DANBRIDGE DENMARK

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UNIVERSAL BRIDGE TYPE UB 1

INEXPENSIVE

FLEXIBILITY OF MEASUREMENTS

RELIABLE

This bridge may by used in conjunction with a few accessories for most of the usual d-c and a-c measurements. By means of the various switches and shorting straps provided the bridge circuit may be adjusted for the measurement of e.g. resistance, capacitance and power factor, self inductance and effective resistance, mutual inductance, Q factor, frequency, turns ratio, resonant resistance etc.
The bridge is, therefore, especially useful in laboratories, where occasionally measurements have to be carried out, which do not warrant the expense of the more specialised types ot bridges. The accuracy of measurement is sufficient for all but the most exacting work.
All the necessary instructions, circuit diagrams and formulas for the different measurements are included with the instrument.

SPECIFICATION

RANGE

R. 1 milliohm–10 Megohms.
L: 1 microhenry–1 Henry.
C: 1 picofarad–100 microfarads.

FREQUENCY

0-20 kHz.

BASIC ACCURACY

R: ½% or 2 m Ω.
L: 1% or 2 μH at 1 kHz.
C: 1% or 2 pF at 1 kHz.
The actual accuracy obtained on a-c measurements will depend on the various earth-admittances of generator, detector, measuring object and the bridge circuit itself. Thus it is not possible to give exact figures for the total accuracy.

CONSTRUCTION

A normal 4 arm bridge consisting of: 2 sets of ratio resistors, a 4 decade resistor, standard capacitor, and switch with limiting resistors for battery or generator.

RATIO RESISTORS

Adjustable to 0—1—10—100—1000—10000 ohms. Accuracy 0.2%. Maximum dissipation 1 watt.

4-DECADE RESISTOR

10×0.1–10×100 ohms, accuracy 0.2% except 10×0.1 ohms decade accuracy 3 %. Maximum dissipation 1 watt per resistor.

STANDARD CAPACITOR

Value 0.1 microfarad, Accuracy 0.2%, dissipation factor about 10^{-4}.

the blue line instruments.....

GENERATOR SWITCH

Switches the bridge source either direct or in series with limiting resistors of 100 or 10000 ohms respectively.

ACCESSORIES REQUIRED

A suitable power source (batteries for d-c – audio oscillator for a-c measurements). Detector (galvanometer for d-c – headphones, amplifier-detector or oscilloscope for a-c measurements).
Decade resistance boxes for dissipation balance in a-c measurements.

TERMINALS

Terminals are provided for: L, C, R, the 0.1 μF standard, and for generator and detector. The terminals not in use are shorted by means of the shorting straps supplied. A separate terminal is provided for earthing the metal cabinet, which serves as a capacitive shield. Screw terminals with hole for 4 mm banana plug. Terminal spacing 19 mm (¾ in.).

MOUNTING

Cabinet in blue plasticcoated aluminium with end castings in blue-grey enamel. Top panel finished in light-grey enamel.

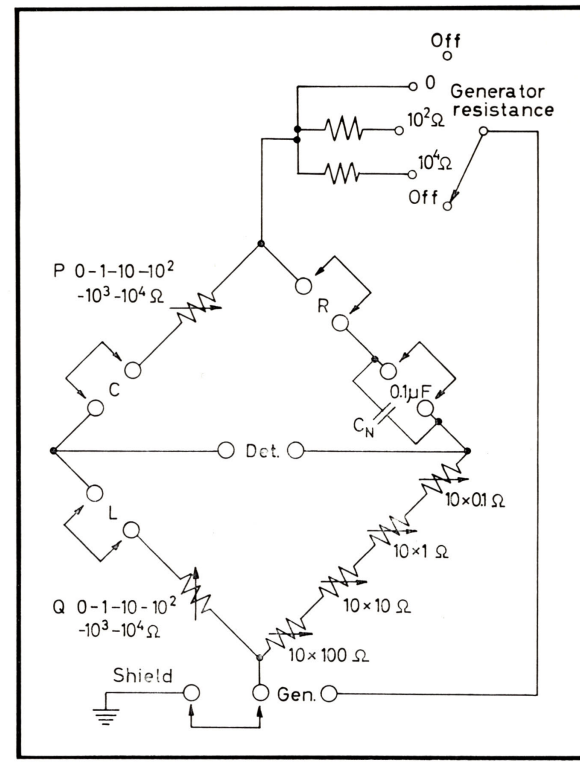
DIMENSIONS

120 high × 150 × 340 mm.
(4¾ high × 6 × 13½ in.).

WEIGHT

2.2 kilos.

FUNCTIONAL DIAGRAM



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TELEX: 19775

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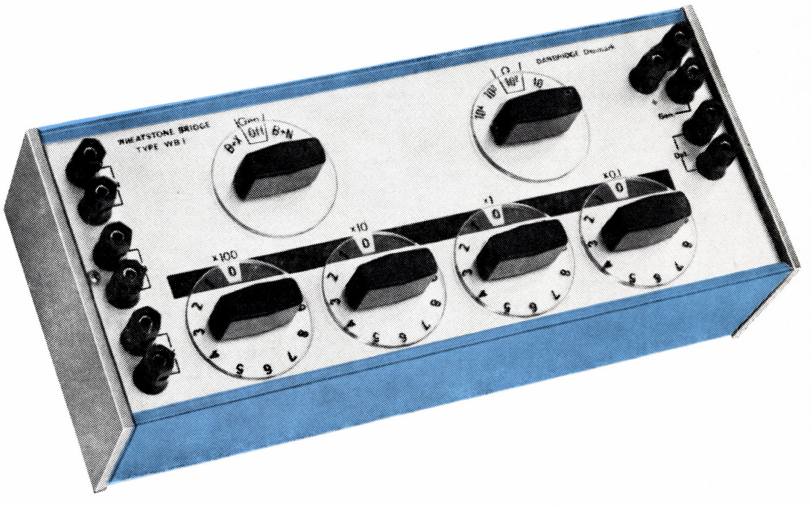
WHEATSTONE BRIDGE
TYPE WB 1

INEXPENSIVE
RELIABLE
GOOD ACCURACY
VERSATILE



For the commonly occuring measurements of R-L-C-M etc. this bridge is very useful. It contains the two arms of a Wheatstone bridge viz. a ratio resistor adjustable in decade steps and a four-section decade resistor.
Thus the accessories required are suitable standards besides a generator and zero-indicator, which latter are available in most laboratories.

SPECIFICATION

RANGE AND ACCURACY

Depending on the standards available.

FREQUENCY RANGE

0–20 kHz.

CONSTRUCTION

The bridge consists of a 4-section decade resistor, the ratio resistor and a switch for the generator and balance resistor with necessary terminals and connections for making up a complete Wheatstone bridge circuit.

DECADE RESISTOR

Range 10×0.1 ohms–10×100 ohms. Accuracy 0.2% except 10×0.1 ohms 3%.

RATIO RESISTOR

Adjustable to 1—10—100—1000—10000 ohms. Accuracy 0.2%.

DISSIPATION

1 watt for each resistor in circuit.

BATTERY SWITCH

Switches the terminal connections for the balancing resistor in series with the terminals for either the unknown or the standard. The third position switches the generator off.

TERMINALS

5 sets of terminals are provided, viz. for the unknown, standard, balancing resistance, generator and zero indicator.
The metal cabinet is connected to a separate terminal and serves as a capacitive shield.
The terminals are screw terminals with hole for 4 mm banana plugs. Terminal spacing ¾" (19 mm).

ACCESSORIES REQUIRED

Suitable standards, generator (for d-c measurements batteries) and zero indicator (for a-c measurement

telephones, amplifier with indicator or oscilloscope, for d-c measurements galvanometer).
For a-c measurements a variable resistor is necessary for use as a balancing resistor when measuring L-C-M etc.

CIRCUIT DIAGRAMS

The instrument is supplied complete with circuit diagrams of various bridge arrangements for measuring R, C and L etc.

MOUNTING

Cabinet in blue plasticcoated aluminium with end castings in blue-grey enamel. Top panel finished in light-grey enamel.

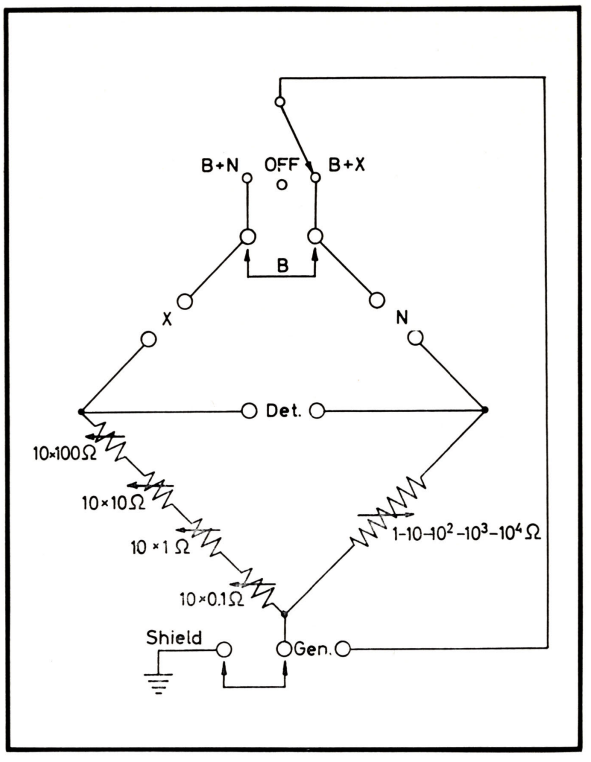
DIMENSIONS

120 high × 150 × 340 mm.
(4¾ high × 6 × 13½ in.).

WEIGHT

2.1 kilos.

FUNCTIONAL DIAGRAM



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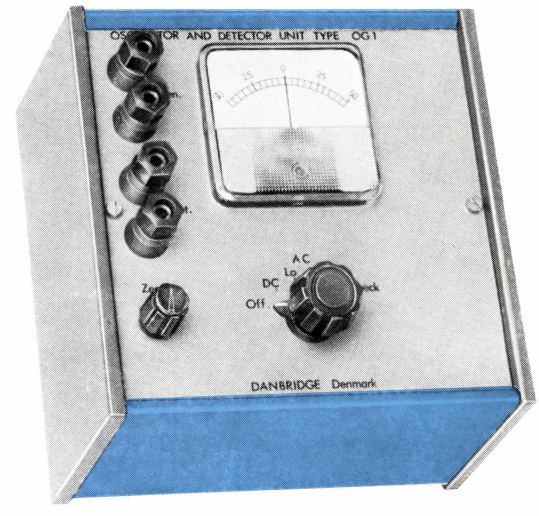
OSCILLATOR AND DETECTOR UNIT TYPE OG 1

FOR AC OR DC MEASUREMENTS
SELFCONTAINED
HIGH SENSITIVITY
UNIVERSAL APPLICATION



Although especially designed for use with our bridges type UB1 and WB1, this instrument may be used with other types of bridge and for various other applications.

GENERAL DESCRIPTION

A 1 kc oscillator provides the supply for AC measurements. For DC measurements, direct battery supply is used.

The detector for AC measurements employs a 3-stage amplifier driving the indicating meter via a rectifier circuit. Negative feedback through a diode circuit provides approximately logarithmic meter response over a wide input range. This facilitates balance adjustment on bridges at large unbalance. For DC measurements the input is applied to a 2-stage differential amplifier with the meter connected between the outputs. A zero control is provided for setting meter zero.

