Tinsley
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Product Range | Tinsley History | Contacting Tinsley | Agents | UKAS Accreditation

H. Tinsley & Co. Ltd.

Part of the Hartest Group PLC

Founded in 1904 by Henry Tinsley the company is internationally recognised as one of the Leading "Specialist" Instrument Making Companies, supplying Instrumentation and Standards to National Standards Laboratories and Industry throughout the World.

Tinsley Standard Resistors Type 5685

Best known for our range of Precision Electrical Standards relating to Resistance, Voltage, and Temperature, the Company also manufacture a wide range of equipment from decade resistance boxes to strain meters to LCR Component Bridges used throughout a broad spectrum of Industry.

Tinsley Transformer Micro-Ohm Meter Type 5896

Tinsley are well established as the main supplier of power transformer test equipment and the range extends to include coil turns counters, shorted turns testers and transformer ratio-meters.

Tinsley Submarine Cable Test Set Type 5910

Tinsley provide the worlds Submarine Cable Operators with reliable means of locating and fault testing cables.

Tinsley Color Grader Series IV

Tinsley have been manufacturing Flour Colour Graders ever since they produced the original, internationally accepted, Kent, Jones and Martin Flour Colour Grader.

The name Tinsley has become synonymous with quality. This can only be maintained by operating to the very highest quality standards. The Company operates its own UKAS Laboratory for calibration, and has attained recognition of the International Standard IS09001.

Visitors

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Product Range

Precision Resistance Thermometry

A comprehensive range of Resistance Thermometer Bridges and Primary Standard Platinum Resistance Thermometers covering the range -189°C to 660°C. Tinsley also manufacture suitable Standard Resistors for calibration.

Resistance Measurement

Precision resistance measurement equipment for a range of applications. Specialist units measure down to fractions of a micro-Ohm with high accuracy

Standard Resistors

The design of our standard resistors is based on work carried out over many years with the co-operation of the National Physical Laboratory. Tinsley Standards are in use by many of the National Standards Laboratories throughout the world

Specialist Standards Equipment

Tinsley manufacture a wide range of Standards and Calibration Room equipment Including Standard Capacitors, Self and Mutual Inductors and a range of Precision Inductive Dividers

Portable Bridges and Potentiometers

A range of affordable battery operated test equipment for the measurement of resistance and calibration of instruments.

Decade Resistance Boxes

A range of units to cover the requirements of both development laboratories and calibration and test departments. High value instruments provide reliable calibration of insulation testers.

Air Cooled Shunts

The Air Cooled DC Shunts cover a very wide range of current from 1.5Amperes to 20,000 Amperes

Transformer Test Equipment

A range of equipment dedicated to the testing of transformers of all types and sizes

Coil Test Equipment

A range of equipment for checking for shorted turns, the number of turns on a former, and the performance of a wide range of transformer cores and laminations.

Precision Strain Measuring Instruments

Precision strain gauge meters with up to 10 channels

LCR-Databridges

Automatic Micro-processor controlled LCR Impedance Bridges

Submarine Cable Test Equipment

A range of equipment for the location of Submarine Cables and the faults in them.

Specialist Electronics Equipment

With many tens of years experience of designing and producing precision electronic equipment we are often able to produce special equipment for unusual requirements

Flour Colour Grader

Instrument based on the Kent Jones and Martin Flour Colour grader**.** Now available direct from Tinsley.

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[Up] [Resistance Thermometry] [Resistance Measurement] [Standard Resistors]
[Portable Bridges and Thermometers] [Specialist Standards Equipment]
[Decade Resistance Boxes] [DC Shunts] [Transformer Test Equipment]
[Coil Test Equipment] [Precision Strain Measuring Instruments] [LCR Data bridges]
[Submarine Cable Test Equipment] [Specialist Design and Production]

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Pioneering Work at Tinsley

Many of our historically significant products are on show in our museum

Click on photo for enlargement	From Left to Right
	An early model of a Stabaumatic Potentiometer first manufactured in 1963. A miniature version of the Vernier Potentiometer designed in the mid 1950's. The instrument below is a redesigned version of the Vernier Potentiometer and the last type of the famous Tinsley potentiometers to be produced. Kelvin Double Bridge with Standards first produced in 1912. The instrument on show was used in the factory for 60 years. Schering Bridge first manufactured in the 1930's and discontinued in the 1980's. Henry Tinsley made the set of Balancers to enable to weigh the chemicals to produce Weston Standard Cells in 1905.

Switch type Wheatstone Bridge first manufactured in the 1930's. A model of this type was once on show in the Science Museum with a cut away top panel showing the Tinsley famous dual contact Switches.

Dr D V Drysdale Torsion Head Wattmeter. Records show that instruments of this type were first in use in 1906, again records have shown that these Wattmeters were in use with
Electricity Boards and manufacturers for calibrating Watt-hour Meters worldwide for over 70 years.

Portable version of Mr D C Gall's AC Co-ordinate Potentiometer.

The Precision version of this type consisted of twelve instruments. Also on show is a Dr D V Drysdale Torsion Head Dynamometer for standardising the AC Potentiometer.

The earliest model of Henry Tinsley's Vernier Potentiometer with Slide Wire manufactured in 1912 and used in the manufacture of Weston Standard Cells.

All switch type Vernier Potentiometers 1920 version later models dual contact switches and top cover panel.

Behind the Vernier Potentiometer is a Precision Double Potentiometer. These instruments had 380 switch positions. A much larger version of this type was produced and consisted of three potentiometers in series.

Smith Bridge No. 3, designed by F E Smith of the N.P.L. in 1912. An early version was manufactured in the 1920's and was in use at the N.P.L. up to the 1960's.

A very precision type of the Smith Bridge was re-designed in the 1950's by three eminent scientists at the N.P.L. and Tinsley manufactured these and supplied to national Laboratories worldwide.

On the left, a set of Balancers made by Henry Tinsley to weigh the exact amount of chemicals used in the manufacture of Weston Standard Cells. The exact date is not known, however Henry Tinsley first manufactured commercially Standard Cells in 1905.

Here is a summary of our major developments over the years.

1905	Weston Standard Cells—first commercially manufactured in England by H. Tinsley
1908	Drysdale Phase Shifters
1909	Non-Inductive Shunts —Drysdale Ayrton Mather Moving Coil Galvanometers
1910	Vibration Galvanometer Drysdale & Tinsley Tinsley Vernier Potentiometer with Slide Wire

1912	Drysdale a.c. Polar Potentiometer Standardizing Bridge Torsion Head Dynamometer Polyphase Wattmeter— Drysdale Kelvin double bridge with standards
1914	Optical Parallelism tester for checking binoculars Syphon Recorders and Telegraph Apparatus Absorption Photometer for testing whiteness Condensers for Submarine Cables and Artificial Lines Precision Mica Condensers
1915	Engine Testing Stroboscopic Speed measuring Apparatus with Dr. Aston
1920	High Precision Vernier Potentiometer
1921	Introduction of self-contained Reflecting Galvanometer
1922	Gall Co-ordinate A.C. Potentiometer
1925	Continuously pumped Cathode Ray Oscillographs for explosion tests. Forerunner of the electron microscope
1926	Non-Inductive Coils and Resistance Boxes
1927	Very large d.c. shunts up to 3o,ooo amps Current Transformer Calibrating Equipment
1928	Apparatus for duplexing submarine cables Coxes Submarine Cable Relays Smith Bridge for Precision Platinum Resistance Thermometry
1930	Tuning Forks and Phonic Motors with Dr. A.B. Wood A.C. short circuit shunts up to 200,000 amps
1930	Marine Biological Apparatus with Dr. W.R.G. Atkins Iron Testing Equipment High Precision Vernier Potentiometer
1932	Geophysical Prospecting equipment using electrical methods — Mr. A. Broughton Edge
1933	Moving Coil Vibration Galvanometer Instrument Switches Dual Contact
1936	Self-contained illuminated galvanometers as limit bridges for high speed equipment testing

1939	Mast Head wind direction indicators for J. Class Yachts Galvanometers with optical magnifiers Galvanometer d.c. Amplifier for automatic control Submarine detecting apparatus Air interception radar apparatus Strain Gauge Bridges Radio Sondes Anemometers Helographs. Auto pilot test gear Shell hardness testers
1944	A.C. and D.C. Stabilisers Flour Colour Graders Platinum Resistance Thermometers.
1959	Very High Precision Potentiometer for discrimination to 1 part in 10,000,000 Infra red bolometers
1961	Infra red Fault Locating equipment Galvanometer amplifiers
1962	Automatic Current Controllers applied to automatic precision measurement
1963	Stabaumatic Potentiometer Automatic Flour Graders Inductive Ratiometers Automatic Potentiometers
1965 - 7	Decade Inductive Voltage Divider
1965	Temperature Controlled Standard Cell Enclosure 12 Cells Temperature Controlled Standard Cell Enclosure 4 Cells
1966	Self Calibrating Volt Ratio Box
1967	Inductively Coupled Temperature Bridge (NPL design)
1969	AC/DC Standard Resistors (NPL design F J Wilkins) Thermodynamic Efficiency Bridge
1970	DC Submarine Cable Test Set Digital Coil Turns Tester Rhodium/Iron Thermometers NPL design Dr R L Rusby
1971	Series 3 Flour Colour Grader
1974	Organic Pollution Monitor Direct Reading AC Comparison Bridge for Standard Resistors
1976	Hydraulic Efficiency Bridge Digital Power Loss Measuring System (British Steel)
1977	Direct Reading AC Resistance Thermometer Bridge (NPL design Dr R B D Knight) Digital Milliohmeter

1978	Digital Micro Ohmmeter Improved Version of the DC Submarine Cable Test Set Lift Overload Indicator Transformer Core Tester
1979	Shorted Turns tester
1982	Automatic AC Resistance Thermometer Bridge
1984	Temperature Controlled Enclosure for Standard Resistors
1985	Series 4 Flour Colour Grader
1986	Field of Vision Analyser (Dr Henson) Three Range Automatic Resistance Thermometer Bridge Electroding Generator
1987	Single Channel Strain Gauge Meter 10 Channel Strain Gauge Meter
1989	Programmable Automatic Resistance Thermometer Bridge Digital Micro Ohmmeter with Auto zero
1990	Micro Ohmmeter for Transformer Testing
1991	Electroding Detector
1994	Short Haul Submarine Cable Test Set
1996	Coil Turns Tester with Computer Interface Submarine Cable Test Set Mk V
1999	25 Amp Micro Ohmmeter 100 Amp Micro Ohmmeter 200 Amp Micro Ohmmeter
2000	Beach Probe for Locating Submarine Telephone Cables.

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Contact Information

For further information on any of our products or if you have any special requirements please contact us. Our engineers will be pleased to help. A large proportion of our production is exported around the world - please contact us and we will get our nearest agent to call you.

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Visiting Tinsley

Whilst we welcome visitors we would always advise you to make an appointment so that we can ensure that the best personnel are available to help you.

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Canada	China	Croatia
Czech Republic	Denmark	Egypt
Finland	France	Germany
Holland	Hong Kong	Hungary
India	Italy	Israel
Japan	Jugoslavia	Korea
Macedonia	Mexico	Malaysia
Netherlands	New Zealand	Norway
Poland	Portugal	Puerto Rico and the Caribbean
Romania	Kingdom of Saudi Arabia	Singapore
Slovak Republic	Slovenia	South Africa
Spain	Sweden	Switzerland
Taiwan	Thailand	United States of America

Note: - Because of the technical nature of **Submarine Cable Testing Equipment** and the use and support requirements across international boundaries, the equipment can only be purchased direct from the manufacturer: - H. Tinsley & Co. in the UK and not through international agents.

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UKAS Accreditation

UKAS UNITED KINGDOM ACCREDITATION SERVICE **0057** Calibration performed on Permanent laboratory premises	**Schedule of Accreditation** **Issued by** **United Kingdom Accreditation Service** 21 - 47 High Street, Feltham, Middlesex, TW13 4UN, UK **Standards Laboratory** **Issue No:** 09 **Issue date:** 1 January 2001

DETAIL OF ACCREDITATION

Measured Quantity Instrument or Gauge	Frequency	Best Measurement Capability Expressed as An Expanded Uncertainty (*k*=2)	Remarks
DC RESISTANCE AT			
NEGLIGIBLE POWER			
SPECIFIC VALUES	100 ¼©	100 ppm	
	1 m©	30 ppm	
	10 m©	12 ppm	
	100 m©	6 ppm	
	1 ©	2ppm	
	10 ©	2ppm	
	25 ©	2ppm	
	100 ©	2ppm	
	1 K©	2ppm	
	10 K©	2 ppm	

	100 K©	4 ppm	
	1 M©	8 ppm	
	10 M©	30 ppm	
	100 M©	250 ppm	
	1 G©	300 ppm	
	10 G©	500 ppm	
	100 G©	0.2%	
	1 T©	1.0%	
OTHER VALUES	UP TO 100 ¼©	0.05%	
	100 ¼ © TO 1 m ©	150 ppm	
	1 M© TO 10 m©	50 ppm	
	10 m© TO 100 m©	25 ppm	
	100 m© TO 1 ©	10 ppm	
	1 © TO 10 ©	5 ppm	
	10 © TO 10 K©	5 ppm	
	10 K© TO 1 M©	20 ppm	
	1 M© TO 10 M©	30 ppm	
	10 M© TO 100 M©	250 ppm	
	100 M© TO 1 G©	500 ppm	
	1 G© TO 10 G©	0.1 %	
	10 G© TO 100 G©	0.5%	
	100 G© TO 1 T©	2.0%	

Measured Quantity **Instrument or Gauge**	**Frequency**	**Best Measurement Capability Expressed as** **An Expanded Uncertainty** **(*k*=2)**	**Remarks**
DC RESISTANCE			
AT SIGNIFICANT POWER			
	100 mW TO 1m©	0.05%	
	1 m© TO 10 m©	0.015%	
	10 m© TO 10 ©	0.01%	
D C VOLTAGE			

	STANDARD CELL VALUES	1.5mV	
	UP TO 10 ¼V	10 nV	
	10mv TO 1.8V	1.6 ppm + 0.4 mV	
	1.8V TO 10 V	1.8 ppm + 1mV	
	10 V TO 100 V	3.7 ppm + 20mV	
DC VOLTAGE RATIO	100 V TO 1 KV	5.9 ppm + 200¼V	
	10^{-7} TO UNITY	10^{-6} TO 10^{-7} OF INPUT	
	UNITY TO 10^{3}	5 IN 10^{-6}	
DC CURRENT			
	1ma TO 10¼A	1Éa to 1.2nA	
	10ma TO 100¼A	120 ppm to 30 ppm	
	100 ma TO 1 mA	30 ppm to 20 ppm	
	1 mA TO 300 mA	20 ppm	
	1A	12 ppm	

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West Asia Trading & Engineering Pte Ltd No. 1 Kim Keat Lane Singapore 328858 Tel: 250 5676 Fax: 252 9890 web: http://www.westasia.com.sg Contact: Mr Tan Thye Ping, Managing Director email: westasia@singnet.com.sg

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Standard Resistors

The design of our standard resistors is based on work carried out over many years with the co-operation of the National Physical Laboratory. Much of the design originated with FJ.Wilkins of the NPL. Tinsley Standards are in use by many of the National and Industrial Standards Laboratories throughout the world

Click on photo for Data	Model	Features
	5685A	Wilkin Standard Resistor
	5685B	1KOhm Wilkin type Standard Resistor
	5685C	10KOhm Wilkin type Standard Resistor
	5615	High Resistance value Standards
	5686	Low Resistance value Standards

	1660	Low Cost Standard Resistor
	1659	Precision Non-Inductive Standard Resistor
	1682	Precision Non-Inductive Standard Resistor
	3111	Precision Non-Inductive Standard Resistor (High Current)
Awaiting Photo	4405	Standard Resistors Grade 2
	5906A	Specialist Standard for the calibration of Model 5902 Submarine Cable Test Set
	5906B	Specialist Standard for the calibration of Model 5902 Submarine Cable Test Set

	4737B	Specialist Standard for the calibration of Micro-Ohmmeters
	Model 5648 Temperature Controlled Enclosure	36 °C +/- 0.1°C

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Precision Resistance Thermometry

A comprehensive range of Resistance Thermometer Bridges and Primary Standard Platinum Resistance Thermometers covering the range -189°C to 660°C. Tinsley also manufacture suitable Standard Resistors for calibration.

