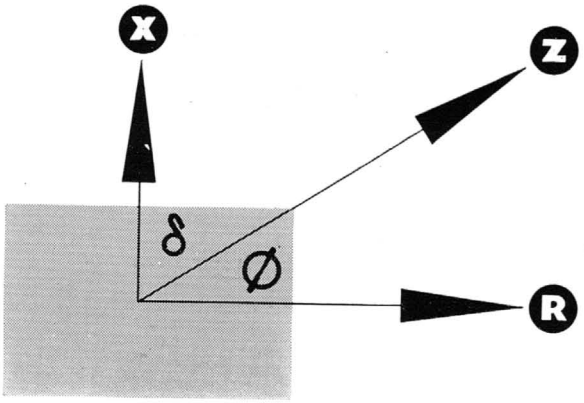
Photographed by courtesy of J. Langham Thompson Limited, Bushey Heath, Hertfordshire.



Impedance Bridges and Meters

IMPEDANCE BRIDGES AND METERS

A.F. Bridges	*Measurement*	*Model*	*Measuring Frequency*	*Page*
TF 1342	Capacitance: 0·002 to 1,111 μμF Shunt Resistance: 1 to 1000 MΩ	TF 1342 Low-Capacitance Bridge	1 kc/s	**141**
TF 868B	Inductance: 1 μH to 100 H Capacitance: 1 μμF to 100 μF Resistance: 0·1 Ω to 100 MΩ	TF 868B Universal Bridge	1 and 10 kc/s	**142**
TF 1313	Inductance: 0·1 μH to 110 H Capacitance: 0·1 μμF to 110 μF Resistance: 0·01Ω to 110 MΩ	TF 1313 ¼% Universal Bridge	1 and 10 kc/s	**144**

R.F. Bridges	*Measurement*	*Model*	*Measuring Frequency*	*Page*
OA 199A/2	Balanced or unbalanced impedances	OA 199A/2 R.F. Impedance Bridge Assembly	100 kc/s to 20 Mc/s	**145**
TF 978	Unbalanced admittance of distributed and lumped components	TF 978 V.H.F. Admittance Bridge	30 to 300 Mc/s	**147**

Q Meters	*Measurement*	*Model*	*Measuring Frequency*	*Page*
TF 1245	Q-factor: 5 to 1,000 Inductance, capacitance, power factor, dielectric loss	TF 1245 Circuit Magnification Meter	1 kc/s to 300 Mc/s	**148**
TF 704B	Permittivity and power factor of solid and liquid dielectrics	TF 704B Dielectric Test Set	50 kc/s to 100 Mc/s	**150**

Slotted Sections	*Measurement*	*Model*	*Measuring Frequency*	*Page*
TF 1264	V.S.W.R. and impedance in coaxial systems	TF 1264 Slotted Line	1,700 to 2,300 Mc/s	**152**

V.S.W.R. Indicators	*Measurement*	*Model*	*Features*	*Page*
TF 1289	V.S.W.R. in three ranges: 1·25, 3, and 10 full-scale	TF 1289 V.S.W.R. Indicator	High sensitivity, low noise	**153**
TF 1291	V.S.W.R. in two ranges: 1 to 3, and 3 to 10	TF 1291 V.S.W.R. Indicator	Transistorized; lightweight and compact Internal battery supply	**154**

MARCONI INSTRUMENTS

Low-Capacitance Bridge Type TF 1342

R6699

- **Capacitance range; 0·002 μμF to 1,111 μμF**
- **Shunt-resistance range: 1 to 1,000 MΩ**
- **Balance indication by dual-sensitivity meter**
- **Decade switching and readout**
- **Independent indication of resistive component**

CAPACITANCES down to 0·002 μμF can be measured with speed and precision by means of this three-terminal transformer ratio-arm bridge.

APPLICATIONS

Its exceptional discrimination and stability make the TF 1342 suitable for such applications as the measurement of the temperature coefficient of capacitors or changes in valve interelectrode capacitance.

The bridge measures the capacitance between any two terminals of a three-terminal network and is virtually unaffected by the impedance between either of these terminals and the third point. As a result, connection to the component under test can be made via long leads without affecting the measurement accuracy. This feature allows *in situ* measurement of remote or wired-in components without the need to disconnect associated circuits, and is particularly valuable where it is important to include inherent shunt and stray capacitances which cannot be 'disconnected' for conventional measurement.

RESISTIVE AND REACTIVE BALANCE

The resistive and reactive components of the unknown capacitor are separately balanced out in a transformer ratio-arm bridge, the unknown and standard impedances being connected in opposite sides of the bridge.

The winding feeding the capacitance standards has ten switched tappings, with the result that only one standard per decade is necessary. There are three switched capacitance decades and one continuously variable decade, giving a measurement range of 0·02 to 1,111 μμF. To enable measurements to be made on smaller-value capacitors, or with greater discrimination, a 10:1 step-up in the transformer arm feeding the unknown can be switched in to give a low range of 0·002 to 111·1 μμF. Automatic decimal point indication ensures that the decade readout is direct reading on either range.

Effective shunt resistance of the component under test is balanced by a standard resistor fed via three switched transformer tappings and a continuously variable potentiometer. The total range is from 1 MΩ to at least 1,000 MΩ.

OSCILLATOR AND DETECTOR

The bridge is complete with internal 1,000-c/s oscillator and detector. The detector gain can be switched to provide high or low sensitivity and, to facilitate balancing, automatic gain control is used to give a progressive increase in sensitivity as the balance point is approached.

SPECIFICATION

Capacitance range

0·002 to 1,111 μμF.

ACCURACY: ±0·2% ±0·002 μμF.

Shunt resistance range

1 to 1,000 MΩ.

ACCURACY: ±5% with values of tan δ down to 0·01.

Oscillator frequency

1,000 c/s.

ACCURACY: ±2%.

Measurement voltage

LOW-CAPACITANCE RANGE: 25 volts.

HIGH-CAPACITANCE RANGE: 2·5 volts.

Overload protection

The meter is protected against serious overloads by the characteristics of the associated valve circuits.

Power supply

200 to 250 volts, or 100 to 150 volts after adjusting internal link, 40 to 100 c/s, 26 watts. Models supplied ready for immediate 100- to 150-volt use if specified at time of ordering.

Dimensions and weight

Height	*Width*	*Depth*	*Weight*
12 in	17 in	8½ in	15¾ lb
(30·5 cm)	(43·5 cm)	(21·5 cm)	(7·1 kg)

Accessories supplied

One *Screened Twin Measuring Lead*, Type TM 5977; 3 feet 6 inches long; one end, BNC plugs; other end, test-clip connectors.

One *Earth Lead*, Type TC 29538; 6 inches long with crocodile clip termination; to fit measuring lead.

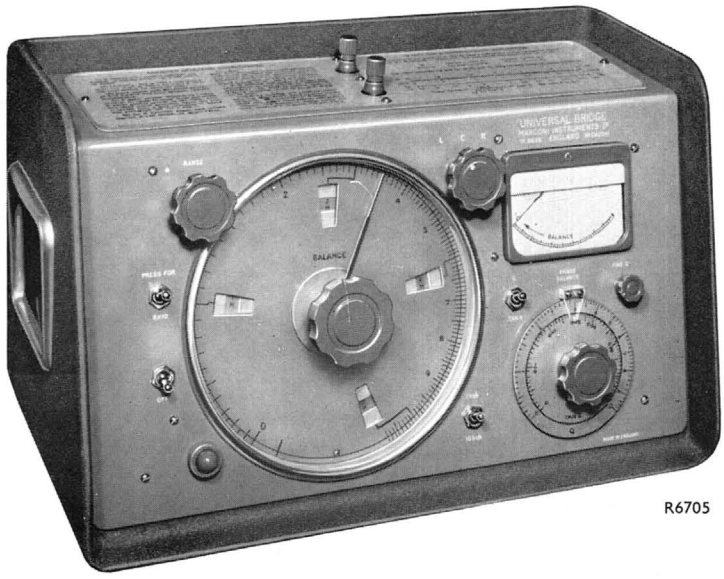
Marconi Instruments Ltd.

St. Albans, Hertfordshire, England

MARCONI INSTRUMENTS

Universal Bridge

Type TF 868B



R6705

- **Measures L: 1 μH to 100 H at 1 and 10 kc/s**
- **Measures C: 1 μμF to 100 μF at 1 and 10 kc/s**
- **Measures R: 0·1Ω to 100 MΩ at d.c.**
- **Single direct-reading dial**
- **Automatic detector sensitivity control**

A DEVELOPMENT of the well-known '868' series of bridges, the TF 868B is almost the ultimate in operational simplicity. It retains the well-established and popular basic features of its predecessors, together with important new advantages, including faster, easier initial balancing, high-discrimination resistance measurement, and precision phase-balancing facilities.

A single dial is used for measurement of L, C, and R; changing the setting of the function selector or range switch automatically changes the calibration of the dial so that the instrument is always direct reading. By this means, the value of an unknown can be determined with no risk of confusion.

APPLICATIONS

The TF 868B measures inductance and Q of inductors, capacitance, power factor and dissipation factor of capacitors, and a wide range of resistance.

Its new bridge-detector design gives positive indication of the direction of the balance point even when the bridge is far off-balance; as a result, components whose values are completely unknown can be evaluated in a matter of seconds with the minimum of searching.

Measurements on inductors carrying a d.c. current can be made by using Adaptor Type TM 6113—see Accessories Available.

BASIC BRIDGE CIRCUITS

The choice of bridge circuit is effected by means of a front-panel L-C-R switch. For resistance measurements the circuit elements are connected as a Wheatstone bridge. Inductance and capacitance are measured by comparison with a standard capacitance in an R-C ratio-arm bridge in which the final arrangement depends on the losses of the test component.

PHASE BALANCE CONTROL

The phase-balance control, inoperative when measuring resistance, carries two scales—one marked in terms of Q, and the other in terms of tan δ. The scale in use is determined by the setting of a Q-TAN δ change-over switch which selects the final arrangement of the 'Standard' arm of the bridge. A FINE Q control allows exact phase balancing with low-Q components.