Protective circuits are included on both AC and DC circuits, so that it is impossible to damage either meter or circuitry even by gross overload e. g. when using external high voltage supplies. Two 4.5 V flash lamp batteries provide supplies for the circuits. One battery supplies the detector circuits and provides approximately 2000 hours of operation. The second battery drives the generator and on AC about 200 hours of operation are obtained. Facilities are provided for checking the batteries.

SPECIFICATION

DC BRIDGE SUPPLY

4.5 V battery through 10 Ω limiting resistor.

DC DETECTOR

Sensitivity 2.5 mV full scale.
Input resistance 0.5 MΩ.

AC GENERATOR

Frequency 1 kc ± 10 %.
High output: 2 V open circuit, 1 V with 100 Ω load.
Low output: 0.7 V open circuit, 0.3 V with 10 Ω load.
Output floating.

AC DETECTOR

Sensitivity about 100 μV for 10 % of meter full scale.
Approximately logarithmic meter deflection from 200 μV to 100 mV (full scale).
Input impedance: 5 kΩ.

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CONTROLS ETC.

Function switch, 6 positions:
Off, DC, AC low, AC high, check 1, check 2.
Zero adjustment for DC detector.
2 terminals for supply output.
2 terminals for detector input.
Center zero meter for balance indication.

BATTERIES

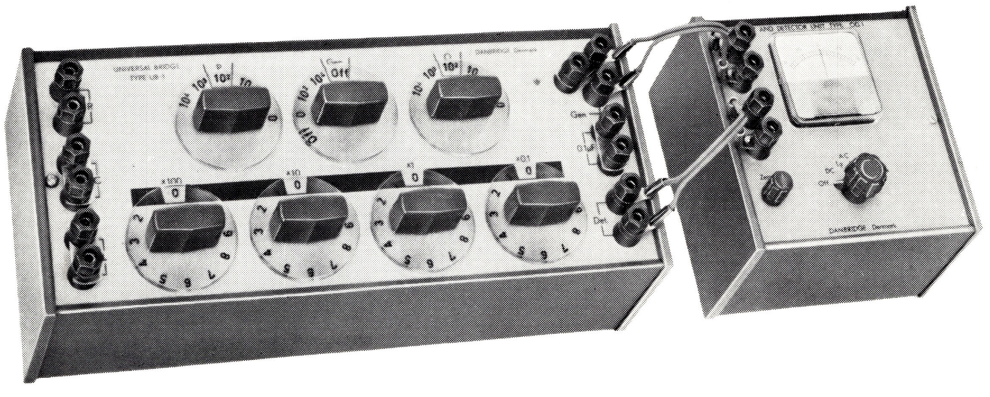
2 off 4.5 V flat type Burgess No. 532 or equivalent.

DIMENSIONS

120 high × 150 × 150 mm
(4¾ high × 6 × 6 in.)

WEIGHT

1.3 kg (2 lb 14 oz).



Oscillator and Detector Unit type OG 1 used to operate the Danbridge Universal Bridge type UB 1.

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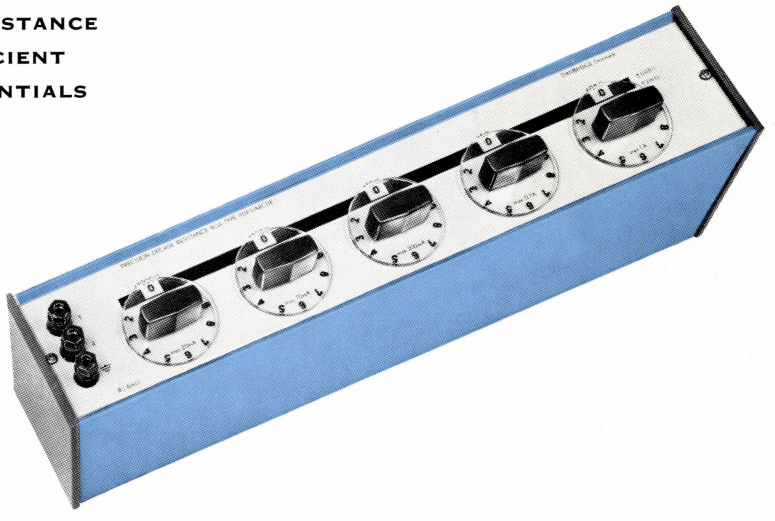
PRECISION DECADE RESISTANCE BOXES TYPE PDR

IN-LINE READING
HIGH ACCURACY
EXTREMELY LOW ZERO RESISTANCE
LOW TEMPERATURE COEFFICIENT
NEGLIGIBLE THERMAL POTENTIALS



These decade resistors are designed for use in cases where a better accuracy is required than that obtained in our type DR. The resistors employed are wound on cards of a material with excellent stability against temperature and humidity variations, and the winding methods are chosen to provide the lowest possible residual reactance values for the different resistance values.
The resistors are specially aged and checked over long periods to ensure the highest possible stability. The switches employ hard silver contacts providing eight separate contact points in parallel in each position. Thus an extremely low and constant switch resistance (about 1 milliohm per decade with variations less than 0.2 milliohms) is obtained. These values are maintained for long periods of use.
Each decade comprises 11 units, thus providing an overlap which in many cases is very valuable e.g. when balancing bridge circuits. The resistance decades have no connection to the shielding box, on which a separate earth terminal is provided.
The boxes are available with 5 and 6 decades in values from 11×0,1 ohms to 11×10000 ohms as required.

SPECIFICATION

WINDING MATERIEL

Manganin except for 10000 ohm resistors, where Centanin is employed.

TEMPERATURE COEFFICIENT

Less than 0.002% per degree centigrade between 15 and 35 degrees centigrade.

THERMAL EMF

About 1 μV per degree centigrade.

STABILITY

The stability of resistance value is normally better than 0.02% per year.

MAXIMUM DISSIPATION

0.5 watt continuous per resistor. For short periods (about 1 minute) 1 watt per resistor. These ratings correspond to a temperature rise of less than 40 degrees centigrade. The currents corresponding to the maximum dissipation of 0.5 watt per resistor are marked on the top panel.

MAXIMUM PEAK VOLTAGE

500 volts between terminals and from terminals to box.

RESIDUAL IMPEDANCE

Zero resistance: 1 milliohm per decade plus 1 milliohm common lead resistance. Total zero resistance is stated on the top panel.
Zero inductance: 0.1 μH per decade.

Shunt capacitance: The total effective shunt capacitance depends on the method of connecting the shield box.
If the capacitance to shield may be eliminated, which is possible e.g. in certain bridge circuits, the effective shunt capacitance attains the lowest possible value and is of the order of 5 pF to 10 pF.
With the shield connected to the upper terminal (marked 1) the total shunt capacitance is 15 pF per decade counting from the highest value decade employed to and including the lowest value decade in the box.
Wen the shield is connected to the lower terminal (marked 2) the shunt capacitance is 15 pF per decade counting from the highest value decade to and including the highest value decade employed.
The residual impedances obtained from the above figures should be used in conjunction with the residuals stated in the table below for the various decade units in order to obtain the total residuals at the terminals.

SWITCHES

Wafer type switches with hard silver contacts providing 8 contacts per position.

TERMINALS

Screw terminals with hole for 4 mm banana plugs. A separate earth terminal is provided. Terminal spacing 3/4" (19 mm).

MOUNTING

Cabinet in blue plasticcoated aluminium with end castings in blue-grey enamel. Top panel finished in light-grey enamel.

SPECIFICATION OF DECADE UNITS

Resistance code	Value ohms	Accuracy	Winding form	Effective series inductance	Max. current or voltage
A	11 × 0.1	2 m Ω	Bifilar loop	0.05 μH per step	1 A
B	11 × 1	0.03 % + 2 m Ω	Ayrton-Perry on cards	0.07 μH per step	0.7 A
C	11 × 10	0.03 %	Ayrton-Perry on cards	0.1 μH per step	200 mA
D	11 × 100	0.03 %	Ayrton-Perry on cards	1 × 100 Ω 0.5 μH 3 × 100 Ω 1 μH 10 × 100 Ω 0 μH	70 mA
E	11 × 1000	0.03 %	Unifilar on cards	1 × 1000 Ω 20 μH 3 × 1000 Ω 0 μH 10 × 1000 Ω ± 200 μH	20 mA
F	11 × 10000	0.03 %	Unifilar on cards	determined by circuit capacitance	7 mA or 500 V

SPECIFICATION OF DECADE BOXES

Type	Number of decades	Zero resistance ohms	Total dimensions	Net weight kilos
PDR 5	5	0.006	165 high × 95 × 459 mm 6½ high × 3¼ × 18 in	2.4
PDR 6	6	0.006	165 high × 95 × 459 mm 6½ high × 3¼ × 18 in	2.6

Please order by type and resistance code

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DECADE RESISTANCE BOXES TYPE DR

- IN-LINE READING
- WIDE RANGE OF VALUES
- SMALL DIMENSIONS
- GOOD ACCURACY
- HIGH DISSIPATION
- LOW RESIDUALS

These shielded decade resistance boxes are accurate enough for general laboratory use, for educational purpose and whereever electrical measurements are made. They are useful e.g. for determination of optimum resistance values in electric circuits, as subsidiary resistance standards and for balancing purposes in bridge measurements etc.
On account of their small dimensions these decade boxes may be used at high frequencies – for values below 5000 ohms up to about 500 kHz.
They are supplied with from 3 to 6 decades and in values from 0.1 ohms to 10 megohm as required.

SPECIFICATION

DISSIPATION

Max. 1 watt continuous for each resistor. For short periods (about 1 minute) the permissible dissipation is double the above values.

MAXIMUM PEAK VOLTAGE

500 volts between terminals and from terminals to box.

RESIDUAL IMPEDANCE

Zero resistance: 0.003 to 0.004 ohms per decade. Total zero resistance is stated on the top panel.
Zero inductance: 0.1 μH per decade.
Shunt capacitance: The total effective shunt capacitance depends on the shield connection.
With the shield unconnected the capacitance is from 5 to 15 pF.
When the shield is connected to the lower terminal the total capacitance is about 12 pF per decade counting from the highest decade employed to the lowest decade in the box.
With the shield connected to the upper terminal the total capacitance is 12 pF per decade counting from the highest decade in the box and including the highest decade in circuit.
The residual impedances should be added to the residuals stated in the table overleaf for the different decade units in order to obtain the total residuals at the terminals.

SWITCHES

Wafer type switches with silver contacts and high quality insulation.

TERMINALS

Screw terminals with hole for 4 mm banana plugs. A separate earth terminal is provided. Terminal spacing ¾″ (19 mm).

MOUNTING

Cabinet in blue plasticcoated aluminium with end castings in blue-grey enamel. Top panel finished in light-grey enamel.

