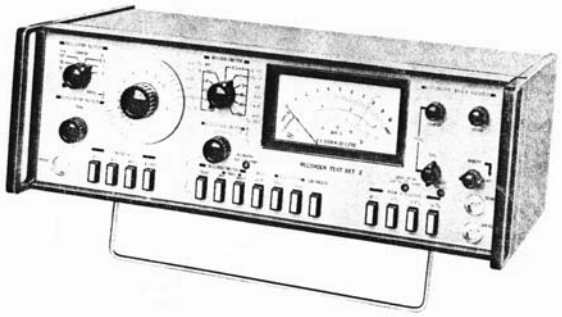
OPERATING INSTRUCTIONS



FERROGRAPH
RECORDER TEST SET
RTS2

FERROGRAPH
RECORDER TEST SET
RTS2

500-033

Contents

THE FERROGRAPH COMPANY LIMITED
AURIEMA HOUSE, 442 BATH ROAD, CIPPENHAM, SLOUGH, BUCKS SL1 6BB
AND SIMONSIDE WORKS, SOUTH SHIELDS

What it is

The Ferrograph Recorder Test Set, RTS2, is a compact and inexpensive instrument that enables all the essential performance parameters of a magnetic tape recorder to be measured. It is supplied complete with a power supply lead, signal input and output leads, a 40 dB attenuator and a test tape. Except for a power supply, nothing extra is needed in order to make a wide range of measurements, including :—

Frequency Response	Signal-to-noise Ratio
Distortion	Wow and Flutter
Drift	Gain
Sensitivity	

The Test Set is equally useful for carrying out similar measurements on other audio apparatus, including amplifiers, disc reproducers and sound-on-film equipment.

What it does

The Recorder Test Set, RTS2 is intended primarily for use by those concerned with operating and maintaining tape recorders and similar equipment; it provides them with a ready means of determining the standard of performance reached by a given machine or item of equipment in all the respects mentioned in the preceding section.

To enable so many different kinds of measurement to be carried out by a single inexpensive instrument, it has been necessary to rationalise the design so that the essential minimum of electronic circuitry is re-arranged into various circuit configurations by means of push-buttons. This also has the effect of making the Test Set notably simple and quick to operate.

In the interest of simplicity and cheapness, it has also been necessary to eliminate a number of features that, desirable though they may be for laboratory standardisation or investigational measurements, are not essential for the purposes for which this Test Set is intended. Thus, both input and output circuits are unbalanced† and the single indicating instrument is an average meter calibrated in r.m.s. values for sinusoidal signals. Also, total harmonic distortion is measured by means of a fundamental-rejection filter: this is all that is required for determining whether mid-band distortion is within proper limits and for establishing the 2% or 3% distortion levels from which signal-to-noise ratios are usually reckoned.

Nevertheless, in spite of this rigorous simplification, the Recorder Test Set contains its own built-in facilities for checking calibration in each of its various modes without the use of external equipment. In addition, the distortion and the wow and flutter signals are not only measured by the meter but are also available on a socket on the front panel. Consequently, the use of the Test Set as an investigational tool can be extended by the use of additional external equipment such as an oscilloscope, a wave analyser or filters.

†With the addition of a RTS Auxiliary Unit, balanced input and outputs are also available.

What it contains

The Recorder Test Set, RTS2, consists essentially of three parts:—

(1) A power supply unit that enables the instrument to operate on alternating current of either 105 to 120 volts or 200 to 250 volts and at either 50 Hz or 60 Hz.

(2) A variable frequency oscillator and variable attenuator that enable a sine wave test signal (15 Hz to 150 kHz and about 0·03 mV to 3V) to be fed (from the Test Set's "oscillator" socket) to the equipment under test.

(3) A millivoltmeter which, with its associated electronics, measures either the output from the equipment under test (fed into the Test Set's "meter" socket) or the output signal of the Test Set itself.

The electronics associated with the millivoltmeter are selected by push buttons on the front panel, to enable it to measure:—

(a) voltages in the range 1 mV to 100 V, full scale deflection.

(b) the distortion products of a sinusoidal test signal in the range 400 to 1100 Hz approx. For this purpose a tunable fundamental-rejection filter is switched into circuit.

(c) drift and peak wow and flutter weighted to D.I.N. 45507. When switched for these measurements, the Test Set provides a 3·15 kHz* test signal from its "oscillator" socket.

In addition, the Test Set contains built-in facilities for checking and, if necessary, adjusting calibration for each type of measurement.

***Note:** Model RTS2A provides a 3 kHz test signal.

Operating Instructions

1. CONNECTING UP AND SWITCHING ON

1.1. Power Supply Connections

Check whether the voltage selector at the back of the Test Set is set to the appropriate voltage range, 105-120 V or 200-250 V. If it is not, pull the selector knob outwards, rotate it to the required position and then press it home again firmly but gently.

No adjustment for supply frequency in the range 50-60 Hz (approx.) is required.

The power lead attached to the Test Set should be connected, through an appropriate plug, to the power supply (A.C. only).

1.2. Signal Connections

The BNC socket marked "oscillator" should be connected to the input of the equipment under test.

If the external 40 dB Attenuator is required, the 'flying' lead should be connected to the "oscillator" socket and the connecting cable to the Attenuator.

The BNC socket marked "meter" should be connected to the output of the equipment under test.

Note 1. Cables for connecting the Test Set to the Line Input and Line Output sockets of a Ferrograph Series 7 recorder are supplied. These leads are irreversible and ensure that the 'earthy' sides of the Test Set and the recorder input and output circuits are connected together. When other leads or other end connectors are used, care must be taken to ensure that this condition still obtains.

Note 2. Since the Test Set has a common earth path between input and output sockets, great care should be taken to ensure that this does not result in a small part of the audio output current flowing through the input earth. When high sensitivity inputs are being used, this could give rise to spurious noise or distortion readings. These can usually be prevented by the insertion of a small resistor (*e.g.* 100 ohm) in series with the "meter" input earth lead.

1.3. Switching On and Off

The Test Set is switched on by turning to "on" the "SUPPLY" knob at the right of the front panel. The meter is illuminated to show when power has been applied.

2. CHECKING AND ADJUSTING CALIBRATION

2.1. General

For this purpose it does not matter whether the Test Set is connected to the equipment to be tested or not. It is recommended, however, that the power supply should have been switched on for at least 5 minutes before calibration in the Drift and the Wow and Flutter modes is checked.

The adjustments are not interdependent and can be carried out individually.

After the Test Set had been switched on, the procedures are as follows:—

2.2. Millivoltmeter Calibration

(1) Set the "MILLIVOLTMETER" switch to the "1 V" position.

(2) Press down the "read input" push button. (This releases the button to its left and the three buttons to its right.)

(3) Press down the "CALIBRATE" push button.

(4) The meter pointer should now lie on the CAL mark above the outer scale. If it does not, adjust it to do so by means of the screwdriver-operated control marked "mV meter cal (1 V range)".

(5) Press the "CALIBRATE" push button to release it.

Note: When this adjustment has been carried out, the meter, with the "MILLIVOLTMETER" switch in the "1 V" position, measures voltage on the top scale with full scale deflection of 1 V. Movement of the "MILLIVOLTMETER" switch adjusts the meter sensitivity to give full scale deflection for inputs of 1 mV to 100V, as indicated on the switch, reading on the appropriate one of the two upper scales.

For setting the meter to read arbitrarily, see 3.4, below.

2.3. Drift Calibration

(1) Press down the "W & F drift" push button. This releases the two buttons on either side and applies a 3·15 kHz* test signal to the "oscillator" socket and to the meter circuits.

(2) Press down the "CALIBRATE" and the "WOW & FLUTTER drift" push buttons (thus releasing the "1%", "0·3%" and "0·1%" buttons).

(3) The meter pointer should now read 0 on the "drift %" scale. If it does not, adjust it to do so by means of the screwdriver-operated, pre-set control marked "drift set zero".

(4) Press down the "CALIBRATE" push button to release it.

The meter will now measure drift directly on the "drift %" scale.

2.4. Wow and Flutter Calibration

(1) With the "W & F drift" push button still pressed down (see above), press down the "CALIBRATE" and the "0·3%" push buttons (releasing the "drift", "1%" and "0·1%" buttons).

(2) The meter pointer should now lie on the CAL mark above the top scale. If it does not, adjust it to do so by means of the screwdriver-operated pre-set control marked "peak wow cal (0·3% range)".

(3) Press down the "CALIBRATE" push button to release it.

The meter will now read percentage wow and flutter (0·3% f.s.d.) on the next to top scale.

Pressing down the "1%" or "0·1%" button will release the "0·3%" button and the meter will then read percentage wow and flutter on the top scale with f.s.d. 1% or 0·1%.

3. MAKING MEASUREMENTS

3.1. Preparing to Measure

In the following it is assumed that the gain controls on the equipment under test have been set for normal operating conditions. It is also assumed that the input and output signal voltages under these conditions are, at least approximately, known. If this is not the case then, initially, the "OSCILLATOR OUTPUT coarse" switch should be set to its lowest (10 mV) position and the "MILLIVOLTMETER" switch to its highest (100 V) position. When connecting to a microphone input socket, the external 40 dB Attenuator should be inserted between the Test Set and the equipment under test (see 1.2).

The "OSCILLATOR OUTPUT coarse" control should then be turned clockwise, step by step, until a proper operating level has been obtained. If this requires the "OSCILLATOR OUTPUT coarse" control to be set higher than 3V, then the 40 dB Attenuator should be removed from the output. (When testing a Ferrograph Series 7 recorder this is shown by the reading of the VU meter when it is switched to *Source*.)

With a proper output level from the equipment under test (shown on a Ferrograph Series 7 recorder by the reading of the VU meter when it is switched to *Tape*) the "MILLIVOLTMETER" switch on the Test Set should be turned anti-clockwise step by step, until a convenient reading on the meter is obtained.

3.2. Measuring Frequency Response

(1) Set the "OSCILLATOR OUTPUT coarse" switch to an appropriate position (see 3.1 above) and the "OSCILLATOR OUTPUT fine" control to about mid-position.

(2) Set the "FREQ" control to 100 and press down the "FREQUENCY" range selecting button below it marked "X 10".

The Test Set is now delivering a 1 kHz test signal to the equipment under test. The level of this signal can be controlled in steps by the "OSCILLATOR OUTPUT coarse" control and, continuously, by the "OSCILLATOR OUTPUT fine" control. Once adjusted at 1 kHz, the adjustment must not be varied throughout the rest of this test.

(3) Press down the "input" push button and check that the "LF cut" and "CALIBRATE" buttons are both released.

The Test Set will now measure the output voltage from the equipment under test (see Note to 2.2.).

(4) The frequency of the test signal can be changed by means of the "FREQ" control and the range selecting push buttons below it. The output level at various frequencies can be read on the meter, its sensitivity being increased or decreased, if required, by use of the "MILLIVOLTMETER" switch (see Note to 2.2.).

A plot of output voltage against frequency shows the frequency response of the equipment under test.

Note 1: When making frequency response and similar measurements, it is usually convenient to have the meter reading 0 on the dB scale, or some other round number, at a chosen reference frequency, say 1 kHz. Normally this is done by using the "OSCILLATOR OUTPUT fine" control to adjust the level of the input signal to the equipment under test or by a fine adjustment of its gain control.

When neither of these things can be done, as, for example, when reproducing a pre-recorded tape on equipment with no output level control, the meter reading may be adjusted to a convenient reference value by pressing down the "DISTORTION set 100%" push button (thus releasing the "input" push button) and adjusting the meter to the required reading by use of the "DISTORTION METER set 100%" control. The meter will now indicate relative levels e.g. in decibels, at the various frequencies but it will not, of course, read in volts or millivolts.

The "MILLIVOLTMETER" control should only be used on the distortion meter ranges of "0·3%" to "100%". In view of the extreme sensitivity (100μ V) of the "0·1%" range, this should not be used for reading voltages with the "DISTORTION 100%" button pressed.

Note 2: When making frequency response measurements on magnetic tape recorders, it is essential that the input signal level shall be at least 20 dB below that which will give full level recording at 1 kHz. Similar restrictions on the permissible level of test signals apply to some other types of equipment.

Note 3: When testing a tape recorder that cannot record and reproduce simultaneously, it is necessary first to record a series of test frequencies (with a fixed input signal level) and then to measure output levels at the various frequencies when this recording is reproduced.

The above procedures will measure the overall response of a tape recorder. To determine whether the reproducing frequency response is correct, it is necessary to measure the output levels at various frequencies when reproducing a standard test tape on which the various frequencies have been recorded at the levels prescribed by the appropriate Standard.

3.3. Measuring Drift

(1) Press down the "W & F drift" button and also the "drift" button under the "WOW & FLUTTER" heading.

The Test Set is now delivering a 3·15 kHz* test signal to the recorder under test.

(2) Set the recorder controls so that this signal is recorded at a normal level for, say, 40 seconds. Stop the machine, and rewind the tape to the beginning of the recording.

(3) Reproduce this recording.

Note: The level of the signal reaching the Test Set should not be less than 75 mV. To check this, see Note 1 to 3.4.

(4) The meter will now indicate directly on the "drift %" scale the percentage difference between the frequency of the reproduced signal and the 3·15 kHz* test signal that was recorded.

Note: When testing a disc reproducer it will be necessary, and when testing a tape reproducer it may be convenient, to reproduce a test recording made on another machine. The indicated percentage drift may then be due partly to a difference in the recording and reproducing speeds and partly to the original signal not having been 3·15 kHz*.

3.4. Measuring Wow and Flutter

(1) If it has not already been done, first prepare a test recording as in (1) and (2) of 3.3. above.

(2) Press down the "1%" button under the "WOW & FLUTTER" heading (releasing the adjacent "drift" button) and reproduce the test recording (see Note 1 below).

The meter will now indicate wow and flutter on the top scale; f.s.d. 1%. If the meter reading is inconveniently small, press down the "0·3%" or "0·1%" button (releasing the "1%" button). The meter will now indicate wow and flutter on the next to top scale with f.s.d. 0·3% or on the top scale with f.s.d. 0·1%.