The Q scale is calibrated from 0·1 to 10 and the tan δ scale from 0·001 to 0·1; as $Q = 1/\tan\delta$, the two scales combine to give continuous Q coverage up to 1,000 and tan δ up to 10. For convenience, a chart is fitted to the top of the instrument and interrelates tan δ and Q, together with effective series and parallel values. When using the instrument at 10 kc/s, the readings of the phase balance control are subject to a simple conversion factor of ×10.

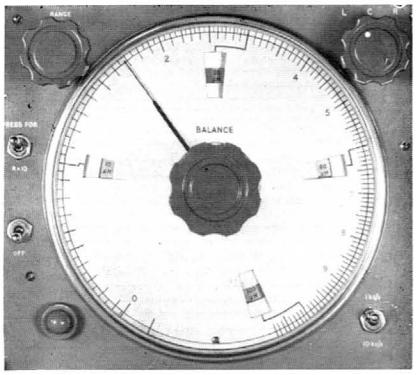
R, L, AND C MEASUREMENT

Resistance measurements are made at d.c. and the bridge is energized by a built-in d.c. supply. The normal direct-reading measurement range extends up to 10 MΩ; to allow measurements on higher-value resistances, a ×10 multiplier is included to extend the range up to 100 MΩ. The bridge output is applied to a vibrator, operating at twice the supply frequency, and thence to the a.c. detector used for inductance and capacitance measurements. This system has a great advantage over the conventional d.c.-galvanometer method of balance indication in that it is very much more sensitive at high and low resistance values.

For inductance and capacitance measurements, the bridge is energized by an R-C phase-shift oscillator feeding a triode amplifier in whose anode line is a fully-screened bridge-input transformer. The oscillator is switched to allow operation at 1 and 10 kc/s. Most determinations are made at 1 kc/s: for certain measurements, however, particularly on small low-Q inductors, using the bridge at 10 kc/s gives greater discrimination with consequent ease in determining the balance point.

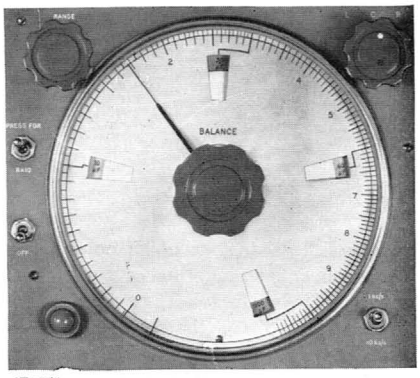
DETECTOR

The detector is a three-stage selective amplifier and diode voltmeter. It is arranged to exhibit maximum sensitivity at the two oscillator frequencies and also the range over which the vibrator operates. A.G.C. is included to eliminate the need for detector-sensitivity and oscillator-amplitude controls: this arrangement simplifies measurement procedure because detector sensitivity automatically increases as the balance point is approached. The a.g.c. circuit has a long time constant in order to delay its stabilizing effect; therefore, by using relatively rapid movements of the BALANCE control, the slope of the detector sensitivity characteristic can be utilized during initial searching to give a clear indication of the direction of the balance point.



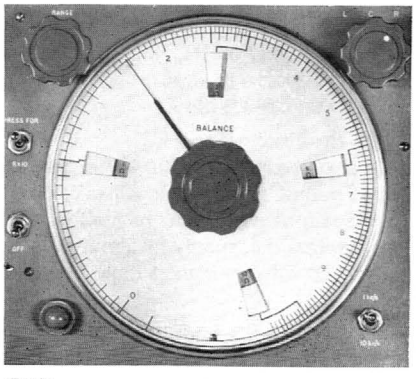
6705/2

INDUCTANCE MEASUREMENT *by Hay or Maxwell bridge, depending upon position of Q-tan δ switch. Total measurement range: 1 μH to 100 henrys. Illustration shows 1- to 100-μH settings of* L-C-R *and* RANGE *controls.*



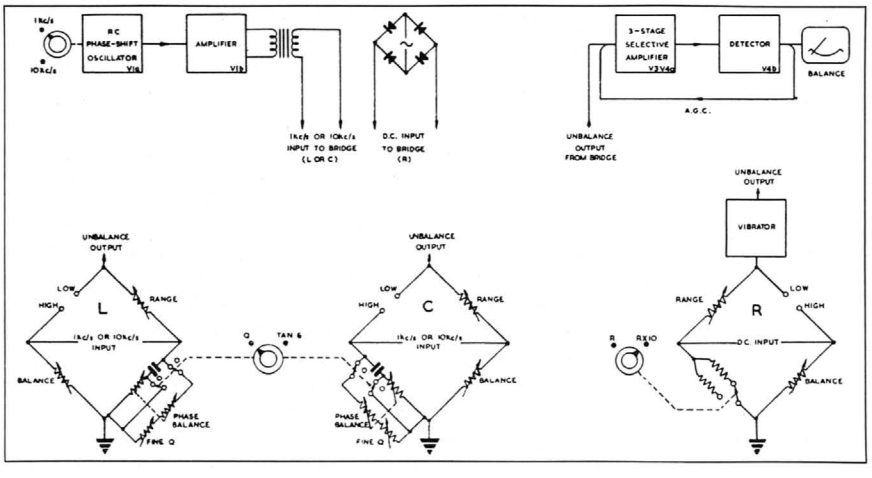
6705/1

CAPACITANCE MEASUREMENT *by resistance ratio arm bridge. Total measurement range: 1 μμF to 100 μF. Illustration shows 1- to 100-μF settings of* L-C-R *and* RANGE *controls.*



6705/3

RESISTANCE MEASUREMENT *by Wheatstone bridge. Total measurement range: 0·1 ohm to 100* MΩ. *Illustration shows 0·1- to 10-ohm settings of* L-C-R *and* RANGE *controls.*



Functional Diagram of TF 868B

SPECIFICATION

Range

INDUCTANCE: 1 μH to 100 henrys in seven decades; at 1 and 10 kc/s.
CAPACITANCE: 1 μμF to 100 μF in seven decades; at 1 and 10 kc/s.
RESISTANCE: 0·1 ohm to 100 MΩ in eight decades; at d.c.
Q: 0·1 to 10 at 1 kc/s; 1 to 100 at 10 kc/s.
TAN δ: 0·001 to 0·1 at 1 kc/s; 0·01 to 1 at 10 kc/s.
As $Q = 1/\tan\delta$, scales combine to give extended Q coverage up to 1,000 and tan δ up to 10.

Accuracy

INDUCTANCE: At 1 kc/s: ±1% ±0·3 μH ±0·1% of full scale. At 10 kc/s: ±3%.
CAPACITANCE: At 1 kc/s: ±1% ±0·3 μμF ±0·1% of full scale. At 10 kc/s: ±3%.
RESISTANCE: ±1% ±0·01 ohm ±0·1% of full scale.
Q: At 1 kc/s: ±10% ±0·2.
TAN δ: At 1 kc/s and for capacitors of 50 μμF and over: ±10% ±0·002.
OSCILLATOR FREQUENCY: ±2½%.

Bridge energizing source

L AND C: Internal 1- and 10-kc/s oscillator; fixed output level between 250 and 500 mV.
R: Internal d.c. supply; nominally 5 volts. When ×10 multiplier is used, voltage is increased to not more than 25 volts.

Power supply

200 to 250 volts, or 100 to 150 volts after adjusting internal links, 40 to 60 c/s, 25 watts approx. Models supplied ready for immediate 100- to 150-volt use if specified at time of ordering.

Dimensions and weight

Height	*Width*	*Depth*	*Weight*
11½ in (30 cm)	19½ in (50 cm)	10 in (26 cm)	26 lb (12 kg)

Accessories available

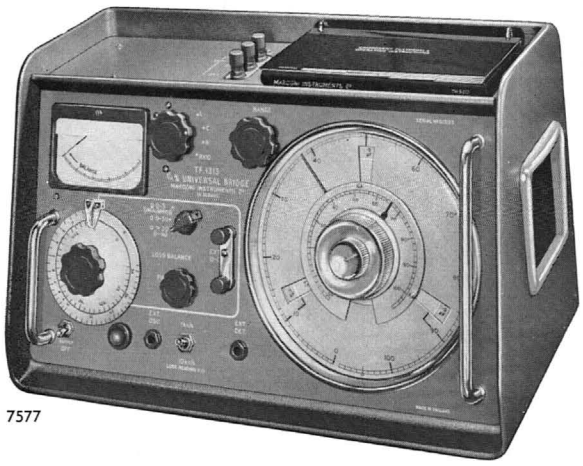
D.C. Choke Adaptor, Type TM 6113; enables d.c. currents up to 200 mA from an external supply to be passed through inductors under test in the range 100 mH to 100 H; fitted with spade lugs for attaching to bridge terminals. Errors introduced by the adaptor do not generally exceed 3% and may be eliminated by simple substitution methods.

Marconi Instruments Ltd.
St. Albans, Hertfordshire, England

MARCONI INSTRUMENTS

¼% Universal Bridge

Type TF 1313



7577

- **Measures L: 0·1 μH to 110 H at 1 and 10 kc/s**
- **Measures C: 0·1 μμF to 110 μF at 1 and 10 kc/s**
- **Measures R: 0·003Ω to 110 MΩ at d.c.**
- **¼% accuracy**
- **Discrimination: 0·02% of full-scale**

TF 1313 is a new general-purpose impedance bridge with ¼% measurement accuracy over a wide range of inductance, capacitance, and resistance. A precision version of the 1% bridge, TF 868B, it also gives you exceptional discrimination and resettability, an extra Q range, and facilities for using an external oscillator and detector.