SPECIFICATION OF DECADE UNITS

Resistance code	Value ohms	Accuracy %	Material Winding	Inductance	Max. current or voltage
A	10 × 0.1	0.5 + 3 m Ω	Manganin Hairpin	0.05 μH per step	3 A
B	10 × 1	0.3 + 3 m Ω	Manganin Ayrton-Perry on card	1 × 1 ohm 0.2 μH 3 × 1 ohm 0.5 μH 10 × 1 ohm 1 μH	1 A
C	10 × 10	0.1	Manganin Ayrton-Perry on card	1 × 10 ohm 0.4 μH 3 × 10 ohm 0.8 μH 10 × 10 ohm 1.5 μH	0.3 A
D	10 × 100	0.1	Manganin Ayrton-Perry on card	1 × 100 ohm 0.5 μH 3 × 100 ohm 1 μH 10 × 100 ohm 0 μH	100 mA
E	10 × 1000	0.1	Manganin Ayrton-Perry on card	1 × 1000 ohm 3 × 1000 ohm *) 10 × 1000 ohm	30 mA
F	10 × 10000	0.1	Centanin on card	*)	10 mA 500 V
G	10 × 100000	1	High Stability Metallised	*)	3 mA 500 V
H	10 × 1 M	2	High Stability Metallised	*)	500 V

*) For values above 1000 ohms the residuals are mainly determined by the effective shunt capacitance in the box as detailed previously

SPECIFICATION OF DECADE BOXES

Type	Number of decades	Zero resistance ohms	Total dimensions	Net weight kilos
DR4	4	0.014	115 × 85 × 305 mm	1.2
DR5	5	0.018	115 × 85 × 367 mm	1.4
DR6	6	0.021	115 × 85 × 430 mm	1.7

PLEASE ORDER BY TYPE AND RESISTANCE CODE

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DECADE RESISTANCE BOXES
TYPE CDR (1 %)

- INEXPENSIVE
- IN-LINE READING
- HIGH DISSIPATION
- HIGH RELIABILITY
- WIREWOUND RESISTORS
- SMALL DIMENSIONS

These inexpensive decade resistance boxes are very suitable for elementary education and for purposes, where the application of more accurate, more delicate, and more expensive decade resistance boxes are not required.
The instruments are robustly built, use switches of high quality, and are designed to withstand hard use by untrained persons. Educational establishments will appreciate these facts together with the high permissible dissipation of the resistors used, which are wirewound resistors similar to those employed in the Danbridge decade resistance boxes types DR and PDR. Types DR and PDR are used when greater accuracy is required – the accuracy is 0.1 % for type DR and 0.03 % for type PDR.

SPECIFICATION

DISSIPATION

Max. 2 watt continuous for each resistor.

MAXIMUM PEAK VOLTAGE

500 volts between terminals and from terminals to box.

ZERO RESISTANCE

20 to 50 mohms.

SWITCHES

Wafer type switches with silver plated contacts.

RANGE

Four or six decades with specification as below.
CDR4/BCDE: 10 x 1 ohm to 10 x 1,000 ohms.
CDR4/DEFG: 10 x 100 ohms to 10 x 100,000 ohms
CDR6/BCDEFG: 10 x 1 ohm to 10 x 100,000 ohms.

Code	Value ohms	Accuracy	Max. current or voltage	Resistor type
B	10 x 1	2 %	1.4A	Wirewound
C	10 x 10	1 %	0.45A	Wirewound
D	10 x 100	1 %	0.14A	Wirewound
E	10 x 1,000	1 %	0.045A	Wirewound
F	10 x 10,000	1 %	0.014A	Wirewound
G	10 x 100,000	1 %	500 volt	Deposited carbon

TERMINALS

Screw terminals with hole for 4 mm banana plugs. A separate earth terminal is provided. Terminal spacing ¾" (19 mm).

MOUNTING

Cabinet in blue plasticcoated aluminium with grey end castings. Top panel finished in light-grey enamel.

DIMENSIONS AND WEIGHT

Types CDR4: 115 x 85 x 305 mm.
Weight 1.2 kilos.
Type CDR6: 115 x 85 x 430 mm.
Weight 1.7 kilos.

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DECADE ATTENUATORS TYPE DA3

- IN-LINE READING
- GOOD ACCURACY
- DECADE SWITCHING
- EFFICIENT SHIELDING
- WIDE RANGE OF ATTENUATION

These instruments are designed to provide accurately known values of attenuation, which may be varied in steps. They are very useful for tests on communication circuits, amplifiers, filters etc. They are designed as 4-terminal networks with constant and equal values of input and output impedance at all settings. Either unbalanced T-networks or balanced H-networks may be supplied. The lower value decades are designed as bridged-T networks allowing practically noiseless switching for fine adjustment. The highest value decade employs switched T-pads for the 5 lowest positions. On the 5 higher positions a further 5-unit pad is switched in series. The various sections of the highest value decade pads are shielded mutually so that stray coupling is eliminated and the attenuation accuracy is maintained over a wide frequency range. The shielding is completed by enclosing each decade in a separate shield box. Wafer type switches are employed with hard silver contacts requiring a minimum of attention over long periods. The H-type pads comprise 2 T-pads with a common neutral lead brought out to separate terminals. The attenuators may thus be employed in several ways, e.g. with the common line floating or earthed. In the latter case one of the half-sections of the attenuator may be employed as an unbalanced T-network with a characteristic impedance half the value of that of the balanced network. The individual resistors are wound with manganin wire on cards with non-inductive windings for the lower values to reduce reactive effects. For values above 3000 ohms high-stability carbon resistors are employed.

SPECIFICATION

RANGE

Two standard types are available, an unbalanced T type and a balanced H type. Decade values are 10×0.1 dB, 10×1 dB and 10×10 dB.

IMPEDANCE

The characteristic impedance of both types is 600 ohms ± ½ % in both directions.

ACCURACY

All resistors below 3000 ohms are adjusted to ± ½ % except the series resistors on the lowest value decade which are ± 1%.
Resistors above 3000 ohms are carbon-film resistors with an accuracy of ± 2% to ± 5%.
Attenuation accuracy at frequencies up to 50 kHz is ± ½% of the indicated value ± 0.01 dB up to 50 dB. Above 50 dB add ± 0.1 dB.
At frequencies up to 300 kHz and attenuation settings up to 80 dB accuracy is ± 1% of the indicated value ± 0.02 dB.
For type DA3HS/D the accuracy is better than ± 1% at all settings up to 300 kHz.

INPUT DISSIPATION

max. 1 watt.

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TERMINALS

2 input and 2 output terminals are provided. The shield is connected to a separate terminal. In the T-section types this may be connected to the common neutral terminal by a strap. In the H-types, the center points of the sections are connected and brought out to a terminal, which may likewise be connected to the shield. The terminals are screw terminals with hole for 4 mm banana plugs. Terminal spacing ¾" (19 mm).

MOUNTING

Light-weight cabinet in blue plasticcoated aluminium with end castings in blue-grey enamel. Top panel finished in light-grey enamel.

SPECIAL TYPES

Decade Attenuators with 2 decades calibrated in dB or with 2 or 3 decades calibrated in Neper may be supplied to order if reasonable quantities are required.

STANDARD TYPES

Type	Network	Range	Smallest Step	Total Dimensions	Net weight kilos
DA3T/D	Unbalanced T	111 dB	0.1 dB	165 high × 95 × 383 mm 6½ high × 3¾ × 15 in.	3.1
DA3HS/D	Balanced H	111 dB	0.1 dB	165 high × 95 × 383 mm 6½ high × 3¾ × 15 in.	3.2

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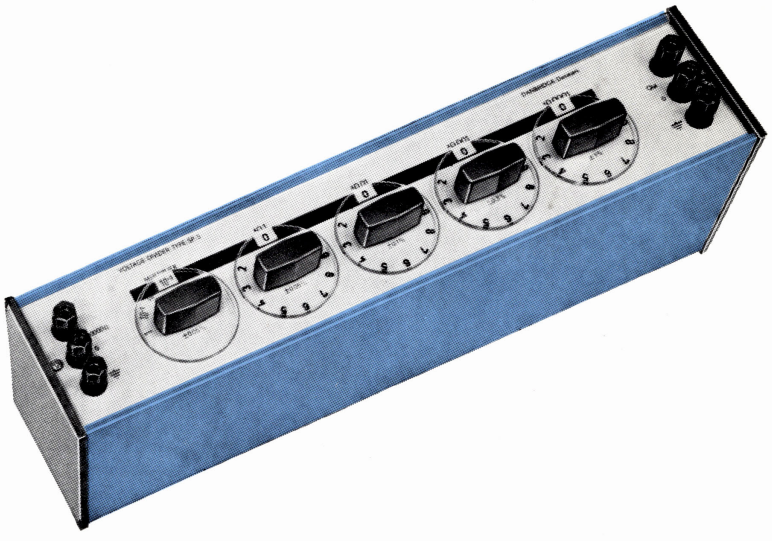
VOLTAGE DIVIDER TYPE SP5

IN-LINE READING
HIGH ACCURACY
HIGH RESOLUTION
STEPS OF 0,1 PPM



This instrument is designed to provide accurately known voltage ratios over a very wide range.
The input voltage is applied to a 4-step divider with steps giving ratios of 1, 0.1, 0.01 and 0.001 of the input. This divider is followed by a 4-decade Kelvin-Varley divider with resolution of 0.01 % of input. Thus even at low ratios a high resolution is obtained (smallest step 0.1 ppm of input).
Carefully aged and checked wirewound resistors of low TC material are employed in the circuit. Temperature variations cause insignificant variations in the voltage ratios, as the resistors have nearly equal TC's.

SPECIFICATION

VOLTAGE RATIO RANGE

Decade Multiplier: 4 steps. Ratios 1, 0.1, 0.01 and 0.001 of input. Kelvin-Varley Divider: Ratios from 0 to 1 in steps of 0.0001 of input switched in 4 decades: 10× 0.0001, 9×0.001, 9×0.01, and 9×0.1.

Resultant ratio is multiplier setting multiplied by Kelvin-Varley setting.

ACCURACY

± 0.02 % of indicated ratio for ratios from 0.1 to 1.0 and for multiplier ratios of 1, 0.1 and 0.01.
± 0.05 % for ratios 0.01 to 0.09 and multiplier ratio 0.001.
± 0.1 % for ratios 0.001 to 0.009.
± 1 % for ratios 0.0001 to 0.001.

Additional error for zero setting with multiplier × 1 less than 0.3 ppm of input measured between output terminals.

INPUT RESISTANCE

10.000 Ω ± 0.03 %

OUTPUT RESISTANCE

With a low source resistance the output resistance varies from zero at ratios 0.0000 and 1.0000 to max. 3.000 Ω at ratios of 0.5.

FREQUENCY ERROR

With output load of 100 pf error less than 0.2 % up to 30 KHz.

MAXIMUM INPUT VOLTAGE

100 V DC or AC.

SWITCHES

Wafer type switches with double silver contacts.

TERMINALS

Screw terminals with hole for 4 mm banana plugs. A separate earth terminal is provided. Terminal spacing ¾" (19 mm).

MOUNTING

Cabinet in blue plasticcoated aluminium with end castings in blue-grey enamel. Top panel finished in light-grey enamel.

DIMENSIONS

165 mm high × 95 mm × 430 mm.

WEIGHT

2.1 kilos.

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A/S DANBRIDGE

47. BRIGADEVEJ . 2300 COPENHAGEN S . DENMARK
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CABLES: DANBRIDGE-COPENHAGEN
TELEX: 19775

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LEAFLET NO. 1014 B

AXELHOLM A/S. KBH.

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research production education

DECADE CAPACITORS TYPE DK

- IN-LINE READING
- LOW LOSSES
- GOOD ACCURACY
- WIDE RANGE OF VALUES
- SMALL DIMENSIONS
- HIGH STABILITY

These decade condensers are due to their relative cheapness, low losses and small dimensions very valuable for general laboratory work and educational purposes. They find uses in every laboratory as tuned circuit elements, bridge impedances and filter elements and are very useful components in a number of other applications in service and laboratory work.