Click on photo	Model	Accuracy
	Senator 5840D Thermometer Bridge	1.0mK
	Consort 5840E AC. Thermometer Bridge	5.0mK
	Model 5885 Precision Digital Thermometer with PRT and Thermocouple inputs	10mK
	Model 5187SA Primary Standard Platinum Resistance Thermometer	1.0mK

	Model 5187L Helium Filled Platinum Sheath Thermometer	
	Model 5840 Selector switches	
	Model 5648 Temperature Controlled Enclosure	36 °C +/- 0.1 °C

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Precision Resistance Measurement

Precision resistance measurement equipment for a range of applications. Specialist units measure down to fractions of a micro-Ohm with high accuracy

Click on photo	Model	Features
	QJ84	**Digital Resistance test Instrument** 20mΩ to 20 kΩ full scale in 7 ranges nominal 0.05% accuracy
	PC9	**Milli-Ohmmeter** 20mΩ to 2 kΩ full scale in 6 ranges nominal 0.1% accuracy
	ZY9858	**Digital Micro-Ohmmeter** 2mΩ to 2 kΩ full scale in 7 ranges nominal 0.05% accuracy
	5890	**Micro-Ohmmeter** 1.9mΩ to 1900 Ω full scale in 7 ranges nominal 0.05% accuracy

	5895	**Transformer Micro-Ohmmeter** 10 mΩ to 100 Ω full scale in 6 ranges nominal 0.1% accuracy
Battery Micro-Ohmmeter (34400 bytes)	5893	**Portable Micro-Ohmmeter** 600 μΩ to 60 Ω full scale in 6 ranges Nominal 0.15% accuracy
	5897	**High Current (100A) Portable Micro-Ohmmeter** 400μΩ to 40Ω full scale in 6 ranges Nominal 0.2% accuracy
	5898	**High Current (200A) Portable Micro-Ohmmeter** 600μΩ to 6Ω full scale in 5 ranges Nominal 0.2% accuracy

	5896	**High Current (25A) Transformer Micro-Ohmmeter** 1mΩ to 100Ω full scale in 6 ranges Nominal 0.1% accuracy

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Portable Bridges and Thermometers

Click on photo	Model - Features
	**Portable Wheatstone Bridge Model QJ23E** 1Ω€ to 9.999MΩ 0.1 to 0.2 % accuracy
	**Portable Precision Wheatstone Bridge Model QJ49E** 1Ω€ to 1.1111MΩ 0.05 % accuracy
	**Portable Wheatstone/Kelvin Bridge Model QJ31E** **10Ω€ to 1MΩ (Wheatstone)** **0.0001Ω€ to 100Ω (Kelvin)** **0.1 % accuracy**

	**Portable Double Bridge Model QJ42E** 0.0001Ω€ to 11Ω€ Accuracy typically 1.0%
	**Portable Precision DC Kelvin Bridge ModelQJ57E** 10^{-8}Ω€ to 1111.1Ω Accuracy 0.03%
	**Portable Multi-Purpose DC Potentiometer Model UJ33E** 1µV to 1.0555V
	**Portable DC Potentiometer Model UJ36E** 10µV to 120mV

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Specialist Standards Equipment

Tinsley manufacture a wide range of specialist, precision Standards and Calibration Room equipment.

Click on Photo	**Model**	**Features**
	4711	Precision Capacitor
	5906B	Specialist Standard for the calibration of Model 5902 Submarine Cable Test Set

	4190 series	Precision Self and Mutual Inductances
	4229	Precision Variable Mutual Inductor
	5560	Precision Seven Decade Inductive Voltage Divider
	5560K	Precision Two Stage Inductive Voltage Divider
	5573A	Precision High Voltage Resistance Divider

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Decade Resistance Boxes

A range of units to cover the requirements of both development laboratories and calibration and test departments.

Click on photo for details	Model	Features
	ZX70 Series	Decade Resistance Boxes (0.01% accuracy)
	ZX90 Series	Decade Resistance Boxes (0.1% accuracy)
	4720 Series	9 Decade High Resistance Boxes for the checking and calibration of Insulation Testers at voltages up to 5000V

	4721	Single, High Resistance Decade Box for the checking and calibration of Insulation Testers at voltages up to 5000V

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DC Shunts

The air cooled DC Shunts cover a very wide range of current from 1.5Amperes to 20,000 Amperes

Click on photo for details	Model	Features
	2276	Very High Current Air Cooled Shunts (Typically 0.1%)
	4638	Air Cooled Shunts (Typically 0.03%)
	4640	Air Cooled Shunts (Typically 1.0 - 0.1%)

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Transformer Test Equipment

A range of equipment dedicated to the testing of transformers of all types and sizes

Click on photo for full details	Model	Features
	5895	Transformer Micro-Ohmmeter (10Amp)
	5896	Transformer Micro-Ohmmeter (25Amp)
	5897	High Current (100Amp) Portable Micro-Ohmmeter

	5898	High Current (200A) Portable Micro-Ohmmeter
	4167P	Portable Transformer Ratiometer
	4167C	Manual Transformer Ratiometer
	4167D/H	Automatic Transformer Ratiometer

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Coil Test Equipment

A range of equipment for checking for shorted turns, the number of turns on a former, and the performance of a wide range of transformer cores and laminations.

Click on photo for full details	Model	Features
	9600/ 9601 /9602 /9603	Coil Turns Counter
	5846	Transformer Iron Tester
	5863	Shorted Turn Tester

	4167C	Manual Transformer Ratiometer

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Precision Strain Measuring Instruments

Single and ten channel strain meters for a wide range of applications

Click on photo for full details	Model	Features
	8691	Single Channel Strain Meter
Ten Channel Strain Meter (33245 bytes)	8692	Ten Channel Strain Meter

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LCR Databridges

Automatic micro-processor controlled LCR Impedance Bridges with accuracies up to 0.1%. Providing resistance, capacitance and inductance measurement, these versatile instruments are ideal for inspection, production line testing and general laboratory use on a wide variety of components. Accessory probes provide the means of checking surface mount components.

Click on photo for more details	Model	Features
	6401	0.25% nominal accuracy 100/120Hz - 1kHz
	6451	0.1% nominal accuracy 100/120Hz, 1kHz, 10kHz
	6458	0.1% nominal accuracy 100/120Hz, 1kHz, 10kHz

	6471	0.1% nominal accuracy 100/120Hz, 1kHz, 10kHz, 100kHz
 	Databridge accessories	Test leads, Calibration Standards, Computer Interfaces, Software etc.

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Submarine Cable Test Equipment

A range of equipment for the location of Submarine Cables and the faults in them.

Click on photo for full details	Model	Application
	5902	Long Haul Submarine Cable Test Set
	5930/5931	Submarine Cable Survey System

 		
	5910	Portable Short haul Submarine Cable Test Set.
	5910R	Rack Mount Short haul Submarine Cable Test Set.
	5915	Electroding Generator

Electroding Detector (32995 bytes)	5916	Electroding Detector
	5917	Beach Probe
	5918	Battery Powered Portable Electroding Detector
	5901C	Submarine Cable DC Test Set
	5941	Cable Termination Unit

Note: - Because of the technical nature of Submarine Cable Testing Equipment and the use and support requirements across international boundaries, the equipment can only be purchased direct from the manufacturer: - H. Tinsley & Co. in the UK and not through international agents.

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Specialist Design and Production Services

With many tens of years experience of designing and producing precision electronic equipment we are often able to produce special equipment for unusual requirements

Click on photo	Model
	Flour Color Grader Series IV
	Model 5762 High Resistance Fault locator
	Model 5860a Lift Overload Indicator

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[Up] [Colour Grader]

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Tinsley Colour Grader, Series IV

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Tinsley have been manufacturing Flour Colour Graders ever since they produced the original, internationally accepted, Kent, Jones and Martin Flour Colour Grader over 40 years ago. The Tinsley Colour Grader Series IV is a direct descendant of the original.

Designed for the quality control of flour this instrument provides an accurate, reliable repeatable method of measuring the colour and hence purity of flour. It is also ideal for other applications where the precise measurement of whiteness is important.

Specification

Range	-5 to +18 Flour grades
Accuracy	+/-0.2 Flour grades
Resolution	Better than 0.1 Flour grade
Calibration Control range	+/-5 Flour grades
Drift	less than 0.05 Flour grade per hour
Power Supply	220-245V or 110-122V, 50/60Hz
Power Consumption	80 Watts

Operation

The sample of flour to be tested is weighed, mixed with pure water and poured into the glass cuvette. The timing of the process is critical and the Colour Grader automatically assists by providing lamp and buzzer indication of mixing time. The sample is then inserted into the Grader which then automatically moves the sample in front of its internal light source and at the correct time measures the intensity of the reflected light from the sample. The results are presented on a LED display and are printed out along with time and date on the internal printer.

Calibration

At the beginning of each day, or as required, the instrument is calibrated against an internal ceramic tile. Overall standardisation is carried out using a sample of National Standard Flour.

Summary

The Tinsley Colour Grader Series IV, accurately and reliably resolves very small differences in whiteness of flour samples compared with an internal white standard that is itself calibrated against national or international colour standards.

The equipment enables millers and bakers to monitor closely the quality and consistency of the flour that they are producing or using.

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PO Box 53, Horsfield Way
Bredbury
Stockport SK6 2FG
England

Flour Milling
Telephone: +44 (0)161 406 3800
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General Information email: info@satake.co.uk

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High Resistance Fault Locator, Model 5762

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Introduction

The High Resistance Fault Locator, Type 5762, utilises a conventional Wheatstone Bridge circuit in which the two sections of the faulted conductor, one on each side of the fault, comprise the two external arms of the bridge. The other two arms of the bridge are contained in the instrument. By use of a detector circuit, of extremely high input resistance it is possible to locate high resistance faults without loss of sensitivity.

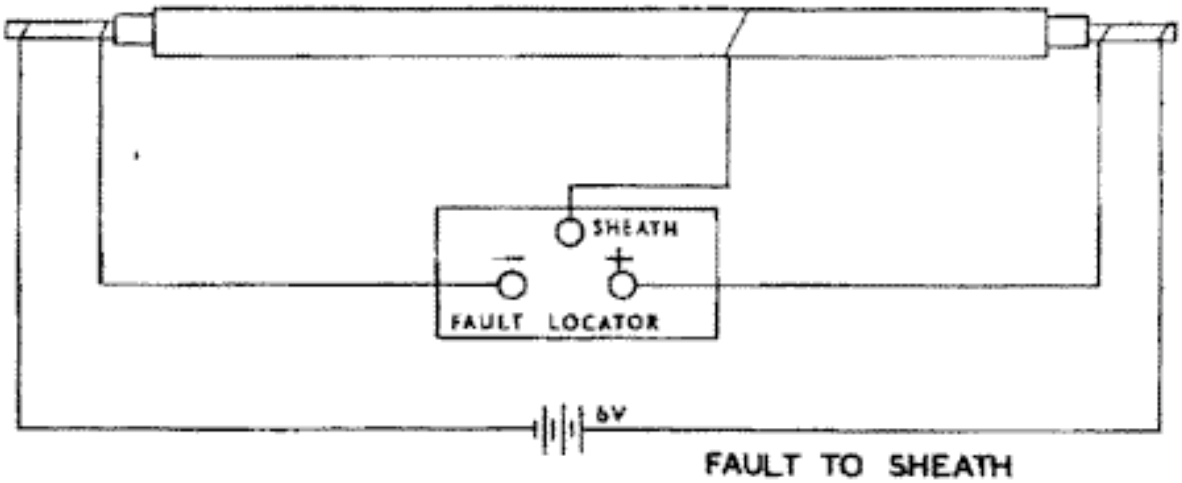
With this bridge arrangement, faults having resistance from zero up to 200 MΩ in dielectrics such as rubber and polythene, can be located with an accuracy to well within ±0.5%, a typical error being 6” in 500 feet (150mm in 150m) or ±0.1%. The limitation is determined by the uniformity of the conductor.

Accuracy

- Well within ±0.5%, a typical error being 6” in 500 feet (150mm in 150m) or ±0.1%.

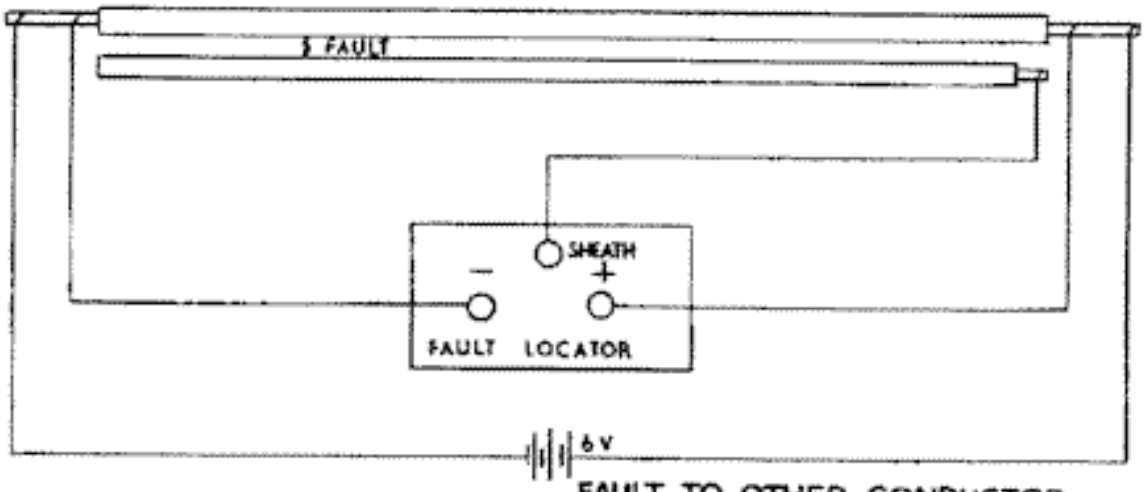
Connection Methods

a. WHEN BOTH ENDS OF THE FAULTED CONDUCTOR ARE TOGETHER, as in cable manufacture, or when the cable is on a cable reel. (Fig I and Fig.2)



FAULT TO SHEATH
BOTH ENDS ACCESSIBLE AT SAME POINT

FIG I



FAULT TO OTHER CONDUCTOR
BOTH ENDS ACCESSIBLE AT SAME POINT

FIG 2

b. WHEN THE ENDS OF THE FAULTED CONDUCTOR ARE NOT AVAILABLE AT THE SAME POINT, as in the case of a cable in service.

Two methods may be used. The preferred method is to run out two insulated wires to the distant end to serve as current and potential leads. The resistance of these leads should be as low as possible, e.g. less than I Ohm. Alternatively, a good conductor in the cable may be used. Connect the good conductor and the faulted conductor solidly together at the distant end and adequately insulate the joint from earth. Make connections at the near end as shown in Fig.3.