Like the TF 868B, it uses a single dial for L, C, and R measurements, but with coarse and fine concentric controls; the coarse one moves in 1% steps and the fine interpolates 50 divisions per step. Its meter gives a clear indication of the direction of the balance point even when far off-balance, bringing speed and simplicity to measurements of completely unknown components. An external audio oscillator can be plugged in where L and C measurements are required at frequencies other than the internal 1 and 10 kc/s; and the detector output is available externally to allow an oscilloscope or headphones to be used for balance indication.

APPLICATIONS

This is the bridge for precision evaluation of resistance, capacitance and inductance, for measuring dissipation factor and power factor of capacitors and Q of inductors, for quickly identifying unknown components. Measurements on high-loss components are made easier by the low-Q range of the loss balance control and the relative independence between the adjustment of the main and loss balance control. Its high discrimination and resettability make it particularly suitable for comparative measurements such as checking the difference between an unknown and a standard component. Measurements on inductors carrying a d.c. current can be made by using Adaptor Type TM 6113 — see Accessories available.

BRIDGE CIRCUITS

The TF 1313 uses the simple classical bridge circuits that have been proved the best for a general-purpose instrument: a Wheatstone bridge for resistance and an R-C ratio-arm bridge for inductance and capacitance. The loss balance control has two Q ranges and a D (tan δ) range, and there is also a fine Q control for exact loss balancing with low-Q components. Terminals are provided for connection of an external potentiometer to assist Q and D adjustment at low frequencies.

BALANCE INDICATOR

The bridge output, chopped by a vibrator when the bridge is d.c.-energized for resistance measurement, is indicated by an a.c. detector circuit giving high sensitivity over the whole measurement range. A.G.C. eliminates the need for a sensitivity control and has a long time constant to delay its stabilizing effect; this means that by using fairly rapid movements of the balance control, the slope of the detector sensitivity characteristic can be utilized during initial searching to give a definite indication of the direction of the balance point.

SPECIFICATION

Measurement ranges

INDUCTANCE: 0·1 μH to 110 henrys in 7 decades; at 1 and 10 kc/s.

CAPACITANCE: 0·1 μμF to 110 μF in 7 decades; at 1 and 10 kc/s.

RESISTANCE: 0·003 ohm to 110 MΩ in 8 decades; at d.c.

Q: 0·1 to 31 at 1 kc/s; 1 to 310 at 10 kc/s.

D (TAN δ): 0·001 to 0·031 at 1 kc/s; 0·01 to 0·31 at 10 kc/s.

Since Q = 1/D, scales combine to give extended Q coverage up to 1,000 and D up to 10.

Accuracy (at 1 kc/s)

INDUCTANCE: ±0·25% ±0·01% of range full-scale.

CAPACITANCE: ±0·25% ±0·01% of range full-scale.

RESISTANCE (AT D.C.): ±0·25% ±0·01% of range full-scale.

Q: ±7% ±0·1, for Q greater than 0·5.

D: ±7% ±0·0015.

OSCILLATOR FREQUENCY: ±2½%.

Residuals (approximate)

INDUCTANCE: 0·05 μH.

CAPACITANCE: 0·08 μμF.

RESISTANCE: 0·001 ohm.

Bridge energizing source

L AND C: Internal 1- and 10-kc/s oscillator; fixed output level of about 400 mV. External audio oscillator may be used instead.

R: Internal d.c. supply of about 4 volts; about 20 volts on highest range.

Power supply

200 to 250 volts and 100 to 150 volts, plug-selected; 40 to 60 c/s; 40 watts.

Dimensions and weight

Height	*Width*	*Depth*	*Weight*
11½ in (30 cm)	19½ in (50 cm)	10 in (26 cm)	27 lb (12·5 kg)

Accessories supplied

Two *Telephone Plugs*, Type P40; for external oscillator and detector jacks.

Accessories available

D.C. Choke Adaptor, Type TM 6113; enables d.c. currents up to 200 mA from an external supply to be passed through inductors under test in the range 100 mH to 100 H; fitted with spade lugs for attaching to bridge terminals. Errors introduced by the adaptor do not generally exceed 3% and may be eliminated by simple substitution methods.

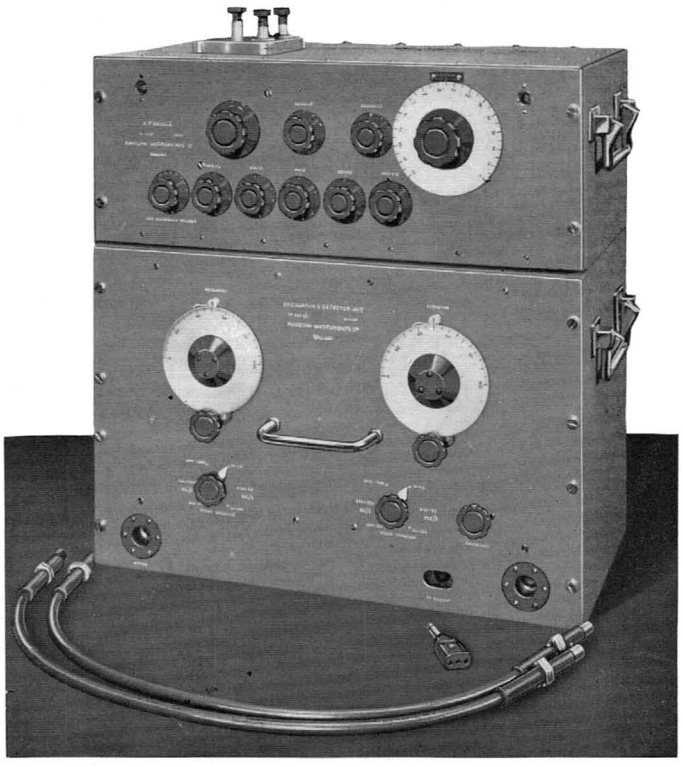
Marconi Instruments Ltd.

St. Albans, Hertfordshire, England

MARCONI INSTRUMENTS

R.F. Impedance Bridge Assembly

Type OA 199A/2



R3788

- **Frequency range: 100 kc/s to 20 Mc/s**
- **Precision-built unity-ratio bridge**
- **Measures balanced or unbalanced impedances**
- **Bridge and oscillator-detector unit separately available**

THE ASSEMBLY consists of an R.F. Impedance Bridge Type TME 20B/1 and an Oscillator-Detector Unit, Type TF 562B/2. The Bridge and Oscillator-Detector are housed in individual steel carrying cases mounted one upon the other and are supplied complete with flexible concentric inter-connecting leads. The instruments may be immediately separated for independent use or may be purchased individually.

APPLICATIONS

The bridge is designed for the measurement of a wide range of balanced or unbalanced impedances at frequencies between 100 kc/s and 20 Mc/s. It allows precision evaluation of the characteristics of open-wire or coaxial transmission lines. It will also measure the input admittance of amplifiers, self-capacitance of resistors, inductance of wire-wound potentiometers, capacitor losses, and the effective impedance of components at their working frequency.

R.F. IMPEDANCE BRIDGE TME 20B/1

The bridge is of the type in which the ratio arms are equal, the basis of operation consisting in the establishment of equality of admittance between two arms either by the addition of capacitance across the terminals connected to the unknown, with resistance adjustment for the remaining arm, or by the adjustment of both resistance and capacitance in the latter.

The variable arm always includes resistance elements, but capacitance elements can be bridged across either the variable or unknown arms by means of a four-position switch. In two positions of the switch one pair of the ratio arms is short-circuited for measuring impedances which are earthed at one terminal, while in the remaining two positions impedances symmetrical (balanced) with respect to earth may be measured.

For an unknown which is purely resistive, the added capacitance is zero and the bridge is used as a Wheatstone Bridge.

When the unknown is capacitive, capacitance must be added to the variable arm to procure balance. This capacitance is added in parallel with the resistance in that arm and the unknown is therefore measured as a resistance in shunt with a capacitance.

When the unknown is inductive, capacitance must be added to the unknown arm to produce balance. This capacitance is added in shunt, so that the unknown is again measured as a resistance equal to that in the variable arm but shunted by an inductance equal in reactance to the capacitance added to the unknown arm.

In construction every effort has been made to maintain the symmetrical nature of the bridge, avoiding changes in geometry with change in electrical values; a plane of symmetry exists midway between the main bus-bars, while the latter are equally spaced between the front panel and the rear of the case. The variable air capacitor used is of a special balanced type and the decade units consist of rotating drums carrying capacitors and resistors selected by brushes attached to the bus-bars, the latter construction enabling undesired circuit impedances to be maintained at constant values for every setting of the decade.

The input and output transformers are screened, balanced and toroidally wound, final open-circuit balance being obtained by means of a variable trimming capacitor across the test terminals.

OSCILLATOR-DETECTOR UNIT TYPE TF 562B/2

The two sub-units—oscillator and heterodyne detector—which are contained in the TF 562B/2 have separate power supply arrangements and are each housed in

separate screened compartments to eliminate stray coupling.

The r.f. oscillator covers the range 100 kc/s to 20 Mc/s in six bands. It is followed by an r.f. amplifier which is amplitude modulated by a 1,000-c/s oscillator, the amplifier and a.f. oscillator utilizing separate halves of a double triode. The tuned circuits of the r.f. oscillator and amplifier each use sets of coils selected by ganged switching and are tuned by a two-gang capacitor.

The detector employs a tuned input circuit in order to discriminate against any harmonic present in the bridge output; this precedes a triode-hexode in a self-oscillating frequency-changer/demodulator circuit, the tuning systems for input circuit and frequency-changer being arranged and ganged as in the case of the oscillator. The frequency-changer is followed by a two-stage a.f. amplifier comprising the two halves of a double triode, and the amplified beat note is transformer-coupled to a telephone jack at which low-impedance headphones may be used as a null-point detector. The frequency-changer can be readily tuned to emit the 1,000-c/s product of demodulation; this forms a convenient high-stability tone suitable for rapid initial balancing of the bridge. The high sensitivity required for final balancing is obtained by tuning for the normal heterodyne beat note between local oscillator and r.f. carrier. Sensitivity is controlled by a potentiometer connected across the input coupling coil.