SPECIFICATION

The decade condensers are manufactured in various types with decades from 10×0.001 μF to 10×1 μF. The specifications for the various capacitors employed are as follows:

POLYSTYRENE CAPACITORS

These are used for all S type decades, except for the 10×1 μF decade in type DK4S, and are also used for the 10×0.001 μF and 10×0.01 μF decades in types with suffix A.
The capacitors used in S type boxes are stabilised by a special process ensuring a good stability over long periods (about 0.1% for capacitors of 0.01 μF and larger) and are mounted in totally sealed cans. Adjustment accuracy is ½%. Power factor 2–5×10^{-4}. Maximum alternating voltage 200. Temperature coefficient about – 130×10^{-6}.
The capacitors used in A type boxes are not stabilised and accordingly their stability is somewhat inferior to that of the S types. Accuracy 2½%. Power factor 2–5×10^{-4}. Maximum alternating voltage 200. Temperature coefficient about –130×10^{-6}.

POLYCARBONATE CAPACITORS

Are used for the 10×0.1 μF decade in types with suffix A and for the 10×1 μF decade in type DK4S & DK4A. They are mounted in hermetically sealed cans and feature a high stability. Adjusted to 1% or 2½% accuracy. Temperature coefficient about +200 ×10^{-6}. Power factor 5×10^{-3}. Maximum alternating voltage 200.

AIR CAPACITORS

Types with suffix V are made continuously variable by addition of a small type air capacitor with a dial calibrated directly in pF. Calibration accuracy is 2% or 5 pF. Maximum alternating voltage 200.

TERMINALS

Two insulated terminals are provided, with a separate earth terminal on the metal cabinet.
The terminal next to the earth terminal has the greatest capacitance to the shield and should be used as the "low" potential terminal if required connected to the earth terminal.
The terminals are screw terminals with hole for 4 mm banana plugs. Terminal spacing ¾" (19 mm).

SWITCHES

Each decade is made up of 4 capacitors with values 1–2–2 and 5 units. These are connected as required by a 4 section wafer switch with high quality insulation and silver contacts.

MOUNTING

Cabinet in blue plasticcoated aluminium with end castings in blue-grey enamel. Top panel finished in light-grey enamel.

MEASURING FREQUENCY

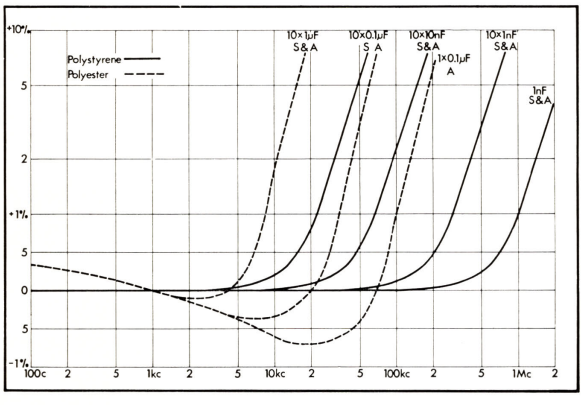
All data are measured at 1 kHz.

FREQUENCY CHARACTERISTICS

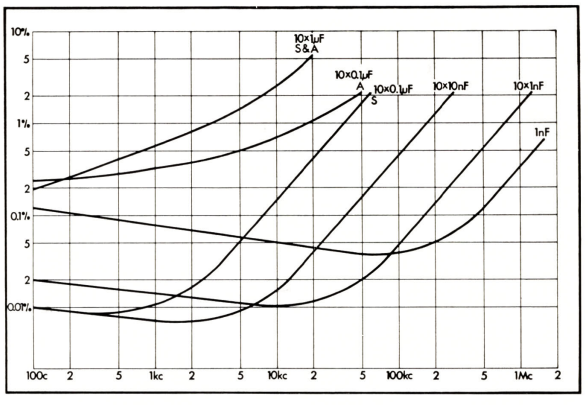
See curves below.

ZERO CAPACITANCE

Direct capacitance between terminals: For types DK4A–DK4S 10–20 pF. Capacitance between terminals with earth terminal and nearest terminal interconnected: For types DK4A–DK4S 25–35 pF. The above values should be added to the dial readings for accurate measurements.
For types with suffix V no correction is required when used with the earth terminal connected to the nearest terminal. The direct capacitance is about 15 pF less than the indicated value.



Change in capacitance with frequency for DK decade capacitors. Typical values.



Dissipation factor vs. frequency for DK decade capacitors. Typical values.

Type	Decade Value μF				Accuracy	Maximum AC voltage	Total Dimensions	Weight kilos
	10×0.001	10×0.01	10×0.1	10×1				
DK 4 A	Polystyrene		Polycarbonate		2½%	200	115×150×325 mm	2.6
DK 4 S	Polystyrene			Poly-carbonate	½% + 5 pF 10×1 μF 1%	200	115×150×325 mm	2.8
DK 4 AV	Polystyrene		Poly-carbonate	Calibrated variable air capacitor 50-1050 pF		2½% + 10 pF	200	115×150×325 mm	2.2
DK 4 SV	Polystyrene			Calibrated variable air capacitor 50-1050 pF		½% + 10 pF	200	115×150×325 mm	2.4

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FERRITE-CORED DECADE INDUCTOR TYPE DI 4

- IN-LINE READING
- HIGH Q - VALUES
- GOOD ACCURACY
- SMALL DIMENSIONS
- FERRITE CORES

This Decade Inductor is useful for laboratory tests and measurements e. g. for determining circuit constants in wave filters, tuned circuits etc. The accuracy and stability of the Inductor allows its use as a secondary standard of inductance. The inductance coils used are wound on ferrite cores providing a high Q value even at the lower audio frequencies.

SPECIFICATION

RANGE

10×1 mH to 10×1 H.

FREQUENCE DEPENDENCY

The stray capacitance shunting the inductors will increase the effective series inductance at high frequencies.
The stray capacitance varies according to which inductors are in circuit and how the earth terminal is connected.
The lowest capacitance is obtained on earthing the terminal adjacent to the earth terminal when the two lowest decades are used.
When only the higher decades are in use the upper terminal should be earthed.
In these cases the stray capacitance varies from 25 to 40 pF.
If – as is normally the case – the inductor is employed in a tuned circuit this capacitance is simply added to the external capacitance in order to obtain the total effective capacitance.
In case the effective series inductance must be determined the percentage increase with frequency can be calculated from

$$\triangle L/L_0\% = L \cdot f^2 \cdot K$$

where L is Inductance in henries, f is Frequency in kHz and K is between 0.1 & 0.16 with the highest value for the intermediate decades.

DISSIPATION FACTOR

The curves in Fig. 1 show the dissipation factor as a function of frequency for the separate decades. The

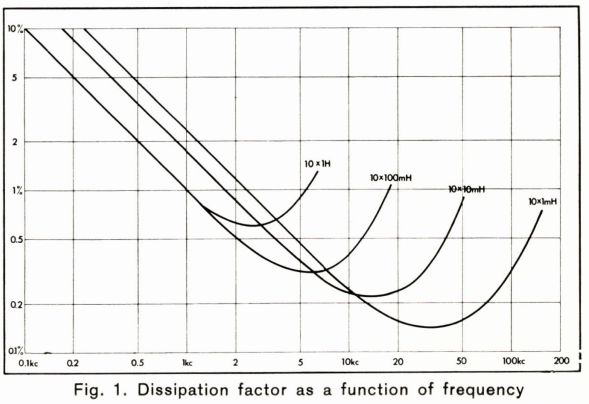

Fig. 1. Dissipation factor as a function of frequency

the blue line instruments.....

curves give average values for each decade. The actual values spread somewhat so that at high values in each decade the curve moves towards the curve for the next higher decade and vice versa for low values.

CONSTRUCTION

Each unit comprises four coils with ferrite cores. The coils have the values 1-2-2-5 units and are series connected. The decade switch shortcircuits the appropriate coils to give the values required.

TEMPERATURE COEFFICIENT

About + 100×10^{-6} per degree C.

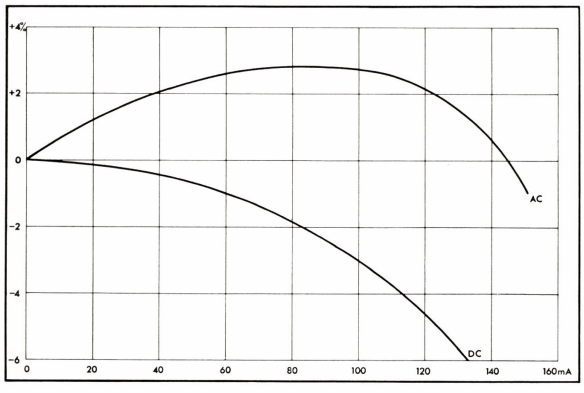

Fig. 2. Inductance variation with current for 100 mH coil.

INDUCTANCE VARIATION WITH CURRENT

The curves in Fig. 2 show the percentage variation of inductance with direct and alternating current measured on the 1 × 100 mH setting.

To find the corresponding currents for other settings multiply by the factors in the table below.

MAXIMUM CURRENT

For maximum stability the alternating or direct current should be limited to 120 mA on the 1×100 mH setting with corresponding values for other setting as determined from the table below.

SWITCHES

Wafer switches with fixed and moving contacts in pure silver.

TERMINALS

Two terminals are provided with a separate earth terminal.
Terminal spacing ¾″ (19 mm).

ACCURACY

10×1 mH 1%, 10×10 mH ½%, 10×100 mH ½%, and 10×1 H ½%.

MOUNTING

Cabinet in blue plasticcoated aluminium with chromiumplated end castings. Top panel finished in light-grey enamel.

DIMENSIONS

165 high×95×383 mm.
(6½ high×3¼×15 in.)

WEIGHT

4.3 kilos.

MULTIPLICATION FACTORS FOR DETERMINING INDUCTANCE VARIATION AND MAXIMUM CURRENT.

Inductance setting	× 1 H			× 100 mH			× 10 mH			× 1 mH		
	1	2-4	5-10	1	2-4	5-10	1	2-4	5-10	1	2-4	5-10
Multiply current by	0.32	0.22	0.14	1	0.71	0.45	3.2	2.2	1.4	10	7.1	4.5

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TELEX: 2775

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LEAFLET NO. 1002 B

AXELHOLM A/S. KBH.

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UNIVERSAL BRIDGE TYPE UB 1

INEXPENSIVE

FLEXIBILITY OF MEASUREMENTS

RELIABLE

This bridge may by used in conjunction with a few accessories for most of the usual d-c and a-c measurements. By means of the various switches and shorting straps provided the bridge circuit may be adjusted for the measurement of e.g. resistance, capacitance and power factor, self inductance and effective resistance, mutual inductance, Q factor, frequency, turns ratio, resonant resistance etc.
The bridge is, therefore, especially useful in laboratories, where occasionally measurements have to be carried out, which do not warrant the expense of the more specialised types ot bridges. The accuracy of measurement is sufficient for all but the most exacting work.
All the necessary instructions, circuit diagrams and formulas for the different measurements are included with the instrument.

SPECIFICATION

RANGE

R. 1 milliohm–10 Megohms.
L: 1 microhenry–1 Henry.
C: 1 picofarad–100 microfarads.

FREQUENCY

0-20 kHz.

BASIC ACCURACY

R: ½% or 2 m Ω.
L: 1% or 2 μH at 1 kHz.
C: 1% or 2 pF at 1 kHz.
The actual accuracy obtained on a-c measurements will depend on the various earth-admittances of generator, detector, measuring object and the bridge circuit itself. Thus it is not possible to give exact figures for the total accuracy.

CONSTRUCTION

A normal 4 arm bridge consisting of: 2 sets of ratio resistors, a 4 decade resistor, standard capacitor, and switch with limiting resistors for battery or generator.

