001μF	Tub. Cer. Feed Thru'	+80% -20%	500V	C
C30	0.0047μF	Plate Ceramic	+80% -20%	30V	C
C31	0.0047μF	Plate Ceramic	+80% -20%	30V	C
C32	22pF	Tubular Ceramic	5%	200V	C
C33	-	Ref not allocated	-	-	-
C34	0.001μF	Tub. Cer. Feed Thru'	+80% -20%	500V	C
C35	0.001μF	Tub. Cer. Feed Thru'	+80% -20%	500V	C
C36	0.001μF	Tub. Cer. Feed Thru'	+80% -20%	500V	C
C37	-	Ref not allocated	-	-	-
C38	0.0047μF	Plate Ceramic	+80% -20%	30V	C
C39	100pF	Tubular Ceramic	5%	200V	C
C40	47pF	Polystyrene	5%	125V	C
C41	0.5-8pF	Tub. Trimmer 408	-	-	C
C42	4-14pF	Part gang - C21-4	-	-	C
C43	4-14pF	Part gang - C21-4	-	-	C
C44	0.0047μF	Plate Ceramic	+80% -20%	30V	C
C45	0.001μF	Tub. Cer. Feed Thru'	+80% -20%	500V	C
C46	0.001μF	Tub. Cer. Feed Thru'	+80% -20%	500V	C
C47	0.0047μF	Plate Ceramic	+80% -20%	30V	C
C48	2-12pF	Air Trimmer C32-01	-	-	C
C49	15pF	Tubular Ceramic	10%	200V	C
C49A	3.3pF	Tubular Ceramic	0.5pF	200V	C
C50	0.0047μF	Plate Ceramic	+80% -20%	30V	C
C51	0.001μF	Tub. Cer. Feed Thru'	+80% -20%	500V	C
C52 -59	-	Refs not allocated	-	-	-
C60	22pF	Tubular Ceramic	5%	200V	D
C60A	4.7pF	Tubular Ceramic	0.5pF	200V	D
C61	2-12pF	Air Trimmer C32-01	-	-	D
C62	15pF	Tubular Ceramic	5%	200V	D
C63	25pF	Tubular Ceramic	5%	200V	D
C64	20pF	Tubular Ceramic	5%	200V	D
C65	-	Ref not allocated	-	-	-
C66	0.0047μF	Plate Ceramic	+80% -20%	30V	D
C67	0.001μF	Tub. Cer. Feed Thru'	+80% -20%	500V	D

Ref	Value	Type	Tol	Wkg V	Loc
C68	22pF	Tubular Ceramic	5%	200V	D
C68A	0.0047µF	Plate Ceramic	+80% -20%	30V	D
C69	0.001µF	Tub. Cer. Feed Thru'	+80% -20%	500V	D
C69A	0.001µF	Tub. Cer. Feed Thru'	+80% -20%	500V	D
C70	4-14pF	Part gang - C21-4	-	-	D
C71	4-14pF	Part gang - C21-4	-	-	D
C72	10pF	Tubular Ceramic	5%	200V	D
C72A	0.001µF	Tub. Cer. Feed Thru'	+80% -20%	500V	D
C73	0.0047µF	Plate Ceramic	+80% -20%	30V	D
C73A	0.001µF	Tub. Cer. Feed Thru'	+80% -20%	500V	D
C74	0.0047µF	Plate Ceramic	+80% -20%	30V	D
C75	10pF	Tubular Ceramic	5%	200V	D
C76	0.001µF	Tub. Cer. Feed Thru'	+80% -20%	500V	D
C77	0.001µF	Tub. Cer. Feed Thru'	+80% -20%	500V	D
C78	0.001µF	Tub. Cer. Feed Thru'	+80% -20%	500V	D
C79	0.0047µF	Plate Ceramic	+80% -20%	30V	D
C80	0.0047µF	Plate Ceramic	+80% -20%	30V	D
C81	100pF	Tubular Ceramic	5%	200V	D
C82	180pF	Polystyrene	2%	125V	D
C83	0.5-8pF	Tub. Trimmer 408	-	-	D
C84	4-14pF	Part gang - C21-4	-	-	D
C85	4-14pF	Part gang - C21-4	-	-	D
C85A	0.001µF	Tub. Cer. Feed Thru'	+80% -20%	500V	D
C86	2-12pF	Air Trimmer C32-01	-	-	D
C87	-	Ref not allocated	-	-	-
C88	0.0047µF	Plate Ceramic	+80% -20%	30V	D
C89	0.001µF	Tub. Cer. Feed Thru'	+80% -20%	500V	D
C90 -99	-	Refs not allocated	-	-	-
C100	100pF	Tubular Ceramic	5%	200V	E
C100A	10pF	Tubular Ceramic	5%	200V	E
C101	0.001µF	Tub. Cer. Feed Thru'	+80% -20%	500V	E
C102	0.001µF	Tub. Cer. Feed Thru'	+80% -20%	500V	E
C103	100pF	Tubular Ceramic	5%	200V	E
C104	4-14pF	Part gang - C21-4	-	-	E
C105	0.5-8.5pF	Tub. Trimmer 408	-	-	E
C106	10pF	Tubular Ceramic	5%	200V	E
C107	0.5-8.5pF	Tub. Trimmer 408	-	-	E
C108	4-14pF	Part gang - C21-4	-	-	E
C109	10pF	Tubular Ceramic	5%	200V	E
C110	0.001µF	Tub. Cer. Feed Thru'	+80% -20%	500V	E
C111	0.001µF	Tub. Cer. Feed Thru'	+80% -20%	500V	E
C112	10pF	Tubular Ceramic	5%	200V	E

Ref	Value	Type	Tol	Wkg V	Loc
C113	0.001µF	Tub. Cer. Feed Thru'	+80% -20%	500V	E
C114	0.0047µF	Plate Ceramic	+80% -20%	30V	E
C115	2.2pF	Tubular Ceramic	0.5pF	200V	E
C116	0.001µF	Tub. Cer. Feed Thru'	+80% -20%	500V	E
C117	3.3pF	Tubular Ceramic	0.5pF	200V	E
C118	39pF	Tubular Ceramic	5%	200V	E
C119	4-14pF	Part gang - C21-4	-	-	E
C120	2-12pF	Air Trimmer C32-01	-	-	E
C121	22pF	Tubular Ceramic	5%	200V	E
C122	0.001µF	Tub. Cer. Feed Thru'	+80% -20%	500V	E
C123	0.001µF	Tub. Cer. Feed Thru'	+80% -20%	500V	E
C124	0.001µF	Tub. Cer. Feed Thru'	+80% -20%	500V	E
C125 -129	-	Refs not allocated	-	-	-
C130 -139	-	Refs not allocated	-	-	-
C140	150pF	Polystyrene	2%	125V	F
C141	120pF	Polystyrene	2%	125V	F
C142	120pF	Polystyrene	2%	125V	F
C143	80pF	Polystyrene	2%	125V	F
C144 -149	-	Refs not allocated	-	-	-
C150	0.0047µF	Plate Ceramic	+80% -20%	30V	H
C151	0.0047µF	Plate Ceramic	+80% -20%	30V	H
C152	0.0047µF	Plate Ceramic	+80% -20%	30V	H
C153	2-12pF	Air Trimmer C32-01	-	-	H
C154	10pF	Tubular Ceramic	5%	200V	H
C155	0.0047µF	Plate Ceramic	+80% -20%	30V	H
C156	0.0047µF	Plate Ceramic	+80% -20%	30V	H
C157	22pF	Tubular Ceramic	5%	200V	H
C158	2-12pF	Air Trimmer C32-01	-	-	H
C159	39pF	Tubular Ceramic	5%	200V	H
C160	0.0047µF	Plate Ceramic	+80% -20%	30V	H
C161	0.0047µF	Plate Ceramic	+80% -20%	30V	H
C162	0.0047µF	Plate Ceramic	+80% -20%	30V	H
C163	0.0047µF	Plate Ceramic	+80% -20%	30V	H
C164	0.0047µF	Plate Ceramic	+80% -20%	30V	H
C165	0.0047µF	Plate Ceramic	+80% -20%	30V	H
C166	30pF	Tubular Ceramic	5%	200V	H
C167	2-12pF	Air Trimmer C32-01	-	-	H
C168	100pF	Silvered Mica	5%	350V	H
C169	100pF	Silvered Mica	5%	350V	H
C169A	0.0047µF	Plate Ceramic	+80% -20%	30V	H