Note 1: For proper operation of the limiter (which ensures that amplitude variations do not affect the readings), the reproduced voltage reaching the Test Set should be more than 75 mV. This can readily be checked by pressing down the "MILLIVOLTMETER read input" button (releasing the adjacent "W & F drift" button) and determining the level from the combined readings of the meter and the "MILLIVOLTMETER" switch (see Note to 2.2.). After such a level check, the "W & F drift" button must, of course, be pressed down again to measure wow and flutter.

Note 2: For a proper measurement of wow and flutter, the frequency of the signal fed to the Test Set should be within about ±5% of the nominal value, 3·15 kHz*. When reproducing a test recording just made on the same machine, as above, it will almost always be within the ±2% indicated directly on the "drift %" scale. This may not be the case when reproducing a test recording made on a different machine or at another time but satisfactory measurements of wow and flutter can still be made if, when measuring drift, the meter can be made to read within its ±2% range by use of the "drift set zero" control.

Note 3: Readings of wow and flutter taken while the test recording is being made usually give a fair indication of magnitude but do not give the true values since speed fluctuations that repeat in a period corresponding to the time taken by the tape to move from the record to the replay head do not appear

3.5. Measuring Distortion

For this measurement, the output signal from the equipment under test should preferably be greater than 100 mV (see Note 3 below).

The procedure is as follows:—

(1) Set the "MILLIVOLTMETER" switch to "1 V".

(2) Set the "FREQ" control to 100 and press down the range selecting push button marked "X 10".

A 1 kHz test signal is now delivered to the equipment under test.

(3) Press the "DISTORTION set 100%" button.

(4) Now use the "DISTORTION METER set 100%" control knob to adjust the meter to read 10 on the top scale.

(5) Press the "DISTORTION read" button (releasing the "DISTORTION set 100%" button). Also press down the "LF cut" button.

(6) Set the "DISTORTION METER BALANCE fine" control to about mid-position (vertical) and then use the "freq-coarse" control and the "phase" control to reduce the meter reading to a minimum.

During this process, the meter sensitivity should be progressively increased, by means of the "MILLIVOLTMETER" switch, as required to maintain a convenient reading. Complete the adjustment for minimum reading by use of the "freq-fine" control and the "phase" control.

(7) The percentage distortion can now be read on the appropriate one of the two upper scales in combination with the % markings on the "MILLIVOLTMETER" switch.

Note 1: The test signal need not be 1 kHz, as above, but it should be within the range 400 - 1100 Hz, approximately. Otherwise, a minimum will not be obtained within the range of the "BALANCE" controls.

Note 2: The meter reading includes signals of all frequencies between 30 Hz and 20 kHz except for the test frequency and a narrow band on either side of it. It therefore includes hum and other low frequencies. Pressing down the "LF cut" button cuts the lower frequencies progressively below 400 Hz.

Note 3: If a level of 100 mV or more cannot be obtained from the equipment under test, it will not be possible to adjust the meter to full scale deflection as in (4) above. The measurement may still be carried out but with the "MILLIVOLTMETER" switch set below 1V, with a corresponding allowance in the calculation of percentage and with a restriction in the lowest level of distortion that can be measured.

Note 4: When testing a tape recorder that cannot record and reproduce simultaneously it is, of course, necessary first to record the test signal and then to measure distortion while it is being reproduced.

3.6. Measuring Signal-to-Noise Ratio

(1) With the equipment under test working at normal operating levels, measure the total harmonic distortion on a 1 kHz test signal as in 3.5. above.

(2) If the total harmonic distortion is less than 2%, then increase the level of the test signal by means of the "OSCILLATOR OUTPUT" "coarse" and "fine" controls (or, if testing a tape recorder, the recording gain control) until the distortion is 2%.

Note: A good idea of the rate of increase of distortion with signal level can be obtained by successively decreasing meter sensitivity and increasing signal level in steps of 10 dB but, for the final determination of distortion, the full procedure of 3.5. should be carried out.

(3) With the equipment under test adjusted so that total harmonic distortion of a 1 kHz output signal is 2%, press the "MILLIVOLTMETER input" button (releasing the "DISTORTION read" button).

(4) Adjust the "MILLIVOLTMETER" switch to give a convenient meter deflection. The reading of the meter, in combination with the switch (see Note to 2.2.), indicates the output level at which there is 2% distortion.

(5) Remove the signal from the input of the equipment under test and apply a short circuit (But see Note 2 below).

(6) Press the "LF cut" button to release it. (But see Note 5 below).

(7) Increase the meter sensitivity, by means of the "MILLIVOLTMETER" switch, until a convenient reading is obtained. The number of millivolts indicated by the combined meter and switch readings (see Note 2.2) is the total noise level. The ratio of this to the voltage determined in (3) above, is the Signal-to-Noise Ratio, usually stated in decibels.

Note 1: When determining the 2% distortion level of a tape recorder, care must be taken that the gain controls are so set that the distortion does not arise primarily because of overloading of the electronics. This could happen, for example, because of an excessive input level compensated by a low setting of the recorder gain control or because of an excessive output level.

It is the condition when the distortion arises primarily in the record/replay processes that is usually referred to when the signal-to-noise ratio of a tape recorder is quoted.

Note 2: In the case of a tape recorder, there are several different signal-to-noise ratios that may be considered significant, according to circumstances, but in all cases it is necessary first to determine the output level at which the total harmonic distortion of a 1 kHz test signal is 2% (see (1), (2) and (3) above).

It is with this output level that the various noise levels are usually compared. (But see Note 3 below).

The signal-to-noise levels most usually quoted are those obtained by:—

(a) recording and reproducing simultaneously with the input short circuited and using a bulk-erased or virgin tape.

(b) as (a) but using a tape previously recorded to saturation level.

(c) reproducing only, using a bulk-erased or virgin tape.

(d) reproducing with the tape stationary.

In each case the noise level must be measured under the stated conditions.

Note 3: Signal-to-noise ratios are sometimes reckoned from the 3% rather than from the 2% total harmonic distortion level or from a specified tape flux level.

Note 4: Signal-to-noise ratio measurements are made with various types of meter (e.g. r.m.s. or peak indicating) sometimes with and sometimes without a frequency weighting. This Test Set measures unweighted noise using an average reading meter scaled in r.m.s. values for sinusoidal signals.

Note 5: When it is tape hiss or other high frequencies that are of most interest, it will usually be convenient to make the noise measurement with the "LF cut" button pressed down.

3.7. Measurement of Gain

(1) First proceed with steps (1), (2) and (3) of the procedure for measuring frequency response, 3.2. above.

(2) Press the "MILLIVOLTMETER read input" button and then adjust the "MILLIVOLTMETER" switch to obtain a convenient reading on the meter.

This reading, in combination with the switch, indicates the output voltage of the equipment under test. (see Note to 2.2.).

(3) Now, press the "MILLIVOLTMETER read osc" button. This releases the "read input" button and connects the meter to indicate the output voltage from the Test Set oscillator, that is to say the input voltage to the equipment under test.

(4) Adjust the "MILLIVOLTMETER" switch to obtain a convenient reading on the meter.

This reading, in combination with the switch, indicates the input level to the equipment under test.

The ratio of the output level (2) above, to the input level (4) above, is the gain of the equipment. It may be expressed as a numerical ratio or in decibels.

Note: Gain can be measured at any frequency desired by an appropriate setting of the "FREQ" control and the range selecting push buttons below it. Care must be taken, however, to avoid overloading. (See Note 2 to 3.2. above.)

FERROGRAPH
RECORDER TEST SET
RTS2

Technical Specification

1. VARIABLE FREQUENCY TEST SIGNAL GENERATOR

Frequency Range
15 Hz to 150 kHz in four ranges.

Frequency Response
Flat within ±0·2 dB over the range 15 Hz to 150 kHz.

Distortion
Less than 0·025% at 1 kHz
Less than 0·08% over the range 100 Hz to 20 kHz

Maximum Output Level†
3 V (approx.) into open circuit
Not less than +8 dBm into 600 Ohm load

Output Attenuator
Coarse: Six steps of 10 dB
Fine: Continuous over range of 15 dB approx.
External: Fixed 40 dB

Output Impedance
Independent of frequency
Dependent on setting of output attenuator coarse control: always less than 450 ohms. From external 40 dB attenuator 47 ohms.

2. FIXED FREQUENCY TEST SIGNAL GENERATOR (FOR DRIFT AND WOW & FLUTTER MEASUREMENTS)

Frequency
3·15 kHz (RTS2A models, 3 kHz)

Output Level
350 mV approx.

Output Impedance
220 ohms approx.

3. MILLIVOLTMETER

Frequency Response
Flat within ±0·2 dB over range 10 Hz to 150 kHz

Accuracy
Within ± 2% f.s.d. over range 30 Hz to 20 kHz

Sensitivity
1 mV to 100 V f.s.d. in 11 steps of 10 dB

Input Impedance
2 Megohms (approx.) **Note:** No D.C. path between the input leads.

Indication
Average reading meter scaled in r.m.s. values for sinusoidal signals.

†With the addition of a RTS Auxiliary Unit, up to +20 dB into 600 ohm load.

4. WOW AND FLUTTER METER

Type of Measurement
Meter measures peak wow and flutter weighted to D.I.N. 45507.

Input Signal Required
3·15 kHz (RTS2A models 3 kHz) at level not less than 75 mV.

Normally this is supplied by the Fixed Frequency Test Signal Generator of the Test Set itself (see 2 above).

If the test signal is from another source, e.g. a pre-recorded test disc or tape, then the frequency of the test signal should be within ±5% of the nominal value.

Sensitivity
Three ranges for wow and flutter measurements: 0·1%, 0·3% and 1% f.s.d.
One range, direct reading for drift measurements: ±2% f.s.d.

Input Impedance
50,000 ohms, approx.

Frequency Response for Wow and Flutter Measurements
Maximum at 4·0 Hz: 6 dB points at 0·8 Hz and 20 Hz

Alternative Output
The signal measured by the meter also appears on a BNC socket on the front panel and can be fed to an external oscilloscope, wave analyser, filters, etc.

The output level is 3 V (approx.) for meter f.s.d. from a source impedance of 15,000 ohms.

5. DISTORTION METER

Type of Measurement
Rejection of fundamental by a tuned filter.

Input Signal Required
Frequency within the range 400 to 1100 Hz (approx.). Signal normally supplied by the Variable Frequency Test Signal Generator (see 1, above).

The level of the signal from the equipment under test should be 100 mV or more. Smaller inputs may be used but with an increased minimum distortion reading.

Second Harmonic Rejection
Less than 0·25 dB

Minimum Reading (from a distortionless source)
Less than 0·05%

Bandwidth of Harmonic Distortion Measurement
15 Hz to 20 kHz

There is an optional L.F. cut (turnover 400 Hz) for the rejection of hum and other L.F. noise components.

Input Impedance
100,000 ohms approx.

Alternative Output
The signal measured by the meter also appears on a BNC socket on the front panel and can be fed to an external oscilloscope, wave analyser, filters, etc.

The output level is 1 V (approx.) for meter f.s.d. from a source impedance of approximately 500 ohms.

6. GENERAL

Power Supply
105-120 V, 50 or 60 Hz or 200-250 V, 50 or 60 Hz; 12 watts approx.

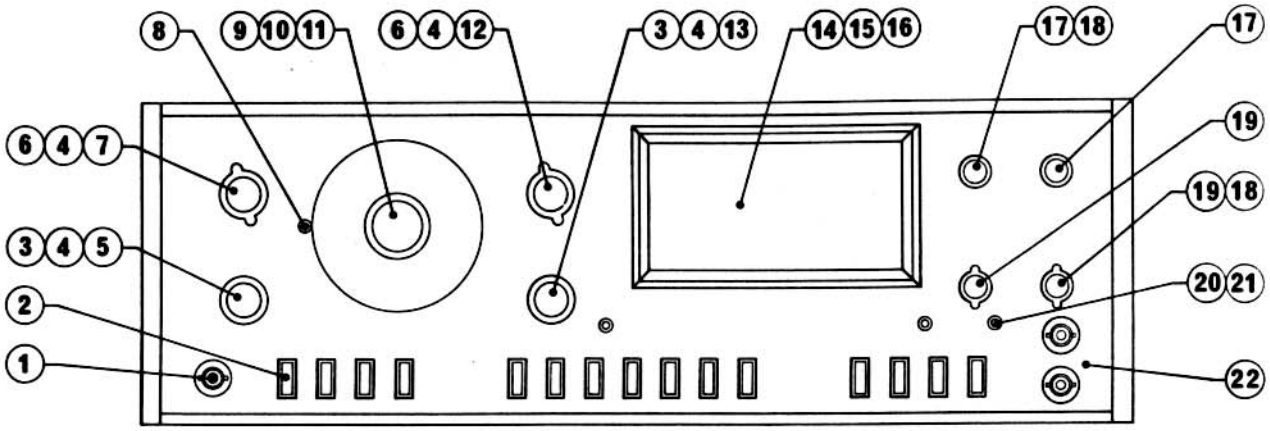
Dimensions
17$\frac{3}{8}$ in. (441 mm) wide
10 in. (254 mm) deep over handles
5$\frac{5}{8}$ in. (143 mm) high

Weight
13 lb (5·9 kg) approx.

Access
Access to the inside of the case is obtained by removing two screws from the underside of the lip above the back panel.