RATIO RESISTORS

Adjustable to 0—1—10—100—1000—10000 ohms. Accuracy 0.2%. Maximum dissipation 1 watt.

4-DECADE RESISTOR

10×0.1–10×100 ohms, accuracy 0.2% except 10×0.1 ohms decade accuracy 3 %. Maximum dissipation 1 watt per resistor.

STANDARD CAPACITOR

Value 0.1 microfarad, Accuracy 0.2%, dissipation factor about 10^{-4}.

the blue line instruments.....

GENERATOR SWITCH

Switches the bridge source either direct or in series with limiting resistors of 100 or 10000 ohms respectively.

ACCESSORIES REQUIRED

A suitable power source (batteries for d-c – audio oscillator for a-c measurements). Detector (galvanometer for d-c – headphones, amplifier-detector or oscilloscope for a-c measurements).
Decade resistance boxes for dissipation balance in a-c measurements.

TERMINALS

Terminals are provided for: L, C, R, the 0.1 μF standard, and for generator and detector. The terminals not in use are shorted by means of the shorting straps supplied. A separate terminal is provided for earthing the metal cabinet, which serves as a capacitive shield. Screw terminals with hole for 4 mm banana plug. Terminal spacing 19 mm (¾ in.).

MOUNTING

Cabinet in blue plasticcoated aluminium with end castings in blue-grey enamel. Top panel finished in light-grey enamel.

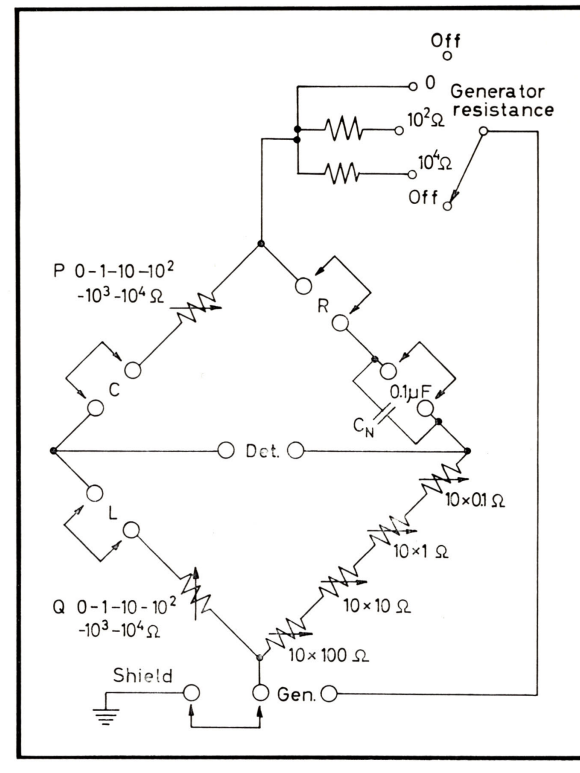
DIMENSIONS

120 high × 150 × 340 mm.
(4¾ high × 6 × 13½ in.).

WEIGHT

2.2 kilos.

FUNCTIONAL DIAGRAM



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AXELHOLM A/S, KBH.

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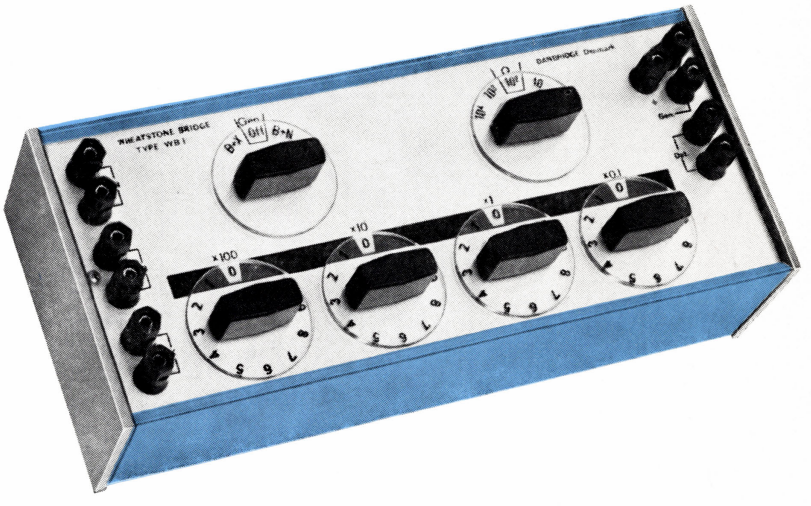
WHEATSTONE BRIDGE
TYPE WB 1

INEXPENSIVE
RELIABLE
GOOD ACCURACY
VERSATILE



For the commonly occuring measurements of R-L-C-M etc. this bridge is very useful. It contains the two arms of a Wheatstone bridge viz. a ratio resistor adjustable in decade steps and a four-section decade resistor.
Thus the accessories required are suitable standards besides a generator and zero-indicator, which latter are available in most laboratories.

SPECIFICATION

RANGE AND ACCURACY

Depending on the standards available.

FREQUENCY RANGE

0–20 kHz.

CONSTRUCTION

The bridge consists of a 4-section decade resistor, the ratio resistor and a switch for the generator and balance resistor with necessary terminals and connections for making up a complete Wheatstone bridge circuit.

DECADE RESISTOR

Range 10×0.1 ohms–10×100 ohms. Accuracy 0.2% except 10×0.1 ohms 3%.

RATIO RESISTOR

Adjustable to 1—10—100—1000—10000 ohms. Accuracy 0.2%.

DISSIPATION

1 watt for each resistor in circuit.

BATTERY SWITCH

Switches the terminal connections for the balancing resistor in series with the terminals for either the unknown or the standard. The third position switches the generator off.

TERMINALS

5 sets of terminals are provided, viz. for the unknown, standard, balancing resistance, generator and zero indicator.
The metal cabinet is connected to a separate terminal and serves as a capacitive shield.
The terminals are screw terminals with hole for 4 mm banana plugs. Terminal spacing ¾" (19 mm).

ACCESSORIES REQUIRED

Suitable standards, generator (for d-c measurements batteries) and zero indicator (for a-c measurement

telephones, amplifier with indicator or oscilloscope, for d-c measurements galvanometer).
For a-c measurements a variable resistor is necessary for use as a balancing resistor when measuring L-C-M etc.

CIRCUIT DIAGRAMS

The instrument is supplied complete with circuit diagrams of various bridge arrangements for measuring R, C and L etc.

MOUNTING

Cabinet in blue plasticcoated aluminium with end castings in blue-grey enamel. Top panel finished in light-grey enamel.

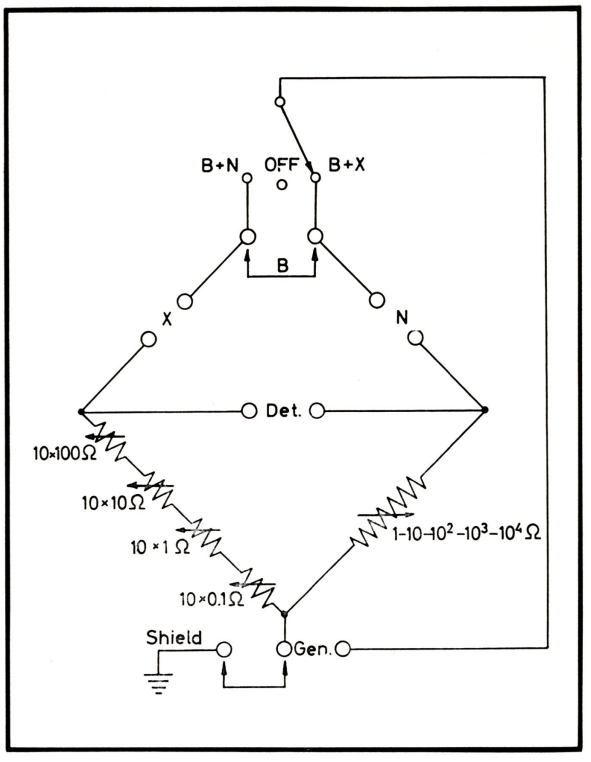
DIMENSIONS

120 high × 150 × 340 mm.
(4¾ high × 6 × 13½ in.).

WEIGHT

2.1 kilos.

FUNCTIONAL DIAGRAM



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TELEX: 19775

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LEAFLET NO. 1005 B

AXELHOLM A/S, KBH.

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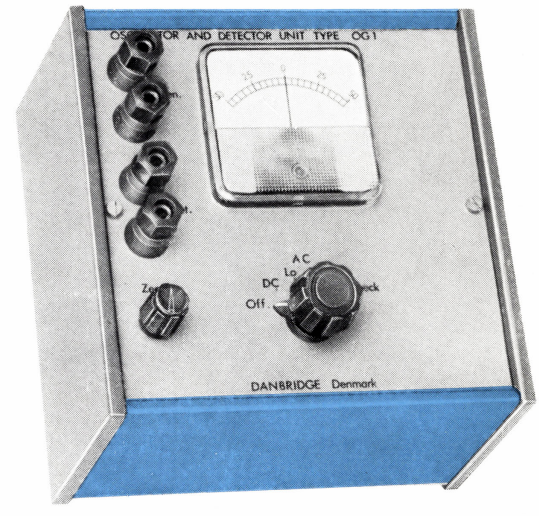
OSCILLATOR AND DETECTOR UNIT TYPE OG 1

FOR AC OR DC MEASUREMENTS
SELFCONTAINED
HIGH SENSITIVITY
UNIVERSAL APPLICATION



Although especially designed for use with our bridges type UB1 and WB1, this instrument may be used with other types of bridge and for various other applications.

GENERAL DESCRIPTION

A 1 kc oscillator provides the supply for AC measurements. For DC measurements, direct battery supply is used.

The detector for AC measurements employs a 3-stage amplifier driving the indicating meter via a rectifier circuit. Negative feedback through a diode circuit provides approximately logarithmic meter response over a wide input range. This facilitates balance adjustment on bridges at large unbalance. For DC measurements the input is applied to a 2-stage differential amplifier with the meter connected between the outputs. A zero control is provided for setting meter zero.

Protective circuits are included on both AC and DC circuits, so that it is impossible to damage either meter or circuitry even by gross overload e. g. when using external high voltage supplies. Two 4.5 V flash lamp batteries provide supplies for the circuits. One battery supplies the detector circuits and provides approximately 2000 hours of operation. The second battery drives the generator and on AC about 200 hours of operation are obtained. Facilities are provided for checking the batteries.

SPECIFICATION

DC BRIDGE SUPPLY

4.5 V battery through 10 Ω limiting resistor.

DC DETECTOR

Sensitivity 2.5 mV full scale.
Input resistance 0.5 MΩ.

AC GENERATOR

Frequency 1 kc ± 10 %.
High output: 2 V open circuit, 1 V with 100 Ω load.
Low output: 0.7 V open circuit, 0.3 V with 10 Ω load.
Output floating.

AC DETECTOR

Sensitivity about 100 μV for 10 % of meter full scale.
Approximately logarithmic meter deflection from 200 μV to 100 mV (full scale).
Input impedance: 5 kΩ.

the blue line instruments.....

CONTROLS ETC.

Function switch, 6 positions:
Off, DC, AC low, AC high, check 1, check 2.
Zero adjustment for DC detector.
2 terminals for supply output.
2 terminals for detector input.
Center zero meter for balance indication.