Ref	Value	Type	Tol	Wkg V	Loc
C170	125μF	Tubular Electrolytic	+50% -10%	16V	H-
C171 -179	-	Refs not allocated	-	-	-
C180	100pF	Silvered Mica	5%	350V	I
C181	22pF	Tubular Ceramic	5%	200V	I
C182	0.0047μF	Plate Ceramic	+80% -20%	30V	I
C183	225pF	Silvered Mica	1%	350V	I
C184	0.0047μF	Plate Ceramic	+80% -20%	30V	I
C185	100pF	Tubular Ceramic	5%	200V	I
C186	225pF	Silvered Mica	1%	350V	I
C187	32pF	Tubular Ceramic	5%	200V	I
C188	0.0047μF	Plate Ceramic	+80% -20%	30V	I
C189	0.0047μF	Plate Ceramic	+80% -20%	30V	I
C190	22pF	Tubular Ceramic	5%	200V	I
C191	0.0047μF	Plate Ceramic	+80% -20%	30V	I
C192	225pF	Silvered Mica	1%	350V	I
C193	0.0047μF	Plate Ceramic	+80% -20%	30V	I
C194	100pF	Tubular Ceramic	5%	200V	I
C195	225pF	Silvered Mica	1%	350V	I
C196	39pF	Tubular Ceramic	5%	200V	I
C197	0.0047μF	Plate Ceramic	+80% -20%	30V	I
C198	0.0047μF	Plate Ceramic	+80% -20%	30V	I
C199	-	Ref not allocated	-	-	-
C200	0.0047μF	Plate Ceramic	+80% -20%	30V	J
C201	100pF	Silvered Mica	5%	350V	J
C202	10μF	Tubular Electrolytic	+50% -10%	16V	J
C203	0.0047μF	Plate Ceramic	+80% -20%	30V	J
C203A	0.0047μF	Plate Ceramic	+80% -20%	30V	J
C204	0.0047μF	Polystyrene	1%	125V	J
C205	0.0047μF	Plate Ceramic	+80% -20%	30V	J
C206	0.1μF	Polycarbonate	20%	100V	J
C207	0.0047μF	Plate Ceramic	+80% -20%	30V	J
C208	0.0047μF	Plate Ceramic	+80% -20%	30V	J
C209	0.0047μF	Plate Ceramic	+80% -20%	30V	J
C210	225pF	Silvered Mica	5%	350V	J
C211	2-12pF	Air Trimmer C32-01	-	-	J
C212	10pF	Tubular Ceramic	5%	200V	J
C213	0.0047μF	Plate Ceramic	+80% -20%	30V	J
C214	0.0047μF	Plate Ceramic	+80% -20%	30V	J
C215	0.022μF	Metallised Film	20%	250V	J
C216	0.0047μF	Plate Ceramic	+80% -20%	30V	J
C217	0.0047μF	Plate Ceramic	+80% -20%	30V	J
C218	6.8pF	Tubular Ceramic	0.5pF	200V	J
C219	0.0047μF	Plate Ceramic	+80% -20%	30V	J

Ref	Value	Type	Tol	Wkg V	Loc
C220	82pF	Tubular Ceramic	5%	200V	J
C221	8.2pF	Tubular Ceramic	5%	200V	J
C222	0.001µF	Polystyrene	5%	125V	J
C223	0.001µF	Polystyrene	5%	125V	J
C224	1µF	Tubular Electrolytic	+100% -10%	40V	J
C225	25µF	Tubular Electrolytic	+50% -10%	25V	J
C226	0.1µF	Polycarbonate	20%	100V	J
C227	25µF	Tubular Electrolytic	+50% -10%	25V	J
C228	0.1µF	Polycarbonate	20%	100V	J
C229	0.47µF	Polycarbonate	20%	100V	J
C230	25µF	Tubular Electrolytic	+50% -10%	25V	J
C231	125µF	Tubular Electrolytic	+50% -10%	16V	J
C232	25µF	Tubular Electrolytic	+50% -10%	25V	J
C233	25µF	Tubular Electrolytic	+50% -10%	25V	J
C234	25µF	Tubular Electrolytic	+50% -10%	25V	J
C235 -239	-	Refs not allocated	-	-	-
C240	250µF	Tubular Electrolytic	+50% -10%	25V	K
C241	250µF	Tubular Electrolytic	+50% -10%	25V	K
C242	25µF	Tubular Electrolytic	+50% -10%	25V	K
C243	25µF	Tubular Electrolytic	+50% -10%	25V	K
C244	25µF	Tubular Electrolytic	+50% -10%	25V	K
C245	64µF	Tubular Electrolytic	+50% -10%	64V	K
C246	25µF	Tubular Electrolytic	+50% -10%	25V	K
C247	25µF	Tubular Electrolytic	+50% -10%	25V	K
C248	25µF	Tubular Electrolytic	+50% -10%	25V	K
C249	-	Ref not allocated	-	-	-
C250	125µF	Tubular Electrolytic	+50% -10%	16V	K-

RESISTORS

Ref	Value	Tol	Rtg	Loc
R1	33Ω	5%	0.3W	A
R2	82Ω	5%	0.3W	A
R3	82Ω	5%	0.3W	A
R4	33Ω	5%	0.3W	A
R5	68Ω	5%	0.3W	A
R6	33Ω	5%	0.3W	A
R7	68Ω	5%	0.3W	A
R8	Not used	-	-	-
R9	Not used	-	-	-

Ref	Value	Tol	Rtg	Loc
R10	267Ω	1%	0.4W	B
R11	143Ω	1%	0.4W	B
R12	107Ω	1%	0.4W	B
R13	90.9Ω	1%	0.4W	B
R14	84.5Ω	1%	0.4W	B
R15	45.3Ω	1%	0.4W	B
R16	105Ω	1%	0.4W	B
R17	205Ω	1%	0.4W	B
R18	374Ω	1%	0.4W	B
R19	665Ω	1%	0.4W	B