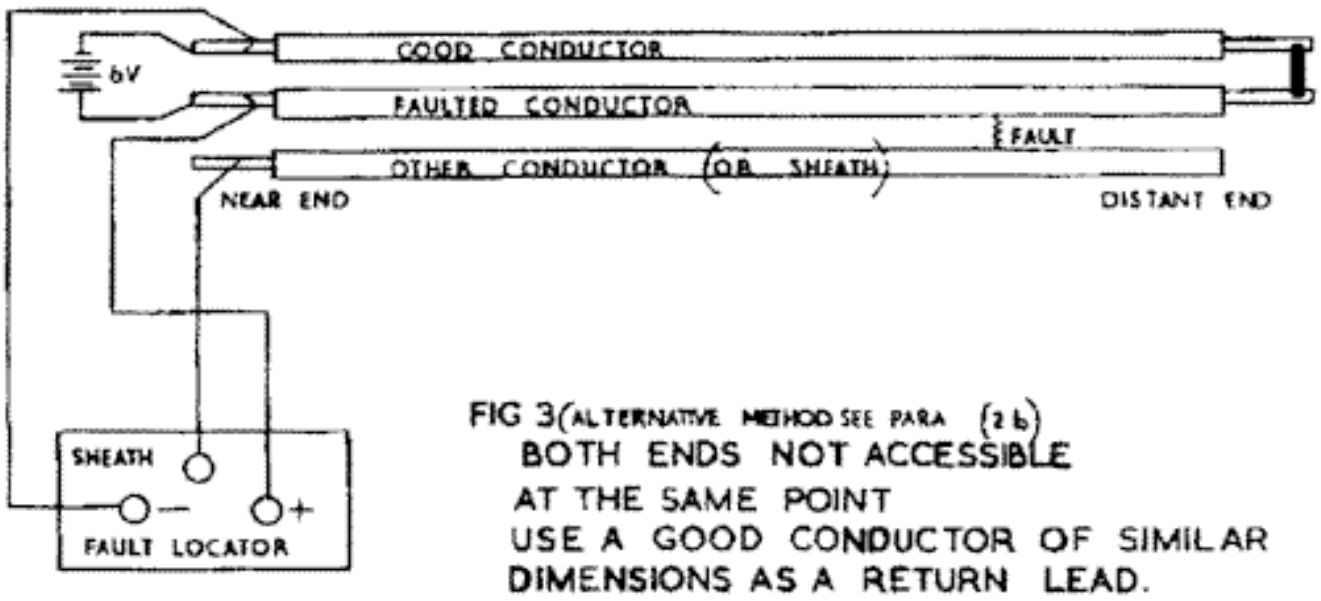


FIG 3 (ALTERNATIVE METHOD SEE PARA (2b)
BOTH ENDS NOT ACCESSIBLE
AT THE SAME POINT
USE A GOOD CONDUCTOR OF SIMILAR DIMENSIONS AS A RETURN LEAD.

This method effectively doubles the length of the faulted conductor and reduces the accuracy to half

Fault Location

i) With all the connections made as in (2) switch on the fault locator and allow the instrument to settle for one minute.

ii) By means of the zero control adjust the instrument until the microammeter reads zero.

iii) Connect the second current lead to the battery.

iv) Adjust the Fault Locator main dial for zero reading on the microammeter.

The reading of the main dial then indicates the location of the fault as a percentage of the total length of cable loop from the end connected to the “+“ terminal on the instrument.

v) Reverse the connections to the conductor terminals and rebalance. The sum of the readings obtained in (iv) and (v) should add to 100%.

Note:

The total length of the cable loop means the total length of cable between the potential points, that is the points at which the leads to the terminals of the instrument are connected to the cable. This is equal to the length of the cable in the case shown in Figs I and 2 but is equal to

twice the length of cable in the case shown in Fig. 3.

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Lift Overload Indicators - 5860 Series

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A reliable indicator which may be rapidly attached to any lift to give an indication of the loading condition and/or provide a trip signal to the lift control circuit.

A range of models are manufactured to suit most requirements and special units can be made to order.

Installation is very easy and requires no dismantling of the lift assembly. The solid state electronics unit is contained in a robust, sealed metal case with external indicating lights showing the operating condition.

The unit is essentially maintenance-free but should either the sensor or the indicator be damaged all units are interchangeable and do not require any matching.

The advantages of using the Tinsley Lift Overload Indicator are:

For the lift owner

- The electrical and mechanical components of the installation are not overloaded and are working within their design criteria. The brakes in particular are not having to do excessive work and hence will not require frequent attention. Maintenance costs are therefore kept to a minimum.

For the lift user

- Lift breakdowns resulting from overloaded operation will be avoided. The lift will remain in continual safe operating condition. The only downtime experienced will be the usual routine maintenance.

For the lift engineer and his company

- Urgent callouts to lifts out of action due to misuse by overloading are avoided. The company can work to a planned programme of maintenance and parts replacement.

For the lift design engineer

- By designing in overload protection the manufacturer will enhance his reputation by offering his customer a better, safer and more durable installation.
- The Tinsley Overload Indicator can be easily fitted to existing installations with a minimum of downtime.

The following models are available: -

5860 A	1 Set Point
5860 B	2 Set Points
5860 C	5 Set Points
5860 D	10 Set Points
All the above models are compatible with all Tinsley Type 5861 sensors	
Type 5861 A	Single Sensor Unit
Type 5861 B	Double Sensor Unit
Type 5861 C	Four Sensor Unit
Type 5881 H	Hydraulic Sensor

TYPE 5860A

A unit having one set point for overload cut-off or warning. It may be used in conjunction with a counter for monitoring the number of overload or near-overload operations.

The Overload Indicator consists of 2 assemblies:

- 1. A small strain gauged beam which is bolted by 2, 6mm bolts to the Cross Head of the lift.
- 2. An electronic unit which looks at the output of the strain gauged beam and amplifies the signal and then compares it with an adjustable preset voltage. This voltage control sets the point at which the unit will trip and when used on a lift may be adjusted between the equivalent of 1 and 50 people.

In order to prevent rapid fluctuations of the electronic signal with a hesitant passenger, a built-in time delay requires that the signal should be applied for a period of 1/2 second before a response is produced.

In addition, to prevent hunting of the unit at the critical weight a built-in hysteresis control enables the limits of the dead zone to be set as required, usually about 0.4 of a person is adequate.

The whole unit is powered by a built-in stabilised power supply operating at a low voltage and only requires connection to the normal a.c. mains.

Indicator lights are provided on the outside of the instrument showing that mains power is applied and also giving an indication of the overload condition.

Three relay contacts are provided giving a common, normally open and normally closed connection, it is therefore possible to operate a warning sign in the lift car and a buzzer or chime and also to signal the lift control apparatus to prevent operation of the lift whilst in an overload condition

Three controls are available on the instrument panel:

- 1. Zero. “COARSE” and “FINE” zero controls compensate for any slight strain in the load cell after it has been bolted down to the lift.
- 2. Relay Trip Point. This control is adjustable to operate the relay at the appropriate load. It will be noted that asmall built-in time delay prevents rapid operation of the relay (as could occur if a person jumped up and down in the lift).
- 3. Dead Zone. This a control which operates from zero to approximately 5% of full load and it prevents the indicator from hunting at the critical weight. Generally, it should be set at about the half-way position.

Click on photo for enlargement

The photograph shows a typical Overload Indicator Installation. The single sensor Type 5861A is shown bolted to the crosshead of the lift whilst the 5860A Indicator Unit is mounted close by.

Typical take-off arrangements are shown on page five with suggested sensor positions.

TYPE 5860B

A 2 set point indicator generally as type 5806A but having an additional output relay operated by a separate trip point control. The intermediate trip point control having a fixed dead zone. This unit is designed to provide a warning signal at a percentage full load and a trip signal at full load.

TYPE 5860C

A unit similar to 5860B but having 5 set points consisting of one overload trip point with variable dead zone and 4 intermediate set points with fixed dead zone. Each of the trip points control an isolated volt-less set of changeover relay contacts.

TYPE 5860D

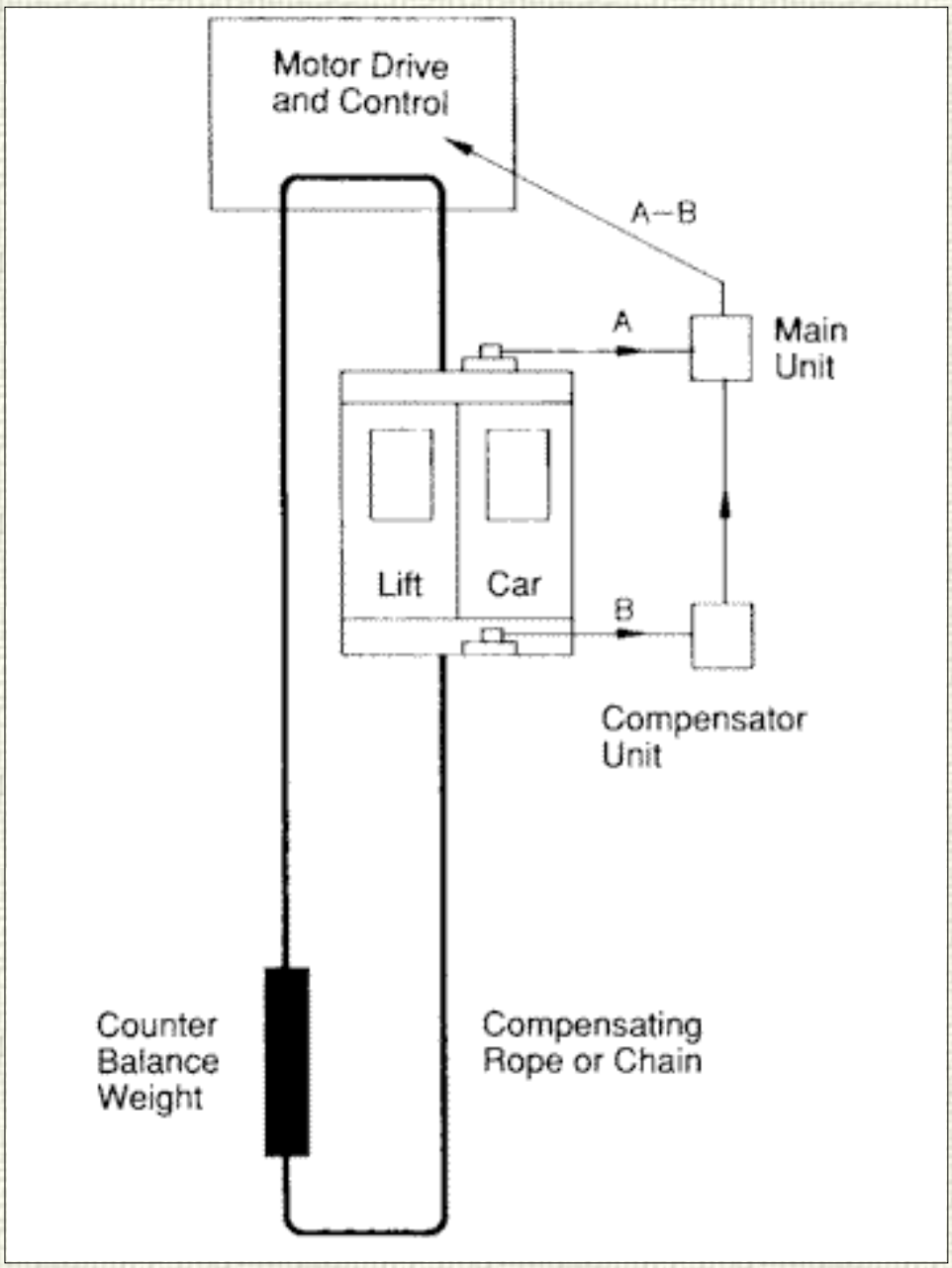
Click on photo for enlargement

As type 5860C but with one set point with variable dead zone control and nine intermediate set points with fixed dead zone.

TYPE 5861 AC COMPENSATOR

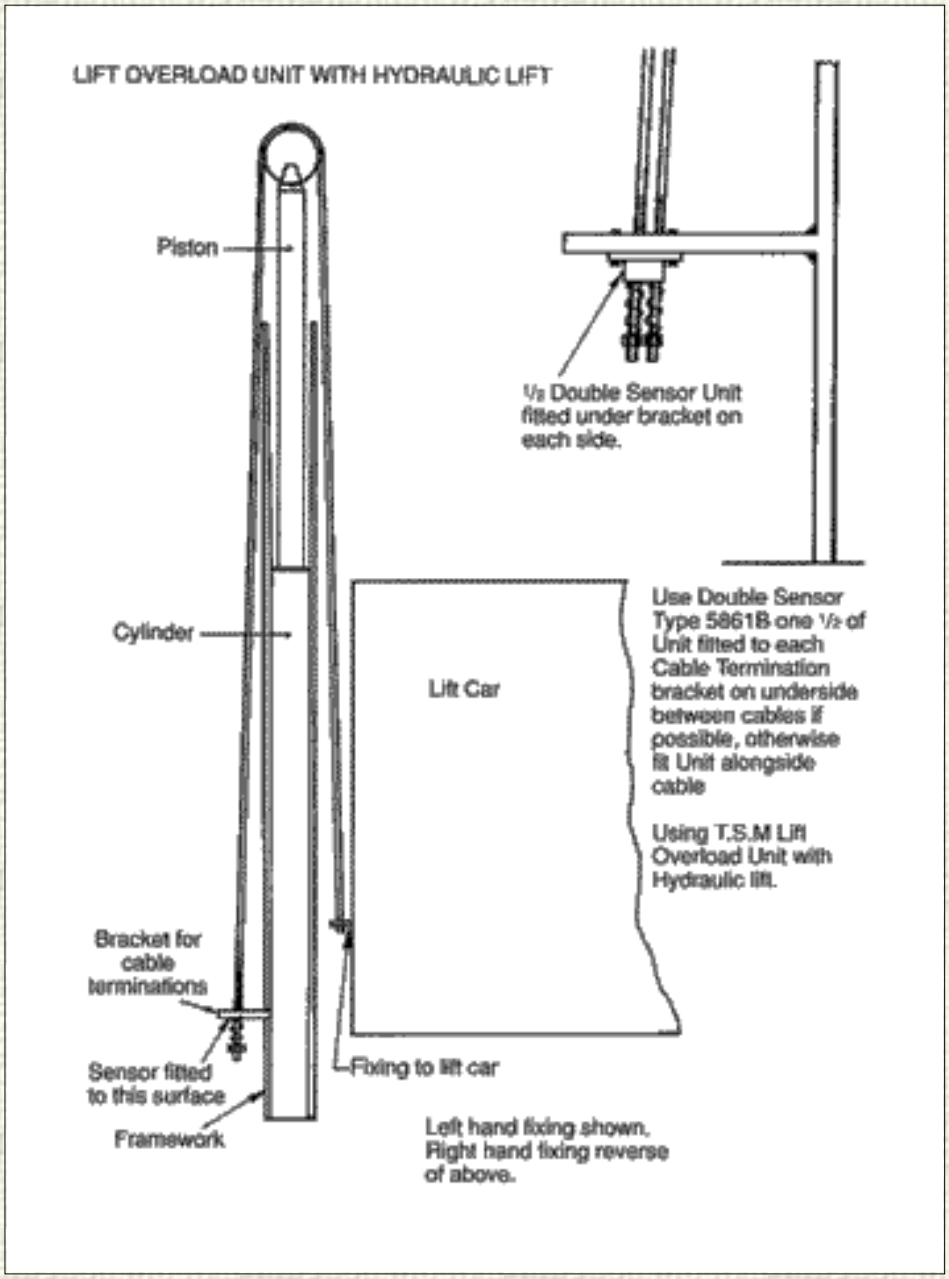
The compensating unit is designed to operate with any of the Tinsley Lift Overload Indicators. The unit compensates for the weight of chain under the car at any position in the shaft.