BATTERIES

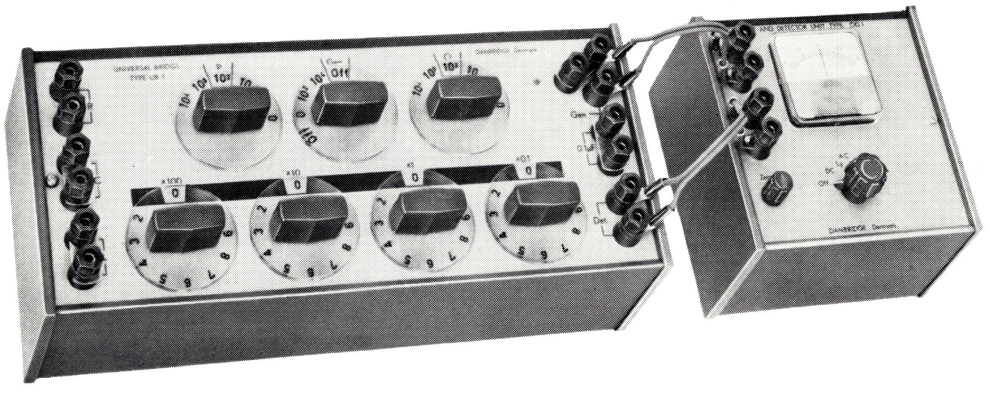
2 off 4.5 V flat type Burgess No. 532 or equivalent.

DIMENSIONS

120 high × 150 × 150 mm
(4¾ high × 6 × 6 in.)

WEIGHT

1.3 kg (2 lb 14 oz).



Oscillator and Detector Unit type OG 1 used to operate the Danbridge Universal Bridge type UB 1.

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TELEX: 19775

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LEAFLET NO. 1014 B

AXELHOLM A/S, KBH.

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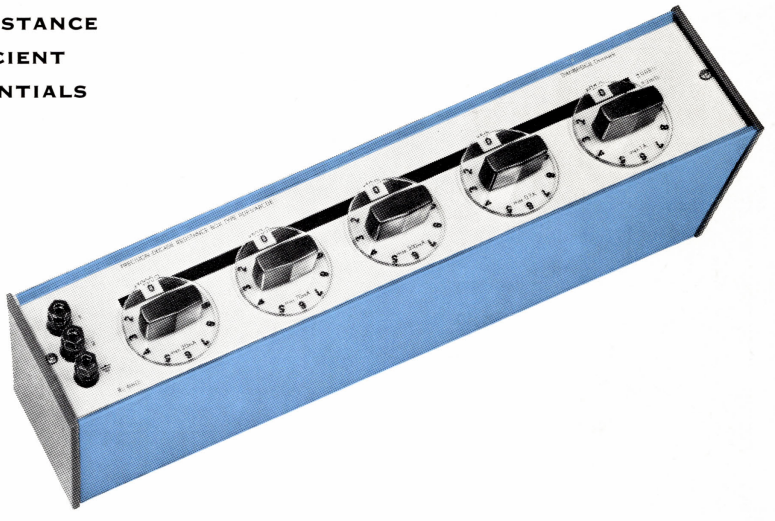
PRECISION DECADE RESISTANCE BOXES TYPE PDR

IN-LINE READING
HIGH ACCURACY
EXTREMELY LOW ZERO RESISTANCE
LOW TEMPERATURE COEFFICIENT
NEGLIGIBLE THERMAL POTENTIALS



These decade resistors are designed for use in cases where a better accuracy is required than that obtained in our type DR. The resistors employed are wound on cards of a material with excellent stability against temperature and humidity variations, and the winding methods are chosen to provide the lowest possible residual reactance values for the different resistance values.
The resistors are specially aged and checked over long periods to ensure the highest possible stability. The switches employ hard silver contacts providing eight separate contact points in parallel in each position. Thus an extremely low and constant switch resistance (about 1 milliohm per decade with variations less than 0.2 milliohms) is obtained. These values are maintained for long periods of use.
Each decade comprises 11 units, thus providing an overlap which in many cases is very valuable e.g. when balancing bridge circuits. The resistance decades have no connection to the shielding box, on which a separate earth terminal is provided.
The boxes are available with 5 and 6 decades in values from 11×0,1 ohms to 11×10000 ohms as required.

SPECIFICATION

WINDING MATERIEL

Manganin except for 10000 ohm resistors, where Centanin is employed.

TEMPERATURE COEFFICIENT

Less than 0.002% per degree centigrade between 15 and 35 degrees centigrade.

THERMAL EMF

About 1 μV per degree centigrade.

STABILITY

The stability of resistance value is normally better than 0.02% per year.

MAXIMUM DISSIPATION

0.5 watt continuous per resistor. For short periods (about 1 minute) 1 watt per resistor. These ratings correspond to a temperature rise of less than 40 degrees centigrade. The currents corresponding to the maximum dissipation of 0.5 watt per resistor are marked on the top panel.

MAXIMUM PEAK VOLTAGE

500 volts between terminals and from terminals to box.

RESIDUAL IMPEDANCE

Zero resistance: 1 milliohm per decade plus 1 milliohm common lead resistance. Total zero resistance is stated on the top panel.
Zero inductance: 0.1 μH per decade.

Shunt capacitance: The total effective shunt capacitance depends on the method of connecting the shield box.
If the capacitance to shield may be eliminated, which is possible e.g. in certain bridge circuits, the effective shunt capacitance attains the lowest possible value and is of the order of 5 pF to 10 pF.
With the shield connected to the upper terminal (marked 1) the total shunt capacitance is 15 pF per decade counting from the highest value decade employed to and including the lowest value decade in the box.
Wen the shield is connected to the lower terminal (marked 2) the shunt capacitance is 15 pF per decade counting from the highest value decade to and including the highest value decade employed.
The residual impedances obtained from the above figures should be used in conjunction with the residuals stated in the table below for the various decade units in order to obtain the total residuals at the terminals.

SWITCHES

Wafer type switches with hard silver contacts providing 8 contacts per position.

TERMINALS

Screw terminals with hole for 4 mm banana plugs. A separate earth terminal is provided. Terminal spacing 3/4" (19 mm).

MOUNTING

Cabinet in blue plasticcoated aluminium with end castings in blue-grey enamel. Top panel finished in light-grey enamel.

SPECIFICATION OF DECADE UNITS

Resistance code	Value ohms	Accuracy	Winding form	Effective series inductance	Max. current or voltage
A	11 × 0.1	2 m Ω	Bifilar loop	0.05 μH per step	1 A
B	11 × 1	0.03 % + 2 m Ω	Ayrton-Perry on cards	0.07 μH per step	0.7 A
C	11 × 10	0.03 %	Ayrton-Perry on cards	0.1 μH per step	200 mA
D	11 × 100	0.03 %	Ayrton-Perry on cards	1 × 100 Ω 0.5 μH 3 × 100 Ω 1 μH 10 × 100 Ω 0 μH	70 mA
E	11 × 1000	0.03 %	Unifilar on cards	1 × 1000 Ω 20 μH 3 × 1000 Ω 0 μH 10 × 1000 Ω ± 200 μH	20 mA
F	11 × 10000	0.03 %	Unifilar on cards	determined by circuit capacitance	7 mA or 500 V

SPECIFICATION OF DECADE BOXES

Type	Number of decades	Zero resistance ohms	Total dimensions	Net weight kilos
PDR 5	5	0.006	165 high × 95 × 459 mm 6½ high × 3¼ × 18 in	2.4
PDR 6	6	0.006	165 high × 95 × 459 mm 6½ high × 3¼ × 18 in	2.6

Please order by type and resistance code

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TELEX: 2775

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LEAFLET NO. 1007 B

AXELHOLM A/S, KBH.

DANBRIDGE DENMARK

research production education

DECADE RESISTANCE BOXES TYPE DR

- IN-LINE READING
- WIDE RANGE OF VALUES
- SMALL DIMENSIONS
- GOOD ACCURACY
- HIGH DISSIPATION
- LOW RESIDUALS

These shielded decade resistance boxes are accurate enough for general laboratory use, for educational purpose and whereever electrical measurements are made. They are useful e.g. for determination of optimum resistance values in electric circuits, as subsidiary resistance standards and for balancing purposes in bridge measurements etc.
On account of their small dimensions these decade boxes may be used at high frequencies – for values below 5000 ohms up to about 500 kHz.
They are supplied with from 3 to 6 decades and in values from 0.1 ohms to 10 megohm as required.

SPECIFICATION

DISSIPATION

Max. 1 watt continuous for each resistor. For short periods (about 1 minute) the permissible dissipation is double the above values.

MAXIMUM PEAK VOLTAGE

500 volts between terminals and from terminals to box.

RESIDUAL IMPEDANCE

Zero resistance: 0.003 to 0.004 ohms per decade. Total zero resistance is stated on the top panel.
Zero inductance: 0.1 μH per decade.
Shunt capacitance: The total effective shunt capacitance depends on the shield connection.
With the shield unconnected the capacitance is from 5 to 15 pF.
When the shield is connected to the lower terminal the total capacitance is about 12 pF per decade counting from the highest decade employed to the lowest decade in the box.
With the shield connected to the upper terminal the total capacitance is 12 pF per decade counting from the highest decade in the box and including the highest decade in circuit.
The residual impedances should be added to the residuals stated in the table overleaf for the different decade units in order to obtain the total residuals at the terminals.

SWITCHES

Wafer type switches with silver contacts and high quality insulation.

TERMINALS

Screw terminals with hole for 4 mm banana plugs. A separate earth terminal is provided. Terminal spacing ¾″ (19 mm).

MOUNTING

Cabinet in blue plasticcoated aluminium with end castings in blue-grey enamel. Top panel finished in light-grey enamel.

SPECIFICATION OF DECADE UNITS

Resistance code	Value ohms	Accuracy %	Material Winding	Inductance	Max. current or voltage
A	10 × 0.1	0.5 + 3 m Ω	Manganin Hairpin	0.05 μH per step	3 A
B	10 × 1	0.3 + 3 m Ω	Manganin Ayrton-Perry on card	1 × 1 ohm 0.2 μH 3 × 1 ohm 0.5 μH 10 × 1 ohm 1 μH	1 A
C	10 × 10	0.1	Manganin Ayrton-Perry on card	1 × 10 ohm 0.4 μH 3 × 10 ohm 0.8 μH 10 × 10 ohm 1.5 μH	0.3 A
D	10 × 100	0.1	Manganin Ayrton-Perry on card	1 × 100 ohm 0.5 μH 3 × 100 ohm 1 μH 10 × 100 ohm 0 μH	100 mA
E	10 × 1000	0.1	Manganin Ayrton-Perry on card	1 × 1000 ohm 3 × 1000 ohm *) 10 × 1000 ohm	30 mA
F	10 × 10000	0.1	Centanin on card	*)	10 mA 500 V
G	10 × 100000	1	High Stability Metallised	*)	3 mA 500 V
H	10 × 1 M	2	High Stability Metallised	*)	500 V

*) For values above 1000 ohms the residuals are mainly determined by the effective shunt capacitance in the box as detailed previously

SPECIFICATION OF DECADE BOXES

Type	Number of decades	Zero resistance ohms	Total dimensions	Net weight kilos
DR4	4	0.014	115 × 85 × 305 mm	1.2
DR5	5	0.018	115 × 85 × 367 mm	1.4
DR6	6	0.021	115 × 85 × 430 mm	1.7

PLEASE ORDER BY TYPE AND RESISTANCE CODE

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AXELHOLM A/S. KBH.