FERROGRAPH
RECORDER TEST SET

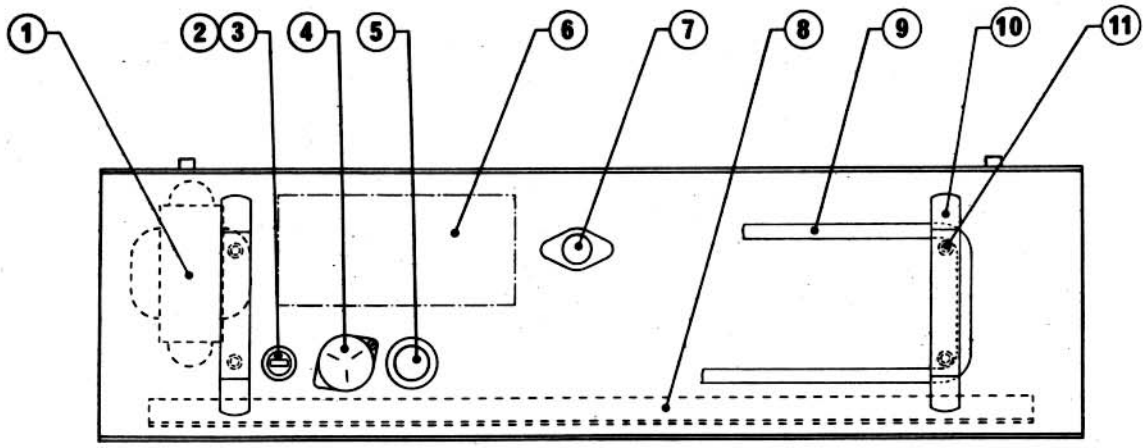
Appendix



FRONT VIEW

Ref. Number	Item	RTS 2 Qty.	Part No.
1	Socket	3	692-030
2	Button	15	448-019
3	Knob K2	2	448-021
4	Bush	4	100-037
5	Extension Spindle	1	705-028F
6	Knob K2W	2	448-023
7	Extension Spindle	1	705-028D
8	Zero Stud	1	666-071
9	Knob K3	1	448-025
10	Dial	1	295-004
11	Potentiometer 10kΩ Logarithmic	1	582-033
12	Extension Spindle	1	705-028C
13	Extension Spindle	1	705-028E
14	Meter	1	512-005
15	Lamp Holder	1	455-008
16	Lamp Festoon 3W	1	455-010(12V
17	Knob K1	2	448-022
18	Extension Spindle	2	705-028A
19	Knob K1W	2	448-026
20	Bush	3	100-038
21	Extension Spindle	3	705-029
22	Front Panel	1	573-178

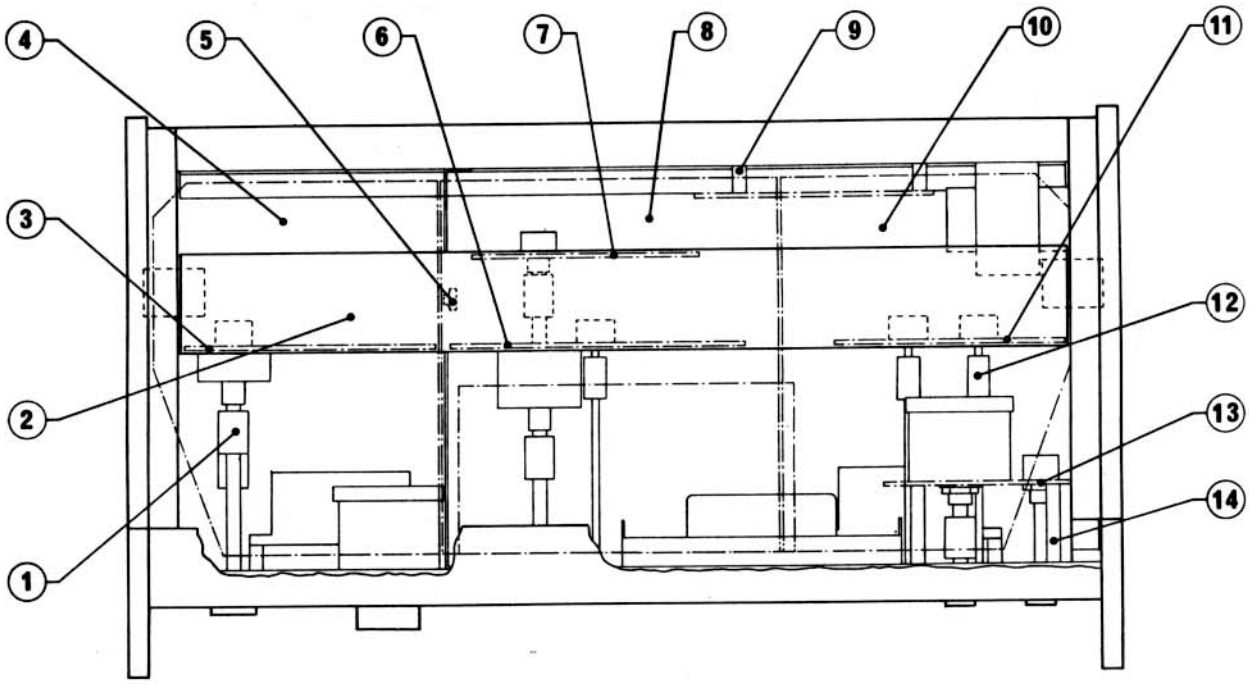
FERROGRAPH
RECORDER TEST SET



REAR VIEW

Ref. Number	Item	Qty.	RTS 2 Part No.
1	Mains Transformer	1	T1721
2	Fuse Holder	1	380-005
3	Fuse (0.75A, 20mm x 5mm dia.)	1	380-008
4	Voltage Selector	1	920-001
	Grommet	1	398-014
6	Power Board	1	025-310
7	Transistor (type 40312)	1	825-002
8	P.C. Board Support Bracket	1	025-255
9	Power Supply Lead	1	110-017
10	Cable Clip	2	196-011
11	Spacer	4	698-079

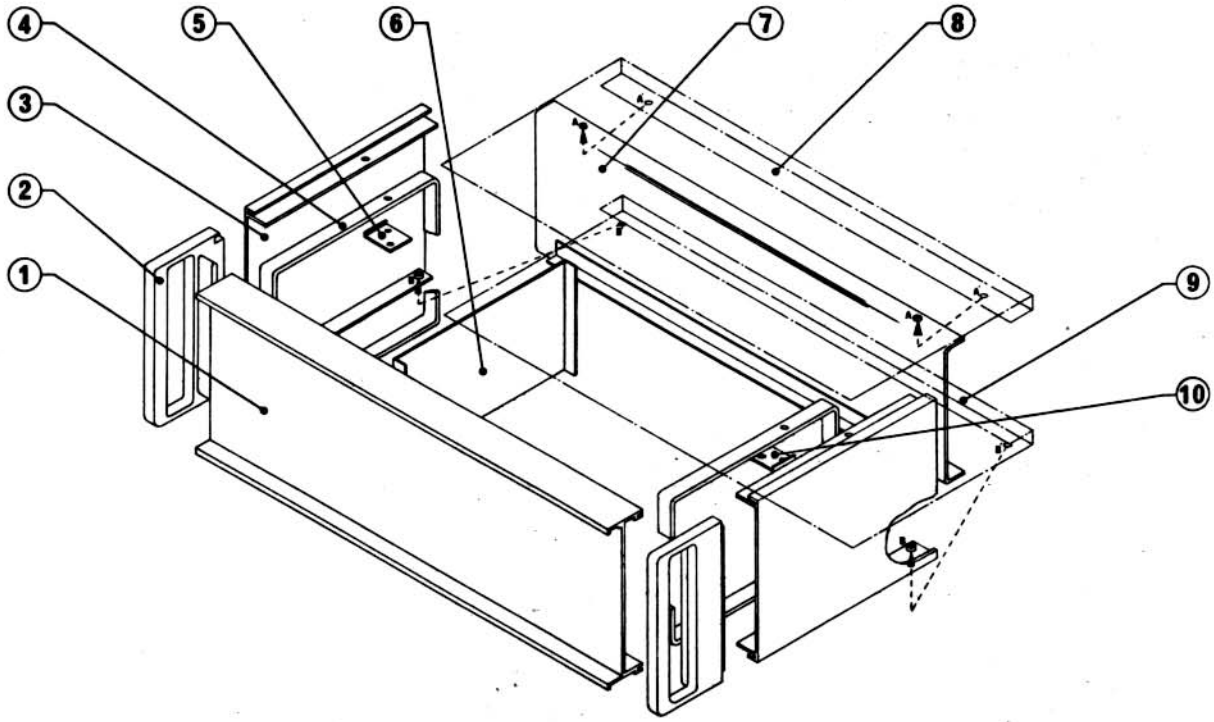
FERROGRAPH
RECORDER TEST SET



PLAN VIEW

Ref. Number	Item	RTS 2 Qty.	Part No.
1	Coupling	6	687-029
2	P.C. Board Fixing Strap	1	025-256
3	Oscillator Board	1	025-245
4	Oscillator Mother Board	1	025-247
5	Terminal Nut 4BA	1	BP/2025/N
6	Millivoltmeter Board	1	025-246
7	Distortion Meter Board	1	025-322
8	Millivoltmeter Mother Board	1	025-320
9	Spacer	9	698-068
10	Wow & Flutter Mother Board	1	025-311
11	Wow & Flutter Board	1	025-312
12	Coupling	3	202-005
13	Potentiometer Mounting Board	1	025-309
14	Spacer	4	698-069

FERROGRAPH
RECORDER · TEST SET



EXPLODED VIEW

Ref. Number	Item	RTS2 Qty.	Part No.
1	Front Extrusion	1	573-180
2	Handle	2	412-002
3	Side Panel Extrusion	2	320-036
4	Hoop Frame	2	360-003
5	Bracket (top strap, L.H.)	1	025-254A
6	Screen	1	671-005
7	Rear Panel	1	573-177
8	Top Panel	1	573-143
9	Bottom Panel	1	573-144
10	Bracket (top strap, R.H.)	1	025-254B

FERROGRAPH
RECORDER TEST SET

List of Components

Cct. Ref.	OSCILLATOR BOARD			Part No.
	Resistors (R) & Potentiometers (RV)			
R1	1.8kΩ	¼W	1% High Stab.	625-24-1k8
R2	15kΩ	¼W	10%	625-13-15k
R3	10kΩ	¼W	5%	625-12-10k
R4	1.6kΩ	¼W	1% High Stab.	625-24-1k6
R5	560Ω	¼W	5%	625-12-560
R6	47kΩ	¼W	10%	625-13-47k
R7	680Ω	¼W	5%	625-12-680
R8	47kΩ	¼W	10%	625-13-47k
R9	1kΩ	¼W	1% High Stab.	625-24-1k
R10	620Ω	¼W	5%	625-12-620
R11	1370Ω	¼W	0.2% High Stab.	624-015
R12	432Ω	¼W	0.2% High Stab.	624-014
R13	137Ω	¼W	0.2% High Stab.	624-013
R14	43.2Ω	¼W	0.2% High Stab.	624-012
R15	13.7Ω	¼W	0.2% High Stab.	624-011
R16	6.34Ω	¼W	0.2% High Stab.	624-010
R17	100Ω	½W	5%	625-12-100
R18	100Ω	½W	5%	625-12-100
RV19	2.2kΩ Linear (OUTPUT - fine)			582-035
	Capacitors			
C1	3300µF	40V	Electrolytic	130-024
C2	125µF	16V	Electrolytic	130-002
C3	125µF	16V	Electrolytic	130-002
C4	950pF	30V	2½%	131-775
C5	0.01µF	30V	2½%	131-774
C6	0.1µF	160V	2%	131-514
C7	1µF	160V	2%	131-515
C8	1µF	160V	2%	131-515
C9	0.1µF	160V	2%	131-514
C10	0.01µF	30V	2½%	131-774
C11	950pF	30V	2½%	131-775
	Miscellaneous			
VT1	Transistor BC183LB			825-015
VT2	Transistor BC154LB			825-016
VT3	Transistor BC183LB			825-015
SW1	Switch (OSC. OUTPUT coarse)			750-013
TH1	Thermistor ITT-R25			800-000

Cct. Ref.	FRONT PANEL	Part No.
RV20a RV20b	10kΩ Log.) 10kΩ Log.) (FREQ.)	582-033
	Miscellaneous	
M1	Meter (Sifam 100µA)	512-005
LP1	Lamp 12V, 3W	455-010
SKT30	Socket BNC (1637/CS)	692-030
SKT31	Socket BNC (1637/CS)	692-030
SKT32	Socket BNC (1637/CS)	692-030

Cct. Ref.	WOW & FLUTTER BOARD			Part No.
	Resistors (R) & Potentiometers (RV)			
R31	3.3kΩ	¼W	5%	625-12-3k3
R32	1kΩ	¼W	1% High Stab.	625-24-1k
RV33	22kΩ	Linear SET 3150Hz		582-012
R34	430kΩ	¼W	2% High Stab.	625-25-430k
R35	430kΩ	¼W	2% High Stab.	625-25-430k
R36	3.3kΩ	¼W	5%	625-12-3k3
R37	5.6kΩ	¼W	5%	625-12-5k6
R38	10MΩ	¼W	10%	625-13-10M
R39	22kΩ	¼W	10%	625-13-22k
R40	47kΩ	¼W	5% High Stab.	624-001
R41	22kΩ	¼W	10%	625-13-22k
R42	3.3kΩ	¼W	5%	625-12-3k3
R43	390kΩ	¼W	1% High Stab.	625-24-390k
R44	22kΩ	¼W	10%	625-13-22k
R45	3.3kΩ	¼W	5%	625-12-3k3
R46	22kΩ	¼W	1% High Stab.	625-24-22k
R47	39kΩ	¼W	5%	625-12-39k
R48	56kΩ	¼W	10%	625-13-56k
R49	22kΩ	¼W	10%	625-13-22k
R50	1kΩ	¼W	10%	625-13-1k
R51	620Ω	¼W	5%	625-12-620
R52	2.2kΩ	¼W	1% High Stab.	625-24-2k2
R53	1kΩ	¼W	10%	625-13-1k
RV54	1kΩ	Linear DRIFT SENS.		582-032
R55	22kΩ	¼W	10%	625-13-22k
RV56	25kΩ	Linear drift set zero		582-055
R57	22kΩ	¼W	1% High Stab.	625-24-22k
R58	33kΩ	¼W	1% High Stab.	625-24-33k
R59	33kΩ	¼W	1% High Stab.	625-24-33k
R60	100kΩ	¼W	5% High Stab.	624-002
R61	220kΩ	¼W	5%	625-12-220k
R62	1.6kΩ	¼W	1% High Stab.	625-24-1k6
R63	1MΩ	¼W	10%	625-13-1M
R64	4.7kΩ	½W	5%	625-12-4k7
R65	390Ω	¼W	1% High Stab.	625-24-390
R66	100kΩ	¼W	5% High Stab.	624-002
R67	1.6kΩ	¼W	1% High Stab.	625-24-1k6
R68	47kΩ	½W	5%	625-12-47k
RV69	25kΩ	Linear peak wow cal.		582-055
R70	470Ω	½W	10%	625-13-470
	Capacitors			
C21	950pF	63V	2½%	131-775
C22	950pF	63V	2½%	131-775
C23	0.22µF	100V	10%	131-253
C24	0.22µF	100V	10%	131-253
C25	0.33µF	100V	10%	131-257
C26	950pF	63V	2½%	131-775
C27	950pF	63V	2½%	131-775
C28	950pF	63V	2½%	131-775
C29	950pF	63V	2½%	131-775