SPECIFICATION for TME 20B/1

Frequency range

100 kc/s to 20 Mc/s.

Ratio arms

100 ohms each.

Variable resistance

1 to 100,000 ohms or 1,000 to 0·01 millimhos; 5 decades, 1 uncalibrated fine control.

Shunt capacitance

Applicable in shunt with unknown or variable arms.
0·0111 μF max.
2 decades, 1 continuously variable.

Accuracy

Nominal ±2%. For corrections see Operating Instructions.

Dimensions and weight

Height	*Width*	*Depth*	*Weight*
9 in	21 in	11 in	32 lb
(23 cm)	(54 cm)	(28 cm)	(14·5 kg)

Accessories supplied

One *Coaxial Lead*, Type WSK 7265/C, with WSK 7258 plug at each end.

SPECIFICATION for TF 562B/2

Frequency range

100 kc/s to 20 Mc/s in six bands:
100 to 250 kc/s.
250 to 600 kc/s.
600 to 1,500 kc/s.
1·5 to 3·5 Mc/s.
3·5 to 8·5 Mc/s.
8·5 to 20·0 Mc/s.

Oscillator output

Generally between 0·5 and 2 volts, depending on frequency.

Detector sensitivity

An input of the order of 5 to 10 μV can be detected, except at the highest frequencies where an input of the order of 200 μV is required.

Power supply

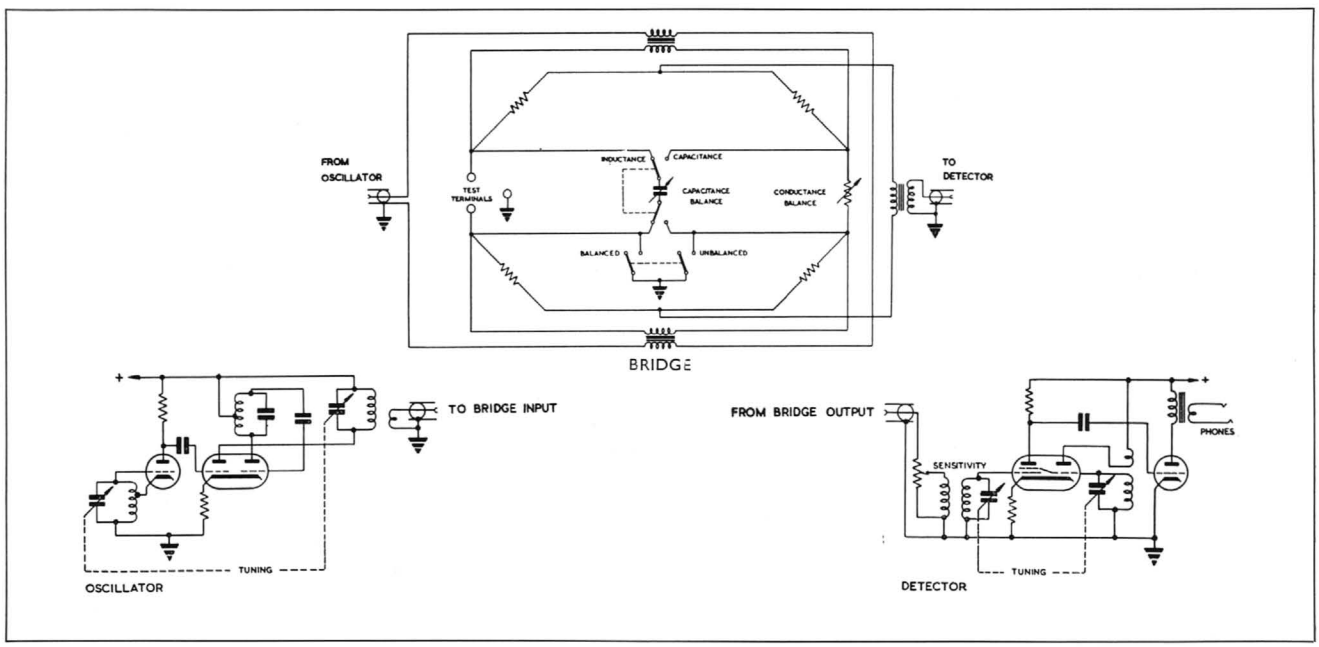
100 to 125 volts, or 200 to 250 volts, as ordered; 40 to 100 c/s, 40 watts.

Dimensions and weight

Height	*Width*	*Depth*	*Weight*
13 in	21 in	12 in	97 lb
(33 cm)	(54 cm)	(30 cm)	(44 kg)

Accessories supplied

One *Coaxial Lead*, Type WSK 7265/C, with WSK 7258 plug at each end.
Jack Plug, Igranic Type P40; for use with phones output socket.
Two *Mains Leads*, Type TM 2560C; each 6 feet long; one lead for oscillator unit mains input, and one lead for detector unit mains input.

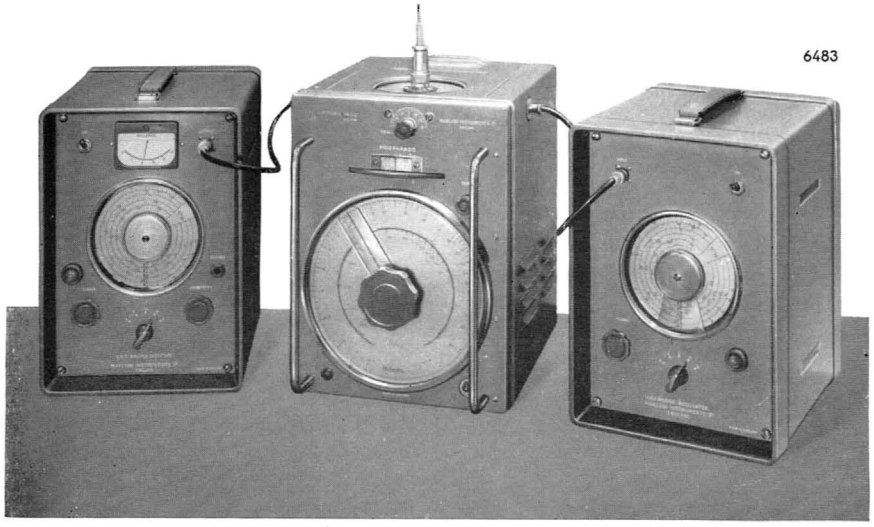


Functional Diagram of OA 199A/2

Marconi Instruments Ltd.
St. Albans, Hertfordshire, England

MARCONI INSTRUMENTS

V.H.F. Admittance Bridge Type TF 978



V.H.F. Bridge Detector Type TF 1275 — *V.H.F. Admittance Bridge Type TF 978* — *V.H.F. Bridge Oscillator Type TF 1274*

- **Frequency range: 30 to 300 Mc/s**
- **Measures conductance: 0 to 50 millimhos**
- **Measures capacitance: −40 to +40 μμF (inductance measured as negative capacitance)**
- **Features high-stability servo-controlled conductance balance system**

OPERATING IN THE RANGE 30 to 300 Mc/s, the TF 978 fills the gap between slotted lines and conventional r.f. bridges.

APPLICATIONS

Simple and direct-reading, this general-purpose v.h.f. bridge is particularly suitable for measurements on unbalanced aerial systems, coaxial lines and components, and two-terminal networks in general. Specific applications include measurement of transmission line impedance and v.s.w.r., and precision aerial matching; it can also be used in the design and testing of filters and attenuators, and for measuring the input and output impedance of v.h.f. transistors.

THERMISTOR CONDUCTANCE CONTROL

It presents a completely new approach to v.h.f. bridge design: the inherent problem of reducing residual strays to negligible proportions has been overcome mainly by the use of a thermistor bead in place of the normal bulky conductance components. Thermistor conductance is controlled by means of a calibrated conductance standard in an audio-frequency servo system which is virtually unaffected by transient and long-term changes in ambient temperature, amplifier gain, or thermistor characteristics.

The design is based on principles originated by the British Broadcasting Corporation Research Department and is the subject of British Patent Nos. 658,348 and 665,650.

OSCILLATOR AND DETECTOR

The Bridge is intended for use with an external oscillator and detector, both of which can be supplied as optional accessories; alternatively, a conventional v.h.f. signal generator and receiver can be used.

V.H.F. Bridge Oscillator, Type TF 1274. This bridge-energizing source covers the range 30 to 300 Mc/s in five bands with an accuracy of 2%. Its output is squarewave modulated at 1 kc/s. To suit the requirements of the bridge, the output level is designed to vary with frequency from about 150 to 300 mV. Negligible spurious f.m. ensures that a clearly defined bridge balance can be obtained.

V.H.F. Bridge Dectector, Type TF 1275. The Detector has the same frequency range and accuracy as the Oscillator and can detect inputs down to a few microvolts. It is a super-regenerative receiver, free from spurious responses, and with an audio bandwidth of 150 c/s centred on the 1-kc/s modulation frequency of the Oscillator Unit. The inherent a.g.c. action of this type of receiver eliminates the need to reset the sensitivity control during bridge balancing.

SPECIFICATION

Frequency range

30 to 300 Mc/s.

Measurement range

CONDUCTANCE: 0 to 50 millimhos; a subsidiary resistance scale calibrated 20 ohms to ∞ is included.

CAPACITANCE: −40 to +40 μμF. This is equivalent to a normal working range of:

Capacitance, 1 to 40 μμF.

Inductance, 0·7 to 25 μH at 30 Mc/s and 0·007 to 0·25 μH at 300 Mc/s;

Susceptance, −7·5 to +7·5 millimhos at 30 Mc/s; − 75 to +75 millimhos at 300 Mc/s.

Measurement accuracy

CONDUCTANCE: ±2% ±0·1 millimho.

CAPACITANCE: ±2% ±0·5 μμF; the accuracy of inductance and susceptance determinations will depend on the frequency accuracy of the bridge-energizing source.

