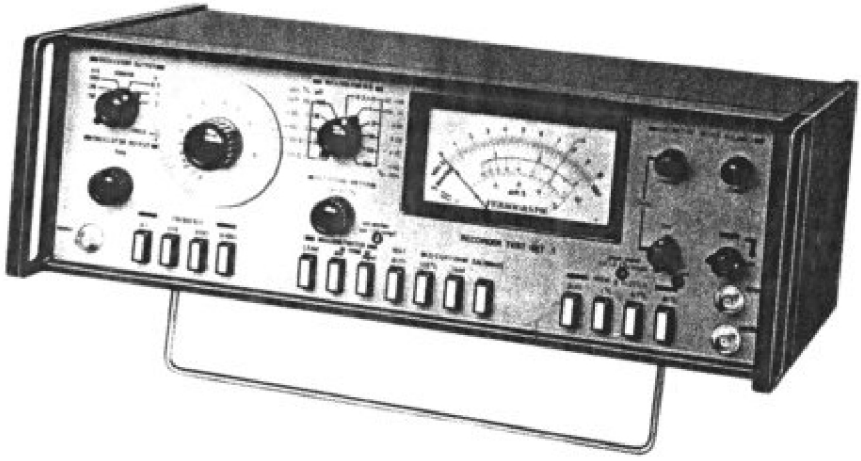
OPERATING INSTRUCTIONS



FERROGRAPH

RECORDER TEST SET

RTS2

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 a nti-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.)

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

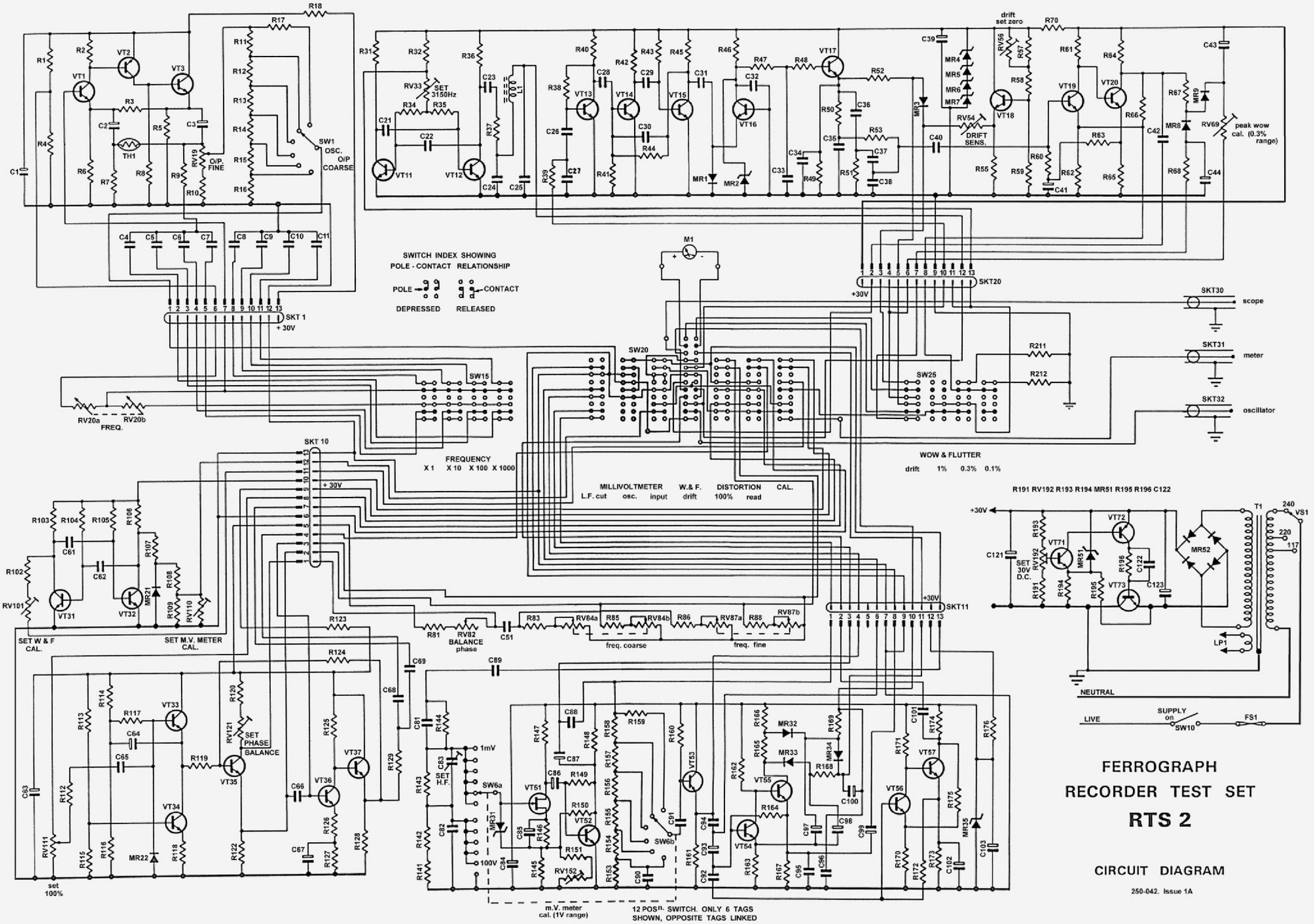
Power Supply
105-120 V, 50 or 60 Hz or 200-250 V, 50 or 60 Hz; 12 watts approx.