FERROGRAPH
RECORDER TEST SET

List of Components

Cct. Ref.	WOW & FLUTTER BOARD			Part No.
	Capacitors			
C30	950pF	63V	2½%	131-775
C31	0.01µF	30V	2½%	131-774
C32	0.047µF	250V	10%	131-256
C33	0.22µF	100V	10%	131-253
C34	0.22µF	100V	10%	131-253
C35	0.1µF	100V	10%	131-250
C36	0.047µF	250V	10%	131-256
C37	0.047µF	250V	10%	131-256
C38	0.047µF	250V	10%	131-256
C39	25µF	25V	Electrolytic	130-016
C40	1µF	250V	10%	131-259
C41	25µF	25V	Electrolytic	130-016
C42	0.22µF	100V	10%	131-253
C43	12.5µF	25V	Electrolytic	130-026
C44	12.5µF	25V	Electrolytic	130-026
C45	950pF	63V	2½%	131-775
	Miscellaneous			
VT11	Transistor BC184LC			825-005
VT12	Transistor BC184LC			825-005
VT13	Transistor BC184LC			825-005
VT14	Transistor BC183LB			825-015
VT15	Transistor BC183LB			825-015
VT16	Transistor BC183LB			825-015
VT17	Transistor BC184LC			825-005
VT18	Transistor BC184LC			825-005
VT19	Transistor BC184LC			825-005
VT20	Transistor BC183LB			825-015
MR1	Diode MAX16			290-001
MR2	Zener Diode BZY88C12			290-017
MR3	Diode NKT249A30			290-015
MR4	Zener Diode BZY88C5V6			290-013
MR5	Zener Diode BZY88C4V7			290-016
MR6	Zener Diode BZY88C4V7			290-016
MR7	Zener Diode BZY88C4V7			290-016
MR8	Diode NKT 249A30			290-015
MR9	Diode NKT 249A30			290-015
L1	Coil			Spec. 800

Cct. Ref.	POT. MOUNTING BOARD			Part No.
	Resistors (R) & Potentiometers (RV)			
R81	10kΩ	¼W	1% High Stab.	625-24-10k
RV82	2kΩ 10 turn BALANCE phase			582-056
R83	3.9kΩ	½W	5%	625-12-3k9
RV84a	10kΩ Log.)			
RV84b	10kΩ Log.)	(Freq. coarse)		582-033
R85	3.9kΩ	½W	5%	625-12-3k9
R86	330kΩ	½W	5%	625-12-330k
RV87a	100kΩ Log.)			
RV87b	100kΩ Log.)	(Freq. fine)		582-034
R88	330kΩ	½W	5%	625-12-330k

Cct. Ref.	POT. MOUNTING BOARD			Part No.
	Capacitors			
C51	0.033µF	250V	1%	131-260
	Miscellaneous			
SW10	Switch SUPPLY on			750-004

Cct. Ref.	DISTORTION METER BOARD			Part No.
	Resistors (R) & Potentiometers (RV)			
RV101	22kΩ	Linear SET W&F CAL		582-012
R102	47kΩ	¼W	5% High Stab.	624-001
R103	47kΩ	¼W	5% High Stab.	624-001
R104	360kΩ	¼W	1% High Stab.	625-24-360k
R105	360kΩ	¼W	1% High Stab.	625-24-360k
R106	18kΩ	¼W	10%	625-13-18k
R107	4.7kΩ	¼W	1% High Stab.	625-24-4k7
R108	10kΩ	¼W	1% High Stab.	625-24-10k
R109	6.8kΩ	¼W	1% High Stab.	625-24-6k8
RV110	22kΩ Linear SET mVmeter CAL			582-012
RV111	100kΩ Log. set 100%			582-036
R112	1kΩ	¼W	10%	625-13-1k
R113	22kΩ	¼W	1% High Stab.	625-24-22k
R114	33kΩ	¼W	1% High Stab.	625-24-33k
R115	1.8kΩ	¼W	5%	625-12-1k8
R116	22kΩ	¼W	1% High Stab.	625-24-22k
R117	47kΩ	¼W	5% High Stab.	624-001
R118	100Ω	½W	5%	625-12-100
R119	3.3kΩ	½W	5%	625-12-3k3
R120	1.8kΩ	¼W	1% High Stab.	625-24-1k8
RV121	1kΩ Linear SET PHASE BAL.			582-032
R122	1kΩ	¼W	1% High Stab.	625-24-1k
R123	1.8kΩ	½W	5%	625-12-1k8
R124	39kΩ	½W	10%	625-13-39k
R125	100kΩ	¼W	5% High Stab.	624-002
R126	270Ω	½W	5%	625-12-270
R127	47kΩ	¼W	5% High Stab.	624-001
R128	10kΩ	½W	10%	625-13-10k
R129	1.5kΩ	½W	5%	625-12-1k5
	Capacitors			
C61	0.1µF	100V	10%	131-250
C62	0.1µF	100V	10%	131-250
C63	640µF	25V	Electrolytic	130-004
C64	25µF	25V	Electrolytic	130-016
C65	0.47µF	250V	10%	131-258
C66	0.033µF	250V	10%	131-262
C67	25µF	25V	Electrolytic	130-016
C68	4700pF	30V	2½%	131-778
C69	0.47µF	250V	10%	1310258

FERROGRAPH
RECORDER TEST SET

List of Components

Cct. Ref.	DISTORTION METER BOARD	Part No.
	Miscellaneous	
VT31	Transistor BC183LB	825-015
VT32	Transistor BC183LB	825-015
VT33	Transistor 2 SC 1000BL	825-035
VT34	Transistor BC183LB	825-015
VT35	Transistor 2 SC 1000 BL	825-035
VT36	Transistor 2 SC 1000 BL	825-035
VT37	Transistor 2 SC 1000 BL	825-035
MR21	Zener Diode BZY88C5V6	290-013
MR22	Diode MAX 16	290-001

Cct. Ref.	MILLIVOLTMETER BOARD	Part No.
	Resistors (R) & Potentiometers (RV)	
R141	22Ω ¼W 5%	625-12-22
R142	2kΩ ¼W 0.2% High Stab.	624-016
R143	2MΩ ¼W 0.2% High Stab.	624-017
R144	1kΩ ½W 5%	625-12-1k
R145	180Ω ¼W 1% High Stab.	625-24-180
R146	1kΩ ¼W 5%	625-12-1k
R147	10kΩ ¼W 5%	625-12-10k
R148	1kΩ ¼W 1% High Stab.	625-24-1k
R149	270kΩ ½W 5%	625-12-270k
R150	1.5kΩ ¼W 1% High Stab.	625-24-1k5
R151	470Ω ½W 10%	625-13-470
RV152	2kΩ Linear mVmeter cal.	582-054
R153	6.34Ω ¼W 0.2% High Stab.	624-010
R154	13.7Ω ¼W 0.2% High Stab.	624-011
R155	43.2Ω ¼W 0.2% High Stab.	624-012
R156	137Ω ¼W 0.2% High Stab.	624-013
R157	432Ω ¼W 0.2% High Stab.	624-014
R158	1370Ω ¼W 0.2% High Stab.	624-015
R159	470Ω ½W 10%	625-13-470
R160	10MΩ ¼W 10%	625-13-10M
R161	100kΩ ¼W 5% High Stab.	624-002
R162	100kΩ ¼W 5% High Stab.	624-002
R163	47Ω ¼W 1% High Stab.	625-24-47
R164	470kΩ ½W 10%	625-13-470k
R165	620Ω ¼W 5%	625-12-620
R166	10kΩ ¼W 5%	625-12-10k
R167	1.5kΩ ½W 10%	625-13-1k5
R168	1kΩ ¼W 1% High Stab.	625-24-1k
R169	1kΩ ¼W 1% High Stab.	625-24-1k
R170	100Ω ¼W 5%	625-12-100
R171	220kΩ ½W 10%	625-13-220k
R172	470kΩ ½W 10%	625-13-470k
R173	1kΩ ½W 5%	625-12-1k
R174	15kΩ ½W 5%	625-12-15k

Cct. Ref.	MILLIVOLTMETER BOARD	Part No.
	Resistors (R) & Potentiometers (RV)	
R175	10kΩ ½W 5%	625-12-10k
R176	180Ω ½W 5%	625-07-180
	Capacitors	
C81	500pF 160V 10%	131-765
C82	0.01μF 30V 2½%	131-774
C83	Variable Ceramic	131-001
C84	160μF 25V Electrolytic	130-011
C85	125μF 16V Electrolytic	130-002
C86	5μF 64V Electrolytic	130-007
C87	32μF 40V Electrolytic	130-013
C88	0.22μF 100V 10%	131-253
C89	0.1μF 400V 10%	131-516
C90	0.022μF 250V 10%	131-255
C91	0.22μF 100V 10%	131-253
C92	0.22μF 100V 10%	131-253
C93	5μF 64V Electrolytic	130-007
C94	0.047μF 250V 10%	131-256
C95	0.1μF 100V 10%	131-250
C96	500pF 160V 10%	131-765
C97	25μF 25V Electrolytic	130-016
C98	25μF 25V Electrolytic	130-016
C99	25μF 25V Electrolytic	130-016
C100	12.5μF 25V Electrolytic	130-026
C101	0.22μF 100V 10%	131-253
C102	125μF 16V Electrolytic	130-002
C103	160μF 25V Electrolytic	130-011
	Miscellaneous	
VT51	Transistor 2SK30GR	825-006
VT52	Transistor BC184LC	825-005
VT53	Transistor BC183LB	825-015
VT54	Transistor BC183LB	825-015
VT55	Transistor BC183LB	825-015
VT56	Transistor BC183LB	825-015
VT57	Transistor BC183LB	825-015
MR31	Zener Diode BZY88C5V6	290-013
MR32	Diode MAX16	290-001
MR33	Diode MAX16	290-001
MR34	Diode MAX16	290-001
MR35	Zener Diode BZX70C20 (or 3TZ20 or 1N5357B)	290-011
SW6	Switch MILLIVOLTMETER	750-014

Cct. Ref.	POWER BOARD	Part No.
	Resistors (R) & Potentiometers (RV)	
R191	22kΩ ¼W 1% High Stab.	625-24-22k
RV192	1kΩ Linear SET 30V D.C.	582-032
R193	4.3kΩ ¼W 1% High Stab.	625-24-4k3
R194	3.9kΩ ½W 5%	625-12-3k9
R195	100kΩ ½W 10%	625-13-100k
R196	10kΩ ½W 10%	625-13-10k

FERROGRAPH
RECORDER TEST SET

List of Components

Cct. Ref.	POWER BOARD	Part No.
	Capacitors	
C121	100µF 40V Electrolytic	130-001
C122	0.01µF 100V 10%	131-500
C123	250µF 64V Electrolytic	130-010
	Miscellaneous	
VT71	Transistor BC183LB	825-015
VT72	Transistor BC461	825-032
MR51	Zener Diode BZY 88C 5V6	290-013
MR52	Bridge Rectifier WO2	600-002

Cct. Ref.	REAR PANEL	Part No.
VT73	Transistor 40312	825-002
T1	Transformer, Power Supply	T1721
FS1	Fuse 0.75A, 20mm x 5mm dia.	380-008
VS1	Voltage Selector	920-001

Cct. Ref.	W & F MOTHER BOARD	Part No.
R211	680Ω ¼W 1% High Stab.	625-24-680
R212	137Ω ¼W 0.2% High Stab.	624-013
SW25	Push Button Switch W & F	749-005
SKT20	P.C. Board Socket - 26 way	692-029

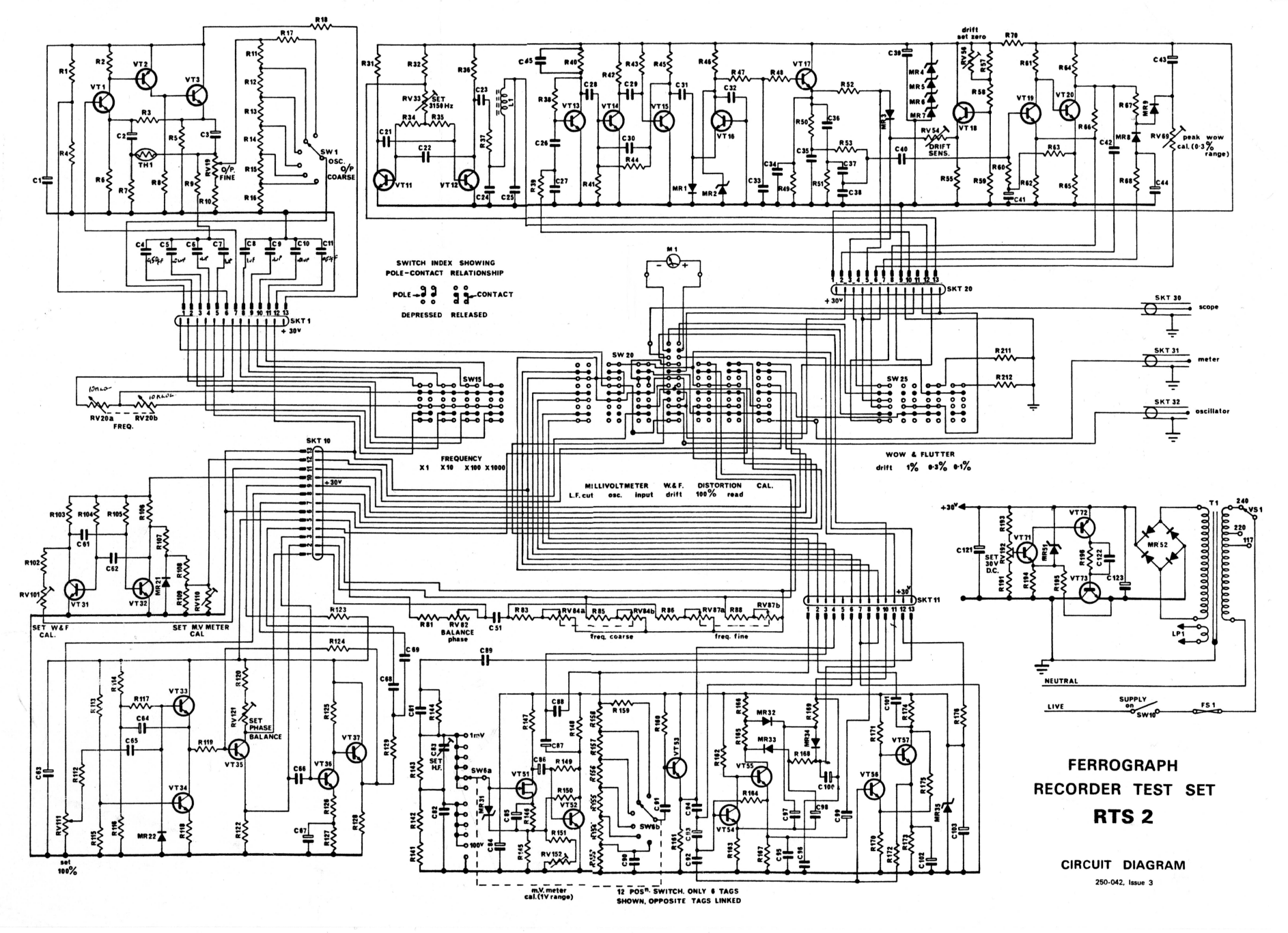
Cct. Ref.	OSCILLATOR MOTHER BOARD	Part No.
SW15	Push Button Switch FREQUENCY	749-005
SKT1	P.C. Board Socket - 26 way	692-029