Ref	Value	Tol	Rtg	Loc
R20	133Ω	1%	0.4W	B
R21	71.5Ω	1%	0.4W	B
R22	53.6Ω	1%	0.4W	B
R23	47.5Ω	1%	0.4W	B
R24	42.2Ω	1%	0.4W	B
R25	45.3Ω	1%	0.4W	B
R26	105Ω	1%	0.4W	B
R27	205Ω	1%	0.4W	B
R28	374Ω	1%	0.4W	B
R29	665Ω	1%	0.4W	B
R30	267Ω	1%	0.4W	B
R31	143Ω	1%	0.4W	B
R32	107Ω	1%	0.4W	B
R33	90.9Ω	1%	0.4W	B
R34	84.5Ω	1%	0.4W	B
R35 -39	Not used	-	-	-
R40	22Ω	5%	0.3W	C
R41	470Ω	5%	0.3W	C
R42	22Ω	5%	0.3W	C
R43	6,800Ω	5%	0.3W	C
R44	2,200Ω	5%	0.3W	C
R45	470Ω	5%	0.3W	C
R46	470Ω	5%	0.3W	C
R47	6,800Ω	5%	0.3W	C
R48	2,200Ω	5%	0.3W	C
*R49	470Ω	5%	0.3W	C
R50	39Ω	5%	0.3W	C
R51	470Ω	5%	0.3W	C
R52	470Ω	5%	0.3W	C
R53	6,800Ω	5%	0.3W	C
R54	2,200Ω	5%	0.3W	C
R55	470Ω	5%	0.3W	C
R56 -59	Not used	-	-	-
R60	27Ω	5%	0.3W	D
R61	6,800Ω	5%	0.3W	D
R62	2,200Ω	5%	0.3W	D
R63	470Ω	5%	0.3W	D
R64	470Ω	5%	0.3W	D
R65	6,800Ω	5%	0.3W	D
R66	2,200Ω	5%	0.3W	D
R67	270Ω	5%	0.3W	D
R68	470Ω	5%	0.3W	D
R69	6,800Ω	5%	0.3W	D
R70	1,200Ω	5%	0.3W	D
R71	470Ω	5%	0.3W	D
R72	470Ω	5%	0.3W	D
R73 -79	Not used	-	-	-
R80	270Ω	5%	0.3W	E
R81	39Ω	5%	0.3W	E
R82	2,200Ω	5%	0.3W	E
R83	6,800Ω	5%	0.3W	E
R84	470Ω	5%	0.3W	E
R85	470Ω	5%	0.3W	E
R86	2,200Ω	5%	0.3W	E
R87	6,800Ω	5%	0.3W	E
R88	470Ω	5%	0.3W	E
R89	470Ω	5%	0.3W	E
R90	2,200Ω	5%	0.3W	E
R91	6,800Ω	5%	0.3W	E
*R92	470Ω	5%	0.3W	E
R93	10,000Ω	5%	0.3W	E
R94	6,800Ω	5%	0.3W	E
R95	1,000Ω	5%	0.3W	E
R96	470Ω	5%	0.3W	E
R97 -99	Not used	-	-	-
R100	90.9Ω	1%	0.4W	B
R101	143Ω	1%	0.4W	B
R102	374Ω	1%	0.4W	B
R103	105Ω	1%	0.4W	B
R104	90.9Ω	1%	0.4W	B
R105	143Ω	1%	0.4W	B
R106 -109	Not used	-	-	-
R110	1,300Ω	1%	0.4W	G
R111	8.66Ω	1%	0.4W	G
R112	1,300Ω	1%	0.4W	G
R113	649Ω	1%	0.4W	G
R114	17.4Ω	1%	0.4W	G
R115	649Ω	1%	0.4W	G
R116	432Ω	1%	0.4W	G
R117	26.1Ω	1%	0.4W	G
R118	432Ω	1%	0.4W	G
R119	332Ω	1%	0.4W	G

(*) Subject to adjustment during test.

Ref	Value	Tol	Rtg	Loc
R120	35.7Ω	1%	0.4W	G
R121	332Ω	1%	0.4W	G
R122	267Ω	1%	0.4W	G
R123	45.3Ω	1%	0.4W	G
R124	267Ω	1%	0.4W	G
R125	226Ω	1%	0.4W	G
R126	56.2Ω	1%	0.4W	G
R127	226Ω	1%	0.4W	G
R128	196Ω	1%	0.4W	G
R129	66.5Ω	1%	0.4W	G
R130	196Ω	1%	0.4W	G
R131	174Ω	1%	0.4W	G
R132	78.7Ω	1%	0.4W	G
R133	174Ω	1%	0.4W	G
R134	158Ω	1%	0.4W	G
R135	90.9Ω	1%	0.4W	G
R136	158Ω	1%	0.4W	G
R137	143Ω	1%	0.4W	G
R138	105Ω	1%	0.4W	G
R139	143Ω	1%	0.4W	G
R140	82Ω	5%	0.3W	H
R141	15,000Ω	5%	0.3W	H
R142	12,000Ω	5%	0.3W	H
R143	2,700Ω	5%	0.3W	H
R144	330Ω	5%	0.3W	H
R145	120Ω	5%	0.3W	H
R146	2,200Ω	5%	0.3W	H
R147	680Ω	5%	0.3W	H
R148	18Ω	5%	0.3W	H
R149	4,700Ω	5%	0.3W	H
R150	10,000Ω	5%	0.3W	H
R151	6,800Ω	5%	0.3W	H
R152	470Ω	5%	0.3W	H
R153	330Ω	5%	0.3W	H
R154	22Ω	5%	0.3W	H
R155	680Ω	5%	0.3W	H
R156	180Ω	5%	0.3W	H
R157	100Ω	5%	0.3W	H
R158	1,500Ω	5%	0.3W	H
R159	270Ω	5%	0.3W	H
R160	4,700Ω	5%	0.3W	H
*R161	3,300Ω	5%	0.3W	H
R162	15,000Ω	5%	0.3W	H
R163	6,800Ω	5%	0.3W	H

Ref	Value	Tol	Rtg	Loc
R164 -169	Not used	-	-	-
R170	68Ω	5%	0.3W	I
R171	15,000Ω	5%	0.3W	I
R172	15,000Ω	5%	0.3W	I
R173	15,000Ω	5%	0.3W	I
R174	1,000Ω	5%	0.3W	I
R175	22Ω	5%	0.3W	I
R176	3,300Ω	5%	0.3W	I
R177	15,000Ω	5%	0.3W	I
R178	68,000Ω	5%	0.3W	I
R179	22,000Ω	5%	0.3W	I
R180	180Ω	5%	0.3W	I
R181	330Ω	5%	0.3W	I
*R182	56Ω	5%	0.3W	I
R183	1,000Ω	5%	0.3W	I
R184	8,200Ω	5%	0.3W	I
R185	8,200Ω	5%	0.3W	I
R186	15,000Ω	5%	0.3W	I
R187	470Ω	5%	0.3W	I
R188	33Ω	5%	0.3W	I
R189	1,000Ω	5%	0.3W	I
R190	15,000Ω	5%	0.3W	I
R191	8,200Ω	5%	0.3W	I
R192	8,200Ω	5%	0.3W	I
R193	100Ω	5%	0.3W	I
R194	470Ω	5%	0.3W	I
*R195	56Ω	5%	0.3W	I
R196	1,000Ω	5%	0.3W	I
R197 -199	Not used	-	-	-
R200	220Ω	5%	0.3W	J
R201	8,200Ω	5%	0.3W	J
R202	6,800Ω	5%	0.3W	J
R203	1,500Ω	5%	0.3W	J
R204	82Ω	5%	0.3W	J
R205	82Ω	5%	0.3W	J
R206	4.7MΩ	5%	0.3W	J
R206A	2,200Ω	5%	0.3W	J
R207	0.22MΩ	5%	0.3W	J
R208	68,00Ω	5%	0.3W	J
R209	47,000Ω	5%	0.3W	J

(*) Subject to adjustment
during test.