Temperature range

Up to 40°C (104°F).

Connections

TEST: Coaxial; 4- and 6-BA tapped holes are provided for making test connections.

OSCILLATOR AND DETECTOR: 50-ohm BNC sockets.

Input

Any level, dependent on sensitivity of detector, up to a maximum of 500 mV.

Power supply

200 to 250 volts, or 100 to 150 volts after adjusting internal links, 40 to 100 c/s, 125 watts. Models supplied ready for immediate 100- to 150-volt operation if specified at the time of ordering.

Dimensions and weight

Height	*Width*	*Depth*	*Weight*
13 in (33 cm)	10 in (25 cm)	13 in (33 cm)	32 lb (15 kg)

Accessories supplied

Two *Coaxial Free Plugs*, 50-ohm, Type BNC; for oscillator and detector connections.

Accessories available

V.H.F. Bridge Oscillator, Type TF 1274.

V.H.F. Bridge Detector, Type TF 1275.

The Oscillator and Detector are each complete with a coaxial lead for connecting to the Bridge.

Marconi Instruments Ltd.
St. Albans, Hertfordshire, England

MARCONI INSTRUMENTS

Circuit Magnification Meter Type TF 1245

with Oscillators Types TF 1246 and TF 1247

R6341

Q-Meter and TF 1247 Oscillator

- **Frequency range: 1 kc/s to 300 Mc/s**
- **External oscillators, customer selected**
- **Capacitance range: 7·5 to 500 μμF**
- **Measures Q from 5 to 1,000**
- **Delta-Q and Q multiplier facilities**

HERE, FOR THE FIRST TIME, is a single Q Meter covering the range a.f. to v.h.f.

APPLICATIONS

It allows direct measurement of Q-factors from 5 to 1,000; inductance of coils can be readily determined from the test-circuit capacitor reading by means of an attached conversion chart; self-capacitance of coils, inductance and power factor of capacitors, phase angle of resistors, characteristics of transmission lines, and many other quantities can be evaluated by indirect measurements. A delta-Q control facilitates measurements on low-loss insulators and simplifies batch testing.

EXTERNAL OSCILLATORS

This new Q Meter also embodies a unique concept in mechanical design in which the Q-indicator and test-circuit section is a separate unit energized by one of two specially designed external oscillator units: these have ranges of 40 kc/s to 50 Mc/s and 20 to 300 Mc/s respectively, and one or both can be supplied as required. Below 40 kc/s, an l.f. oscillator such as the Marconi TF 1101 may be used.

This flexible arrangement means economy for the customer, whether the initial requirement is for wide-band or restricted coverage; it also allows for the addition of extra units at a later date.

Matching units are available to allow the oscillators to be used as general-purpose signal sources.

TEST CIRCUITS

TF 1245 incorporates two separate low-loss test circuits to ensure optimum operating conditions over the complete 1-kc/s to 300-Mc/s range. Both are of the conventional series-resonant type, in which Q is measured in terms of the voltage developed across the tuned-circuit capacitance. The l.f. test circuit uses 0·02-ohm resistive injection and operates in the range 1 kc/s to 50 Mc/s; whereas the h.f. test circuit, range 20 to 300 Mc/s, employs 0·1-mμH inductive injection.

The test circuits are coupled to separate panel inlets to which the appropriate oscillator unit is connected by means of a special lead provided.

Q is read directly on a 3-scale panel meter common to both test circuits and operated by a transductor-stabilized valve voltmeter. A second meter monitors the input level to the test circuits and is calibrated in terms of Q-reading multiplication factor.

Details of optional accessories, the use of which greatly extends the measurement capabilities of the Q Meter, are described on the following page.

SPECIFICATION

Frequency range

1 kc/s to 300 Mc/s, using external oscillators.

Magnification factor (Q)

RANGES: 5 to 50, 10 to 150, and 60 to 500, with Q multiplier at × 1.

Q MULTIPLIER RANGE: × 0·9 to × 2.

ACCURACY OF Q READING: With the Q multiplier at × 1 and a Q reading of 50, ±5% up to 100 Mc/s, rising to ± 12% at 200 Mc/s, and ±20% at 300 Mc/s. At Q readings of 150 and 500, measurement accuracy falls by about ±1% from figures quoted above.

DELTA-Q RANGE: 25–0–25.

Nominal test circuit parameters

1-kc/s TO 50-Mc/s TEST CIRCUIT: Injection impedance: resistive, 0·02 ohm. Shunt loss: 12 MΩ at 1 Mc/s.

20- TO 300-Mc/s TEST CIRCUIT: Injection impedance: inductive, 0·1 mμH. Shunt loss: 0·3 MΩ at 100 Mc/s.

Tuning capacitor

1-kc/s to 50-Mc/s test circuit:

MAIN CAPACITOR: 20 to 500 μμF; accuracy, ±1 μμF ±1%.

INCREMENTAL: 5–0–5 μμF with 0·2-μμF increments; accuracy, ±0·2 μμF.

20- to 300-Mc/s test circuit:

MAIN CAPACITOR: 7·5 to 110 μμF; accuracy, ±0·5 μμF ±1%.

INCREMENTAL: 1–0–1 μμF with 0·05 μμF increments; accuracy, ±0·1 μμF.

The h.f. test circuit capacitor can be used in the l.f. test circuit by external cross-connection.

Power supply

190 to 260 volts, or 95 to 130 volts after adjusting internal link, 40 to 100 c/s; 22 watts. Models supplied ready for immediate 95- to 130-volt use if specified at time of ordering.

Dimensions and weight

Height	*Width*	*Depth*	*Weight*
14 in	17¼ in	9½ in	23 lb
(36 cm)	(43 cm)	(24 cm)	(10·5 kg)

Accessories supplied

Inductor Support Platform, TC 28850; for supporting small test components.

Coaxial Lead, TM 5725; for coupling TF 1245 to either TF 1246 or TF 1247 oscillators.

Two *Tie Bars*, TB 28691; for bonding TF 1245 to either TF 1246 or TF 1247 oscillators.

SPECIFICATION—*continued*

Accessories available

600- to 0·5-ohm, 1- to 40-kc/s Transformer, TM 5728, for coupling to a conventional l.f. oscillator. Accessories for extending the measurement facilities of the Q Meter are described on the right.

Oscillators types TF 1246 and TF 1247

RANGE: TF 1246—40 kc/s to 50 Mc/s in 8 bands.

TF 1247—20 to 300 Mc/s in 6 bands.

FREQUENCY ACCURACY: ±1%.

OUTPUT: Suitable for use with TF 1245; or, with optional Matching Unit added, approx. 4 volts across 50-ohm load.

POWER SUPPLY: 200 to 250 volts, or 100 to 150 volts after adjusting internal link, 40 to 100 c/s. Models supplied ready for immediate 100- to 150-volt use if specified at time of ordering.

DIMENSIONS AND WEIGHT:

Height	*Width*	*Depth*	*Weight*
14 in (36 cm)	10¼ in (26 cm)	9½ in (24 cm)	27 lb (12 kg)

ACCESSORIES AVAILABLE: *50-ohm Matching Unit:* TM 5726 for TF 1246; TM 5727 for TF 1247; enables oscillator to be used as 50-ohm general-purpose test source.

SPECIFICATION for TJ 155B/1 and C/1

Range

TAN δ: Varies with capacitance of specimen within overall limits 0·001 to 0·07.

R: Varies with frequency within overall limits 100 kΩ to 10 MΩ.

Accuracy

Approx. ±5%.

Thickness of specimen

Up to 0·375 in (9·5 mm).

Electrodes

1-inch diameter, with edges bevelled to minimize fringing.

Equivalent shunt-loss of jig

About 10 MΩ at 1 Mc/s.

SPECIFICATION for TJ 230

Measurement range

C: 480 μμF to 0·25 μF.

L: 0·005 μH at 50 Mc/s to 25 mH at 40 kc/s.

R: 0·003 ohm at 50 Mc/s to 1·5 kΩ at 40 kc/s.

Accuracy

C AND L: Maximum accuracy of about 4% when C reading changes by 2:1.

R: Maximum accuracy of about 10% when Q of circuit is halved.

OPTIONAL ACCESSORIES FOR USE WITH TF 1245

INDUCTORS

Types TM 1438 series and TM 4947 series

A range of twenty-one inductors, any of which can be supplied separately, is available for use with the Q Meter. Two basic series are available:

TM 1438 series — for l.f. test circuit; eighteen fully screened inductors on ceramic formers, fitted with 'banana' plug connectors. Values range from 0·2 μH to 25 mH; each adjusted to within ±3% ±0·05 μH of its nominal value. Can be supplied as a complete set, type TM 4520, in a polished hard-wood case.

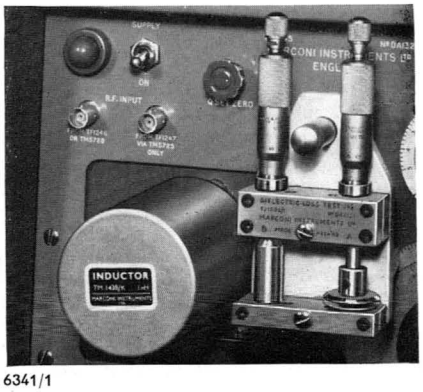
TM 4947 series — for h.f. test circuit; three fully screened inductors fitted with spade-lug connectors.

The inductors available and details of their frequency coverage are given in the adjoining table.