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DECADE RESISTANCE BOXES
TYPE CDR (1 %)

- INEXPENSIVE
- IN-LINE READING
- HIGH DISSIPATION
- HIGH RELIABILITY
- WIREWOUND RESISTORS
- SMALL DIMENSIONS

These inexpensive decade resistance boxes are very suitable for elementary education and for purposes, where the application of more accurate, more delicate, and more expensive decade resistance boxes are not required.
The instruments are robustly built, use switches of high quality, and are designed to withstand hard use by untrained persons. Educational establishments will appreciate these facts together with the high permissible dissipation of the resistors used, which are wirewound resistors similar to those employed in the Danbridge decade resistance boxes types DR and PDR. Types DR and PDR are used when greater accuracy is required – the accuracy is 0.1 % for type DR and 0.03 % for type PDR.

SPECIFICATION

DISSIPATION

Max. 2 watt continuous for each resistor.

MAXIMUM PEAK VOLTAGE

500 volts between terminals and from terminals to box.

ZERO RESISTANCE

20 to 50 mohms.

SWITCHES

Wafer type switches with silver plated contacts.

RANGE

Four or six decades with specification as below.
CDR4/BCDE: 10 x 1 ohm to 10 x 1,000 ohms.
CDR4/DEFG: 10 x 100 ohms to 10 x 100,000 ohms
CDR6/BCDEFG: 10 x 1 ohm to 10 x 100,000 ohms.

Code	Value ohms	Accuracy	Max. current or voltage	Resistor type
B	10 x 1	2 %	1.4A	Wirewound
C	10 x 10	1 %	0.45A	Wirewound
D	10 x 100	1 %	0.14A	Wirewound
E	10 x 1,000	1 %	0.045A	Wirewound
F	10 x 10,000	1 %	0.014A	Wirewound
G	10 x 100,000	1 %	500 volt	Deposited carbon

TERMINALS

Screw terminals with hole for 4 mm banana plugs. A separate earth terminal is provided. Terminal spacing ¾" (19 mm).

MOUNTING

Cabinet in blue plasticcoated aluminium with grey end castings. Top panel finished in light-grey enamel.

DIMENSIONS AND WEIGHT

Types CDR4: 115 x 85 x 305 mm.
Weight 1.2 kilos.
Type CDR6: 115 x 85 x 430 mm.
Weight 1.7 kilos.

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DECADE ATTENUATORS TYPE DA3

- IN-LINE READING
- GOOD ACCURACY
- DECADE SWITCHING
- EFFICIENT SHIELDING
- WIDE RANGE OF ATTENUATION

These instruments are designed to provide accurately known values of attenuation, which may be varied in steps. They are very useful for tests on communication circuits, amplifiers, filters etc. They are designed as 4-terminal networks with constant and equal values of input and output impedance at all settings. Either unbalanced T-networks or balanced H-networks may be supplied. The lower value decades are designed as bridged-T networks allowing practically noiseless switching for fine adjustment. The highest value decade employs switched T-pads for the 5 lowest positions. On the 5 higher positions a further 5-unit pad is switched in series. The various sections of the highest value decade pads are shielded mutually so that stray coupling is eliminated and the attenuation accuracy is maintained over a wide frequency range. The shielding is completed by enclosing each decade in a separate shield box. Wafer type switches are employed with hard silver contacts requiring a minimum of attention over long periods. The H-type pads comprise 2 T-pads with a common neutral lead brought out to separate terminals. The attenuators may thus be employed in several ways, e.g. with the common line floating or earthed. In the latter case one of the half-sections of the attenuator may be employed as an unbalanced T-network with a characteristic impedance half the value of that of the balanced network. The individual resistors are wound with manganin wire on cards with non-inductive windings for the lower values to reduce reactive effects. For values above 3000 ohms high-stability carbon resistors are employed.

SPECIFICATION

RANGE

Two standard types are available, an unbalanced T type and a balanced H type. Decade values are 10×0.1 dB, 10×1 dB and 10×10 dB.

IMPEDANCE

The characteristic impedance of both types is 600 ohms ± ½ % in both directions.

ACCURACY

All resistors below 3000 ohms are adjusted to ± ½ % except the series resistors on the lowest value decade which are ± 1%.
Resistors above 3000 ohms are carbon-film resistors with an accuracy of ± 2% to ± 5%.
Attenuation accuracy at frequencies up to 50 kHz is ± ½% of the indicated value ± 0.01 dB up to 50 dB. Above 50 dB add ± 0.1 dB.
At frequencies up to 300 kHz and attenuation settings up to 80 dB accuracy is ± 1% of the indicated value ± 0.02 dB.
For type DA3HS/D the accuracy is better than ± 1% at all settings up to 300 kHz.

INPUT DISSIPATION

max. 1 watt.

the blue line instruments.....

TERMINALS

2 input and 2 output terminals are provided. The shield is connected to a separate terminal. In the T-section types this may be connected to the common neutral terminal by a strap. In the H-types, the center points of the sections are connected and brought out to a terminal, which may likewise be connected to the shield. The terminals are screw terminals with hole for 4 mm banana plugs. Terminal spacing ¾" (19 mm).

MOUNTING

Light-weight cabinet in blue plasticcoated aluminium with end castings in blue-grey enamel. Top panel finished in light-grey enamel.

SPECIAL TYPES

Decade Attenuators with 2 decades calibrated in dB or with 2 or 3 decades calibrated in Neper may be supplied to order if reasonable quantities are required.

STANDARD TYPES

Type	Network	Range	Smallest Step	Total Dimensions	Net weight kilos
DA3T/D	Unbalanced T	111 dB	0.1 dB	165 high × 95 × 383 mm 6½ high × 3¾ × 15 in.	3.1
DA3HS/D	Balanced H	111 dB	0.1 dB	165 high × 95 × 383 mm 6½ high × 3¾ × 15 in.	3.2

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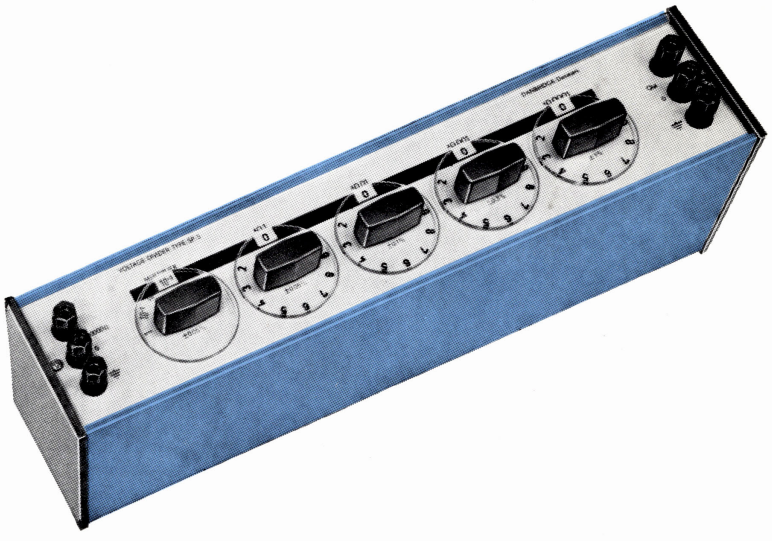
VOLTAGE DIVIDER TYPE SP5

IN-LINE READING
HIGH ACCURACY
HIGH RESOLUTION
STEPS OF 0,1 PPM



This instrument is designed to provide accurately known voltage ratios over a very wide range.
The input voltage is applied to a 4-step divider with steps giving ratios of 1, 0.1, 0.01 and 0.001 of the input. This divider is followed by a 4-decade Kelvin-Varley divider with resolution of 0.01 % of input. Thus even at low ratios a high resolution is obtained (smallest step 0.1 ppm of input).
Carefully aged and checked wirewound resistors of low TC material are employed in the circuit. Temperature variations cause insignificant variations in the voltage ratios, as the resistors have nearly equal TC's.

SPECIFICATION

VOLTAGE RATIO RANGE

Decade Multiplier: 4 steps. Ratios 1, 0.1, 0.01 and 0.001 of input. Kelvin-Varley Divider: Ratios from 0 to 1 in steps of 0.0001 of input switched in 4 decades: 10× 0.0001, 9×0.001, 9×0.01, and 9×0.1.

Resultant ratio is multiplier setting multiplied by Kelvin-Varley setting.

ACCURACY

± 0.02 % of indicated ratio for ratios from 0.1 to 1.0 and for multiplier ratios of 1, 0.1 and 0.01.
± 0.05 % for ratios 0.01 to 0.09 and multiplier ratio 0.001.
± 0.1 % for ratios 0.001 to 0.009.
± 1 % for ratios 0.0001 to 0.001.

Additional error for zero setting with multiplier × 1 less than 0.3 ppm of input measured between output terminals.

INPUT RESISTANCE

10.000 Ω ± 0.03 %

OUTPUT RESISTANCE

With a low source resistance the output resistance varies from zero at ratios 0.0000 and 1.0000 to max. 3.000 Ω at ratios of 0.5.

FREQUENCY ERROR

With output load of 100 pf error less than 0.2 % up to 30 KHz.

MAXIMUM INPUT VOLTAGE

100 V DC or AC.

SWITCHES

Wafer type switches with double silver contacts.

TERMINALS

Screw terminals with hole for 4 mm banana plugs. A separate earth terminal is provided. Terminal spacing ¾" (19 mm).

MOUNTING

Cabinet in blue plasticcoated aluminium with end castings in blue-grey enamel. Top panel finished in light-grey enamel.

DIMENSIONS

165 mm high × 95 mm × 430 mm.

WEIGHT

2.1 kilos.

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DECADE CAPACITORS TYPE DK

- IN-LINE READING
- LOW LOSSES
- GOOD ACCURACY
- WIDE RANGE OF VALUES
- SMALL DIMENSIONS
- HIGH STABILITY

These decade condensers are due to their relative cheapness, low losses and small dimensions very valuable for general laboratory work and educational purposes. They find uses in every laboratory as tuned circuit elements, bridge impedances and filter elements and are very useful components in a number of other applications in service and laboratory work.

SPECIFICATION

The decade condensers are manufactured in various types with decades from 10×0.001 μF to 10×1 μF. The specifications for the various capacitors employed are as follows:

POLYSTYRENE CAPACITORS

These are used for all S type decades, except for the 10×1 μF decade in type DK4S, and are also used for the 10×0.001 μF and 10×0.01 μF decades in types with suffix A.
The capacitors used in S type boxes are stabilised by a special process ensuring a good stability over long periods (about 0.1% for capacitors of 0.01 μF and larger) and are mounted in totally sealed cans. Adjustment accuracy is ½%. Power factor 2–5×10^{-4}. Maximum alternating voltage 200. Temperature coefficient about – 130×10^{-6}.
The capacitors used in A type boxes are not stabilised and accordingly their stability is somewhat inferior to that of the S types. Accuracy 2½%. Power factor 2–5×10^{-4}. Maximum alternating voltage 200. Temperature coefficient about –130×10^{-6}.

POLYCARBONATE CAPACITORS

Are used for the 10×0.1 μF decade in types with suffix A and for the 10×1 μF decade in type DK4S & DK4A. They are mounted in hermetically sealed cans and feature a high stability. Adjusted to 1% or 2½% accuracy. Temperature coefficient about +200 ×10^{-6}. Power factor 5×10^{-3}. Maximum alternating voltage 200.

AIR CAPACITORS

Types with suffix V are made continuously variable by addition of a small type air capacitor with a dial calibrated directly in pF. Calibration accuracy is 2% or 5 pF. Maximum alternating voltage 200.