Ref	Value	Tol	Rtg	Loc
R210	2,200Ω	5%	0.3W	J
R211	10,000Ω	5%	0.3W	J
R212	10,000Ω	5%	0.3W	J
R213	470Ω	5%	0.3W	J
R214	100Ω	5%	0.3W	J
R215	470Ω	5%	0.3W	J
R216	22Ω	5%	0.3W	J
R217	1,000Ω	5%	0.3W	J
R218	15,000Ω	5%	0.3W	J
R219	15,000Ω	5%	0.3W	J
R220	330Ω	5%	0.3W	J
R221	1,000Ω	5%	0.3W	J
R222	12,000Ω	5%	0.3W	J
R223	330Ω	5%	0.3W	J
R224	3,300Ω	5%	0.3W	J
R225	33,000Ω	5%	0.3W	J
R226	560Ω	5%	0.3W	J
R227	680Ω	5%	0.3W	J
R228	680Ω	5%	0.3W	J
R229	68,000Ω	5%	0.3W	J
R230	68,000Ω	5%	0.3W	J
R231	0.1MΩ	5%	0.3W	J
R232	0.22MΩ	5%	0.3W	J
R233	0.22MΩ	5%	0.3W	J
R234	2,700Ω	5%	0.3W	J
R235	47,000Ω	5%	0.3W	J
R236	47,000Ω	5%	0.3W	J
R237	1,000Ω	5%	0.3W	J
R238	3,900Ω	5%	0.3W	J
R239	68Ω	5%	0.3W	J
R240	4,700Ω	5%	0.3W	J
R241	33,000Ω	5%	0.3W	J
R242	4,700Ω	5%	0.3W	J
R243	100Ω	5%	0.3W	J
R244	1,500Ω	5%	0.3W	J
R245	270Ω	5%	0.3W	J
R246 -249	Not used	-	-	-
R250	10,000Ω	5%	0.3W	K
R251	1,200Ω	5%	0.3W	K
R252	180Ω	5%	0.3W	K
R253	2,700Ω	5%	0.3W	K
R254	100Ω	5%	0.3W	K
*R255	22Ω	5%	0.3W	K

Ref	Value	Tol	Rtg	Loc
R256	1,800Ω	5%	0.3W	K
R257	330Ω	5%	0.3W	K
R258	2,200Ω	5%	0.3W	K
R259	5,600Ω	5%	0.3W	K
R260	68,000Ω	5%	0.3W	K
R261	220Ω	5%	0.3W	K
R262	0.1MΩ	5%	0.3W	K
R263	10,000Ω	5%	0.3W	K
R264	1,000Ω	5%	0.3W	K
R265	2,200Ω	5%	0.3W	K
R266	390Ω	5%	0.3W	K
R267	390Ω	5%	0.3W	K
R268	470Ω	5%	0.3W	K
R269	2,200Ω	5%	0.3W	K
R270	1,000Ω	5%	0.3W	K
*R271	0.1MΩ	5%	0.3W	K
R272	0.22MΩ	5%	0.3W	K
R273	10,000Ω	5%	0.3W	K
R274 -275	Not used	-	-	-
R276	39Ω	5%	0.3W	K-
R277	1,200Ω	5%	0.3W	K-
R278	62,000Ω	5%	0.3W	K-
R278A	0.68MΩ	5%	0.3W	K-
R279	0.15Ω	5%	1W	K-
R280	16Ω w.w.	5%	2.5W	L

POTENTIOMETERS

Ref	Value	Law	Loc
RV1	10,000Ω	Lin	I
RV2	10,000Ω	Log	J
RV3	10,000Ω	Lin**	K
RV4	1,000Ω	Lin	K
		(**) pre-set.	

(*) Subject to adjustment during test.

APPENDIX 'D'

LIST OF SPARES FOR No.31A RECEIVER

The following list details all major spares applicable for use with the EDDYSTONE Noise Measuring Set No. 31A. Spares should be ordered by quoting the Circuit Ref. (where applicable), the written description given in the list and the Part No. in the right-hand column.

Spares falling in the following categories are not included in this list but will be found in Appendices 'B' and 'C' :-

SEMICONDUCTORS   CAPACITORS (excluding variables)   RESISTORS

The Serial No. of the receiver should be quoted in all communications which should be addressed to:-

EDDYSTONE RADIO LIMITED, SALES & SERVICE DEPARTMENT,
ALVECHURCH ROAD, BIRMINGHAM B31 3PP, ENGLAND.

Ref	Description	Part No.
	UNITS	
	30dB Attenuator	LP3259
	0-70dB Attenuator	LP3257
	0-10dB Attenuator	LP3258
	RF Tuning Unit No. 1 (31-68MHz).	LP3252
	RF Tuning Unit No. 2 (68-135MHz)	LP3253
	RF Tuning Unit No. 3 (135-250MHz)	LP3254
	Low Pass Filter	LP3261
	25MHz IF Unit	LP3251
	3MHz IF Unit	LP3250
	Det/Audio & Meter/Batt Protection Unit	LP3249
	PRINTED CIRCUIT BOARDS	
	25MHz IF Board (Part of LP3251)	LP3247/4
	3MHz IF Board (Part of LP3250)	LP3247/3
	Det/Audio Board (Part of LP3249)	LP3247/2
	Meter/Batt Protection Board (Part LP3249)	LP3247/1
	POTENTIOMETERS	
RV1	1,000Ω Lin Law 'CAL'	8098P
RV2	10,000Ω Log Law 'AF GAIN'	8095P
RV3	10,000Ω Lin Law 'COARSE DC BAL' (pre-set)	6840P
RV4	1,000Ω Lin Law 'DC BAL'	8096P

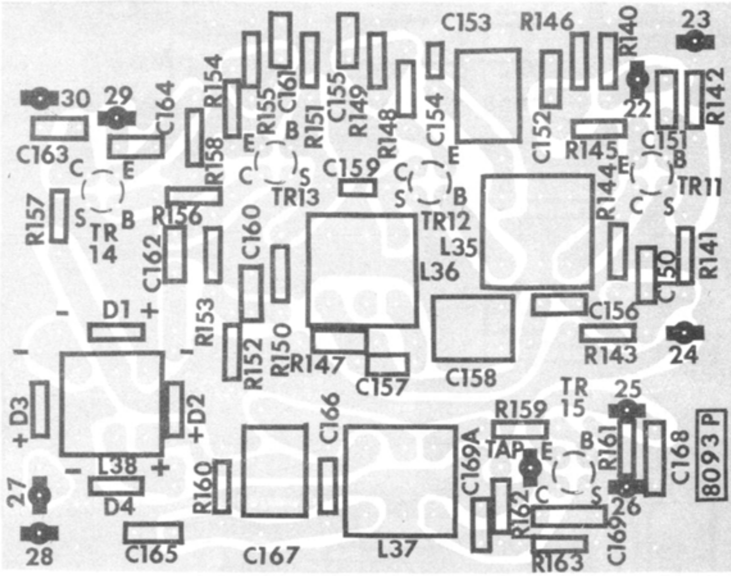
Ref	Description	Part No.
	SWITCHES	
S1	0-70dB ATTEN SWITCH: Wafers S1A & S1B	6302P
	Wafers S1C & S1D	6303P
	Clicker mechanism	8192P
S2	RANGE SWITCH: Wafers S2A, S2B and S2C/D	7285P
	Clicker mechanism	8157P
	Insulated coupler	7353P
S3	0-10dB ATTEN SWITCH: Wafers S3A & S3B	8318P
	Clicker mechanism	8317P
S4	MODE SWITCH: 3-posn lever type	8849P
S5	FUNCTION SWITCH: 7-posn wafer assembly	8097P
	VARIABLE CAPACITORS & ASSOCIATED ITEMS	
Range 1	4-gang tuning capacitor (4 x 4-14pF)	D4495
Range 2	4-gang tuning capacitor (4 x 4-14pF)	D4495
Range 3	4-gang tuning capacitor (4 x 4-14pF)	D4496
	Air Trimmer 2-12pF (Polar C32-01)	4743P
	Tube Trimmer 0.5-8pF (Jackson Style 408)	8100P
	Flexible coupler (Ranges 1 & 3)	LP3262
	Flexible coupler (Range 2)	LP3263
	PLUGS & SOCKETS (see also ACCESSORIES)	
SK1/4/18	BNC coaxial socket (closed type)	8850P
SK2/3	BNC coaxial socket (open type)	8851P
SK5	RECMF coaxial socket (B/Lee)	8852P
SK6-17 & SK19/20	Miniature B/Lee coaxial sockets as used for unit interconnection	7292P
SK21	15-way free socket (female)	7771P
SK22	2-way miniature polarized connector	7245P
SK23	AC Input Connector (free socket, less lead)	8855P
JK1	Telephone socket	8854P
PL6-17 & PL19/20	Miniature B/Lee coaxial plugs as used for unit interconnection	7293P
PL18	BNC bayonet-lock coaxial plug (IF OUTPUT)	8012P
PL21	15-way fixed plug (male)	7772P
PL22	2-way miniature polarized connector	7245P
PL23	AC Input Connector (3-pin fixed plug)	7130P
PL24	3-pin 13-Amp Mains Plug (with 2-Amp fuse)	8853P