Cct. Ref.	MILLIVOLTMETER MOTHER BD.	Part No.
SW20	Push Button Switch	749-003
SKT10	P.C. Board Socket - 26 way	692-029
SKT11	P.C. Board Socket - 26 way	692-029

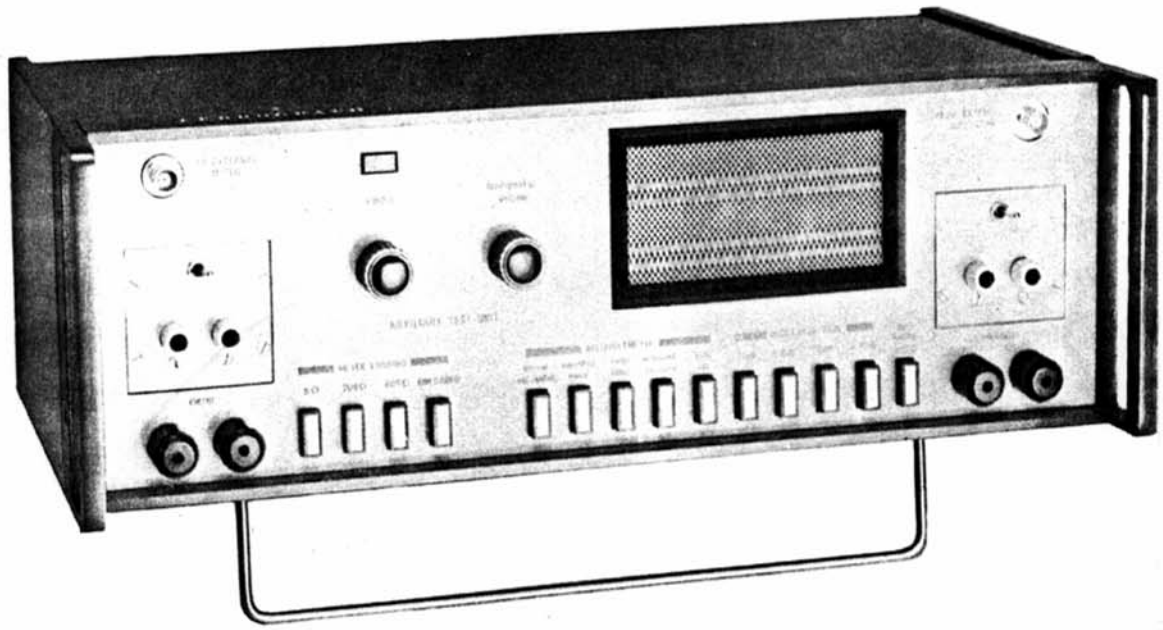
REPLACEMENT BOARD SERVICE

Where it is found necessary to change an electronic component, the RTS2 should be checked and re-calibrated using test equipment which is several times more accurate than the Test Set itself. If this equipment is not available or if difficulty is experienced, the relevant P.C. board(s) can be sent for checking or replacement to the Ferrograph 'Replacement Board Service'.

When returning the board(s) to the appropriate overseas agent, or in the U.K. to the South Shields Service Department, it is essential to include the SERIAL NUMBER of the Test Set.


SWITCH INDEX SHOWING
POLE-CONTACT RELATIONSHIP
POLE
CONTACT
DEPRESSED
RELEASED
SKT 1
+ 30V
SKT 20
SKT 30
scope
SKT 31
meter
SKT 32
oscillator
SW1
OSC. COARSE
O/P. FINE
SET 3150 Hz
DRIFT SENS.
drift set zero
peak wow cal. (0·3% range)
RV20a
RV20b
FREQ.
FREQUENCY
X1 X10 X100 X1000
MILLIVOLTMETER W.& F. DISTORTION CAL.
L.F. cut osc. input drift 100% read
WOW & FLUTTER
drift 1% 0·3% 0·1%
SKT 10
SKT 11
SET W&F CAL.
SET M.V METER CAL
SET 100%
SET PHASE BALANCE
BALANCE phase
freq. coarse
freq. fine
SET H.F.
1mV
100V
m.V. meter cal. (1V range)
12 POSN. SWITCH. ONLY 6 TAGS SHOWN, OPPOSITE TAGS LINKED
NEUTRAL
LIVE
SUPPLY on
FS 1
SW10
240
220
117
VS1
T1
LP1
FERROGRAPH
RECORDER TEST SET
RTS 2
CIRCUIT DIAGRAM
250-042, Issue 3

OPERATING INSTRUCTIONS



FERROGRAPH

AUXILIARY TEST UNIT

FERROGRAPH
AUXILIARY TEST UNIT

Contents

List of Illustrations

General Description

The Ferrograph Auxiliary Test Unit (ATU) is designed to complement the Ferrograph Recorder Test Set (RTS) and to extend its facilities even further so that together they comprise an extremely versatile measuring system. The ATU is styled to match the Recorder Test Set and is built into a case with the same overall dimensions. However, in the same way that the RTS can be used to test apparatus other than recorders, due to its sophisticated circuitry, the Auxiliary Test Unit can be used with virtually any other millivoltmeter and/or audio signal generator.

The Oscillator Amplifier section contains an amplifier coupled with an attenuator (600 Ω) to adjust the gain in pre-set steps between —20 dB and + 10 dB. Together with the RTS, the ATU gives an output signal continuously variable from —75 dBm to +20 dBm into 600 Ω.

As supplied, the output of the ATU is accurately balanced and delivers a maximum of +10 dBm into a 600 Ω load. A special circuit is included to limit the output to this figure to prevent an accidentally overload voltage being applied when the ATU is connected to land lines, etc. If a greater output is required, a small internal adjustment can increase the maximum output to +20 dBm.

The Meter section provides an input loading which may be either balanced or unbalanced, and in the balanced setting it is capable of handling signals of up to +20 dBm. Load impedances of 8 Ω, 200 Ω or 600 Ω can be push-button selected or the input can be left unloaded, when its impedance is either 50 k Ω ('bal') or 2M Ω + 150pF approx. ('unbal').

The actual meter readings are made using the Millivoltmeter section of the RTS (or a millivoltmeter connected to the 'TO EXTERNAL METER' socket), and as selected by the push-buttons these are either 'Wideband Response' (30 Hz - 20 kHz), 1 kHz (±100 Hz) band pass filter to reject hum and noise during the measurement of crosstalk, erasure, etc., or weighted response for the measurement of noise. The weighted response is to the DIN/CCIF characteristic as supplied, but replacement plug-in p.c. boards are available to other characteristics.

The ATU is 'self-powered' from an A.C. mains power supply and has a built-in audio amplifier and loudspeaker with volume control, for audible monitoring of any signal at the 'TO EXTERNAL METER' output. This facility is extremely useful for listening to announcements on frequency response tapes, etc.

Connections

POWER SUPPLY

The Auxiliary Test Unit can be operated from a power supply of 105-120 V or 200-250 V, 50-60 Hz. If not correctly set for the supply voltage, the voltage selector at the rear should be pulled out (it will not come entirely free), re-orientated so that the correct voltage range is next to the indicator, then pushed firmly home. The power supply lead attached to the Unit should be connected to an appropriate plug (Live — brown, Neutral — blue, Earth — green/yellow) and plugged into the power supply (A.C. only).

FERROGRAPH
AUXILIARY TEST UNIT

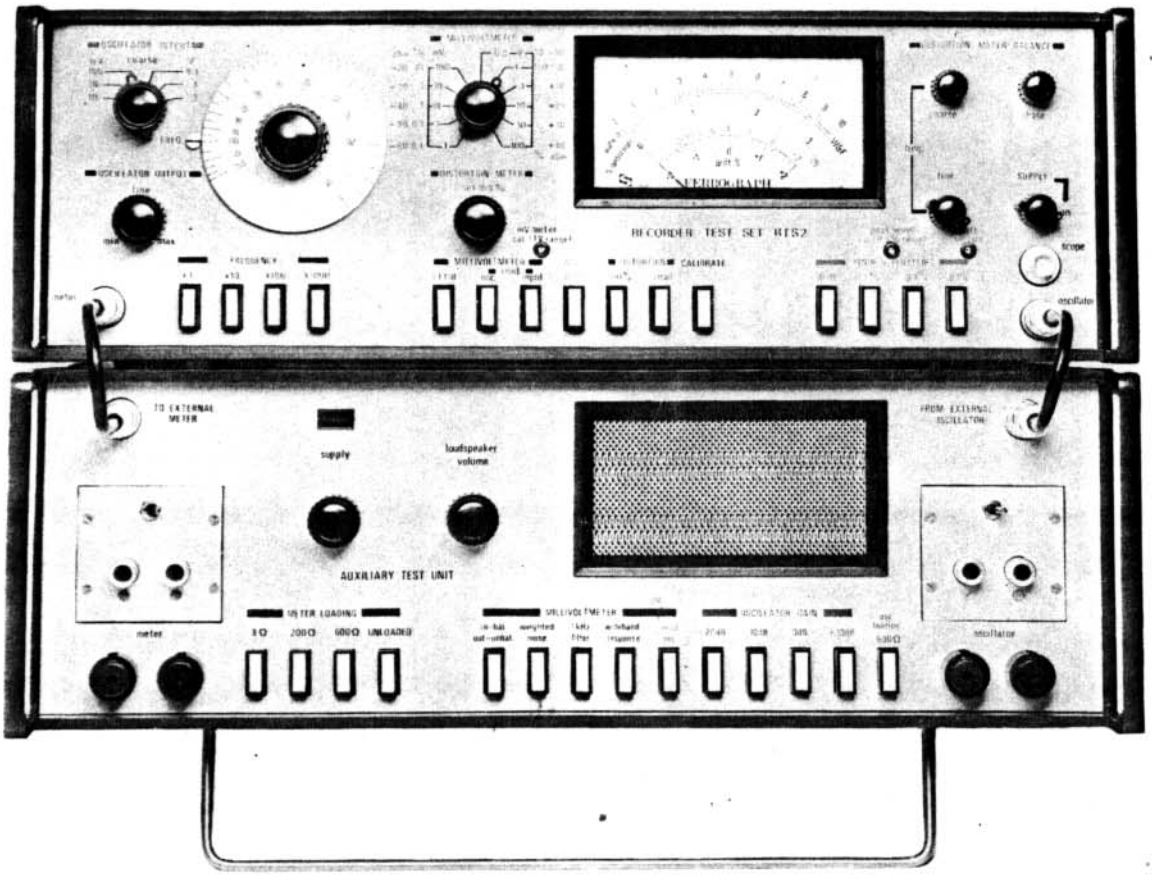


FIG. 1. CONNECTION TO RECORDER TEST SET

OSCILLATOR

The signal from the Recorder Test Set 'Oscillator' socket should be connected to the 'FROM EXTERNAL OSCILLATOR' input socket at the right of the front panel using the lead provided. If an external oscillator is used, its output should be connected to the 'FROM EXTERNAL OSCILLATOR' input using a BNC plug.

The ATU output is taken from the 'oscillator' terminals at the lower right, which are colour coded Red (signal) and Black (earth). This output is duplicated on twin sockets on the panel above. These sockets are normally 3 contact, gauge B jack sockets (T-R-S) which will also accept 3 contact, gauge A jack plugs (T-R-S) without damage. The panel is removable in order that alternative sockets or connectors can be fitted to suit the user's individuals requirements, and 'blank' panels are available onto which these sockets/connectors can be mounted. The two sockets are controlled by a 3-position toggle switch above them, which selects either the left or the right socket, or at the centre position both sockets simultaneously. This enables a stereo recorder, amplifier, etc., to be wired left channel to left socket and right channel to right socket so that during the test procedure it is possible to compare the left and right channels without transferring the leads from track to track.

METER

The signal to be measured should be connected to the two 'meter' terminals at the lower left of the front panel — Red (signal) and Black (earth). This input is also duplicated on twin sockets on the panel above. These sockets are normally 3 contact, gauge B jack sockets (T-R-S) which will also accept 3 contact, gauge A jack plugs (T-R-S) without damage. The panel is removable so that alternative sockets or connectors can be fitted to suit the user's individual requirements, and 'blank' panels are available onto which these sockets/connectors can be mounted. The two sockets are controlled by a 2-position toggle switch above them, which selects either the left or right socket. This enables a stereo recorder, amplifier, etc., to be wired left channel to left socket, right channel to right socket, so that during the test procedure it is possible to compare the left and right channels without transferring the leads from track to track.