The compensator consists of a special sensor with a long lead which is fitted under the car in such a way as to sense the weight of the chain. The signal from the sensor is fed into an electronic compensating unit which is mounted on the top of the lift adjacent to and connected to the lift Overload Unit. As shown in diagram below



Hydraulic Lifts

The Type 5860 Overload Unit can be used for hydraulic lifts by using the 5861B double sensor. Each unit of the sensor is mounted underneath the cable terminating brackets, one on each side of the lift.



The sensor is connected to the overload unit which can be mounted at the base of the lift shaft in any convenient position and connected electrically with the control room.

This system is very effective and reliable where the brackets are accessible and have a suitable area of the bracket free for the fitting of the sensor units.

However, today many brackets are fitted with compensators and safety devices which make it impossible to fit the 5861B sensor units.

TINSLEY have therefore developed a new sensor 5861H which is fitted in the hydraulic line of the lift system.

This system monitors the change in pressure of the hydraulic line as the load in the car changes.

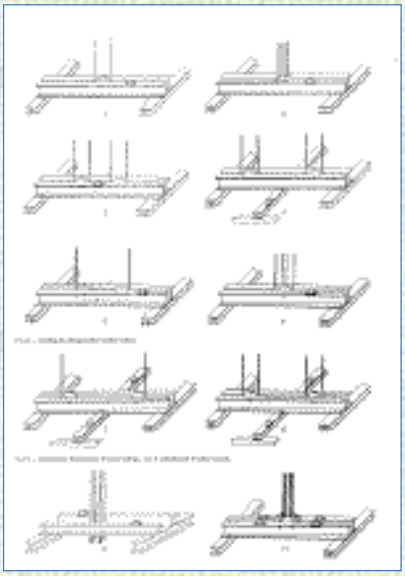
The sensor can be fitted into the pipe line or into a suitable junction point.

The new sensor is shown in the adjacent illustration.

Click on photo for enlargement

Tinsley will be pleased to give advice on the most suitable type of sensor for particular installations on receipt of sketches & details of the lift layout.

The sensor is a interchangeable with the standard sensors and is connected to the overload unit in the normal way. The standard setting up instructions can then be followed.



Sensor Positioning. Click for enlargement

TYPE 5861E

An illuminated indicator and buzzer unit for giving visible and audible warning of the overload condition. Lights up in red ‘Lift Overload” and buzzes to draw attention to the condition but is not unpleasant in volume.

Standard models 110V AC or 240v AC. Other — AC/DC voltages to order.

Type	Dimensions	Weight

OVERLOAD INDICATOR		
5860A	169 x 126 x 90mm	2 kg
5860B	350 x 160 x 100mm	3.77 kg
5860C	350 x 160 x 100mm	4.00 kg
5860D	350 x 160 x 100mm	4.36 kg
COMPENSATOR		
5861AC	169 x 126 x 90mm	1.8 kg
INDICATOR & BUZZER UNIT		
5861E	200 x 125 x 50 mm	1.1kg
	Panel Cut Out: 160 x 89mm	
SENSOR		
5861A	125 x 50 x 50mm	150g
5861B	125 x 100 x 75mm	400g
5861C	200 x 100 x 75 mm	800g
5861H	100 x 75 x 50 mm	110g
COMPENSATOR SENSOR		
5861A	125 x 100 x 50 mm	250g

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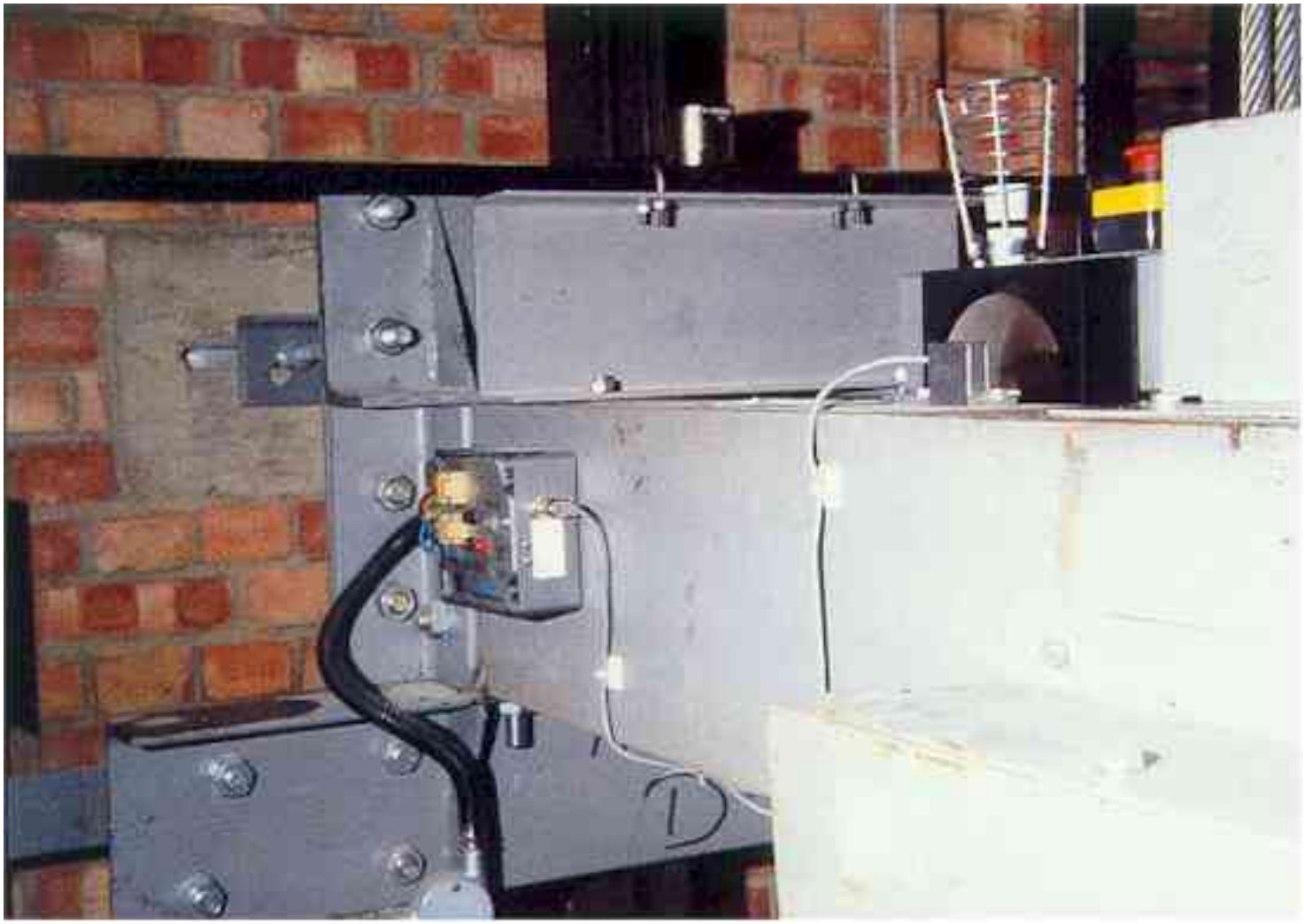

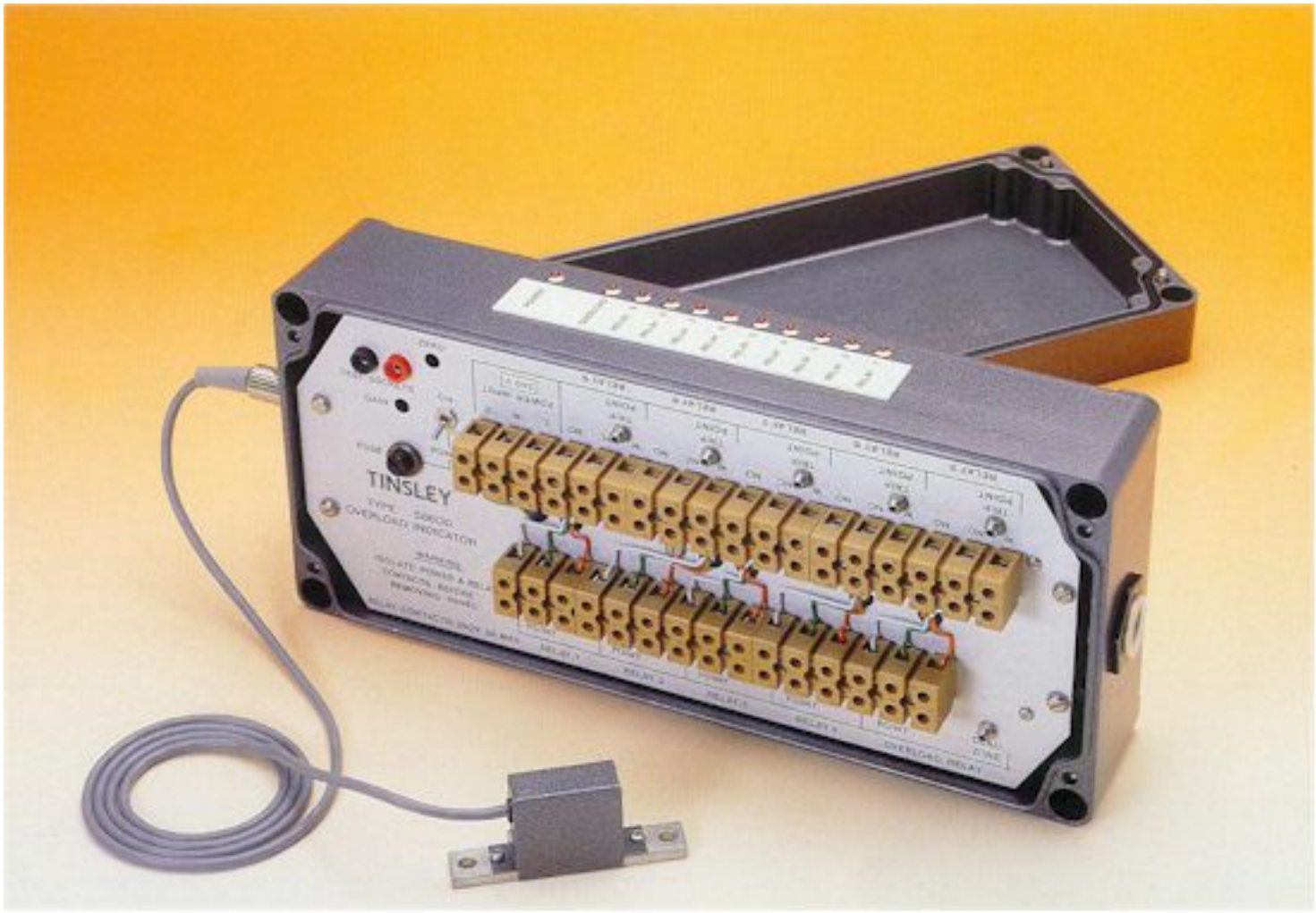
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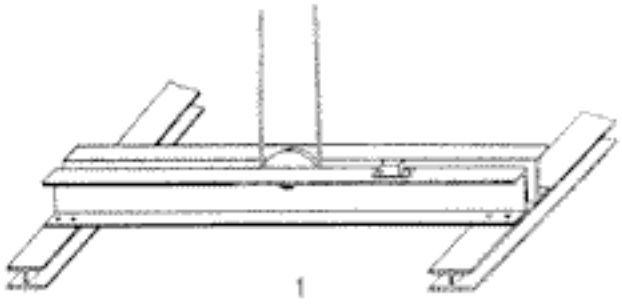
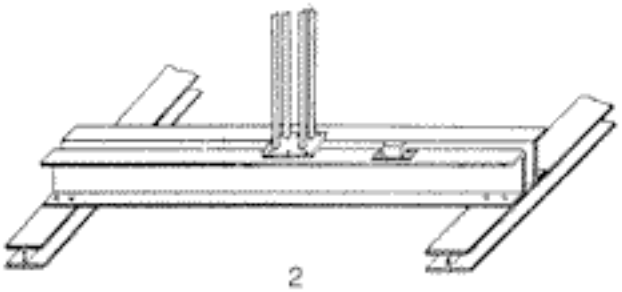
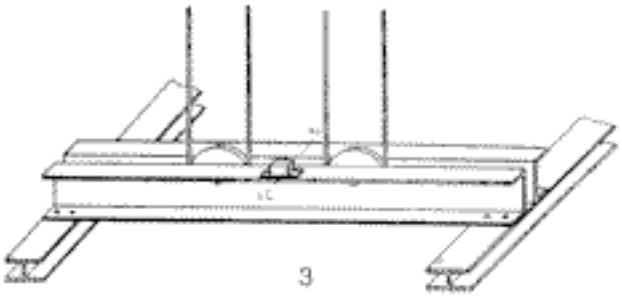
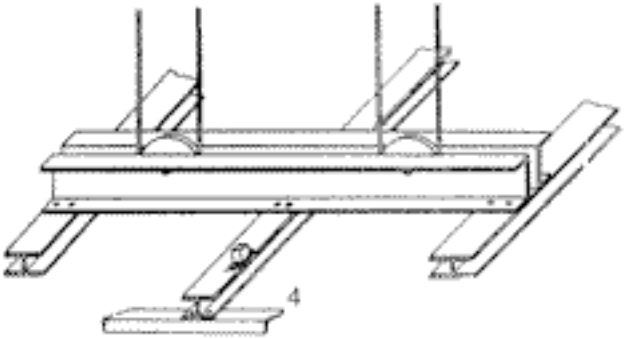
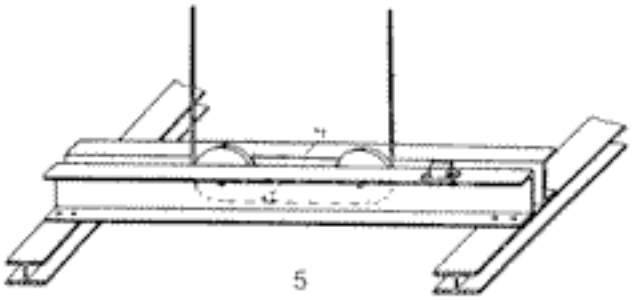
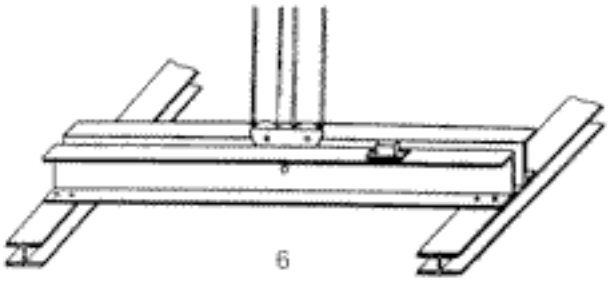