Ref	Description	Part No.
	INDUCTORS	
	RF Tuning Unit No. 1	
L1	25MHz Rejector coil	D4333
L2	Filter coil (81MHz)	D4331
L3	Filter coil	D4332
L4	Filter coil (88MHz)	D4331
L5	RF Amplifier coil	D4329
L6	Mixer coil	D4328
L7	Oscillator coil	D4327
L8	25MHz IF coil	D4326
L9	Choke	D4330
L10	Choke	D4330
L11	Choke	D4330
	RF Tuning Unit No. 2	
L12	25MHz Rejector coil	D4333
L13	Filter coil (181MHz)	D4331
L14	Filter coil (145MHz)	D4337
L15	Filter coil (160MHz)	D4336
L16	Aerial coil	D4338
L17	Mixer Coil	D4335
L18	Oscillator coil	D4334
L19	25MHz IF coil	D4343
L20	Choke	D4330
L21	Choke	D4330
L22	Choke	D4330
	RF Tuning Unit No. 3	
L23	Aerial coil	D4342
L24	Filter coil	D4497
L24A	Filter coil	D4497
L25	Mixer bandpass coil No. 1	D4341
L26	Mixer bandpass coil No. 2	D4341
L27	Oscillator coil	D4340
L28	25MHz IF coil	D4326
L29	Choke	D4329
L30	Choke	D4339
L31	Choke	D4339
	Low-pass Filter	
L32	Low-pass filter coil (34MHz)	D4338
L33	Low-pass filter coil (27MHz)	D4370
L34	Low-pass filter coil (30MHz)	D4371
	25MHz IF Unit	
L35	Image Rejector coil	D4322
L36	25MHz IF coil	D4320
L37	2nd Oscillator coil	D4323
L38	2nd Mixer transformer	D4321

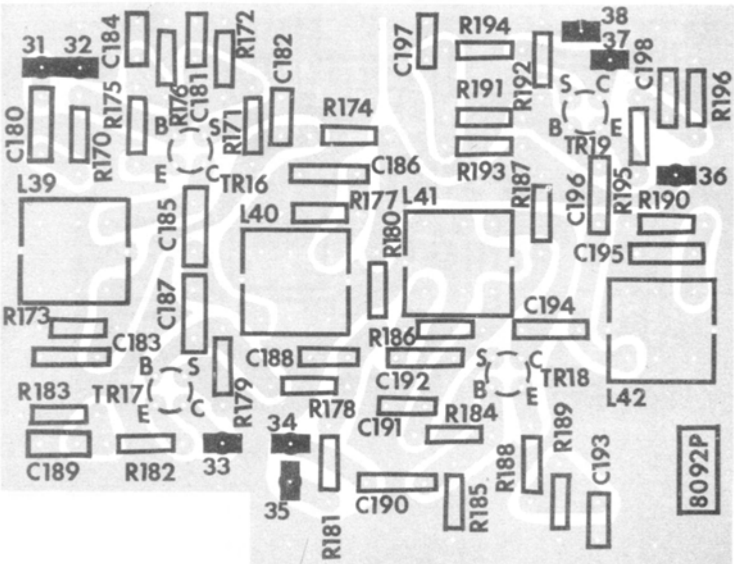
Ref	Description		Part No.
	INDUCTORS (contd.)		
L39	3MHz IF coil No. 1	3MHz IF Unit	D4319
L40	3MHz IF coil No. 2	3MHz IF Unit	D4319
L41	3MHz IF coil No. 3	3MHz IF Unit	D4319
L42	3MHz IF coil No. 4	3MHz IF Unit	D4319
L43	Final 3MHz IF coil (TR21)	Det/Audio & Meter/Batt. Unit	D4314
L44	BFO coil	Det/Audio & Meter/Batt. Unit	D4311
L45	3MHz IF Buffer coil (TR24)	Det/Audio & Meter/Batt. Unit	D4312
L46	3MHz Discrim. coil (D7/8)	Det/Audio & Meter/Batt. Unit	D4313
L47	Batt Protection Osc transfr.	Det/Audio & Meter/Batt. Unit	8094P
	TRANSFORMERS		
T1	Charger transformer		8162P
	DRIVE MECHANISMS & ASSOCIATED ITEMS		
	Range 1 Gear Drive Assembly		LP3256
	Range 2 Gear Drive Assembly		LP3256/1
	Range 3 Gear Drive Assembly		LP3256/2
	Flexible coupler		LP3262
	Dial window		8152P
	Range 1 scale		8163P
	Range 2 scale		8164P
	Range 3 scale		8165P
	Knobs		D3614
	ACCESSORIES		
	Balun transformer unit (complete)		LP3264
	Aerial mast (top section)		D4366
	Aerial mast (centre section)		D4366
	Aerial mast (bottom section)		D4367
	Telescopic rod aerial (complete with plug)		D4713
	Telescopic dipole element (2 reqd.)		D4532
	'U' link fitted with BNC plugs		D4372
	Aerial feeder (complete with BNC plugs)		D4714
	BNC plug/socket adaptor		8848P
	Mains lead (complete with connectors)		D4373
	MISCELLANEOUS		
	Battery		8161P
	Meter		8160P

APPENDIX 'E'