Oscillator Amplifier section

The Oscillator Amplifier section is connected between the equipment under test and the Recorder Test Set (Oscillator) or an external oscillator/audio signal generator. It is used to provide extra gain or attenuation and can also be used to load the oscillator output with a 600 Ω load.

OSCILLATOR AMPLIFIER LOADING

Where the equipment under test provides a load of 600 Ω at the 'oscillator' socket, the oscillator amplifier gain is accurately the nominal value of the push-button selected. If the equipment input impedance is high, the 'osc. loading 600 Ω' button should be pressed (push again to release), which connects a 600 Ω resistor across the 'oscillator' output to provide the correct loading for accuracy.

It is quite in order not to press the 'osc. loading 600 Ω' button, although the nominal figure of each button may then not be accurate, depending upon the impedance of the loading on the 'oscillator' output *viz.* the gain/attenuation may no longer be in exactly 10 dB steps. However, the actual output level can be measured using the RTS Meter or the external millivoltmeter (see METER section).

OSCILLATOR AMPLIFIER GAIN

The frequency and magnitude of the signal is still determined by the settings of the controls on the Recorder Test Set (or on the external oscillator). However, the 'OSCILLATOR GAIN' push buttons can be used in conjunction with the 'Oscillator Output — Coarse & Fine' controls to provide an output signal ranging from —75 dBm to +10 dBm into a 600 Ω load (the latter can be increased to +20 dBm as described in 'Special Features — Output Modification').

The ATU provides extra gain or attenuation on pressing one of the four push-buttons, —20 dB, —10 dB, 0 dB or +10 dB, when the three other buttons are automatically released. The first two buttons provide attenuation, the last additional gain, and the other gives the same output signal level as that fed in. The nominal gain is accurate for a load of 600 Ω but is not accurate for load impedances which differ from this *viz.* the gain/attenuation may no longer be in exactly 10 dB steps.

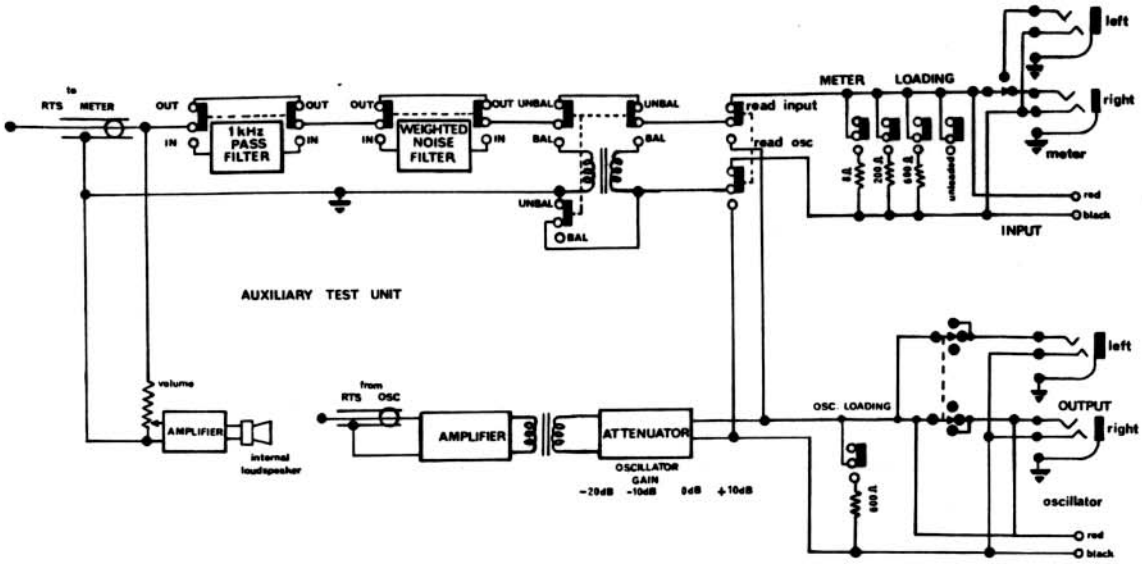


FIG. 2. BLOCK DIAGRAM

Meter section

The Meter section is connected between the equipment under test and the Recorder Test Set (or external millivoltmeter). It provides a range of load impedances and a selection of filters to widen the scope of the Millivoltmeter Section of the Recorder Test Set. It is also connected to the internal audio amplifier and built-in loudspeaker so that by turning up the 'volume' control whatever is being fed out of the 'TO EXTERNAL METER' socket can be monitored aurally.

Note: When the ATU is used with the RTS, the 'read input' button on the RTS must always be pressed; the function of the RTS 'read osc.' button is replaced by the ATU 'read osc.' button as explained below.

METER LOADING

The output of the equipment under test is loaded by 8 Ω, 200 Ω, 600 Ω or left unloaded by pressing the appropriate push-button at the lower left of the front panel — when one is pressed the others are automatically released. When the 'unloaded' button is pressed, the load impedance is either 50 k Ω with the 'bal' button in or 2M Ω +150 pF approx. with the 'bal' button out ('unbal').

If any other impedance loading is required, this can be obtained by connecting a suitable resistor across the 'meter' input terminals.

The loading can be made balanced by pressing the 'bal' button, or it can be unbalanced by leaving the 'bal' button unpressed (or by pressing it again to release it). In the 'unbal' condition (button out) the Black terminal is earthed.

MILLIVOLTMETER

The function of the Meter section is controlled by the five push-buttons on the front panel, titled 'MILLIVOLTMETER'.

Normally the input signal at the 'meter' socket is fed via the 'MILLIVOLTMETER' controls to the 'TO EXTERNAL METER' output socket, but it is possible to change the input signal to that at the 'oscillator' output socket by pressing the 'read osc.' button (press again to release). Use of this button thus gives instantaneous 'A-B' comparison of the input and output signals of the equipment under test, *e.g.* record and replay signals of a tape recorder, and also enables the output signal to be measured accurately.

As explained in 'Meter Loading', the loading on the 'meter' input can be either balanced or with one side earthed (Black terminal). This is determined by the setting of the left hand button; in — 'bal', out — 'unbal' respectively.

The remaining three 'millivoltmeter' buttons are interconnected such that pressing one automatically releases the other two.

On pressing the 'Wideband response' button, the signal is unmodified by the filters and is fed straight through to the output socket. The response of the amplifier is flat over the range 30 Hz - 20 kHz.

On pressing the '1 kHz filter' button, the band pass filter of 1 kHz $\pm$100 Hz is connected in circuit so that only those signals within this narrow band pass through to the output socket. This is very useful for eliminating unwanted signals and noise (hum, hiss, etc.) when measuring erasure, interchannel breakthrough, etc., where the signal being measured is at low level.

On pressing the 'weighted noise' button, the response of the amplifier is modified to a chosen frequency response, permitting noise measurements to the required characteristic. As supplied from the Factory, the response is to the DIN/CCIF characteristic but other characteristics are available as replacement p.c. boards (see 'SPECIAL FEATURES — Filter characteristics').

The overall gain from the 'meter' input to the 'TO EXTERNAL METER' output is unity at 1 kHz for all combinations of the 'MILLIVOLTMETER' push-buttons.

LOUDSPEAKER VOLUME

The signal at the 'TO EXTERNAL METER' output socket is also connected via the 'volume' control to an audio amplifier and internal loudspeaker. This facility is extremely useful for listening to test tape announcements, frequency response tones, etc.

Measurements

The Oscillator Amplifier Section should be used in conjunction with the controls on the Recorder Test Set to set the signal level at that appropriate for the measurement being carried out. When the Millivoltmeter Section is being used, the 'read input' button must always be pressed on the RTS.

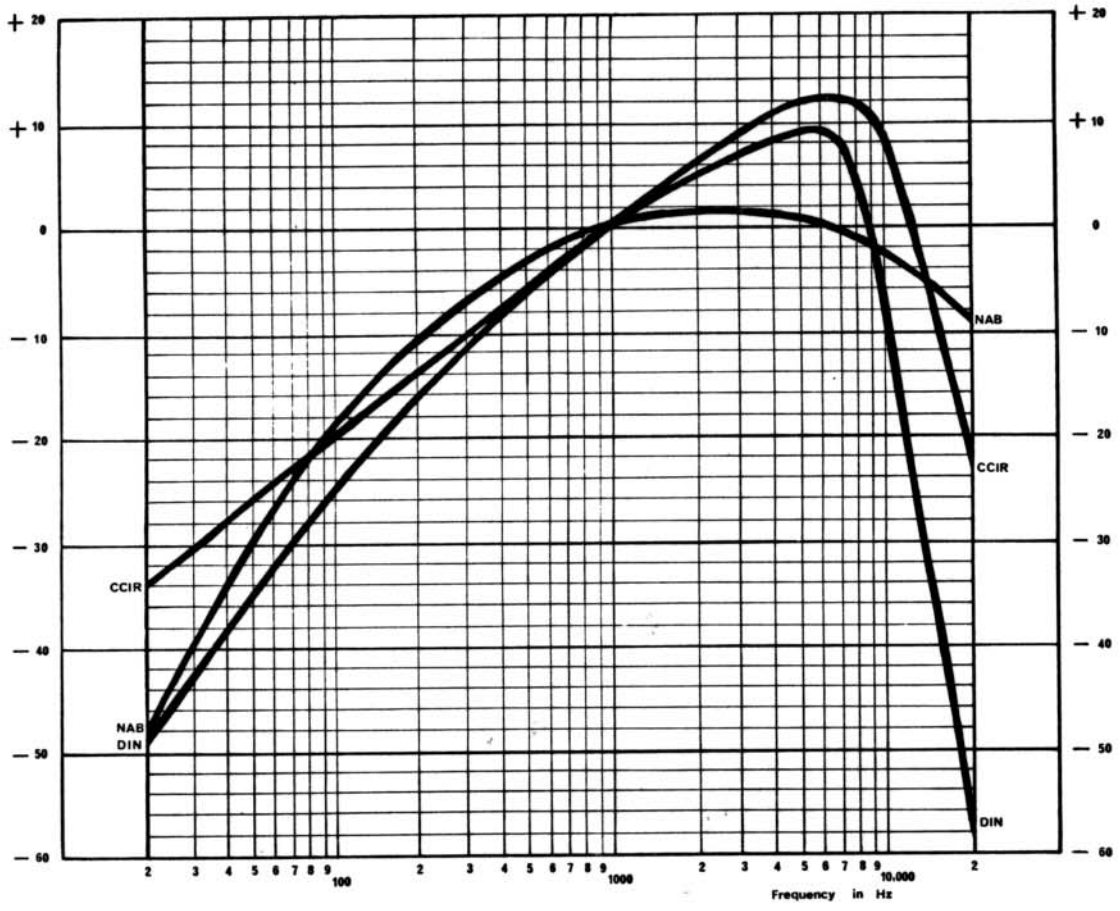


FIG. 3. WEIGHTED NOISE FILTER CHARACTERISTIC

On the Meter section the correct loading should be arranged by pressing the appropriate push-buttons of the 'METER LOADING' controls. For general measurements, such as Frequency Response, Drift, Wow & Flutter, Distortion, etc., the 'Wideband response' button should be pressed, thus releasing the 'weighted noise' and '1 kHz filter' buttons. This means that the signal is fed straight through to the Millivoltmeter and is unmodified by any filters.

SIGNAL-TO-NOISE RATIO

The standard procedure for measuring the Signal-to-Noise should be followed as usual; for the Recorder Test Set this is described in Section 3.6, page 10 of the 'Operating Instructions'.

With the 'Wideband response' button pressed, the normal Signal-to-Noise Ratio is obtained, but with the 'weighted noise' button pressed, the Signal-to-Noise Ratio is measured according to the DIN/CCIF characteristic or to other characteristics as described in 'SPECIAL FEATURES — Filter characteristics'.

ERASURE

(a) Make a peak level recording of a 1 kHz signal as described for 'Signal-to-Noise Ratio' above *viz.* at 2% (or 3%) T.H.D. or with reference to a specified tape flux level.

(b) Wind back to approximately the half way point of this recording and erase the latter part of the recording.

(c) Wind back to the start of the recording.

(d) Press the '1 kHz filter' button and replay the recording.

(e) On the Recorder Test Set press the 'MILLIVOLTMETER input' button and adjust the 'MILLIVOLTMETER' switch to give a convenient reading on the meter.

(f) When the 'erased' section of the recording is reached, re-adjust the 'MILLIVOLTMETER' switch to give a convenient reading on the meter.

(g) The difference in the two readings can be read directly from the R.T.S. meter dB scale plus the difference in the two 'MILLIVOLTMETER' switch settings.

(h) On stereo recorders, this procedure should be repeated for the other track.

Note 1. The 1 kHz filter is necessary to eliminate hum, noise, etc., when measuring the erased signal, which at —60 dB to —70 dB would otherwise be masked by the background noise at about —50 dB to —60 dB depending upon the type of tape recorder.

Note 2. A completely clean (or unused) part of the tape must be used for each repeat measurement.

CROSSTALK

There are two basic types of crosstalk which can occur on tape recorders; inter-channel breakthrough between upper and lower channels on stereo recorders only, and inter-track crosstalk between adjacent tape tracks which can occur on both mono and stereo recorders.

½ Track Mono

(a) Connect the tape recorder to the Left (upper) sockets as in 'CONNECTIONS'.

(b) Using bulk erased or virgin tape, make a peak level recording of a 1 kHz signal.

(c) Set the ATU meter switch to the left, press the '1 kHz filter' button and replay the recording.

(d) On the RTS, adjust the 'MILLIVOLTMETER' switch to give a convenient reading on the meter.

(e) Wind on the tape to the end of the recording, reverse the tape reels and replay the tape.

(f) With the ATU 'meter' switch still to the left, note the difference between this reading and the original 'peak level' reading (intertrack crosstalk).

(e) Set the ATU 'meter' switch to the left, press the '1 kHz filter' button and replay the recording.

(f) On the RTS, adjust the 'MILLIVOLTMETER' switch to give a convenient reading on the meter.