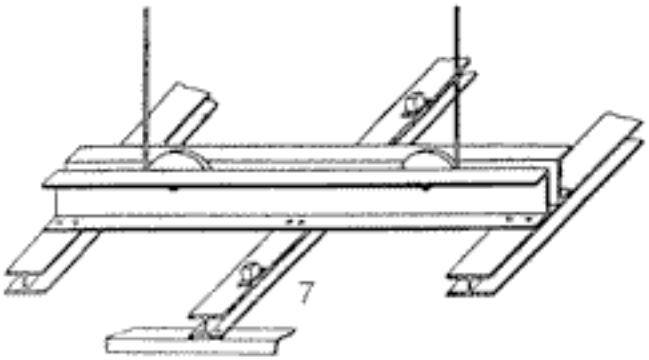


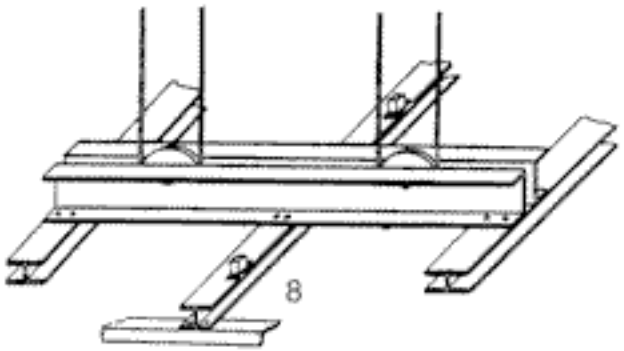




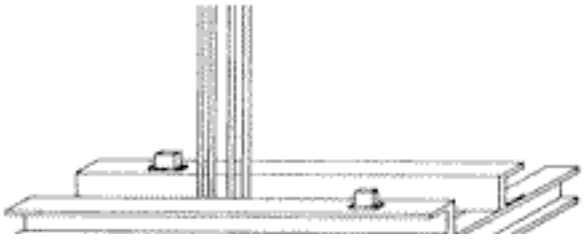


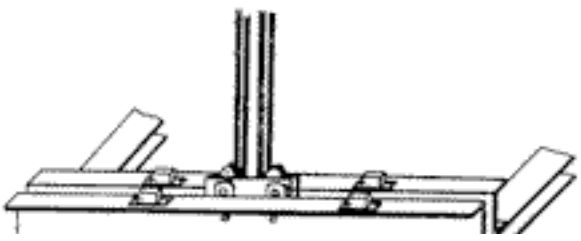
1 to 6 – SINGLE SENSOR POSITIONS

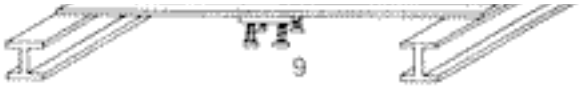




7 to 9 – DOUBLE SENSOR POSITIONS: 10-4 SENSOR POSITIONS







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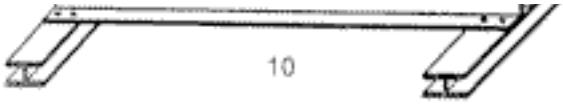

10


LIFT
OVERLOAD

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Long Haul Submarine Cable Test Set Model 5902

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The Tinsley 5902 Long Haul Submarine Cable Test Set brings the latest technology to the tried and tested DC methods of cable fault location. The more common test procedures which are associated with the location of types of cable fault such as “open circuits” and “shunt faults” are pre-programmed into the instrument. This allows the procedure to be carried out automatically

therefore eliminating operator errors and reducing the uncertainty of the prediction of fault position. The instrument may be set for a wide range of voltage and current limits making it suitable for use with most submarine communication cable systems.

Safety being an important feature, the instrument gives a continuous indication of the state of charge of the cable under test and will automatically disallow current, voltage or polarity changes to be made until any voltage on the cable has fallen to a level which is safe for both the cable and the instrument. A safety interlock operates to remove high voltage from the output should a cable patch lead be removed whilst a test is in operation.

The setting up of the instrument is menu driven with prompts being displayed on an eight line LCD display. This display is also used to indicate at which stage a test procedure has reached during its implementation. The RS232 interface is designed for full duplex communication. All functions may be controlled via a computer and obtained data may be stored for future analysis. This interface may also be used to enable two 5902's to communicate with each other when carrying out double ended tests such as “no loss of current”. After fault detection the electroding generator function may be used to assist the cable repair vessel in locating the cable on the sea bed prior to retrieval and repair.

Specifications

Ohm-meter - Conductor Resistance Measurement

Resistance Range	Display Resolution	Accuracy (line Voltage 1V to 1000V)
0Ω to 100.00Ω	0.01Ω	±0.2Ω
100.1Ω to 1000.1Ω	0.1Ω	±0.2Ω up to 200Ω ±0.1% above 200Ω
1000Ω to 10000Ω	1Ω	±0.1%
10KΩ to 100KΩ	10Ω	±0.1% at 10KΩ reducing to ±0.5% at 100KΩ

Current Control

Polarity Selectable positive “+” or negative “-”
Level May be set from 0.5 to 200mA with resolution 0.1mA
Compliance selectable at 50V, 100V, 250V, 500V or 1000V

Voltage Control mode

Level may be set 0.5V to 1000V with resolution of 0.1 V
Drive selectable 20mA or 200mA

Capacitance Meter (CAP or IC)

Direct reading capacitance measurements between 0.05µF and 2000µF. Incorporating automatic compensation for leakage and series resistance evenly distributed along cable length.

Range	Resolution	Accuracy (using standard caps)	Measurement Cycle
0.05 to 2µF	0.001µF	±0.005µF	2 secs @ 1µF
2 to 20µF	0.001µF	±0.2%	2 secs @ 10µF
20 to 200µF	0.01µF	±0.2%	20 secs @ 100µF
200 to 2000µF	0.1µF	±0.2%	200 secs @ 1000µF

MegOhmmeter – insulation resistance measurement

Selection of voltages between 50V and 1000V. Analogue meter display 10^5 to 10^{11}Ohms in 3 ranges. With digital indication on the main display.

Voltage settings +50V, 100V, 250V, 500V, or 1000V
Polarity selectable positive “+” or negative “-”

Range	Applicable Voltage	Accuracy
$10^5\Omega$ to $10^9\Omega$	50V 100V	±1dB (10^5 to $10^8\Omega$) using Standard Resistors
10^6 to $10^{10}\Omega$	250V	±1dB (10^6 to $10^9\Omega$) using Standard Resistors
10^7 to $10^{11}\Omega$	500V 1000V	±1dB (10^7 to $10^{10}\Omega$) using Standard Resistors

Charge Current

Current limit selectable to 20mA or 200mA nominal

Electroding Generator (GEN)

A sine wave generator with selectable current levels and voltage limits

Frequency	Selectable either 10Hz, 16.7Hz, 20Hz, 25Hz or 33.3Hz. Accuracy 0.03Hz
Level	Selectable amplitude 100mA or 200mA peak to peak. Accuracy 5%
Polarity	Selectable positive “+” or negative “-”
Voltage limit	Selectable 50V, 100V, 250V, 500V

Optional Calibration Standards

The Tinsley Model 5906A and 5906B Calibration Standards enable the 5902 test set to be calibrated aboard ship by the operator -

Note: - Because of the technical nature of Submarine Cable Testing Equipment and the use and support requirements across international boundaries, the equipment can only be purchased direct from the manufacturer: - H. Tinsley & Co. in the UK and not through international agents.

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Calibration units for Tinsley Model 5902 Long-Haul Submarine Cable Test Set

Models 5906A and 5906B

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These units enable the Model 5902 to be calibrated at sea by its operators with out the necessity for it to come ashore or to be returned to headquarters.

Model 5906A
Insulation Resistance and Capacitance

The Model 5906A provides high stability Standard Test Resistors and Capacitors to calibrate the Insulation Resistance and Capacitance measurement facilities of the Model 5902 and similar Long-Haul Submarine Cable Test Sets.

Internal standards include: -

Insulation Resistance	100KΩ	1MΩ	10MΩ	100MΩ	1GΩ
Maximum Voltage 1000Vdc					

Capacitance	1µF	10µF	50µF	250µF
Maximum Voltage 520Vdc				

A discharge button and charge meter help ensure operator safety.

Full calibration procedures and certificates are provided.

Model 5906B
Conductor Resistance.

The Model 5906B provides high stability Test Resistors to calibrate the Conductor Resistance measurement facilities of the Model 5902. It can be used in both constant current and constant voltage modes. Forced air cooling is provided for high power tests. An over temperature buzzer sounds if temperature limits are likely to be exceeded.

Internal standards include: -

Conductor Resistance	10Ω	100Ω	1KΩ	5KΩ	10KΩ	100KΩ
Maximum Current	220mA			100mA		30mA

The unit can be used on both 110 and 230 Volt supplies and comes complete with test leads

and connectors.

Full calibration procedures and certificates are provided.

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Submarine Cable Survey System Model 5930

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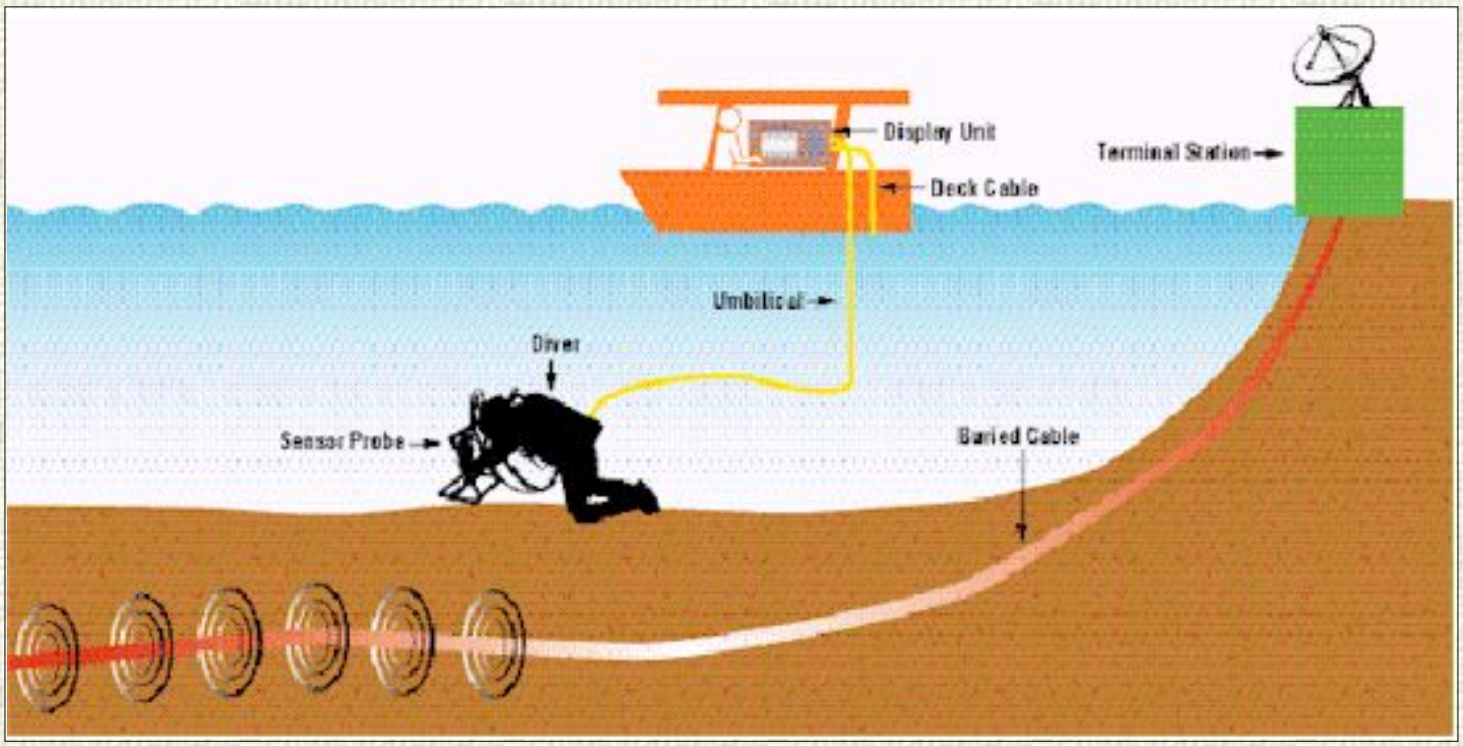
Features

- Accurate Cable Burial Depth Measurement
- Computer Interface
- Integral Test Function
- Divers Audio Output of Signal Strength
- GPS Data Input
- Wide Frequency Range
- Spectrum Analyser Function

- Oscilloscope Function
- Rated to 50 metres water depth
- Two Probe Inputs

The Tinsley Submarine Cable Survey System is designed for use by divers working in areas where it may not be practical to use an R.O.V.. With a low frequency electroding tone applied to the cable, the system can be used to locate cables buried beneath the seabed and to establish their burial depth.



The system consists of a hand held Sensing Unit (Type 5931) that is designed to be easily manoeuvred whilst under water. An audio output to the diver allows the Sensing Unit to be positioned at a point with the highest signal level. This corresponds to a point directly over the cable being surveyed. Once the cable is precisely located the Sensing Unit is placed on the seabed at that point and a measurement of Burial Depth made.

The Sensing Unit is connected to the shipboard Display Unit (Type 5930) via an umbilical cable. The Display Unit uses microprocessor technology to compute the data received from the sensor and to display the information as the burial depth of the cable.

Many special functions are incorporated within the Display Unit. It features a Spectrum Analyser that is used to identify any areas of the usable frequency range for the Survey System that exhibit a particularly high level of electromagnetic interference. The use of this frequency can then be avoided whilst cable surveying in that particular geographical location.

Digital filtering of the input signal is used to ensure the instrument displays clear and unambiguous results. Electronic tuning enables the system to precisely detect the frequency of the tone applied to the cable.

The Single Sensor probe Model 5932 is used for fast location of cables. It does not give burial depth measurement.

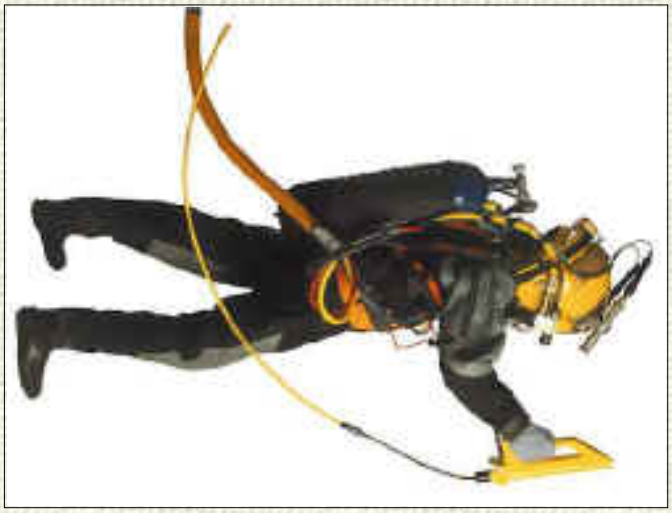
Any standard Electroding Generator operating within the frequency range 16 to 100Hz may be used with the system. Typically the Tinsley Model 5915 or the electroding function of the Tinsley Model 5910 Submarine Cable Test Set could be used to energise the cable.

ORDERING INFORMATION

5930	Dual input Surface Display Unit	**5931**	Triple Sensor Frame for Cable Detection and Burial Depth Measurement
5931E/2m	Bone Conductor Earphone with 2 metre Lead	**5931C1/50**	50 metre Underwater Umbilical Cable
5931C1/100	100 metre Underwater Umbilical Cable	**5931C2/5**	5 metre Deck Cable
5931C2/10	10 metre Deck Cable	**5932**	Single Sensor for Cable Detection

Triple Sensing Unit Model 5931

Gives cable location and burial depth.



Single Sensor Unit Model 5932

For cable location only.