Dimensions
17½ in. (441 mm) wide
10 in. (254 mm) deep over handles
5½ in. (143 mm) high

Weight
13 lb (5·9 kg) approx.

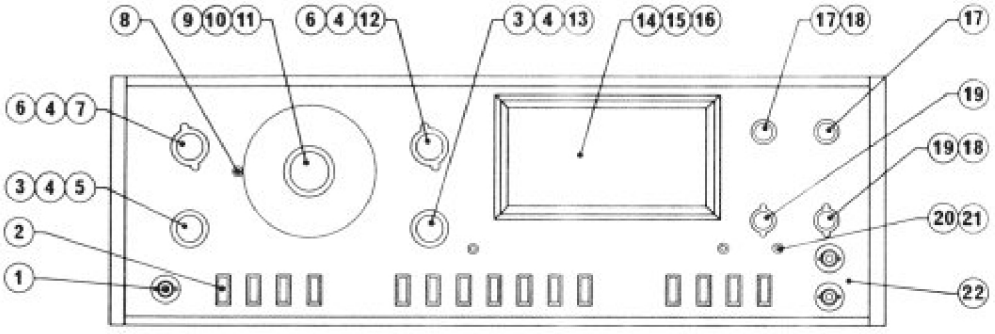
Access
Access to the inside of the case is obtained by removing two screws from the underside of the lip above the back panel.

Printed in England 405/14/500/3/73 Howe Brothers (Gateshead) Ltd.


SWITCH INDEX SHOWING
POLE - CONTACT RELATIONSHIP
POLE
CONTACT
DEPRESSED
RELEASED
SKT 1
+ 30V
SKT20
+30V
SKT30
scope
SKT31
meter
SKT32
oscillator
SKT 10
SKT11
FREQUENCY
X 1 X 10 X 100 X 1000
MILLIVOLTMETER W.& F. DISTORTION CAL.
L.F. cut osc. input drift 100% read
WOW & FLUTTER
drift 1% 0.3% 0.1%
R191 RV192 R193 R194 MR51 R195 R196 C122
SET W & F CAL.
SET M.V. METER CAL.
SET 100%
SET H.F.
SET PHASE BALANCE
BALANCE phase
freq. coarse
freq. fine
drift set zero
DRIFT SENS.
peak wow cal. (0.3% range)
SW1 OSC. O/P COARSE
O/P. FINE
FREQ.
m.V. meter cal. (1V range)
12 POSn. SWITCH. ONLY 6 TAGS SHOWN, OPPOSITE TAGS LINKED
NEUTRAL
LIVE
SUPPLY on
SW10
FS1
LP1
FERROGRAPH
RECORDER TEST SET
RTS 2
CIRCUIT DIAGRAM
250-042. Issue 1A