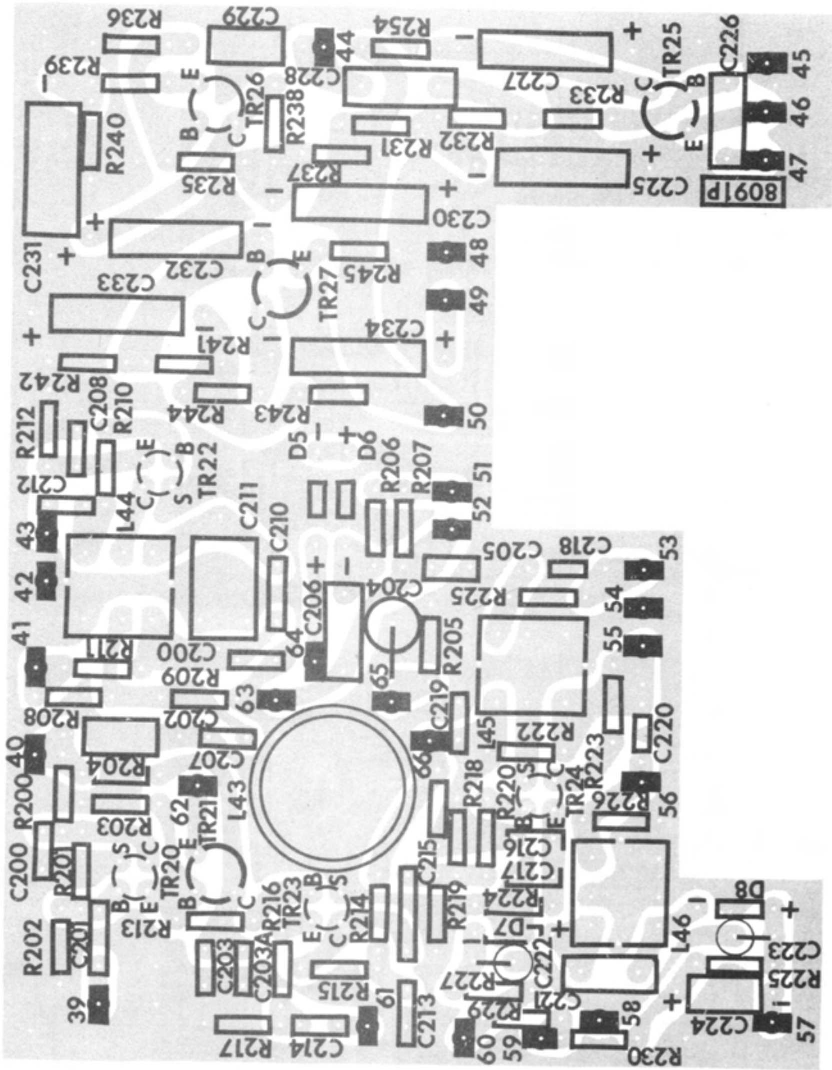
PRINTED CIRCUIT BOARDS



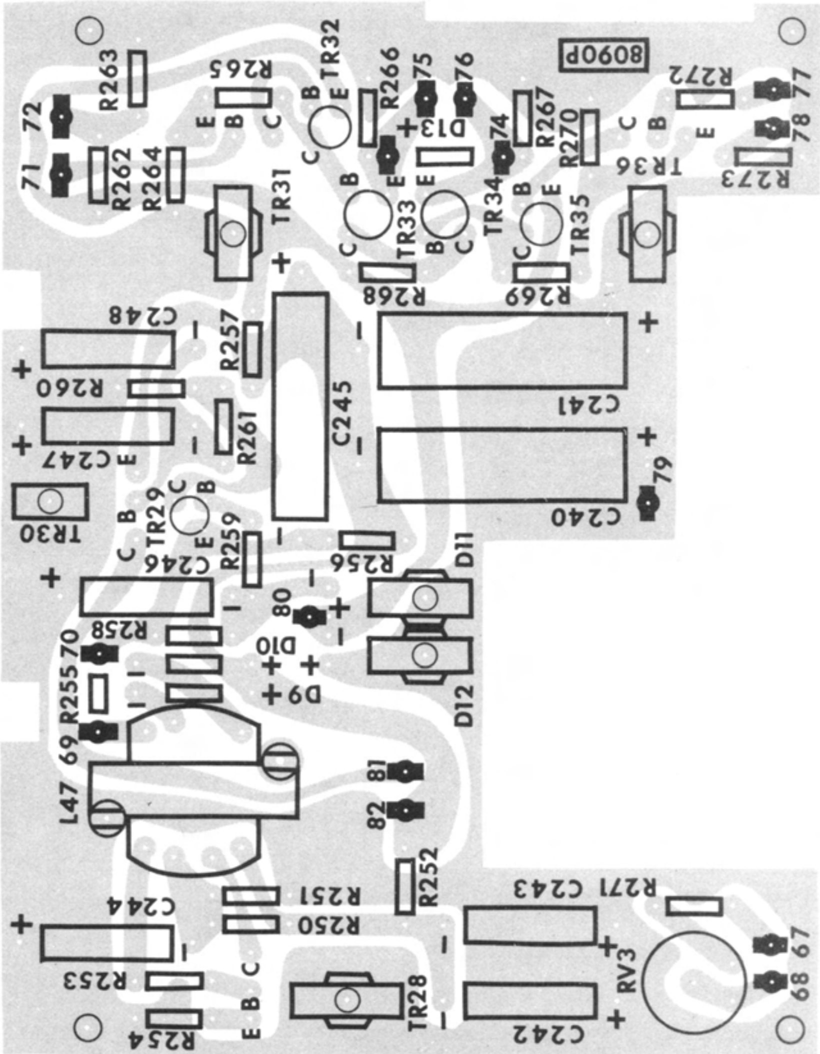
25MHz IF Board - LP3247/4



3MHz IF Board - LP3247/3



Detector/Audio Board - LP3247/2



Meter/Battery Protection Board - LP3247/1

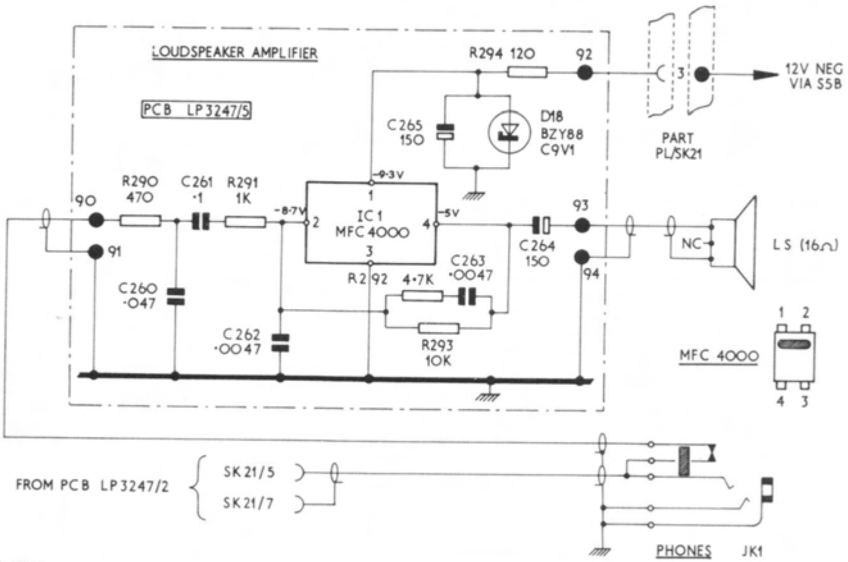
NOISE MEASURING SET No 31A Mk.II

This receiver is a variant of the standard 31A from which it differs in that a miniature high-efficiency loudspeaker is fitted at the right-hand side of the panel. Output is of the order 100mW from an IC amplifier carried on PCB LP3247/5 (fitted at rear of chassis).

A telephone headset output is available as on the standard receiver and the circuit is arranged so that insertion of the headset plug mutes the loudspeaker output. Current drain from the internal battery is slightly higher when using the speaker (30mA at full output), and allowance should be made for this when estimating the re-charging cycle.