SPECIFICATIONS

Burial Depth Accuracy	Basic Accuracy ±5% of measurement	
Burial Depth Range	0.1 to 3 Metres	
Temperature Range	In Use 0°C to 45°C	Storage -10°C to 60°C

Temperature Coefficient	0.5% / °C	
Dimensions	**Sensor Unit**	50cm x 40cm base 50cm high
	Display Unit	36cm wide x 40cm depth x 20cm high
Weight	**Sensor Unit**	7Kg in air 5Kg in water
	Display Unit	11Kgs
Sea Cable 5931C1/50m 5931C1/100m	**Length**	50 metres or 100 metres
	Diameter	10.5mm.
	Colour	Yellow
	Mechanical Strength	Up to 100Kgs. Peak.
	Connectors	Underwater mating moulded at both ends.
Deck Cable 5931C2/50m 5931C2/100m	**Length**	5 meters or 10 metres
	Diameter	10.5mm.
	Colour	Yellow
	Mechanical Strength	Up to 100Kgs. Peak.
	Connectors	Underwater mating moulded at one end – IP63 type fitted at the other
Bone Conducting Earphone 5931E/2m	**Cable Length**	2 Metres
	Cable Diameter	5mm.
	Colour	Black
	Mechanical Strength	Up to 10Kgs Peak
	Connectors	Moulded underwater mating
Display Unit 5930 Special Features	**Computer Interface**	RS232 – RS485
	GPS Data Input	Ships GPS data can be input and recorded with burial depth measurements
	Data Recording	Burial depth information can be stored to a file for later downloading
	Test Oscillator	An integral Test Oscillator allows the system to be tested before immersion

Display	Daylight readable TFT colour
Diver Audio Mute	Audio signal to diver can be muted from the Display Unit in an emergency

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Electroding Generator Model 5915

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The Tinsley Electroding Generator, type 5915, has been developed with British Telecom to locate Submarine Telephone Cables. The method employed is the well established electroding technique. The unit is self-contained, desk top mounting, enabling tests to be carried out without the power feed connected to the cable under test.

Application

The 5915 Tinsley Electroding Generator is intended as an aid to cable repair ships in locating

and identifying telephone cables. The electroding Generator energises the Submarine Cable with a low frequency sine wave signal of up to 500mA at 500 Volts peak to peak. The Electroding Generator is located in the terminal station normally nearest to the fault area and connected to the cable under test by means of two safety probes built-in the instrument.

Principles of Operation

The Electroding Generator is a low frequency oscillator with a sine wave output capable of delivering up to 500mA at 500 Volts peak to peak at any frequency from 5Hz to 40Hz. The frequency is selected by digital thumbwheel switches, Peak current is set via a front panel rotary control. The Current and Voltage levels are clearly displayed on Front Panel Precision Analogue Meters.

The current waveform is controlled to be sinusoidal. The test current has a DC bias to improve the sensitivity detection over longer distance. The test current can be applied in either the forward direction only or in the reverse or forward bias, as required. Longer cable can normally be electroded by energising in the reverse direction. A crystal controlled oscillator ensures that the frequency does not drift while testing is in progress.

Output connections are made by permanently connected probes, which are fully shrouded. A safety circuit disables the Generator output whilst the probes are being applied to the cable under test. A special compartment on the rear of the instrument is provided for stowing the output probes when not in use.

A frequency monitor point (square wave at signal frequency) is provided on the rear on the instrument. Output level is TTL compatible.

Specifications

Output	Continuously adjustable current regulated d.c. – sine wave modulated.
Current Range	Minimum 75mA modulated at ± 25mA (50mA – 100mA pk-pk). Maximum 275mA modulated at ± 225mA (50mA – 500mA pk-pk).
Current Regulation	< 5%
Current Control	Continuously adjustable by 10-turn potentiometer.
Mains Switching	Key operated. The key is removable only in the off position.
Voltage	500V peak max.
Polarity	Output polarity is selected by means of a 3 position key switch (Positive, Off, Negative). The key is removable in any position.
Monitoring	Both current and voltage are continuously monitored by individual front panel meters of accuracy 3% F.S.D.

Modulation Frequency

Range	5Hz to 40Hz, selected in 0. 1Hz steps.
Accuracy	± 0.01Hz
Stability	0.03% Long term (12hr). 0.003% Short term (10min).
Output distortion	THD 5%
Controls	Adjustable by thumbwheel edge switches.

Power requirements

- 105v to 125v or 210v to 250v; 50Hz to 60Hz, (selected via rear panel).
- Power applied by operation of a key switch. Key is removable in the “OFF” position only.
- Mains input circuit is fused. Input is via I.E.C. socket.

Weight and dimensions

Size 300H x 512D x 470W (mm) approx.

Weight 22kg approx.

Note: - Because of the technical nature of Submarine Cable Testing Equipment and the use and support requirements across international boundaries, the equipment can only be purchased direct from the manufacturer: - H. Tinsley & Co. in the UK and not through international agents.

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Portable Short Haul Submarine Cable Test Set Model 5910

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The Tinsley 5910 is a portable Short Haul Submarine Cable Test Set that brings the latest technology to the tried and tested DC methods of cable fault location.

Common test procedures which are associated with the location of cable fault such as “open circuits” and “shunt faults” are pre-programmed into the instrument. This allows the procedure to be carried out automatically therefore eliminating operator errors and reducing the uncertainty of fault position prediction.

The instrument may be set for a range of voltages and currents making it suitable for use with most un-repeatered submarine communication cable systems.

The RS232 interface is designed for full duplex communication with the instrument. All functions may be controlled via a computer and obtained data may be stored for future analysis. This interface may also be used to enable two 5910's to communicate with each other via a computer when carrying out double ended tests such as "no loss of current".

A basic electroding generator function is included which can assist the cable repair vessel in locating the cable on the sea bed prior to retrieval and repair.

A rack mount version the Tinsley Model 5910R is also available

Specifications

Ohmmeter – Conductor resistance measurement

Resistance Range	Resolution	**Accuracy** (within compliance of 1V to 140V)
0.2Ω to 100.00Ω	0.01Ω	±0.2Ω
100.00Ω to 1000.00Ω	0.1Ω	±0.2Ω up to 200Ω ±0.1% above 200Ω
1KΩ to 10kΩ	1Ω	±0.1% at 1KΩ reducing to ±0.2% at 10KΩ
10KΩ to 100KΩ	10Ω	±0.2% at 10KΩ reducing to ±2% at 100KΩ

Current Control

Range	Resolution	Accuracy
0.5 to 10.0mA	0.1mA	±2µA
10.1mA to 100mA	0.1mA	±20µA
Polarity	Positive "+" or negative "-" selectable by thumbwheel switch	

MegOhmmeter – insulation resistance measurement

Voltage settings +50V, 100V, 250V, 500V, or 1000V
Polarity selectable positive "+" or negative "-"

Range	Applicable Voltage	Accuracy
$10^5\Omega$ to $10^9\Omega$	50V, 100V	±1dB (10^5 to $10^8\Omega$) using Standard Resistors
10^6 to $10^{10}\Omega$	250V	±1dB (10^6 to $10^9\Omega$) using Standard Resistors
10^7 to $10^{11}\Omega$	500V, 1000V	±1dB (10^7 to $10^{10}\Omega$) using Standard Resistors

Capacitance

Direct reading capacitance measurements between 0.05µF and 2000µF.

Range	Resolution	Accuracy (using standard caps)	Measurement Cycle
0.05 to 2µF	0.001µF	±0.005µF	2 secs @ 1µF
2 to 20µF	0.001µF	±0.2%	2 secs @ 10µF
20 to 200µF	0.01µF	±0.2%	20 secs @ 100µF
200 to 2000µF	0.1µF	±0.2%	200 secs @ 1000µF

Electroding Generator (GEN)

Output polarity either positive to LINE or negative to LINE

Control	Constant current – compliance 0.1 to 50V
Frequency	25Hz or 16.7Hz
Output	50mA + 50mA sin ωt (i.e. minimum 0mA, maximum 100mA, synthesised, sinusoidal current

Note: - Because of the technical nature of Submarine Cable Testing Equipment and the use and support requirements across international boundaries, the equipment can only be purchased direct from the manufacturer: - H. Tinsley & Co. in the UK and not through international agents.

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Short Haul Submarine Cable Test Set Model 5910R (Rack Mount)

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The Tinsley 5910R is a rack mount version of the 5910 portable Short Haul Submarine Cable Test Set. It brings the latest technology to the tried and tested DC methods of cable fault location.

Common test procedures which are associated with the location of cable fault such as “open circuits” and “shunt faults” are pre-programmed into the instrument. This allows the procedure to be carried out automatically therefore eliminating operator errors and reducing the uncertainty of fault position prediction.

The instrument may be set for a range of voltages and currents making it suitable for use with most un-repeatered submarine communication cable systems.

The RS232 interface is designed for full duplex communication with the instrument. All functions may be controlled via a computer and obtained data may be stored for future analysis. This interface may also be used to enable two 5910's to communicate with each other via a computer when carrying out double ended tests such as "no loss of current".

A basic electroding generator function is included which can assist the cable repair vessel in locating the cable on the sea bed prior to retrieval and repair.

Specifications

Ohmmeter – Conductor resistance measurement

Resistance Range	Resolution	Accuracy (within compliance of 1V to 140V)
0.2Ω to 100.00Ω	0.01Ω	±0.2Ω
100.00Ω to 1000.00Ω	0.1Ω	±0.2Ω up to 200Ω ±0.1% above 200Ω
1KΩ to 10kΩ	1Ω	±0.1% at 1KΩ reducing to ±0.2% at 10KΩ
10KΩ to 100KΩ	10Ω	±0.2% at 10KΩ reducing to ±2% at 100KΩ

Current Control

Range	Resolution	Accuracy
0.5 to 10.0mA	0.1mA	±2µA
10.1mA to 100mA	0.1mA	±20µA
Polarity	Positive "+" or negative "-" selectable by thumbwheel switch	

MegOhmmeter – insulation resistance measurement

Voltage settings +50V, 100V, 250V, 500V, or 1000V
Polarity selectable positive "+" or negative "-"

Range	Applicable Voltage	Accuracy
$10^5\Omega$ to $10^9\Omega$	50V, 100V	±1dB (10^5 to $10^8\Omega$) using Standard Resistors

10^6 to $10^{10}\Omega$	250V	±1dB (10^6 to $10^9\Omega$) using Standard Resistors
10^7 to $10^{11}\Omega$	500V, 1000V	±1dB (10^7 to $10^{10}\Omega$) using Standard Resistors

Capacitance

Direct reading capacitance measurements between 0.05µF and 2000µF.

Range	Resolution	Accuracy (using standard caps)	Measurement Cycle
0.05 to 2µF	0.001µF	±0.005µF	2 secs @ 1µF
2 to 20µF	0.001µF	±0.2%	2 secs @ 10µF
20 to 200µF	0.01µF	±0.2%	20 secs @ 100µF
200 to 2000µF	0.1µF	±0.2%	200 secs @ 1000µF

Electroding Generator (GEN)

Output polarity either positive to LINE or negative to LINE

Control	Constant current – compliance 0.1 to 50V
Frequency	25Hz or 16.7Hz
Output	50mA + 50mA sin ωt (i.e. minimum 0mA, maximum 100mA, synthesised, sinusoidal current

Note: - Because of the technical nature of Submarine Cable Testing Equipment and the use and support requirements across international boundaries, the equipment can only be purchased direct from the manufacturer: - H. Tinsley & Co. in the UK and not through international agents.

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Electroding Detector Model 5916

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The Tinsley 5916 Electroding Detector is the ideal equipment for use on board ship when the electroding method is being employed for the detection of submarine cables buried or laid on the sea bed. This light weight and portable instrument can be mains powered or can operate for several hours from its own internal, rechargeable battery pack. Ideally suited for use with the Tinsley Electroding Generators, the 5916 will also operate with any generator operating in the frequency range 4 to 40Hz.

DESCRIPTION

The Electroding Detector is a high gain low frequency selective Amplifier to detect the electric

field from a submarine cable powered by the Tinsley 5915 electroding generator or similar.

The detector amplifies, filters, indicates and records signals of the selected frequency in the range 4Hz to 40Hz. At the highest gain setting a 1µV RMS input signal of the correct frequency will give a full scale reading on the analogue front panel meter and the optional chart recorder.

The detector is completely self-contained in a splash proof IP65 portable case. Rechargeable batteries are included in the case and also a mains power supply which will recharge them. External batteries may also be used. A clock/timer is incorporated on the front panel to help synchronise detected events.

To use the detector the signal input terminals are connected to the customers receiving probes, the exact operating frequency is selected on the thumbwheel switches and the gain switch is adjusted to obtain a useful indication of the signal.

PRINCIPLE OF OPERATION

The Detector is used to locate submarine cables in water of up to 180 metres (100 fathoms) in depth. A signal in the range of 4 Hz to 40 Hz is transmitted down the submarine cable by an Electroding Generator such as the Tinsley type 5915 unit. This signal is picked up by a set of trailed probes connected to the detector. The Detector and receiving probes are normally aboard the repair ship, however, as they are portable, the detector may be operated from any locally available ship or launch. The received signal is processed and passed to the analogue front panel meter and if fitted, chart recorder.

Normally, the Electroding Generator, Tinsley type 5915, is located in the submarine cable terminal nearest to the fault area. The Electroding Detector, Tinsley type 5916 is aboard the ship. When the ship is in the vicinity of the cable area, the 5915 Electroding Generator is powered thus applying the low frequency signal to the cable under test. At these frequencies, the field of the signal extends into the water surrounding the cable for a considerable distance. The ship would normally steer a course to cross the cable on the landward side of the expected fault position. Before this position is reached, the ship launches the receiving probe(s) which will then connect to the detector.

The Detector is set (by thumbwheel switch) to the frequency being transmitted by the Electroding Generator on shore. As the ship crosses the cable, the field of the signal current on the cable induces a voltage into the probe(s). This signal is then processed by the Electroding Detector and a deflection on the meter is registered. This may be recorded by the optional built-in chart recorder.

For identification purposes, the Electroding Generator may be keyed on and off periodically.

Once the cable signal has been identified and confirmed, the ship then follows the cable on a zigzag course until the signal disappears. When this happens, the fault or break has been located. Use of NAVSAT on a marker buoy would mark the point where the signal was last detected. Further probe runs may be made for a more precise fix of the fault position.

SPECIFICATIONS

Frequency	4Hz to 40Hz in increments of 0.1Hz thumbwheel selection. Built-in test oscillator.
Detector Bandwidth	0.5Hz
Sensitivity	1uV RMS for full scale deflection.
Input Impedance	Balanced low impedance inputs via 4mm terminals.
Auxiliary Input	Socket for external probes.
Power	Built-in rechargeable batteries having life of over 5 hours of continuos use.
	External batteries, +12V and-12V
	Mains supply, single phase, 230V or 115V AC
Display	Analogue meter with battery and signal test.
Event Timing	Front panel Digital Elapsed Timer and Clock
Recorder	Optional chart recorder.
Event Marker	Event marker button is incorporated on the front panel for marking the recording chart and relay closure for external Event signal.
Depth Range	Typically 180 metres (100 fathoms) but depths of up to 300 metres could be possible. However, this is limited by external factors:-e. g. :- Signal to noise ratio and attenuation of cable and the lateral distance at which the ship is operating away from the cable.
Size	Portable self-contained splash proof IP65 case 470 by 360 by 175 mm.
Weight	Approximately 15 Kg.

Note: - Because of the technical nature of Submarine Cable Testing Equipment and the use and support requirements across international boundaries, the equipment can only be purchased direct from the manufacturer: - H. Tinsley & Co. in the UK and not through international agents.

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Beach Probe and Battery Powered Portable Electroding Detector Models 5917 and 5918

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The 5917/5918 Electroding Probe and Detector system is a high gain low frequency selective Receiver/Amplifier to detect the electromagnetic field from a submarine cable energised by the

Tinsley 5915 Electroding generator or similar.

The 5917 Beach Probe and 5917D Divers Probe are inductive probes suitable for receiving 15 to 30Hz signals emanating from a suitably energised submarine cable.

The 5918 detector amplifies, filters, and indicates the signal received at the selected frequency. At the highest gain setting a 10µV RMS input signal at the correct frequency will give a full scale reading on the analogue front panel meter.

The 5918 detector is completely self-contained in a portable carry case with shoulder strap. Integral rechargeable batteries are included and a separate mains power module is supplied to recharge them.