FERROGRAPH
RECORDER TEST SET

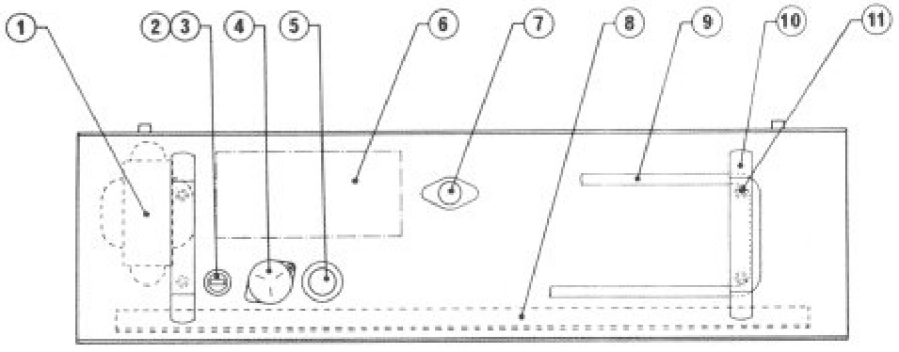
Appendix



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

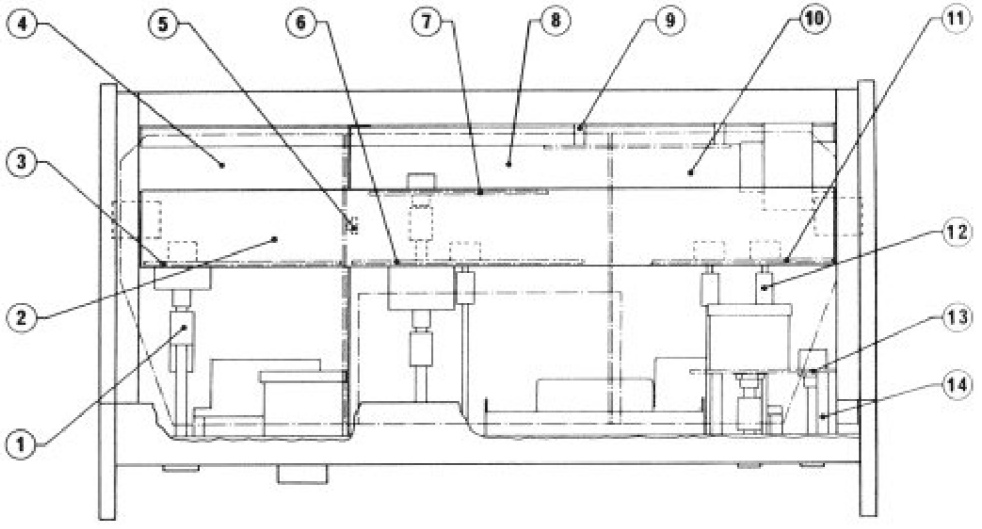
FERROGRAPH
RECORDER TEST SET



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

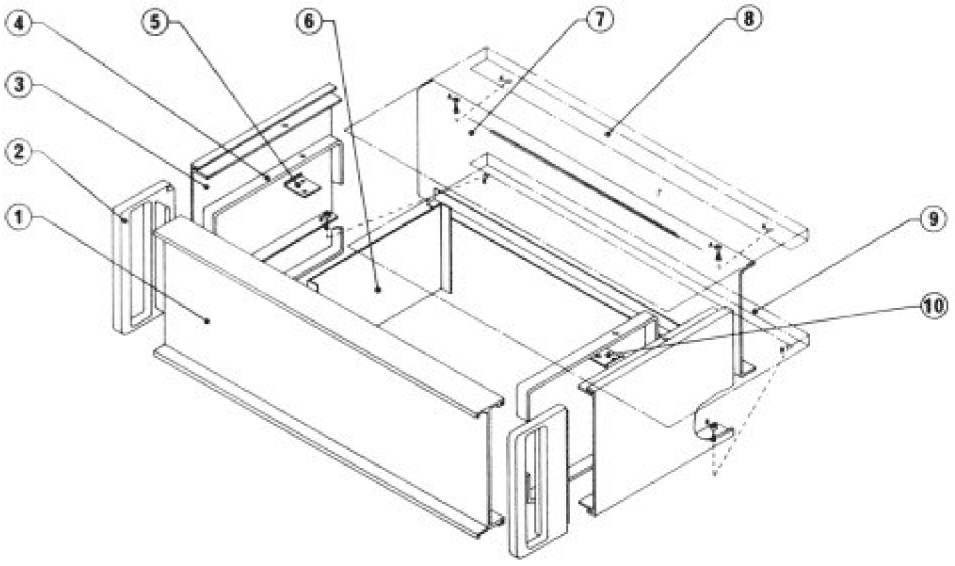
FERROGRAPH
RECORDER TEST SET



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	024-244
8	Millivoltmeter Mother Board	1	025-248
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