Type	Nominal Inductance	Approx. Magnification	Approx. Self-Capacity μμF	Approx. Frequency Range
TM 1438A	0·2 μH	200	8	40–15 Mc/s
TM 1438B	1·0 μH	200	8	22–8·5 Mc/s
TM 1438P	1·5 μH	200	8	18–6·5 Mc/s
TM 1438C	2·5 μH	200	8	14–5·2 Mc/s
TM 1438D	5·0 μH	200	8	9–3·5 Mc/s
TM 1438E	10 μH	200	8	6·5–2·5 Mc/s
TM 1438F	25 μH	200	8	4·3–1·6 Mc/s
TM 1438G	50 μH	200	8	2·9–1·1 Mc/s
TM 1438R	75 μH	200	8	2·4–0·9 Mc/s
TM 1438H	100 μH	200	8	2·0–0·8 Mc/s
TM 1438Q	200 μH	200	8	1·5–0·6 Mc/s
TM 1438I	250 μH	200	8	1·3–0·5 Mc/s
TM 1438J	500 μH	160	9	970–370 kc/s
TM 1438K	1·0 mH	160	9	680–270 kc/s
TM 1438L	2·5 mH	150	10	410–150 kc/s
TM 1438M	5·0 mH	130	10	280–110 kc/s
TM 1438N	10 mH	80	11	220–80 kc/s
TM 1438O	25 mH	80	11	140–50 kc/s
TM 4947/1	2·5 μH	350	4·0	10–30 Mc/s
TM 4947/2	0·5 μH	350	1·5	25–70 Mc/s
TM 4947/3	0·05 μH	300	1·2	70–230 Mc/s

DIELECTRIC LOSS TEST JIG

Types TJ 155B/1 and TJ 155C/1



6341/1

These Jigs are primarily designed for the measurement of the dielectric loss of flat specimens of insulating material by the bandwidth-comparison method. They are also suitable for any measurements where small, accurately known changes of capacitance are required, e.g., self-capacitance and r.f. resistance of resistors.

Each unit comprises a precision circular-plate capacitor to contain the sample under test, and a linear-law incremental capacitor by which the bandwidth is determined; adjustment is by micrometer head; the 'B/1' model is calibrated in thousandths of an inch, whereas the 'C/1' is in millimetres. Both are mounted on a low-loss ceramic base and the assembly is arranged for attachment to the l.f. test circuit terminals of the Q Meter. Each Jig is supplied in a felt-lined wooden case.

SERIES LOSS TEST JIG

Type TJ 230

TJ 230 enables the measurement of small values of R and L and large values of C to be made by connecting them in series with the test circuit of the Q Meter.

The unit consists of a printed-circuit base on which are mounted sockets to accept the TM 1438 series of inductors, and a pair of low-inductance series-connection terminals across which the unknown is connected.

The Jig is arranged for connection to the l.f. test circuit terminals of the Q Meter.

Marconi Instruments Ltd.

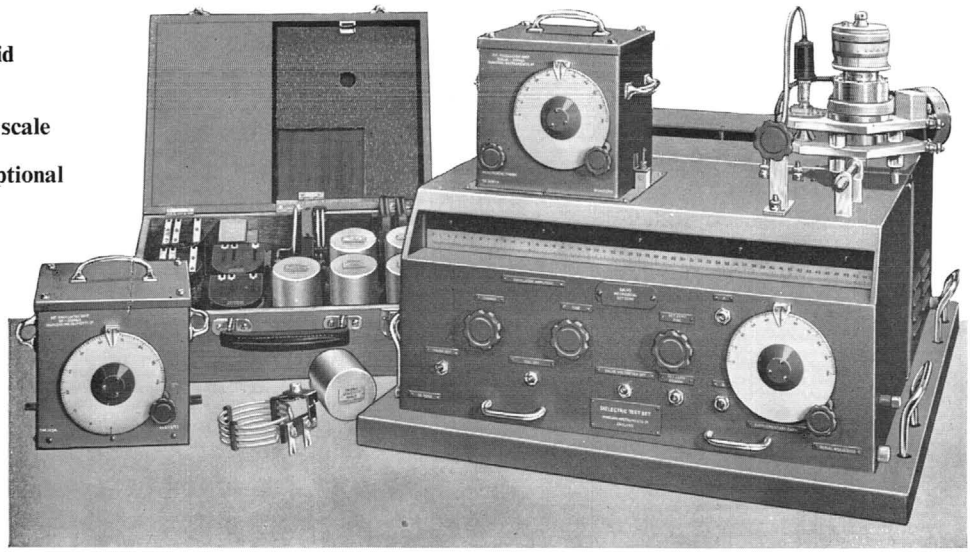
St. Albans, Hertfordshire, England

MARCONI INSTRUMENTS

Dielectric Test Set

Type TF 704B

- **Frequency range: 50 kc/s to 100 Mc/s**
- **Precise determination of dielectric properties**
- **Alternative jigs for solid and liquid specimens**
- **Mirror galvanometer with 50-cm scale**
- **N.P.L. calibration available as optional extra**



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THE DIELECTRIC TEST SET is an instrument for the measurement of the permittivity and power factor of dielectrics. The accessories supplied with the equipment enable measurements to be made at a series of frequencies within the range 500 kc/s to 85 Mc/s; items are also included enabling the user to carry out measurements at any point within the 50 kc/s to 100 Mc/s frequency range embraced by the oscillators forming part of the Test Set. The method of measurement and the design of the special Test Jig incorporated in the equipment are due to the National Physical Laboratory . . . 'The Measurement of the Permittivity and Power Factor of Dielectrics at Frequencies from 10^4 to 10^8 Cycles per Second'; L. Hartshorn and W. H. Ward; J.I.E.E., vol. 79, p. 597.

The method referred to above is that of capacitance variation in a tuned circuit, a square-law thermionic mirror voltmeter being used as resonance indicator. Both permittivity and power factor are obtained as a ratio of capacitance readings; frequency is not involved in their calculation, the feature which gives the instrument its very wide frequency range.

In addition to the investigation of dielectrics, accurate determinations of the properties of high frequency cables can be made by means of open- and short-circuit measurements, while the radio frequency performance of capacitors and resistors can be determined over a wide range of values.

The equipment includes two interchangeable oscillator units—which between them cover the specified frequency range continuously—and a stabilized built-in power pack which supplies all the requirements of the equipment with the exception of the grid bias for the thermionic voltmeter. The latter is supplied by a small dry battery mounted within the instrument.

OSCILLATORS

The interchangeable oscillator units generating the test-circuit voltage are designed to give a high order of frequency and amplitude stability and use plug-in coils for which individual frequency calibration curves are supplied. The unit covering the lower frequency end of the range employs a single valve in a normal tuned circuit, but the unit covering the higher frequency portion makes use of two valves in push-pull in order to provide the necessary output at these higher frequencies.

The oscillator frequency controls are carried on the units themselves but the coarse and fine amplitude controls, being common to both units, are mounted on the front panel of the instrument proper.

TEST CIRCUIT

The test circuit comprises an interchangeable tuning inductor with oscillator coupling coil —a series of such units being supplied with each instrument—shunted by the test jig capacitances. The jig itself incorporates two micrometer capacitors in parallel, one being a plate capacitor of special construction in which the test specimen is inserted and the other a cylindrical capacitor, of linear law and very small range, which serves to measure the sharpness of resonance of the tuned circuit of which the sample forms part. A third variable capacitor, provided with the necessary calibration, is mounted below the jig and may be linked across it when loading is required.

To avoid hand capacitance, extension handles are provided for certain of the controls used while making measurements so that they may be operated without approaching the electrode system.

The square-law thermionic voltmeter

connected across the test circuit uses a balanced valve bridge arrangement with a sensitive mirror galvanometer as the indicator, the galvanometer, lamp and scale being mounted within the instrument. The translucent scale of the galvanometer is mounted at the front of the instrument and is viewed through a horizontal aperture in the case.

When testing a solid specimen, it is held between the plate electrodes of the first micrometer capacitor, which usually forms the main tuning capacitance of the test circuit, and observations are made both at resonance and at specific points off resonance —by adjustment of the second (cylindrical) micrometer capacitor—to determine the width of the resonance curve. Finally, the specimen is removed and the observations then repeated, resonance being first restored by closing up the plate capacitor which now has air as the dielectric in place of the specimen. In the case of liquid specimens, however, the procedure is reversed, the first set of measurements being made with air as the dielectric and the second set with the specimen in position.

PRECISION CONSTRUCTION

Normally, the main sources of possible inaccuracy are due to imperfect contact of the electrodes and, particularly at the highest frequencies, residual inductances and resistances. Very careful attention to detail in the design and construction of the apparatus, together with the procedure adopted, virtually eliminates these errors and results in a precision which is believed to be unattainable by other means.

SPECIFICATION

Oscillator frequency range

50 kc/s to 100 Mc/s, covered by two interchangeable oscillator units.

Frequency accuracy

±5%.

Solid specimen size

MAXIMUM THICKNESS: 5 mm.
PREFERRED THICKNESS: 1 to 2 mm.
PREFERRED DIAMETER: 53 mm.

Liquid specimen

About 10 ml.

Power supply

200 to 250 volts, 50 c/s only. *100 to 125 volts, 60 c/s only to special order.* 150 watts.

Weight

TF 704B: 108 lb (49 kg) (less oscillator, jig, etc.).
TM 3083A: 8 lb 8 oz (3·9 kg).
TM 3123A: 9 lb 8 oz (4·3 kg).
JIG CASE: 12 lb (5·5 kg) (complete with jig).
COIL CASE: 20 lb (9 kg) (complete with coils, etc.).
COMPLETE EQUIPMENT: 158 lb (72 kg).