(g) While still playing the recording, set the ATU 'meter' switch to the right and re-adjust the RTS 'MILLIVOLTMETER' switch to give a convenient reading on the meter.

(h) The difference in the two readings can be observed directly from the RTS meter dB scale plus the difference in the two 'MILLIVOLTMETER' switch settings (interchannel crosstalk, upper to lower).

(i) Wind on the tape to the end of the recording, reverse the tape reels and replay the tape.

(j) With the ATU 'meter' switch to the right, note the difference between this reading and the original 'peak level' reading (inter-track crosstalk, 4-3).

(k) Wind the tape to a completely unused part of the tape (or bulk erase all previous recordings) and make a peak level recording of a 1 kHz signal on the Lower Track only (Record Mode switch at 'lower').

(l) Replay the tape and set the RTS 'MILLIVOLTMETER' switch to give a convenient reading on the meter.

(m) Set the ATU 'meter' switch to the left and re-adjust the RTS 'MILLIVOLTMETER' switch to give a convenient reading on the meter.

(n) The difference in the two readings can be read from the meter dB scale (interchannel crosstalk, lower to upper).

(o) Wind on the tape to the end of the recording, reverse the tape reels and replay the tape.

(p) Set the ATU 'meter' switch to the right, then to the left, comparing each of these readings with the peak level recording (l) (inter-track crosstalk, 2-3 and 2-1 respectively).

Note 1. A completely clean (or unused) part of the tape *must* be used for each repeat measurement.

Note 2. With stereo or two channel recorders, different crosstalk readings are obtained depending upon the setting of the Record Mode selector. As described above, on 'upper' or 'lower', the crosstalk figures for Series 7 Ferrograph recorders is usually better than —65 dB at 1 kHz. If the readings are repeated with the Record Mode selector at 'stereo', the crosstalk figures are typically —45 to —50 dB.

Special Features

FILTER CHARACTERISTIC

As normally supplied, the response of the 'weighted noise' filter is to the DIN/CCIF characteristic. Other characteristics can be provided by replacing the Weighted Noise Filter P.C. Board as described.

(a) Remove the top panel of the ATU by undoing the two screws on the underside of its rear fold.

(b) Remove the P.C. Board Fixing Strap by undoing the screw at each end and lifting clear.

(c) Remove the rear left-hand P.C. Board and plug in the replacement Filter Board which is wired to the required characteristic.

(d) Ensure that all p.c. boards are positioned correctly, then refit the Fixing Strap and tighten the two fixing screws.

(e) Replace the top panel and tighten the fixing screws.

Filter Boards available :—	DIN (45405)/CCIF	025-365
	CCIR (Recom. 468)	025-413
	NAB	025-414

OUTPUT MODIFICATION

As normally supplied, the signal obtainable from the 'oscillator' output is limited by the internal circuitry to +10 dBm. This restriction can be removed by the following procedure, when the maximum signal available from the RTS2/ATU is +20 dBm.

(a) Remove the top panel of the ATU by undoing the two screws on the underside of its rear fold.

(b) Remove the P.C. Board Fixing Strap by undoing the screw at each end and lifting clear.

(c) Remove the right-hand P.C. Board.

(d) Solder a wire link between the two pins at the top of the board (adjacent to the potentiometer).

(e) Replace the P.C. Board.

(f) Ensure that all p.c. boards are positioned correctly, then refit the Fixing Strap and tighten the two fixing screws.

(g) Replace the top panel and tighten the fixing screws.

FERROGRAPH
AUXILIARY TEST UNIT

Specification

METER SECTION

Wideband Response

Maximum Input — Balanced: +10 dBm 30 Hz - 20 kHz
+20 dBm 60 Hz - 20 kHz
Unbalanced: 100 V (direct connection between input and output)

Weighted Noise Filter

Response to DIN (45-405)/CCIF characteristic (see page 11)

Maximum input level at 1 kHz +20 dBm

1 kHz Band Pass Filter

Response: level at 900 - 1,100 Hz
—20 dB at 500 Hz & 2 kHz
—65 dB at 100 Hz & 10 kHz

Maximum input level at 1 kHz +20 dBm

Input/Output Gain

Unity at 1 kHz for all control settings.

Input Termination (push button selected)

Unbalanced: 8 Ω, 200 Ω, 600 Ω or 'unloaded' (2M Ω + 150 pF approx.)

Balanced: 8 Ω, 200 Ω, 600 Ω or 'unloaded' (50 k Ω)

Hum & Noise (600 Ω source)

Less than —85 dBm

Common Mode Rejection

>70 dB at 50 Hz

OSCILLATOR AMPLIFIER SECTION

Maximum Output level (internal limiter)

+10 dBm into 600 Ω load (+20 dBm with internal adjustment)

Frequency Response (into 600 Ω load)

30 Hz - 20 kHz +0, —0·5 dB

Output Impedance

600 Ω balanced (<100 Ω on +10 dB gain settings)

Hum & Noise (600 Ω load)

>85 dB below signal

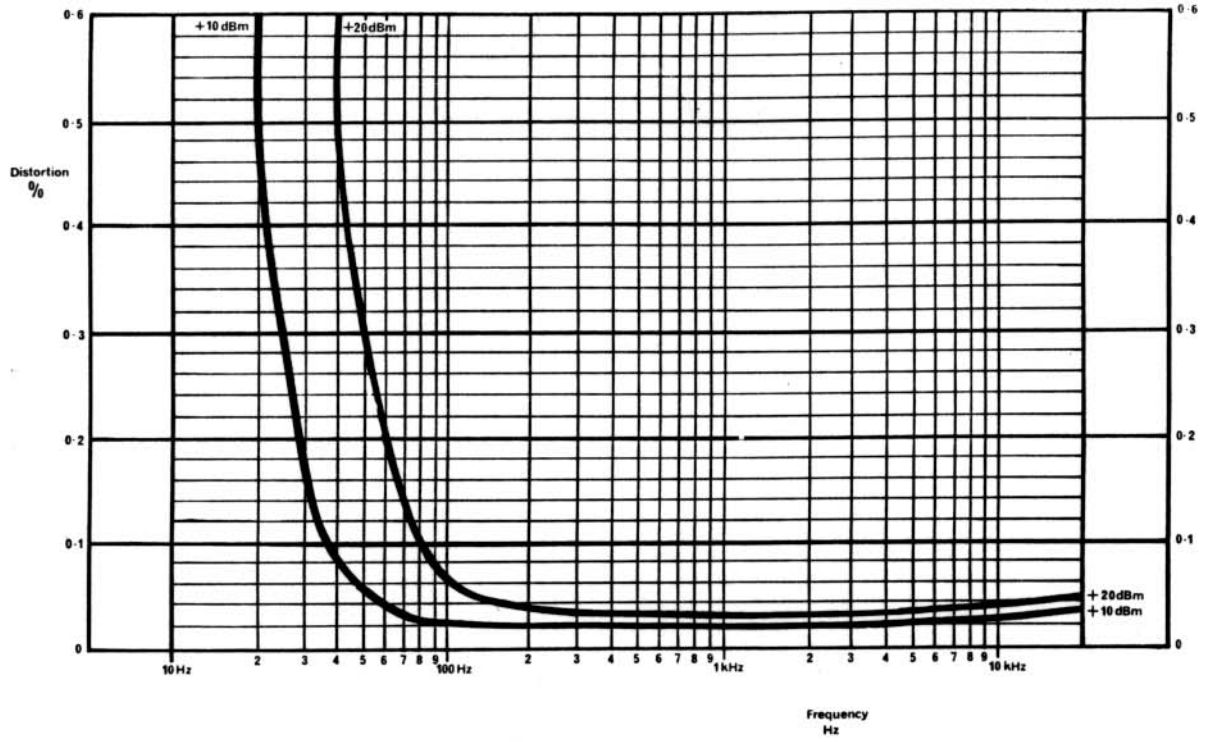


FIG. 5. DISTORTION — METER SECTION (Balanced Condition)

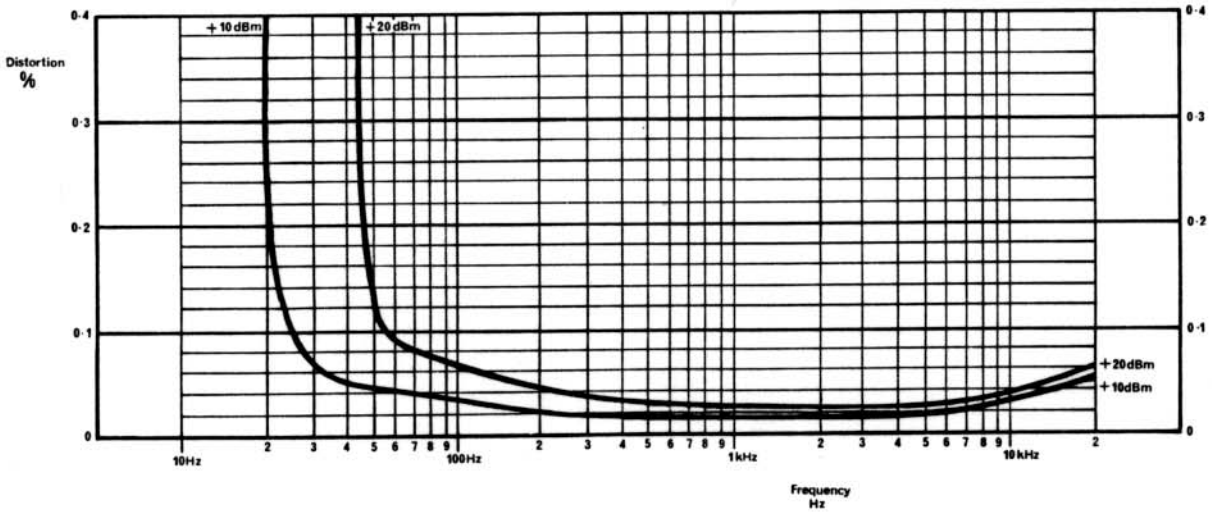


FIG. 6. DISTORTION — OSCILLATOR AMPLIFIER SECTION (600 Ω load)

GENERAL

Power Supply

105-120 V, 200-230 V, or 230-260 V, 50-60 Hz

Weight

12 lbs (5·5 kgs)

Dimensions

17⅜ in wide x 10 in deep over handles x 5⅝ in high
(440 mm x 254 mm x 143 mm)

FERROGRAPH
AUXILIARY TEST UNIT

List of Components

Circuit Reference				Part Number
R325	39 Ω			625-26-39
R326	82k Ω			625-26-82K
R327	680k Ω			625-26-680K
	Capacitors			
C300	0·47μF	100V	10%	131-265
C301	0·47μF	100V	10%	131-265
C302	0·1μF	100V	10%	131-250
C303	250μF	64V	Electrolytic	130-010
C304	1μF	100V	10%	131-521
C305	250pF	350V	10%	131-758
C306	1μF	100V	10%	131-521
C307	100μF	40V	Electrolytic	130-001
C308	640μF	25V	Electrolytic	130-004
C309	0·01μF	250V	10%	131-263
C310	32μF	40V	Electrolytic	130-013
C311	640μF	25V	Electrolytic	130-004
C312	0·015μF	250V	10%	131-267
	Miscellaneous			
VT300	Transistor BC214LB			825-016
VT301	FE Transistor 2SK30GR			825-006
VT302	Transistor BC214LB			825-016
VT303	Transistor BC183LB			825-015
VT304	Transistor BC183LB			825-015
VT305	Transistor BC300			825-033
VT306	Transistor BC461			825-032
MR300	Diode BAX16			290-001
MR301	Zener Diode BZY88 C5V6			290-013
MR302	Diode BAX16			290-001
MR303	Diode BAX16			290-001
MR304	Diode BAX16			290-001
MR305	Diode BAX16			290-001

Circuit Reference	**1 kHz FILTER BOARD**			Part Number
	Resistors (R) & Potentiometers (RV)			
RV400	22k Ω Linear			582-012
R401	100k Ω			625-26-100K
R402	100k Ω			625-26-100K
R403	22k Ω			625-26-22K
R404	22k Ω	1%		625-24-22K
R405	22k Ω	1%		625-24-22K
R406	22k Ω			625-26-22K
R407	100 Ω			625-26-100
R408	100 Ω			625-26-100
R409	5·6k Ω			625-26-5K6
R410	100k Ω			625-26-100K
R411	56k Ω			625-26-56K
R412	680k Ω			625-26-680K
R413	10k Ω			625-26-10K
R414	10k Ω			625-26-10K
R415	33k Ω			625-26-33K
R416	47 Ω			625-26-47
	Capacitors			
C400	4700pF	30V	2½%	131-778
C401	0·47μF	100V	10%	131-265
C402	820pF	30V	2½%	131-773
C403	3000pF	63V	2½%	131-788
C404	3900pF	63V	2½%	131-787
C405	0·01μF	250V	10%	131-263
C406	0·47μF	100V	10%	131-265
C407	250μF	64V	Electrolytic	130-010
	Miscellaneous			
VT400	Transistor 2SC1000			825-035
VT401	Transistor 2SC1000			825-035
VT402	Transistor 2SC1000			825-035

Circuit Reference	**MOTHER BOARD**			Part Number
	Resistors			
R500	8 Ω	5%	17W	626-034
R501	200 Ω	1%	¼W	624-022
R502	600 Ω	1%	¼W	624-023
R503	330k Ω			625-28-330K
R504	10k Ω			625-28-10K
R505	155 Ω	¼%		624-024
R506	155 Ω	¼%		624-024
R507	421·6 Ω	¼%		624-025
R508	155 Ω	¼%		624-024
R509	155 Ω	¼%		624-024
R510	155 Ω	¼%		624-024
R511	155 Ω	¼%		624-024
R512	421·6 Ω	¼%		624-025
R513	155 Ω	¼%		624-024
R514	155 Ω	¼%		624-024
R515	199·8 Ω	¼%		624-028
R516	199·8 Ω	¼%		624-028
R517	462·2 Ω	¼%		624-027
R518	142 Ω	¼%		624-026
R519	142 Ω	¼%		624-026
R520	600 Ω	1%	¼W	624-023