List of Components

Cct. Ref.	OSCILLATOR BOARD			Part No.
	Resistors(R) & Potentiometers(RV)			
R1	2.2kΩ	¼W	1% High Stab.	625-24-2k2
R2	15kΩ	¼W	10%	625-13-15k
R3	10kΩ	¼W	5%	625-12-10k
R4	1.8kΩ	¼W	1% High Stab.	625-24-1k8
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	¼W	5%	625-12-100
R18	100Ω	¼W	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	1%	131-514
C7	1µF	160V	1%	131-515
C8	1µF	160V	1%	131-515
C9	0.1µF	160V	1%	131-514
C10	0.01µF	30V	2½%	131-774
C11	950pF	30V	2½%	131-775
	Miscellaneous			
VT1	Transistor BC183LB			825-015
VT2	Transistor BC184LB			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.
	Potentiometers	
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		582-031
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	¼W	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	56kΩ	½W	10%	625-13-56k
RV69	25kΩ	Linear peak wow cal.		582-031
R70	470Ω	½W	10%	625-13-470
	Capacitors			
C21	1000pF	63V	2½%	131-768
C22	1000pF	63V	2½%	131-768
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

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
	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 NKT 249A30			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	¼W	5%	625-12-3k9
RV84a	10kΩ Log.)			
RV84b	10kΩ Log.)	(freq. coarse)		582-033
R85	3.9kΩ	¼W	5%	625-12-3k9
R86	330kΩ	¼W	5%	625-12-330k
RV87a	100kΩ Log.)			
RV87b	100kΩ Log.)	(freq. fine)		582-034
R88	330kΩ	¼W	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	¼W	5%	625-12-100
R119	3.3kΩ	¼W	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	¼W	5%	625-12-1k8
R124	39kΩ	¼W	10%	625-13-39k
R125	100kΩ	¼W	5% High Stab.	624-002
R126	270Ω	¼W	5%	625-12-270
R127	47kΩ	¼W	5% High Stab.	624-001
R128	10kΩ	¼W	10%	625-13-10k
R129	1.5kΩ	¼W	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%	131-255
C67	25µF	25V	Electrolytic	130-016
C68	4700pF	30V	2½%	131-778
C69	0.47µF	250V	10%	131-258

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 1000 BL	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 BZY 88 C 5V6	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	¼W	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	¼W	5%	625-12-270k
R150	1.5kΩ	¼W	1% High Stab.	625-24-1k5
R151	470Ω	¼W	10%	625-13-470
RV152	2kΩ Linear mV meter cal.			582-030
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	¼W	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	¼W	10%	625-13-470k
R165	620Ω	¼W	5%	625-12-620
R166	10kΩ	¼W	5%	625-12-10k
R167	1.5kΩ	¼W	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	¼W	10%	625-13-220k
R172	470kΩ	¼W	10%	625-13-470k
R173	1kΩ	¼W	5%	625-12-1k
R174	15kΩ	¼W	5%	625-12-15k

Cct. Ref.	MILLIVOLTMETER BOARD			Part No.
	Resistors(R) & Potentiometers(RV)			
R175	10kΩ	¼W	5%	625-12-10k
R176	180Ω	¼W	5%	625-12-180
	Capacitors			
C81	5000pF	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 2 SK30GR			825-006
VT52	Transistor BC184LC			825-005
VT53	Transistor BC183LB			825-015
VT54	Transistor BC183LB			825-015
VT56	Transistor BC183LB			825-015
VT57	Transistor BC183LB			825-015
MR31	Zener Diode BZY 88 C5V6			290-013
MR32	Diode MAX16			290-001
MR33	Diode MAX16			290-001
MR34	Diode MAX16			290-001
MR35	Zener Diode BZX 70 C20			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	¼W	5%	625-12-3k9
R195	100kΩ	¼W	10%	625-13-100k
R196	10kΩ	¼W	10%	625-13-10k

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 RTS 2 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.