Dimensions

MAIN ASSEMBLY TF 704B (less oscillator, jig and drive):

Height	*Width*	*Depth*
13½ in (34 cm)	24½ in (63 cm)	29 in (74 cm)

OSCILLATORS TM 3083A: / TM 3123A:

Height	*Width*	*Depth*
8 in (20 cm)	9 in (23 cm)	7½ in (19 cm)

OVERALL ASSEMBLY (with oscillator, jig, etc., fitted):

Height	*Width*	*Depth*
20 in (51 cm)	25 in (64 cm)	29 in (74 cm)

JIG CASE:

Height	*Width*	*Depth*
6 in (15 cm)	9 in (23 cm)	11 in (28 cm)

COIL CASE:

Height	*Width*	*Depth*
7 in (18 cm)	16½ in (41 cm)	12 in (31 cm)

Coils

The following Coils are supplied:

Oscillator Coils	*Nominal Range*	*Test Coils*	*Approximate Frequency**
TM 2915	50 kc/s to 150 kc/s	TM 4063	85 Mc/s
TM 2915A	150 kc/s to 400 kc/s	TM 4061/1	45 Mc/s
TM 2915B	250 kc/s to 750 kc/s	TM 4061/2	30 Mc/s
TM 2915C	750 kc/s to 2·5 Mc/s	TM 4073	18 Mc/s
TM 2915D	2·5 Mc/s to 8·5 Mc/s	TM 2924A	8·5 Mc/s
TM 2915E	8·5 Mc/s to 20 Mc/s	TM 2924B	4·0 Mc/s
TM 3126	20 Mc/s to 35 Mc/s	TM 2924C	2·0 Mc/s
TM 3126A	35 Mc/s to 65 Mc/s	TM 2924D	1·0 Mc/s
TM 3126B	65 Mc/s to 100 Mc/s		

*With specimen holder set to 1 mm gap (air) and loading capacitor unlinked.

Accessories supplied

R.F. Oscillator Unit, TM 3083A; 50 kc/s to 20 Mc/s in 6 ranges; plugs on to top of main unit.

Set of 6 *Coils for R.F. Oscillator Unit*, TM 2915 series; see table above for full details.

H.F. Oscillator Unit, TM 3123A; 20 to 100 Mc/s in 3 ranges; plugs on to top of main unit.

Set of 3 *Coils for H.F. Oscillator Unit*, TM 3126 series; see table above for full details.

One *Test Jig:* Type TJ 223B for solid dielectrics, or Type TJ 227 for liquid dielectrics, as specified at time of ordering. A pure polystyrene standard disc specimen, Type TA 19933, is supplied with Test Jig TJ 223B. Each Jig supplied in polished hardwood case.

Set of 8 *Test Coils* for loading Specimen Test Jig TJ 223B or TJ 227; see table above for full details.

Two *Test Coil Bases*, TM 2916 and TM 2924; these items are supplied to facilitate construction of jig loading coils for special applications.

Coil Case, TM 2880A; polished hardwood; for stowage of Oscillator Coils, Test Coils, and Test Coil Bases.

Bottle of 'Energel' white oil; for lubrication of Test Jig micrometers; brush-stopper and spare brush supplied.

Accessories available

Capacitor for Liquids, Type TJ 228; heavy silver-plated brass construction with rhodium-flash finish; basically, two coaxial cylindrical electrodes with radial clearance of 2 mm; allows measurement of permittivity and power factor of liquid dielectrics under vacuum conditions and/or at temperatures up to 80°C.

Capacitor for Liquids, Type TJ 228/1; similar to TJ 228 but with 1 mm electrode spacing.

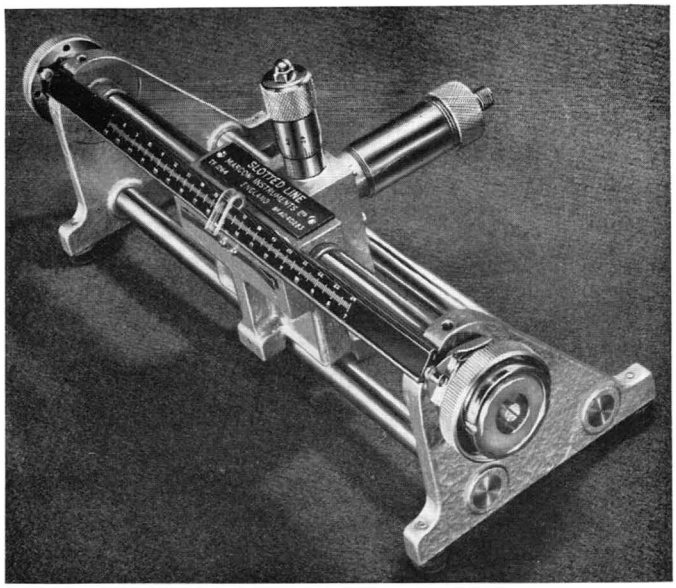
National Physical Laboratory Calibration Data; supplied in place of normal Marconi Instruments Test Certificate. N.P.L. data for Test Jig TJ 223B comprises calibration of micrometer capacitors and loss tangent and capacitance figures for the polystyrene specimen; data for Test Jig 227 comprises calibration of micrometer capacitors and loss tangent and permittivity figures for sample of Grade B transformer oil. M.I. Test Certificate includes similar data with the exception of transformer oil figures.

Marconi Instruments Ltd.
St. Albans, Hertfordshire, England

MARCONI INSTRUMENTS

Slotted Line

Type TF 1264



6276/1

- **Frequency range: 1,700 to 2,300 Mc/s**
- **Simple, robust construction**
- **For field, production line, or laboratory use**
- **Excellent electrical stability**

THIS COAXIAL SLOTTED SECTION is specially designed for use in the 1,700- to 2,300-Mc/s multi-channel link band.

APPLICATIONS

The TF1264 fulfils the need for an accurate, yet robust, unit particularly suited to field use under the varied climatic conditions encountered in radio-link operations. Its principal applications are in the investigation of transmission line mismatch and aerial reflection characteristics; it is, nevertheless, eminently suited for all other slotted-line measurements. In addition, because of its simple and sturdy construction, it is particularly suitable for rapid production-line testing of transmission components.

RUGGED CONSTRUCTION

The outer conductor of the coaxial section is a heavy-gauge electro-formed cylinder slotted along the side rather than the top to keep out dust. The probe carriage is supported by the outer conductor, around which it forms an accurate sliding fit; spring-loaded nylon inserts are fitted to the probe carriage and act against the outer conductor to ensure that probe insertion remains constant over the whole carriage travel. Rigid mechanical stability of the carriage is imparted by three roller bearings which ride on a stainless-steel bar; this bar forms one of a pair connecting the two end supports.

Insertion depth is fixed, and probe traverse relative to the face of each end connector is indicated by a scale marked in millimetres.

The centre conductor of the coaxial section is supported at each end by a dielectric disk, and is brought out to Marconi u.h.f.-pattern connectors.

SCREENED DETECTOR

Since use 'on site' gives rise to the possibility of operating in the presence of strong r.f. fields, particular attention has been paid to efficient filtering and screening of the detector circuit. The detector circuit employs a silicon crystal and is tuned by a resonant cavity with micrometer-controlled plunger.

SPECIFICATION

Frequency range
1,700 to 2,300 Mc/s.

Characteristic impedance
50 ohms.

Residual V.S.W.R.
Better than 1·05.

Probe carriage movement
The probe carriage has a range of movement of 16·5 cm. Carriage position relative to each end is indicated on a scale calibrated in millimetres.

Probe characteristics
Silicon-crystal diode. R.F. input to the correctly terminated line required to produce 10 μV e.m.f. rectified signal varies between about 120 μW at 1,700 Mc/s to about 20 μW at 2,300 Mc/s. Variation of probe coupling with carriage movement does not exceed 0·2 dB.

Dimensions and weight

Height	*Width*	*Depth*	*Weight*
5½ in (14 cm)	12½ in (32 cm)	5½ in (14 cm)	7 lb (3·2 kg)

Accessories supplied
Coaxial Free Plug, Miniature Pye Type 732560; for detected output.
Two *Coaxial Free Connectors*, Marconi u.h.f. pattern, with locating rings and socket/plug adaptor pins.

Accessories available
50-ohm Coaxial Termination TM 5684; Marconi u.h.f. pattern connector.

Marconi Instruments Ltd.
St. Albans, Hertfordshire, England

MARCONI INSTRUMENTS

V.S.W.R. Indicator

Type TF 1289

7075

- **Direct indication of v.s.w.r.**
- **Measurement ranges of 1·25, 3, and 10 full-scale**
- **Noise level less than 0·05 μV**
- **Sensitivity range: 1·5 μV to 4·5 mV**

THE TF 1289 is a high-gain audio amplifier giving a direct indication of standing-wave ratio when used in conjunction with a slotted waveguide or coaxial section. Its three switched v.s.w.r. ranges of 1·25, 3, and 10 full-scale provide excellent discrimination and allow measurement of v.s.w.r.'s of better than 1·02.

The intermediate range is also calibrated in decibels to allow the instrument to be used as a sensitive detector for general slotted-section measurements.

The meter is calibrated for use with slotted sections, such as the Marconi TF 1264, which employ a square-law detector. Suitable amplitude-modulated energizing sources for u.h.f. and s.h.f. slotted sections are the Marconi Signal Generators TF 1060, TF 1145, TF 1058 and TF 1061.

APPLICATIONS

In conjunction with a slotted section, the TF 1289 can be used for investigation of transmission-line characteristics, aerial matching, or impedance measurement of waveguide or coaxial components.

Stepped and fine gain controls, together with high- and low-level inlets, give a sensitivity range of 1·5 μV to 4·5 mV, while the residual noise level of less than 0·05 μV ensures that optimum performance is maintained at the lowest inputs. The amplifier output is available at a panel socket for use with an external detector, oscilloscope, or other monitoring device.

FEEDBACK AMPLIFIER

The Indicator comprises a six-stage 1,000-c/s amplifier feeding one of three switch-selected detector circuits; the detected output is displayed on the panel meter which is calibrated in v.s.w.r. During operation, the amplifier gain is adjusted for standard deflection when the slotted-section probe coincides with a standing-wave peak; with the probe moved to a trough, the v.s.w.r. can be read directly from the meter.

The amplifier gain is controlled by interstage potentiometers and its bandwidth is restricted to 40 c/s by frequency-selective feedback. Input voltages are fed to the amplifier via high- or low-level inlets as required; these inlets have input impedances of 1 MΩ and 10 kΩ respectively.

Each detector circuit has a characteristic which produces a good open scale for the range in which it operates. The detector crystals are protected against overload by gas-filled stabilizer valves.