In use the 5918 detector is connected to the receiving probe, either a Tinsley type 5917 Beach probe or 5917D Divers Probe. The exact operating frequency is selected on the thumbwheel switches and the gain switch is adjusted to obtain a useful indication of the signal. A frequency of either 16.7Hz or 25Hz is recommended when using the 5917 Probes.

An audible output signal is available which can be heard by using the plug in headphones supplied. The larger the signal received the higher the frequency heard. A volume control is provided for adjustment of loudness.

PRINCIPLE OF OPERATION

The 5917/5918 Probe and Detector System is used either on land, or on the beach. The 5917D Divers Probe can also be used in up to 50 metre water to locate submarine cables. A tone in the range of 16 Hz to 25 Hz is transmitted down the submarine cable by an Electroding Generator such as the Tinsley type 5915 unit. This signal is picked up by a Tinsley 5917 or 5917D Probe connected to the 5918 Detector. The 5818 Detector and 5917 Beach receiving probe would normally be held by a person walking along the beach, however, as they are portable, the detector may be operated from any small boat or launch to search over shallow water. The 5917D would normally be held by a diver and would be connected to the 5918 in a boat/ship via an umbilical cable. It is suitable for use in depth up to 50 Metres. The received signal is processed and passed to the analogue front panel meter and headphones audio output.

Normally, the Electroding Generator, Tinsley type 5915, is located in the submarine cable Terminal Station nearest to the search area. When the Electroding Detector System is in the vicinity of the cable, the 5915 Electroding Generator is powered thus applying the low frequency signal to the cable under test. At these frequencies, the field of the signal extends into the land and water surrounding the cable for a considerable distance.

The person holding the 5917 probe would normally walk/swim a course to cross the cable on the landward side of any expected cable fault position with the probe in its horizontal position at right angles to the cable.

The Detector is set (by thumbwheel switch) to the frequency being transmitted by the Electroding Generator. A frequency of either 16.7Hz or 25 Hz is recommended. As the detector crosses the cable, the field from the signal current in the cable induces a voltage into the probe.

This signal is then processed by the Electroding Detector and a deflection on the meter is registered. This may be heard by the operator as a high pitch frequency from the headphones.

For identification purposes, the Electroding Generator may be keyed on and off periodically. Once the cable signal has been identified and confirmed, the person then follows the cable on a zigzag course to plot the position of the cable, or until the signal disappears. When this happens, a fault or break has been located.

Further tests may be made for a more precise fix of the cable position by using the probe in a vertical orientation. In this case a null is registered when the probe passes exactly above the cable.

5918 Detector Specifications

Frequency	4Hz to 40Hz in increments of 0.1Hz thumbwheel selection. Built-in test oscillator. However when using the 5917 probe use either 16.7Hz or 25Hz.
Detector Bandwidth	0.5Hz
Sensitivity- max	10uV RMS for full-scale deflection on range 7.
Input	7 Way DIN Socket for external probe.
Power	Built-in rechargeable batteries having life of over 5 hours of continuous use. 12V 1.2 AH Lead Acid.
Charger	Mains powered, single phase, 90 to 260V AC 50/60Hz
Display	Analogue meter with battery and signal test.
Range of location/depth	Typically 10 metres. However, Using 5917 probes this is limited by external factors:-e. g. :- Signal to noise ratio and attenuation along cable i.e. the distance at which the detector is operating away from the generator.
Size	Portable self-contained unit in a carrying case 250 X 250 X 150 mm.
Weight	Approximately 5 Kg.

5917 Beach Probe Specification

Sensitivity	Suitable for detecting the electromagnetic field from a submarine cable carrying 20mA current at a distance of 10 meters from the cable.
Frequency Range	Suitable for 15 to 30 Hz (16.7 or 25Hz recommended)
ON/OFF Switch	In handle to conserve battery power on 5918
Size	110 cm long handle 40cm long probe.
Weight	6kg

5917D Divers Probe Specifications

5917D consists of:-

- 1 off 5932 Detector
- 1 off 5931C1/50m Underwater Cable 50 meter length
- 1 off 5917D-301 Tuning Box for 16.7/25Hz
- 1 off 5917D-302 Leads from tuning box to 5918.

Sensitivity	Suitable for detecting the electromagnetic field from a submarine cable carrying 100mA current at a distance of 10 meters from the cable.
Frequency Range	Suitable for 15 to 30 Hz (16.7 or 25Hz recommended)
ON/OFF Switch	Mounted on 5917D-301 Tuning Box Assembly.
Size	5932 Probe 380 x 150 x 35mm
	5931C/50m Cable - 50 m length
	5917D-301 - 145 x 120 x 90 mm
	5917D-302 curly cable 0.9m coiled 2.2m stretched
Weight	5932 2kgm in air
	5931C/50m 7kgm
	5917D-301 0.55kgm
	5917D-302 0.20kgm

Note: - Because of the technical nature of Submarine Cable Testing Equipment and the use and support requirements across international boundaries, the equipment can only be purchased direct from the manufacturer: - H. Tinsley & Co. in the UK and not through international agents.

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Submarine Cable DC Test Set Model 5901C

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The Test Set consists of four modules mounted in a standard 19 inch cabinet. It is designed for making d.c. measurements of resistance and capacitance of conventional repeatered coaxial submarine cable and repeatered fibre optic cable. Simplicity of operation without undue circuit complexity has been achieved.

Facilities are provided for:

- Determination of conductor resistance
- Determination of insulation resistance
- Determination of cable capacitance with or without leakage
- Location of insulation faults by the “fall of potential” method the “no loss of current” test

These facilities are selected by a rotary switch and sequential operation is by push button control. The test voltage power supplies outputs are set by banks of rotary switches.

A high performance digital voltmeter coupled to a printer unit is used to measure and record all required voltages during the testing sequence.

A digital seconds counter facilitates the timing of individual stages in the procedure.

Specifications

Fundamental accuracy depends on the following components:

	Accuracy	Temp. Coefficient
D.V.M.	±0.01%	<±10ppm/°C
1K Standard Resistor	±0.01%	<±10ppm/°C
1M Standard Resistor	±0.1%	<±50ppm/°C
Reference capacitance bank 100 µF measured at 400Hz	actual values stated to ±0.50%	<-170ppm/°C

Current Controller Preset Values:

- Low: 2, 2.5, 3, 4 & 5 mA d.c.
- High: 4, 5, 6, 8 & 10 mA d.c.

Test Voltage Power Supply:

- Low: 0 to 200 Volts d.c.
- High: 0 to 300 Volts d.c.

N.B. The high voltage unit is only used when the two power supplies are connected in series for high current measurements of conductor resistance.

Mains input

Mains input is via terminals marked as below:

240V a.c., 200V a.c., 115V a.c., 0V a.c. Please state mains frequency when ordering.

Connections to the submarine cable are made on the top of the cabinet to 2 by 6mm diameter insulated terminal posts. Red for line and black for return.

Dimensions	530 x 580 x 160mm
Weight	9kgs
Trolley dimensions	620 x 640 x 160mm

Weight:	9kgs

(A trolley is supplied for transportation of the cabinet.)

Handbook One copy of the Type 5901C instruction manual and one copy of the DVM operating manual are included with the equipment. Further copies are available as optional extras.

Note: - Because of the technical nature of Submarine Cable Testing Equipment and the use and support requirements across international boundaries, the equipment can only be purchased direct from the manufacturer: - H. Tinsley & Co. in the UK and not through international agents.

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Cable Termination Unit Type 5941

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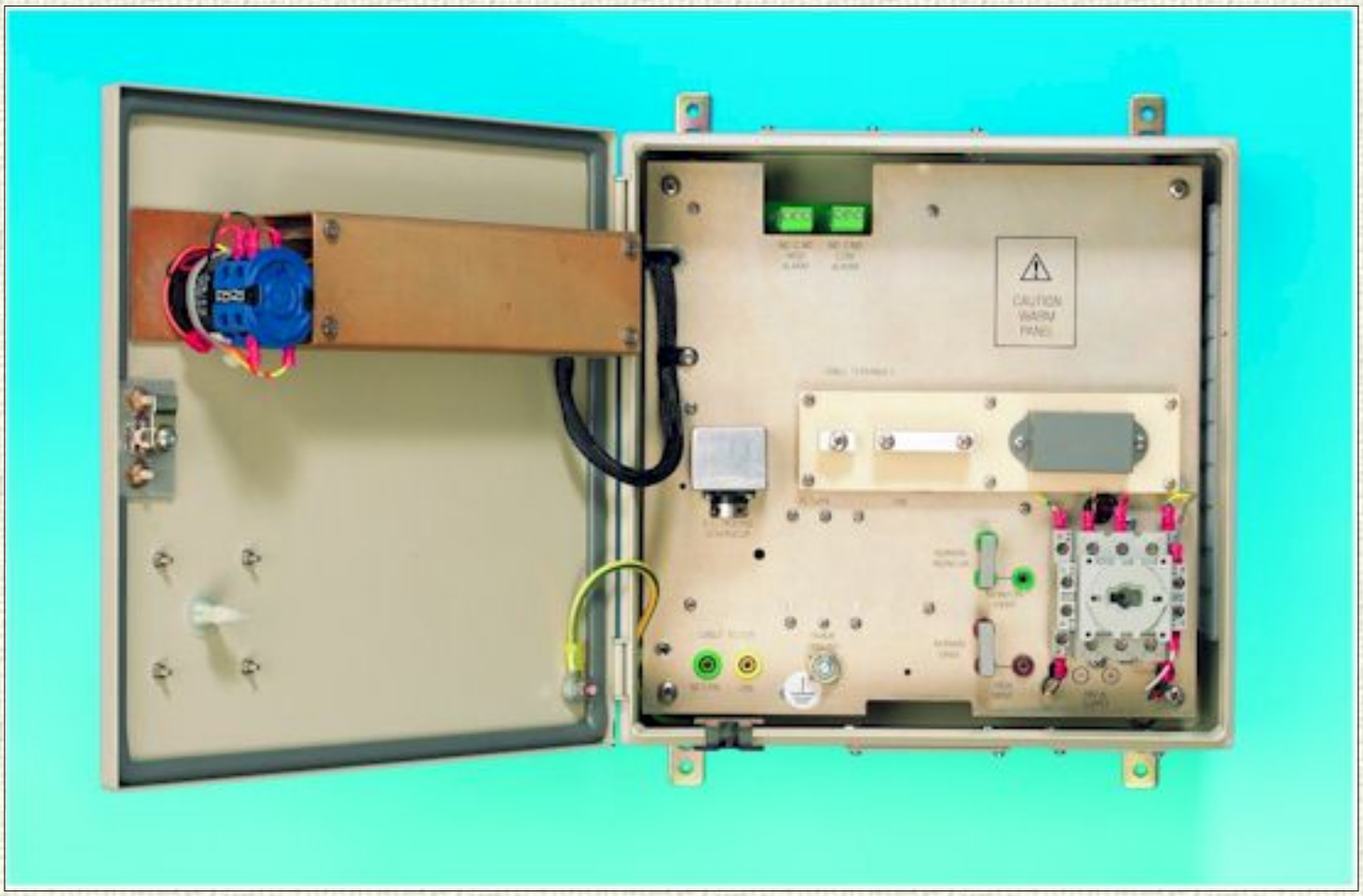
The Tinsley 5941 CTU is the ideal termination unit for non-repeatered submarine cables. It offers a simple method of selecting an open or short circuit condition and a safe means of discharging the cable. The unit is designed to enable the Test Engineer to safely and simply connect other Tinsley test instruments to the system for fault location and electroding.

The Tinsley 5941 CTU also incorporates a Cable Condition Monitor. Any changes in the Submarine Cable electrical characteristics are automatically detected and an alarm is triggered.

An output from the alarm is also available for connection to outside devices.

The unit can be connected to the cable via a dedicated cable connected to the fibre optic cable metallic conductor. Alternatively, the fibre optic cable can be routed into the CTU with a direct path through the unit for the optical fibres. Options that can be set at the time of installation enable the unit to be used with a wide range of cable lengths and types.



5941 SPECIFICATIONS

INPUT SUPPLY VOLTAGE	36V TO 60V DC
MAXIMUM SUPPLY CURRENT	1.5A
OPEN CIRCUIT OUTPUT VOLTAGE (Input 48v)	-100V
OUTPUT VOLTAGE STABILITY (max. load & supply variation)	± 1V
SHORT CIRCUIT CURRENT - NORMAL DRIVE	213 ± 13 mA
SHORT CIRCUIT CURRENT- HIGH DRIVE	297 ± 35 mA
ALARM LEVEL RANGE	-333 mA to + 333 mA
ALARM LEVEL STABILITY (with load, supply and temperature variation)	± 2.5%
ALARM CONTACTS RATING	100V 0.5A DC

MAXIMUM ALLOWABLE CABLE POWER	600V PEAK VOLTAGE 4A CURRENT
OPERATING TEMPERATURE RANGE	0ºC TO 40ºC
SURGE ARRESTOR RATING:-	
MAX. SURGE CURRENT	20KA
DC SPARK OVER VOLTAGE	700V
IMPULSE SPARK OVER VOLTAGE	1400V

CE Marking for Low Voltage Directive (Safety) and EMC Directive (Emissions and Immunity).

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LCR Databridge Model 6401

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The model 6401 is an economically priced, automatic and microprocessor controlled LCR bridge with a basic accuracy of 0.25%. It's useful features and realistic price make it ideally suitable in many applications.

- Measures R, L, C and Q automatically.
- 0.25% of reading, ±1 digit basic accuracy.
- Eight decades of LCR measurement.
- 2 selectable measurement frequencies: 100/120* Hz or 1 kHz (0.025% accuracy)
- 4-digit LED display with automatic decimal point.
- User prompt facility for best accuracy.
- Selectable series or parallel measure
- Integral 4-terminal test fixture.
- External bias voltage up to 50 V possible.

- Input protection against charged capacitors up to 10mF and 50V.
- Model 6403 is equipped with an interface for the limits comparator model 6422. Test limits can be defined either of two ways. In the first of these, the upper and lower acceptable values are set in the two banks of thumbwheel switches. Alternatively the PASS band can be determined using a nominal value and upper and lower percentage tolerance. Three indicators are available to show where the measured value lies with respect to the upper and lower pass band limit. The same information is also available at 3 floating relay contacts of the 6422 comparator.
- Automatic indication for overrange or underrange.
- Easy operation by means of only 6 keys.
- Automatic selection of measurement range (lockable if many components in the same range are to be measured) and automatic distinction between L and C.
- Validity of measurement after 1 second maximum.
- 2 measurements per second.
- An adaptor for axial lead components is provided with the unit.
- Selectable internal 2 V bias voltage for measurements of electrolytic capacitors.
- Detailed operation manual.

*120 Hz measurement frequency available as factory-fitted option.