FERROGRAPH
AUXILIARY TEST UNIT

List of Components

Circuit Reference		*Part Number*
	Capacitor	
C500	100pF 160V 2½%	131-799
	Miscellaneous	
SW500	P.B. Switch (4 pole) 'Meter Loading'	749-015
SW501	P.B. Switch (10 pole) 'Millivoltmeter-Oscillator Gain'	749-014
SKT500	Socket, P.C. Board	692-051
SKT501	Socket, P.C. Board	692-051
SKT502	Socket, P.C. Board	692-051
SKT503	Socket, P.C. Board	692-051
T500	Transformer (Balance)	822-000
T501	Transformer (Osc. Amp. Output)	822-001

Circuit Reference	**CCIR WEIGHTED NOISE BOARD**	*Part Number*
	Resistors	
R600	1M Ω	625-26-1M
R601	560k Ω	625-26-560K
R602	330k Ω	625-26-330K
R603	1k Ω	625-26-1K
R604	10k Ω	625-26-10K
R605	4·7k Ω 1%	625-24-4K7
R606	18k Ω 1%	625-24-18K
R607	18k Ω 1%	625-24-18K
R608	1k Ω	625-26-1K
R609	10k Ω	625-26-10K
R610	4·7k Ω 1%	625-24-4K7
R611	18k Ω 1%	625-24-18K
R612	18k Ω 1%	625-24-18k
R613	1k Ω	625-26-1K
R614	10k Ω	625-26-10K
R615	6·8k Ω 1%	625-24-6K8
R616	56k Ω 1%	625-24-56K
R617	2·2M Ω	625-26-2M2
R618	560 Ω	625-26-560
R619	10k Ω	625-26-10K
R620	1M Ω	625-26-1M
R621	47 Ω	625-26-47
	Capacitors	
C600	250µF 64V Electrolytic	130-010
C601	0·22µF 100V 10%	131-253
C602	3300pF 30V 2½%	131-770
C603	2200pF 160V 2½%	131-801
C604	270pF 30V 2½%	131-804
C605	3300pF 30V 2½%	131-770
C606	270pF 30V 2½%	131-804
C607	2200pF 160V 2½%	131-801
C608	3300pF 30V 2½%	131-770
C609	1µF 63V Electrolytic	130-015
C610	390pF 30V 2½%	131-805
C611	0·22µF 100V 10%	131-253
	Miscellaneous	
VT600	Transistor 2SC1000	825-035
VT601	Transistor 2SC1000	825-035
VT602	Transistor 2SC1000	825-035
VT603	Transistor S2C1000	825-035

Circuit Reference	**NAB WEIGHTED NOISE BOARD**	*Part Number*
	Resistors	
R700	1M Ω	625-26-1M
R701	560k Ω	625-26-560K
R702	1k Ω	625-26-1K
R703	330k Ω	625-26-330K
R704	4·7k Ω	625-26-4K7
R705	15k Ω 1%	625-24-15K
R706	39k Ω 1%	625-24-39K
R707	100 Ω	625-26-100
R708	100 Ω	625-26-100
R709	4·7k Ω	625-26-4K7
R710	56k Ω 1%	625-24-56K
R711	3·3k Ω 1%	625-24-3K3
R712	1·2M Ω	625-26-1M2
R713	82k Ω 1%	625-24-82K
R714	1K Ω	625-26-1K
R715	10k Ω	625-26-10K
R716	1M Ω	625-26-1M
	Capacitors	
C700	250µF 64V Electrolytic	130-010
C701	0·22µF 100V 10%	131-253
C702	0·33µF 30V 2½%	131-270
C703	5600pF 30V 2½%	131-789
C704	1µF 40V Electrolytic	130-015
C705	300pF 30V 2½%	131-792
C706	3300pF 30V 2½%	131-770
C707	0·033µF 30V 1%	131-262
C708	0·22µF 100V 10%	131-253
C709	250µF 64V Electrolytic	130-010
	Miscellaneous	
VT700	Transistor 2SC1000	825-035
VT701	Transistor 2SC1000	825-035
VT702	Transistor 2SC1000	825-035

FERROGRAPH
AUXILIARY TEST UNIT

List of Components

Circuit Reference	**DIN/CCIF WEIGHTED NOISE BOARD**		*Part Number*
	Resistors		
R800	1M Ω		625-26-1M
R801	560k Ω		625-26-560K
R802	560k Ω		625-26-560K
R803	47 Ω		625-26-47
R804	100 Ω		625-26-100
R805	22k Ω		625-26-22k
R806	560 Ω		625-26-560
R807	22k Ω	1%	625-24-22K
R808	22k Ω	1%	625-24-22K
R809	4·7k Ω		625-26-4K7
R810	2·7k Ω	1%	625-24-2K7
R811	12k Ω	1%	625-24-12K
R812	12k Ω	1%	625-24-12K
R813	100 Ω		625-26-100
R814	4·7k Ω		625-26-4K7
R815	2·7k Ω	1%	625-24-2K7
R816	12k Ω	1%	625-24-12K
R817	12k Ω	1%	625-24-12K
R818	100 Ω		625-26-100
R819	4·7k Ω		625-26-4K7
R820	2·7k Ω	1%	625-24-2K7
R821	10k Ω	1%	625-24-10K
R822	120k Ω		625-26-120K
R823	2·2k Ω	1%	625-24-2K2
R824	18k Ω	1%	625-24-18K

Circuit Reference				*Part Number*
R825	33k Ω	1%		625-24-33K
R826	18k Ω	1%		625-24-18K
R827	100 Ω			625-26-100
R828	10k Ω			625-26-10K
R829	1M Ω			625-26-1M
	Capacitors			
C800	0·22μF	100V	10%	131-253
C801	5600pF	30V	2½%	131-789
C802	6800pF	30V	2½%	131-790
C803	8200pF	30V	2½%	131-791
C804	300pF	30V	2½%	131-792
C805	6800pF	30V	2½%	131-790
C806	300pF	30V	2½%	131-792
C807	8200pF	30V	2½%	131-791
C808	12000pF	30V	2½%	131-793
C809	0·047μF	30V	2½%	131-264
C810	0·068μF	30V	2½%	131-269
C811	500pF	30V	2½%	131-794
C812	250μF	64V	Electrolytic	130-010
C813	0·22μF	100V	10%	131-253
	Miscellaneous			
VT800	Transistor 2SC1000			825-035
VT801	Transistor 2SC1000			825-035
VT802	Transistor 2SC1000			825-035
VT803	Transistor 2SC1000			825-035
VT804	Transistor 2SC1000			825-035
VT805	Transistor 2SC1000			825-035

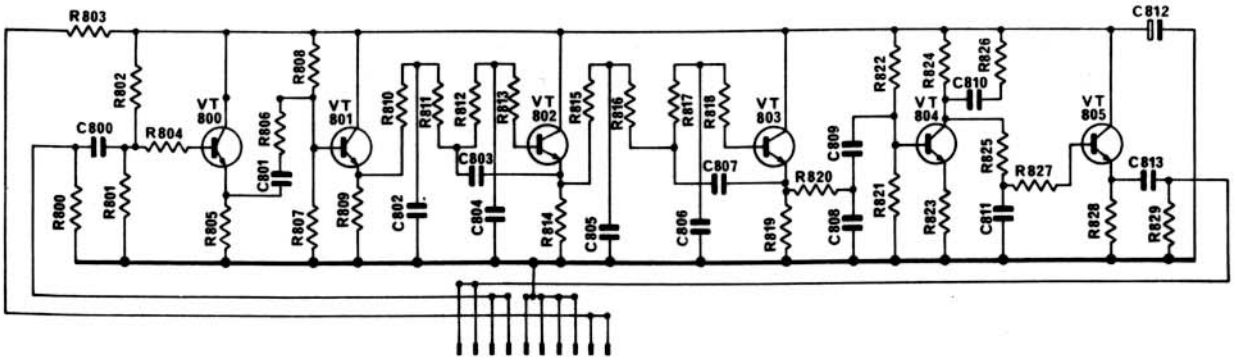


FIG. 8a. DIN/CCIF WEIGHTED NOISE BOARD

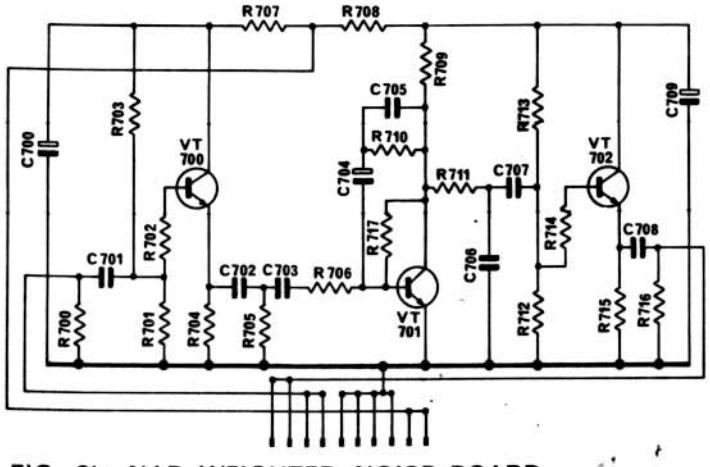


FIG. 8b. NAB WEIGHTED NOISE BOARD

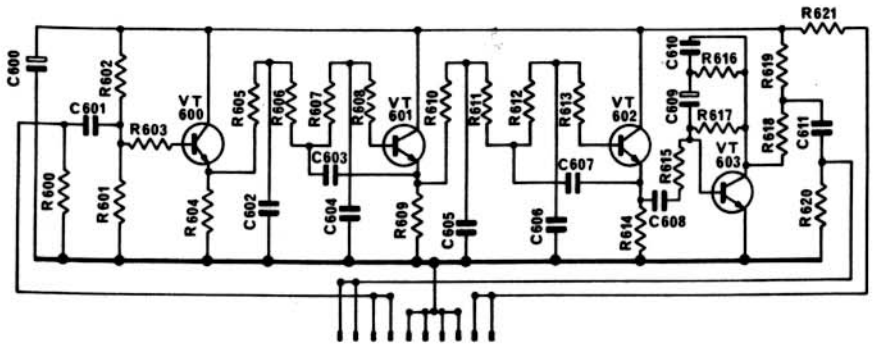


FIG. 8c. CCIR WEIGHTED NOISE BOARD

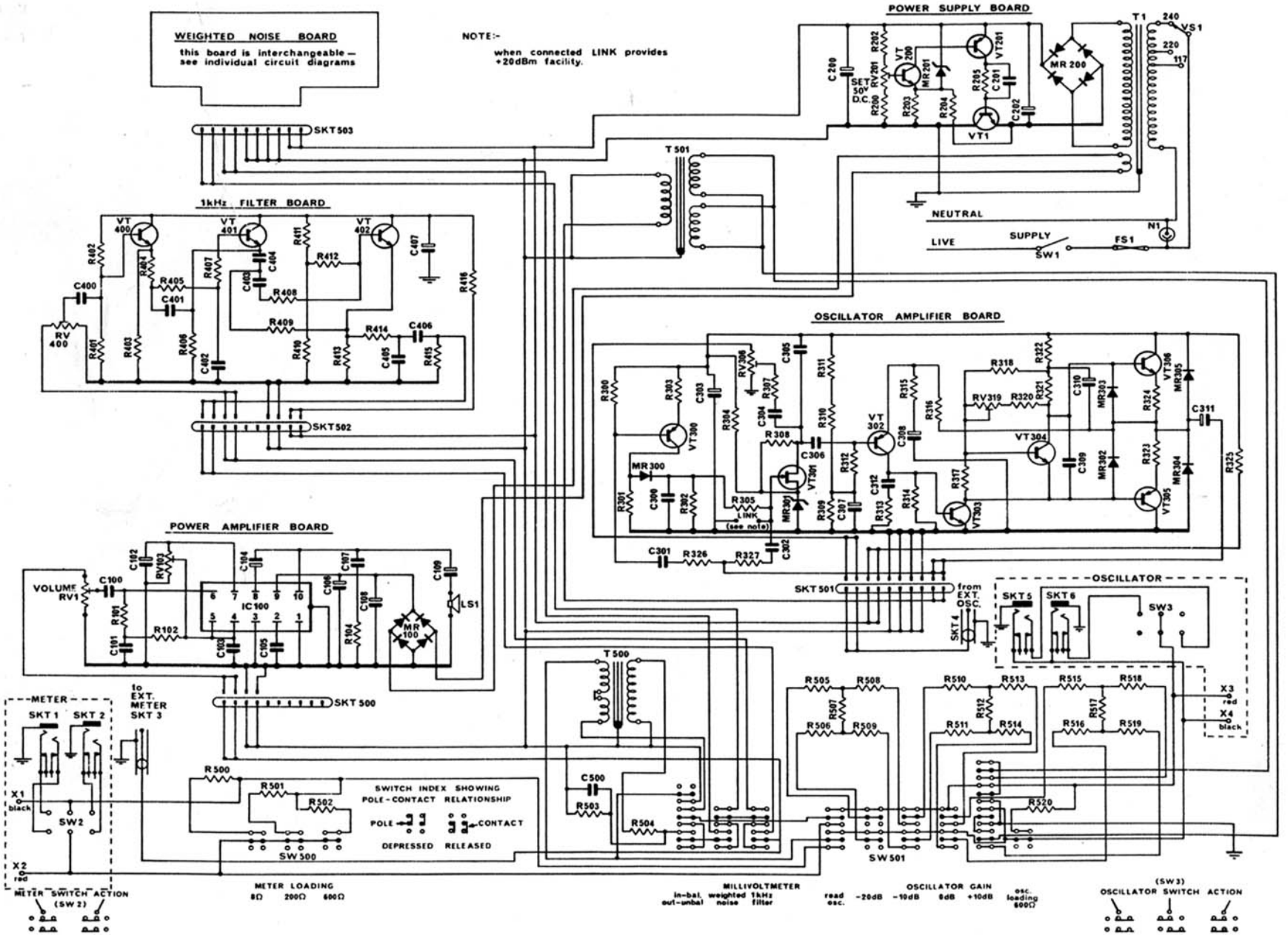


FIG. 7. CIRCUIT DIAGRAM — AUXILIARY TEST UNIT

250-052