The indicator operates from normal a.c. mains and has a built-in regulated power unit.

SPECIFICATION

Centre frequency
1,000 c/s ±2%.

Pass-band
3-dB bandwidth is approx. 40 c/s.

V.S.W.R. measurement range
1 to 10 in three ranges with maximum indications of 1·25, 3, and 10. Intermediate range also calibrated in dB. Accuracy: ±5% of v.s.w.r. reading on intermediate range.

Sensitivity
LOW INLET: 1·5 μV for f.s.d. with maximum gain.
HIGH INLET: 15 μV for f.s.d. with maximum gain.

Input impedance
LOW INLET: Approx. 10 kΩ.
HIGH INLET: Approx. 1 MΩ.

Noise
Less than 0·05 μV referred to low inlet.

Power supply
200 to 250 volts, or 100 to 150 volts after adjusting internal link; 40 to 100 c/s; 100 watts. Models supplied ready for immediate 100- to 150-volt use if specified at time of ordering.

Dimensions and weight

Height	*Width*	*Depth*	*Weight*
11½ in (29 cm)	20½ in (52 cm)	12 in (30 cm)	28 lb (12·7 kg)

Accessories supplied
Two *Coaxial Free Plugs*, Type BNC; for input or output sockets.

Marconi Instruments Ltd.
St. Albans, Hertfordshire, England

MARCONI INSTRUMENTS

Transistorized V.S.W.R Indicator

Type TF 1291

6977

- **Direct indication of v.s.w.r.**
- **Measurement ranges: 1 to 3 and 3 to 10**
- **Transistorized: no external power supplies required**
- **Lightweight and compact**

THE TF 1291 is a high-gain 1,000-c/s amplifier giving a direct indication of standing-wave ratio when used with slotted waveguide or coaxial sections employing a square-law detector. Its two v.s.w.r. ranges of 1 to 3 and 3 to 10 permit measurements of v.s.w.r. down to 1·05.

An additional facility is a calibrated decibel scale which allows the instrument to be used as a sensitive detector for general slotted-section measurements.

The meter is calibrated for use with slotted sections such as the Marconi TF 1264. Suitable amplitude modulated energizing sources for u.h.f. and s.h.f. slotted sections are the Marconi Signal Generators TF 1058, TF 1145, TF 1060 and TF 1061.

Three stages of amplification are employed to give a sensitivity of approximately 10 μV for f.s.d. with the gain control at its maximum setting. A noise figure of less than 0·5 μV is obtained by restricting the emitter current in the first amplifier stage to a low level.

The internal power supply is provided by either conventional dry batteries or mercury batteries.

APPLICATIONS

The V.S.W.R. Indicator can be used with any slotted section whether coaxial or waveguide. Its principal application is as an indicator in the investigation of transmission line mismatch and reflection coefficient, impedances of waveguide components, and aerial reflection characteristics. Its convenient direct-reading indication also makes it suitable for production-line testing.

Lightweight and compact, independent of external power supplies and able to withstand rough usage, it is particularly suitable for measurements in the field.

TRANSISTOR AMPLIFIER

The Indicator comprises a three-stage 1,000-c/s transistor amplifier feeding an emitter follower and a detector; the detected output is displayed on the panel meter which is calibrated in v.s.w.r. During operation, the amplifier gain is adjusted for full-scale deflection when the slotted-section probe coincides with a standing-wave peak; with the probe moved to a trough, the v.s.w.r. can be read directly from the meter.

Amplifier gain is controlled by a single potentiometer and the bandwidth is restricted to approximately 50 c/s by an L-C tuned collector load in each of the three amplifier stages. A 19-dB interstage attentuator, switched in or out, provides the stepped control of gain necessary for the two v.s.w.r. ranges. The 1,000-c/s signal from the slotted-line crystal detector is fed to the amplifier via a 10-kΩ coaxial inlet.

BATTERY SUPPLY

The Indicator operates from internal dry batteries, using one 7·5-volt and one 3-volt battery. Alternatively, two 4-volt mercury batteries may be used where particularly arduous operating conditions are likely to be encountered.

SPECIFICATION

Centre frequency
1,000 c/s ±1%.

Pass band
3-dB bandwidth is approx. 50 c/s.

V.S.W.R. measurement range
TWO RANGES: 1 to 3 and 3 to 10. Also calibrated 0- to 10-dB scale.
ACCURACY: 3% for v.s.w.r.'s up to 1·5, 6% for v.s.w.r.'s between 1·5 and 5.

Sensitivity
Approx. 10 μV for f.s.d. with maximum gain.

Input impedance
10 kΩ.

Noise
Less than 0·5 μV referred to input.

Power supply
One 7·5-volt dry battery and one 3-volt dry battery,
or
Two 4-volt mercury batteries (Mallory Type TR-133R).

Dimensions and weight

Height	*Width*	*Depth*	*Weight*
7½ in (19 cm)	10 in (25·4 cm)	6 in (15·9 cm)	5 lb (2·3 kg)

Accessories supplied
One *Coaxial Free Plug*, Type BNC, for front panel input socket.
Set of *Batteries* comprising one 7·5-volt dry battery (Drydex Type H 1187) and one 3-volt dry battery (Drydex Type DL 323).

Marconi Instruments Ltd.
St. Albans, Hertfordshire, England

ACCESSORIES

D.C. CHOKE ADAPTOR

7433

TM 6113 — For use with TF 868B and TF 1313. Enables d.c. currents up to 200 mA from an external supply to be passed through inductors under test in the range 100 mH to 100 H; errors introduced by the adaptor do not generally exceed 3%.

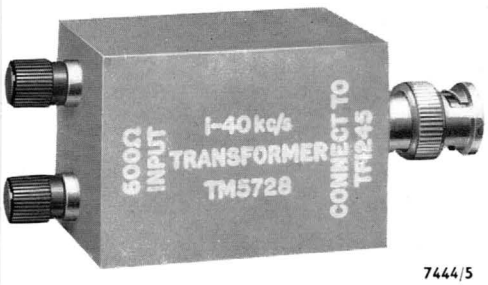
V.H.F. BRIDGE OSCILLATOR

TF 1274 — For use with TF 978. This bridge energizing source covers the range 30 to 300 Mc/s with an accuracy of 2%; the output level varies with frequency to suit the requirements of the bridge, and is squarewave modulated at 1 kc/s. Supplied complete with coaxial connecting lead.

V.H.F. BRIDGE DETECTOR

TF 1275 — For use with TF 978. This is a super-regenerative receiver with the same frequency range and accuracy as TF 1274, and can detect inputs down to a few microvolts. Supplied complete with coaxial connecting lead.

MATCHING TRANSFORMER



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TM 5728 — For use with TF 1245. Enables a conventional oscillator with 600-ohm output to be coupled to the l.f. test circuit for the range 1 to 40 kc/s.

40-kc/s to 50-Mc/s OSCILLATOR

TF 1246 — For use with TF 1245. Used for the range 40 kc/s to 50 Mc/s on the l.f. test circuit; an optional Matching Unit TM 5726 enables oscillator to be used as a 50-ohm general purpose source.

20- to 300-Mc/s OSCILLATOR

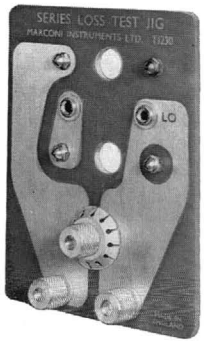
TF 1247 — For use with TF 1245. Used for the range 20 to 300 Mc/s on the h.f. test circuit; an optional Matching Unit TM 5727 enables oscillator to be used as a 50-ohm general purpose source.

DIELECTRIC LOSS TEST JIGS

TJ 155 B/1 and TJ 155 C/1 — For use with TF 1245. Primarily designed for dielectric loss measurements on insulating materials, but can also be used to give small accurately known changes in tuning capacitance; 'B/1' is calibrated in thousandths of an inch, 'C/1' in millimetres.

ACCESSORIES

SERIES LOSS TEST JIG



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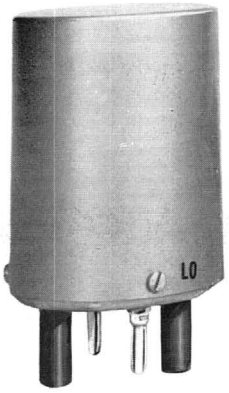
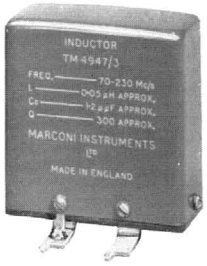
TJ 230 — For use with TF 1245. Enables the measurement of small values of R and L and large values of C to be made by connecting them in series with the test circuit of the Q Meter.

INDUCTORS



7444/6



For use with TF 1245.

TM 1438 (Series) — For l.f. test circuit. A series of eighteen fully screened inductors; values ranging from 0·2 μH to 25 mH. Available separately, or as a complete set, Type TM 4520, in a polished hardwood case.

TM 4947 (Series) — For h.f. test circuit. Three fully screened inductors fitted with spade-lug connectors for the h.f. test circuit terminals.

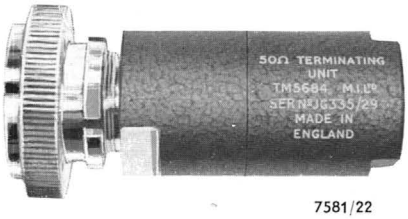
A more complete description of the accessories for TF 1245 is included in the description of TF 1245.

CAPACITORS FOR LIQUIDS

TJ 228 — For use with TF 704B. Allows measurement of permittivity and power factor of liquid dielectrics at temperatures up to 80°C; consists, basically, of two coaxial cylindrical electrodes with radial clearance of 2 mm.

TJ 228/1 — For use with TF 704B. Similar to TJ 228 but with 1 mm. electrode spacing.

50-ohm COAXIAL TERMINATION



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TM 5684 — For use with TF 1264. A matched termination for the Slotted Line, with Marconi u.h.f. pattern connector.