TERMINALS

Two insulated terminals are provided, with a separate earth terminal on the metal cabinet.
The terminal next to the earth terminal has the greatest capacitance to the shield and should be used as the "low" potential terminal if required connected to the earth terminal.
The terminals are screw terminals with hole for 4 mm banana plugs. Terminal spacing ¾" (19 mm).

SWITCHES

Each decade is made up of 4 capacitors with values 1–2–2 and 5 units. These are connected as required by a 4 section wafer switch with high quality insulation and silver contacts.

MOUNTING

Cabinet in blue plasticcoated aluminium with end castings in blue-grey enamel. Top panel finished in light-grey enamel.

MEASURING FREQUENCY

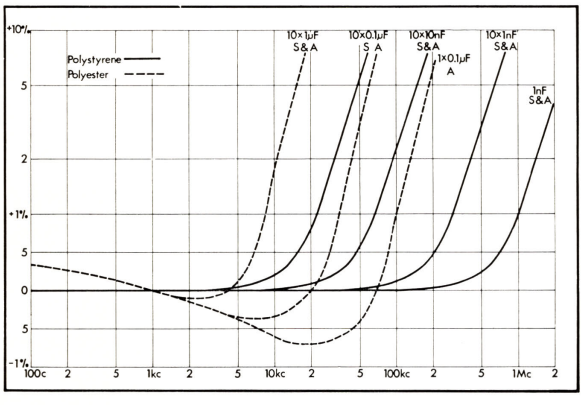
All data are measured at 1 kHz.

FREQUENCY CHARACTERISTICS

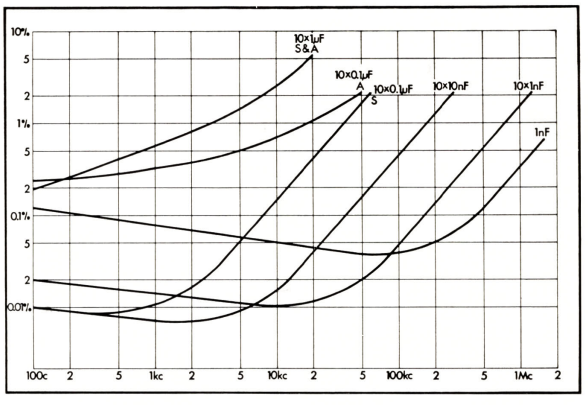
See curves below.

ZERO CAPACITANCE

Direct capacitance between terminals: For types DK4A–DK4S 10–20 pF. Capacitance between terminals with earth terminal and nearest terminal interconnected: For types DK4A–DK4S 25–35 pF. The above values should be added to the dial readings for accurate measurements.
For types with suffix V no correction is required when used with the earth terminal connected to the nearest terminal. The direct capacitance is about 15 pF less than the indicated value.



Change in capacitance with frequency for DK decade capacitors. Typical values.



Dissipation factor vs. frequency for DK decade capacitors. Typical values.

Type	Decade Value μF				Accuracy	Maximum AC voltage	Total Dimensions	Weight kilos
	10×0.001	10×0.01	10×0.1	10×1				
DK 4 A	Polystyrene		Polycarbonate		2½%	200	115×150×325 mm	2.6
DK 4 S	Polystyrene			Poly-carbonate	½% + 5 pF 10×1 μF 1%	200	115×150×325 mm	2.8
DK 4 AV	Polystyrene		Poly-carbonate	Calibrated variable air capacitor 50-1050 pF		2½% + 10 pF	200	115×150×325 mm	2.2
DK 4 SV	Polystyrene			Calibrated variable air capacitor 50-1050 pF		½% + 10 pF	200	115×150×325 mm	2.4

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FERRITE-CORED DECADE INDUCTOR TYPE DI 4

- IN-LINE READING
- HIGH Q - VALUES
- GOOD ACCURACY
- SMALL DIMENSIONS
- FERRITE CORES

This Decade Inductor is useful for laboratory tests and measurements e. g. for determining circuit constants in wave filters, tuned circuits etc. The accuracy and stability of the Inductor allows its use as a secondary standard of inductance. The inductance coils used are wound on ferrite cores providing a high Q value even at the lower audio frequencies.

SPECIFICATION

RANGE

10×1 mH to 10×1 H.

FREQUENCE DEPENDENCY

The stray capacitance shunting the inductors will increase the effective series inductance at high frequencies.
The stray capacitance varies according to which inductors are in circuit and how the earth terminal is connected.
The lowest capacitance is obtained on earthing the terminal adjacent to the earth terminal when the two lowest decades are used.
When only the higher decades are in use the upper terminal should be earthed.
In these cases the stray capacitance varies from 25 to 40 pF.
If – as is normally the case – the inductor is employed in a tuned circuit this capacitance is simply added to the external capacitance in order to obtain the total effective capacitance.
In case the effective series inductance must be determined the percentage increase with frequency can be calculated from

$$\triangle L/L_0\% = L \cdot f^2 \cdot K$$

where L is Inductance in henries, f is Frequency in kHz and K is between 0.1 & 0.16 with the highest value for the intermediate decades.

DISSIPATION FACTOR

The curves in Fig. 1 show the dissipation factor as a function of frequency for the separate decades. The

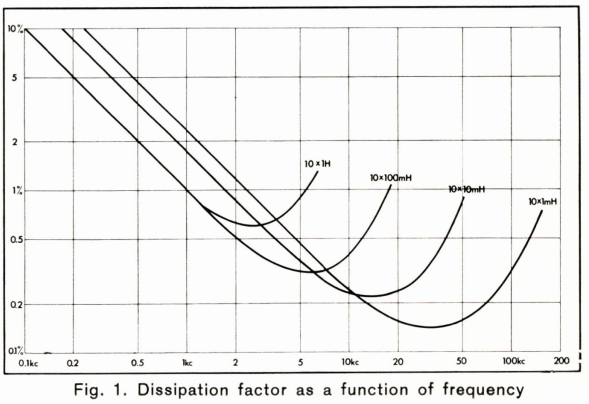

Fig. 1. Dissipation factor as a function of frequency

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curves give average values for each decade. The actual values spread somewhat so that at high values in each decade the curve moves towards the curve for the next higher decade and vice versa for low values.

CONSTRUCTION

Each unit comprises four coils with ferrite cores. The coils have the values 1-2-2-5 units and are series connected. The decade switch shortcircuits the appropriate coils to give the values required.

TEMPERATURE COEFFICIENT

About + 100×10^{-6} per degree C.

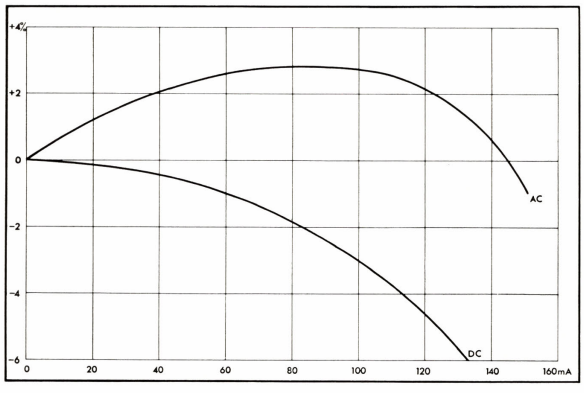

Fig. 2. Inductance variation with current for 100 mH coil.

INDUCTANCE VARIATION WITH CURRENT

The curves in Fig. 2 show the percentage variation of inductance with direct and alternating current measured on the 1 × 100 mH setting.

To find the corresponding currents for other settings multiply by the factors in the table below.

MAXIMUM CURRENT

For maximum stability the alternating or direct current should be limited to 120 mA on the 1×100 mH setting with corresponding values for other setting as determined from the table below.

SWITCHES

Wafer switches with fixed and moving contacts in pure silver.

TERMINALS

Two terminals are provided with a separate earth terminal.
Terminal spacing ¾″ (19 mm).

ACCURACY

10×1 mH 1%, 10×10 mH ½%, 10×100 mH ½%, and 10×1 H ½%.

MOUNTING

Cabinet in blue plasticcoated aluminium with chromiumplated end castings. Top panel finished in light-grey enamel.

DIMENSIONS

165 high×95×383 mm.
(6½ high×3¼×15 in.)

WEIGHT

4.3 kilos.

MULTIPLICATION FACTORS FOR DETERMINING INDUCTANCE VARIATION AND MAXIMUM CURRENT.

Inductance setting	× 1 H			× 100 mH			× 10 mH			× 1 mH		
	1	2-4	5-10	1	2-4	5-10	1	2-4	5-10	1	2-4	5-10
Multiply current by	0.32	0.22	0.14	1	0.71	0.45	3.2	2.2	1.4	10	7.1	4.5

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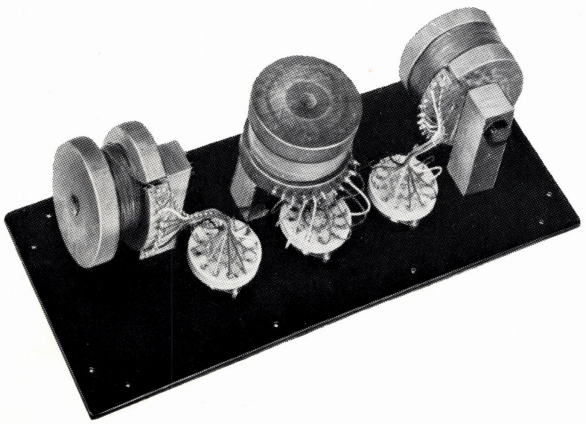
AIR-CORED DECADE INDUCTOR TYPE DI3A

GOOD ACCURACY
HIGH STABILITY
LOW PRICED

A variable inductor for use as a secondary standard of inductance. The coils are air-cored wound on wooden formers and carefully impregnated and aged for maximum stability.



SPECIFICATION

RANGE

10×1 mH – 10×10 mH and 10×100 mH.

ACCURACY

10×1 mH: 2%, 10×10 mH: 1%, 10×100 mH: 1%.

Q-VALUE

At 1 kHz Q-values of 10 to 15 are obtained except for 1×1 mH, Q = 6 and 2×1 mH, Q = 9.
Maximum Q-values of 40 to 50 are obtained at frequences from 5 to 10 kHz.

RESONANT FREQUENCY

The resonant frequencies are 20 kHz to 30 kHz for the 10×100 mH decade, 50 kHz to 80 kHz for 10×10 mH and 150 kHz to 200 kHz for 10×1 mH.

MAX. DISSIPATION

The safe dissipation is about 2 watts for each coil corresponding to maximum currents of 70 mA for the 10×100 mH decade, 200 mA for 10×10 mH and 400 mA for 10×1 mH.

CONSTRUCTION

The coils are tapped for the different values of inductance. The three coil units are mounted in such a way that interaction between them is reduced to a minimum.

SWITCHES

Wafer switches with silver contacts.

MOUNTING

Teak box with black insulated front panel.

DIMENSIONS

38.5×16×16 (over-all height) cm. (15¼×6¼×6¼ inch.).

WEIGHT

3.2 kilos.

DC RESISTANCE

Setting	x 1 mH	x 10 mH	x 100 mH
1	1.0 Ω	6.5 Ω	60 Ω
2	1.7 Ω	11 Ω	120 Ω
3	2.3 Ω	15 Ω	170 Ω
4	2.8 Ω	18 Ω	210 Ω
5	3.2 Ω	21 Ω	250 Ω
6	3.6 Ω	26 Ω	280 Ω
7	4.0 Ω	30 Ω	310 Ω
8	4.3 Ω	34 Ω	340 Ω
9	4.7 Ω	38 Ω	370 Ω
10	5.0 Ω	41 Ω	400 Ω

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