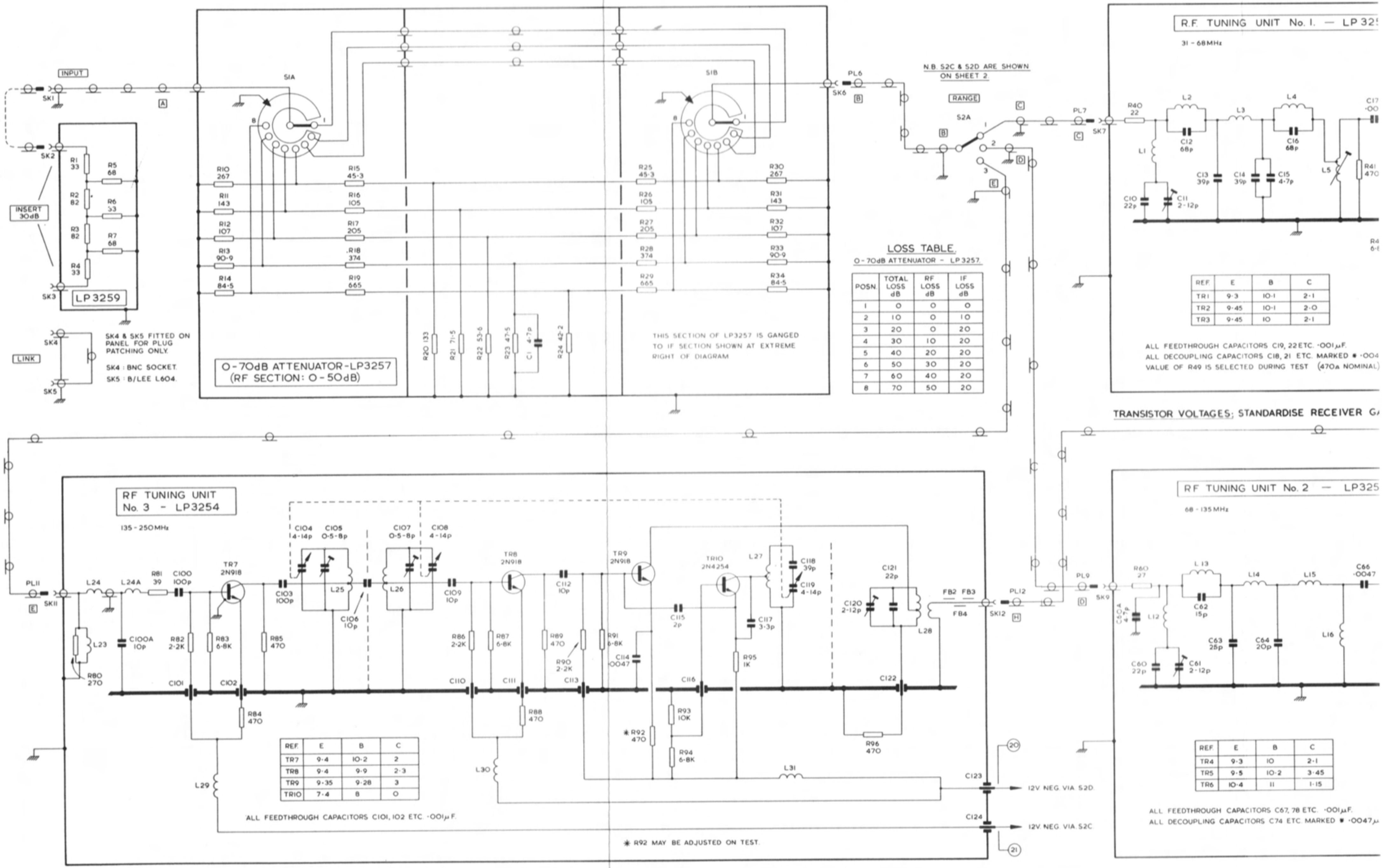
The circuit below shows the additional circuitry of PCB LP3247/5 and the modified wiring applicable to the basic receiver.

NB: Some versions of the No.31A Mk.II have a different type of AC Input Connector from that fitted on the standard receiver.



No.31A MkII

Issued by:- EDDYSTONE RADIO LTD, ALVECHURCH ROAD, BIRMINGHAM, ENGLAND
Tel. 021-475 2231 : Cables Eddystone Birmingham : Telex 337081



LOSS TABLE.
0-70dB ATTENUATOR - LP3257.

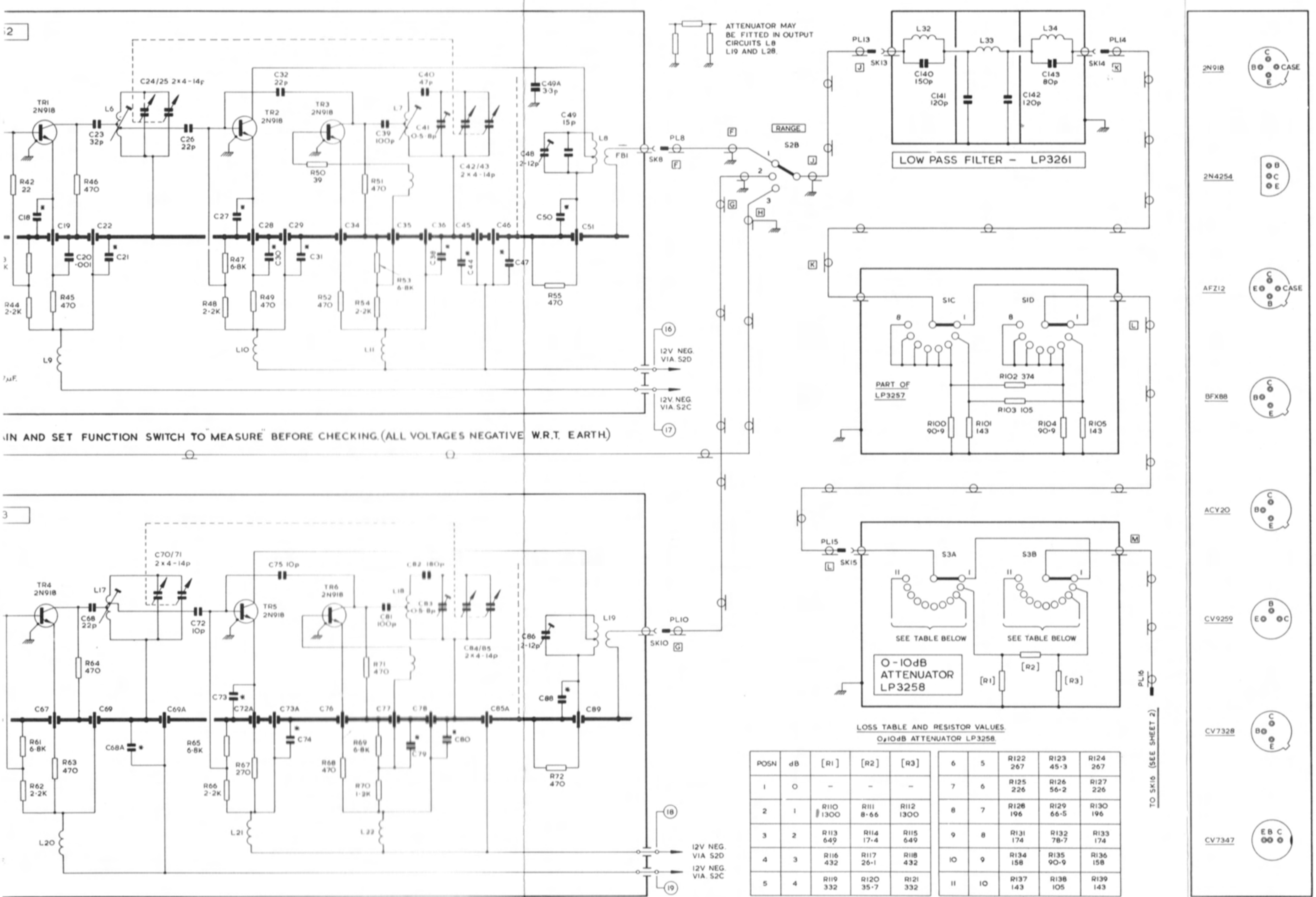
POSN.	TOTAL LOSS dB	RF LOSS dB	IF LOSS dB
1	0	0	0
2	10	0	10
3	20	0	20
4	30	10	20
5	40	20	20
6	50	30	20
7	60	40	20
8	70	50	20

REF.	E	B	C
TR1	9·3	10·1	2·1
TR2	9·45	10·1	2·0
TR3	9·45	10	2·1

REF.	E	B	C
TR7	9·4	10·2	2
TR8	9·4	9·9	2·3
TR9	9·35	9·28	3
TR10	7·4	8	0

REF.	E	B	C
TR4	9·3	10	2·1
TR5	9·5	10·2	3·45
TR6	10·4	11	1·15

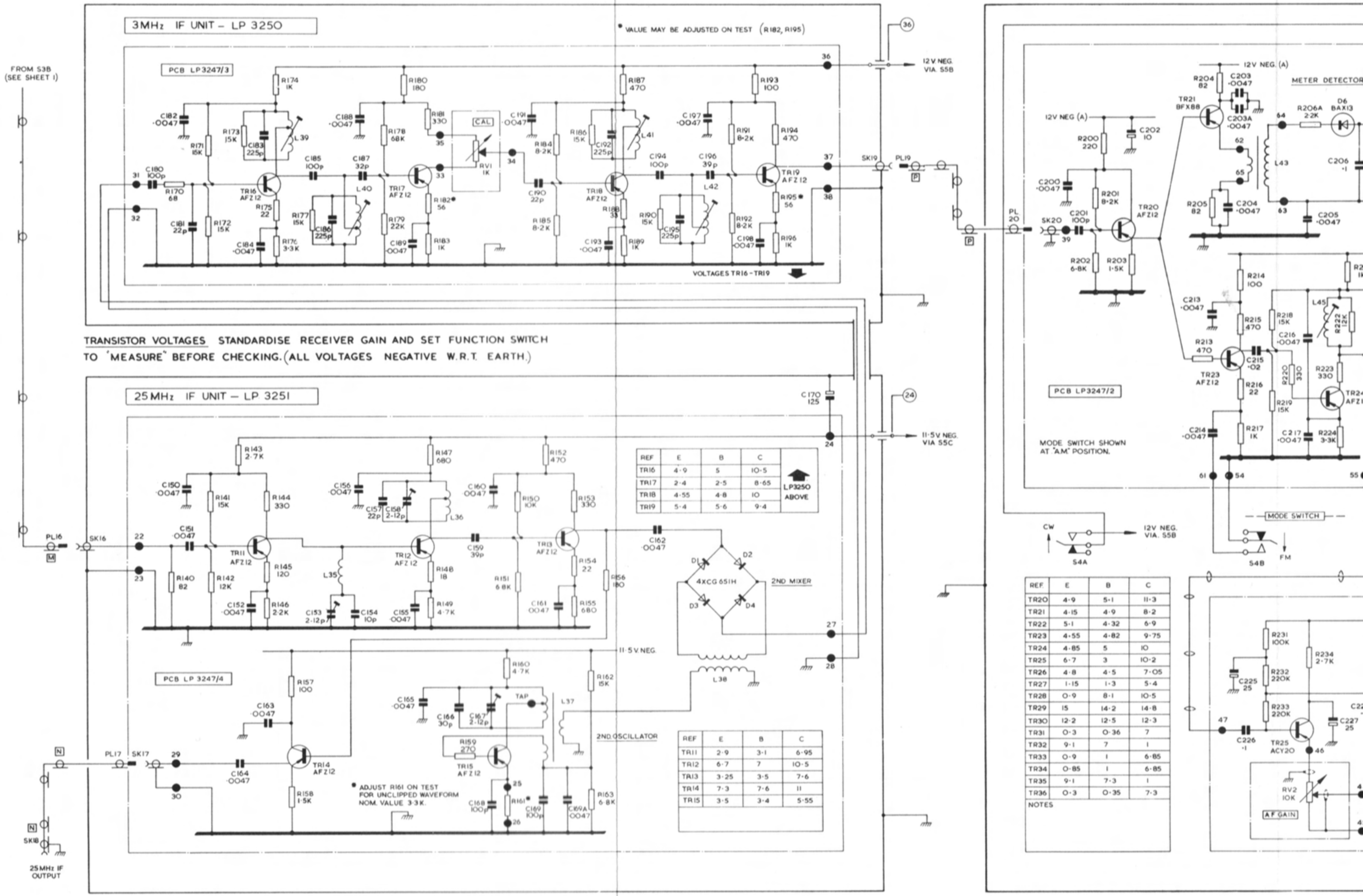
RECEIVER TYPE 31A–SHEET 1.



LOSS TABLE AND RESISTOR VALUES.
O-10dB ATTENUATOR LP3258.

POSN	dB	[R1]	[R2]	[R3]
1	0	–	–	–
2	1	R110 1300	R111 8·66	R112 1300
3	2	R113 649	R114 17·4	R115 649
4	3	R116 432	R117 26·1	R118 432
5	4	R119 332	R120 35·7	R121 332

6	5	R122 267	R123 45·3	R124 267
7	6	R125 226	R126 56·2	R127 226
8	7	R128 196	R129 66·5	R130 196
9	8	R131 174	R132 78·7	R133 174
10	9	R134 158	R135 90·9	R136 158
11	10	R137 143	R138 105	R139 143



TRANSISTOR VOLTAGES STANDARDISE RECEIVER GAIN AND SET FUNCTION SWITCH TO 'MEASURE' BEFORE CHECKING. (ALL VOLTAGES NEGATIVE W.R.T. EARTH.)

REF	E	B	C
TR16	4·9	5	10·5
TR17	2·4	2·5	8·65
TR18	4·55	4·8	10
TR19	5·4	5·6	9·4

LP3250 ABOVE

REF	E	B	C
TR11	2·9	3·1	6·95
TR12	6·7	7	10·5
TR13	3·25	3·5	7·6
TR14	7·3	7·6	11
TR15	3·5	3·4	5·55

REF	E	B	C
TR20	4·9	5·1	11·3
TR21	4·15	4·9	8·2
TR22	5·1	4·32	6·9
TR23	4·55	4·82	9·75
TR24	4·85	5	10
TR25	6·7	3	10·2
TR26	4·8	4·5	7·05
TR27	1·15	1·3	5·4
TR28	0·9	8·1	10·5
TR29	15	14·2	14·8
TR30	12·2	12·5	12·3
TR31	0·3	0·36	7
TR32	9·1	7	1
TR33	0·9	1	6·85
TR34	0·85	1	6·85
TR35	9·1	7·3	1
TR36	0·3	0·35	7·3
NOTES			

RECEIVER TYPE 31A—SHEET 2.