Specifications		
Basic Accuracy		0.25% of reading, ±1 digit
R	Measurement Range	0.001Ω — 100MΩ
	Ultimate Resolution	0.001Ω
	Conditions for Basic Accuracy	100 Hz:- 1Ω - 2 MΩ, 1 kHz:- 1Ω - 2MΩ
L	Measurement Range	0.1µH - 9900 H
	Ultimate Resolution	0.1µH
	Conditions for Basic Accuracy	100Hz:- 2mH - 2000H, 1 kHz:- 200µH - 200H
C	Measurement Range	0.1pF —9900µF
	Ultimate Resolution	0.1pF
	Conditions for Basic Accuracy	100 Hz:- 2nF - 2000µF, 1 kHz:- 200pF - 200µF
Q	Measurement Range	0 — 99
	Ultimate Resolution	0.001
	Conditions for Basic Accuracy	0.25 - 4
Maximal Voltage on Component		0.3 V rms
DC-Bias Voltage		2 V internal (selectable) or up to 50 V external
Measurement Modes		Series or parallel equivalent circuit
Measurement Update Rate		2 per second
Temperature Range		0°C - 50°C
Power		95 V to 125 V or 195 V to 255 V, 48—63 Hz

Dimensions	440 x 250 x 42 mm
Weight	5.6 kg

Model 6401 with 6404 Interface and 6422 Comparator

Ordering Information	
6401	Automatic 0.25% LCR Databridge
6401/6403	Complete with Interface for Comparator
6401/6403/6422	Complete with Interface and Comparator
Accessories	Models 6601, 6602, 6603, 6604, 6613 (for use with 6604), 6615 to 6623

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LCR Databridge Model 6451

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The model 6451 is an economically priced, automatic and microprocessor controlled LCR bridge with a basic accuracy of 0.1%. It's practical features, optional IEEE-488/RS232 interface and limits comparator make the 6451 ideal for the laboratory as well as for applications in ATE systems.

- Measures R, L, C, Q and D automatically
- 0.1% of reading basic accuracy.
- Twelve decades of LCR measurement.
- 3 selectable measurement frequencies: - 100/120* Hz, 1 kHz or 10 kHz. (0.01% accuracy)
- 5-digit LED display with automatic decimal point.
- User prompt facility for best accuracy.
- Selectable series or parallel measurement modes.

- Automatic indication for overrange or underrange.
- Easy operation by means of only 8 keys.
- Full auto ranging and automatic component identification. The instrument itself distinguishes between L, C or R after the component is connected. A manual override enables the minor term to be displayed.
- Capacitance up to 99.9pF in test leads or adaptors can be compensated for.
- Validity of measurement after 1 second maximum.
- 2 measurements per second.
- Actual measured value can be frozen on the display with the HOLD function.
- Integral 4-terminal test fixture.
- An adaptor for axial lead components is provided with the unit.
- Selectable internal 2V bias Voltage for measurement of electrolytic capacitors.
- External bias Voltage up to 50V possible.
- Input protection against charged capacitors up to 10mF and 50V.
- Model 6451/6452 is equipped with IEEE-488 and R5232 interface. It enables full control and measurement readout from a computer.
- Model 6451/6452 is equipped with an interface for the limits comparator model 6422. Test limits can be defined in either of two ways. In the first of these, the upper and lower acceptable values are set in the two banks of thumbwheel switches. Alternatively the PASS band can be determined using a nominal value and upper and lower percentage tolerance. Three indicators are available to show where the measured value lies with respect to the upper and lower pass band limit. The same information is also available at 3 floating relay contacts of the comparator 6422.
- Detailed operation manual

*120 Hz measurement frequency available as factory-fitted option.

Specifications		
Basic Accuracy		0.1% of reading, ±1 digit
R	Measurement Range	0.1mΩ — 990MΩ
	Ultimate Resolution	0.1mΩ
	Conditions for Basic Accuracy	100 Hz/120Hz:- 2Ω - 1MΩ, 1 kHz:- 2Ω -500kΩ, 10kHz:- 2Ω - 100kΩ
L	Measurement Range	0.001µH —9900H
	Ultimate Resolution	0.001µH
	Conditions for Basic Accuracy	100Hz:- 4mH - 2000H, 1kHz:- 400µH - 200H, 10kHz:- 40µH - 10H
C	Measurement Range	0.001pF —99mF
	Ultimate Resolution	0.001pF
	Conditions for Basic Accuracy	100Hz:- 4nF - 2000µF, 1kHz:- 400pF - 200µF, 10kHz:- 40pf - 10µF
	Measurement Range	0.001- 999

Q	Ultimate Resolution	0.001
	Conditions for Basic Accuracy	0.25 - 4
D	Measurement Range	0.001- 999
	Ultimate Resolution	0.001
	Conditions for Basic Accuracy	0.25 - 4
Maximal Voltage on Component		0.3V rms
DC-Bias Voltage		2V internal (selectable) or up to 50V external
Measurement Modes		Series or parallel equivalent circuit
Measurement Update Rate		2 per second
Temperature Range		0°C - 50°C
Power		95V to 125V or 195V to 255V, 48 - 63Hz
Dimensions		440 x 260 x 100 mm
Weight		6.5 kg

Model 6451 with 6452 Interface and 6453 software

Model 6451 with 6424 Interface and 6422 Comparator

Ordering Information	
6451	Automatic 0.1% LCR Databridge
6451/6452	Complete with IEEE-488/RS232 Interface
6451/6424	Complete with Interface for Comparator
6451/6424/6422	Complete with Interface and Comparator
Accessories	
Adaptor 6601, 6602, 6603, 6604, 6613 (for use with 6604)	
Application software package 6453	
Calibration units 6615 and 6616 to 6623	

NOTE: Type 6472 Comparator can also be used in place of Type 6422. This enables capacitors of up to 10,000µF to be measured.

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LCR Databridge Model 6458

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The model 6458 is an economically priced, automatic and microprocessor controlled LCR bridge with a basic accuracy of 0.1%. It offers three measurement frequencies and is housed in a 19”/2U case. The rackmountability and the IEEE-488 and RS232 interface make it ideal for any automatic test system.

- 19” rack mounting
- Measures R, L, C, Q and D automatically.
- 0,1% of reading basic accuracy.
- Twelve decades of LCR measurement.
- 3 selectable measurement frequencies: 100/120* Hz, 1 kHz or 10 kHz.
- 5-digit LED display with automatic decimal point position.
- User prompt facility for best accuracy.
- Selectable series or parallel measurement modes.
- Automatic indication for overrange or underrange.

- Easy manual operation by means of 8 keys on the front panel.
- Full auto ranging and automatic component identification. The instrument itself distinguishes between L, C and R when the component is connected. A manual override enables the minor term to be displayed.
- Capacitance residue up to 99.9pF in the test leads or adaptors can be compensated for.
- Validity of measurement after 1 second maximum.
- 2 measurements per second.
- Actual measured value can be frozen on the display with the HOLD function.
- Connection to the instrument can be via either the 4 integral BNC sockets on the front panel or those on the rear panel for easy system cabling.
- Selectable internal 2V bias Voltage for measurement of electrolytic capacitors.
- External bias voltage up to 50V possible.
- Input protection against charged capacitors up to 10mF and 50V.
- IEEE-488 and R5232 interface with address selector is provided at the instrument's rear as standard.
- Detailed operation manual.

* 120 Hz measurement frequency available as factory-fitted option.

Specifications		
Basic Accuracy		0.1% of reading, ±1 digit
R	Measurement Range	0.1mΩ — 990MΩ
	Ultimate Resolution	0.1mΩ
	Conditions for Basic Accuracy	100 Hz/120Hz:- 2Ω - 1MΩ, 1 kHz:- 2Ω -500kΩ, 10kHz:- 2Ω - 100kΩ
L	Measurement Range	0.001µH —9900H
	Ultimate Resolution	0.001µH
	Conditions for Basic Accuracy	100Hz:- 4mH - 2000H, 1kHz:- 400µH - 200H, 10kHz:- 40µH - 10H
C	Measurement Range	0.001pF —99mF
	Ultimate Resolution	0.001pF
	Conditions for Basic Accuracy	100Hz:- 4nF - 2000µF, 1kHz:- 400pF - 200µF, 10kHz:- 40pf - 10µF
Q	Measurement Range	0.001- 999
	Ultimate Resolution	0.001
	Conditions for Basic Accuracy	0.25 - 4
D	Measurement Range	0.001- 999
	Ultimate Resolution	0.001
	Conditions for Basic Accuracy	0.25 - 4

Maximal Voltage on Component	0.3V rms
DC-Bias Voltage	2V internal (selectable) or up to 50V external
Measurement Modes	Series or parallel equivalent circuit
Measurement Update Rate	2 per second
Temperature Range	0°C - 50°C
Power	95V to 125V or 195V to 255V, 48 - 63Hz
Dimensions	19" x 302mm x 2U
Weight	5.6 kg

Ordering Information	
Model	Description
6458	Automatic 0.1% LCR Databridge in 19” case
Accessories	
Adaptor 6612, 6613	
Application software package 6453	

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LCR Databridge Model 6471

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The model 6471 is a realistically priced, automatic, microprocessor controlled LCR bridge with a basic accuracy of 0.1%. It offers four measurement fre- quencies, of which the highest is 100 kHz. This higher frequency, the accu- racy of measurement and the optional IEEE-488/RS232 interface make this instrument ideally suitable for almost any application.

- Measures R, L, C, Q, D automatically.
- 0.1% of reading basic accuracy.
- Twelve decades of LCR measurements.
- 4 selectable measurement frequencies:- 100/120* Hz, 1 kHz, 10 kHz, 100 kHz. (0.01% frequency accuracy)
- 5-digit LED display with automatic decimal point position.
- User prompt facility for best accuracy.
- Selectable series or parallel measurement modes.
- Automatic indication for overrange or underrange.

- Easy operation by means of only 8 keys.
- Full auto ranging and automatic component identification. The bridge itself distinguishes between L, C or R when the component is connected. A manual override enables the minor term to be displayed.
- Trim function for R, L and C allows compensation for component, fixtures or leads.
- Percentage deviation of a component from a nominal value can be displayed.
- Validity of measurement after 1 second maximum.
- 2 measurements per second.
- Alternatively to the usual repetitive measurement operation, a single measurement can be made each time a button is pressed.
- Actual measured value can be frozen on the display with the HOLD function.
- Integral 4-terminal test fixture.
- An adaptor for axial components is provided with the unit.
- Selectable internal 2V bias voltage for measurement of electrolytic capacitors.
- External bias voltage up to 50 V possible.
- Input protection against charged capacitors up to 10mF and 50V.
- Model 6473 is equipped with an interface for the limits comparator model 6472. Test limits can be defined in either of two ways. In the first of these, the upper and lower acceptable values are set in the two banks of thumbwheel switches. Alternatively the PASS band can be determined using a nominal value and upper and lower percentage tolerance. Three indicators are available to show where the measured value lies with respect to the upper and lower pass band limit. The same information is also available at 3 floating relay contacts of the comparator 6472.
- Detailed operation manual.

*120 Hz measurement frequency available as factory-fitted option.

Specifications		
Basic Accuracy		100/120Hz*: 0.15% of reading, ±1 digit, 1kHz:0.1%±1 digit, 10kHz: 0.45%±1 digit, 100kHz: 0.25%±1 digit
R	Measurement Range	0.1mΩ — 990MΩ
	Ultimate Resolution	0.1mΩ
	Conditions for Basic Accuracy	100 Hz/120Hz*:- 2Ω - 1MΩ, 1 kHz:- 2Ω -500kΩ, 10kHz:- 2Ω - 100kΩ, 100kHz:- 2Ω - 50kΩ
L	Measurement Range	0.001µH —9900H
	Ultimate Resolution	0.001µH
	Conditions for Basic Accuracy	100/120Hz*:- 4mH - 2000H, 1kHz:- 400µH - 200H, 10kHz:- 40µH - 10H, 100kHz:- 10µH - 10mH
C	Measurement Range	0.001pF —99mF
	Ultimate Resolution	0.001pF
	Conditions for Basic Accuracy	100Hz/120Hz*:- 4nF - 2000µF, 1kHz:- 400pF - 200µF, 10kHz:- 40pf - 10µF, 100kHz:- 40pf - 0.1µF
	Measurement Range	0.001- 999

Q	Ultimate Resolution	0.001
	Conditions for Basic Accuracy	0.25 - 4
D	Measurement Range	0.001- 999
	Ultimate Resolution	0.001
	Conditions for Basic Accuracy	0.25 - 4
Maximal Voltage on Component		0.3V rms
DC-Bias Voltage		2V internal (selectable) or up to 50V external
Measurement Modes		Series or parallel equivalent circuit
Measurement Update Rate		2 per second
Temperature Range		0°C - 50°C
Power		95V to 125V or 195V to 255V, 48 - 63Hz
Dimensions		445 x 260 x 100 mm
Weight		6.5 kg

Model 6471 with 6452 interface and 6453 Software

Model 6471 with 6424 Interface and 6472 Comparator

Ordering Information	
Model	Description
6471	Automatic 0.1% LCR Databridge with 100 kHz
6472	Limits Comparator for 6473 (or can be used on 6451/6424 or 6401/6403)
6473	6471 with Comparator Interface fitted
6475	6471 with IEEE/232 Interface fitted
Accessories	
Adaptor 6601, 6602, 6603, 6604, 6613	
Application software package 6453	
Calibration unit 6615 and 6616 to 6623	

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Databridge Accessories

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Chip component tweezers, models 6602, 6612 and 6624

The 6602 chip component tweezers are designed specifically for measuring surface mount (chip) components. They are supplied pre-wired to 6601 test leads and measurements are four-terminal. Interchangeable tips are available for the 6602.

The 6612 has BNC connections and is used for LCR bridge 6458.

The chip component tweezers, model 6624 is used in conjunction with a modified Type 6604 BNC adaptor box. The Type 6624 is a two-terminal device and can be used with the 6401, 6451, and 6471 LCR Databridges.

Remote test leads, models 6601, 6603 and 6611

The 6601 remote test leads enable four-terminal connection to be made to purpose-built test fixtures and probes. They comprise four screened cables. The screens are connected via the adaptor box retaining screw to the common point of the Databridge's measuring circuit.

The 6603 comprises a set of 6601 remote test leads terminated in a pair of Kelvin clips.

The 6611 comprises 4 screened leads with BNC connections at one end, unterminated at the other end.

Kelvin leads adaptor model 6613

The 6613 is a measurement lead equipped with 4 BNC connectors on the one side and 4 Kelvin clips on the other side. The 4 BNC connectors are connected to the databridge by means of the

model 6604 adaptor box, or directly when LCR 6458 is used.

BNC adaptor box, model 6604

The 6604 is a shielded adaptor box fitted with four BNC connectors to enable connection to be made to purpose-built fixtures.

Retro-fittable interface kits for Databridges.

All interfaces which are described with the databridges can be retrofitted also. All necessary parts and a detailed installation guide is provided with the interface.

Model 6404	Interface card to retrofit limits comparator interface to the model 6401
Model 6424	Interface card to retrofit limits comparator interface to the model 6451 or 6471
Model 6452	IEEE-488 and RS232 interface kit to retrofit to model 6451 or 6471

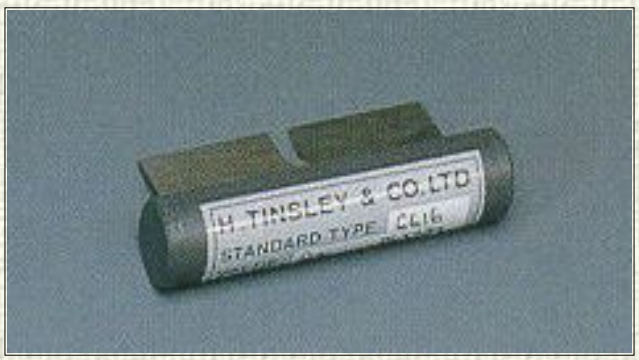
Applications Software Package Model 6453

This software package enables full control of Databridges equipped with a computer interface.

The following functions are available

- Full software control of the Databridge and measurement readout.
- Measurement and display of the major and minor terms
- Display of results on the screen and output to printer and/or disc storage
- Grading into limits bands by major and / or minor terms
- Statistical analysis of results including mean, standard deviation, and coefficient of variance.

Calibration Accessories



Capacitor	
6615	10µF
Resistors	
6616	2Ω
6617	20Ω
6618	500Ω
6619	2kΩ
6620	20kΩ
6621	50kΩ
6622	100kΩ
6623	2MΩ

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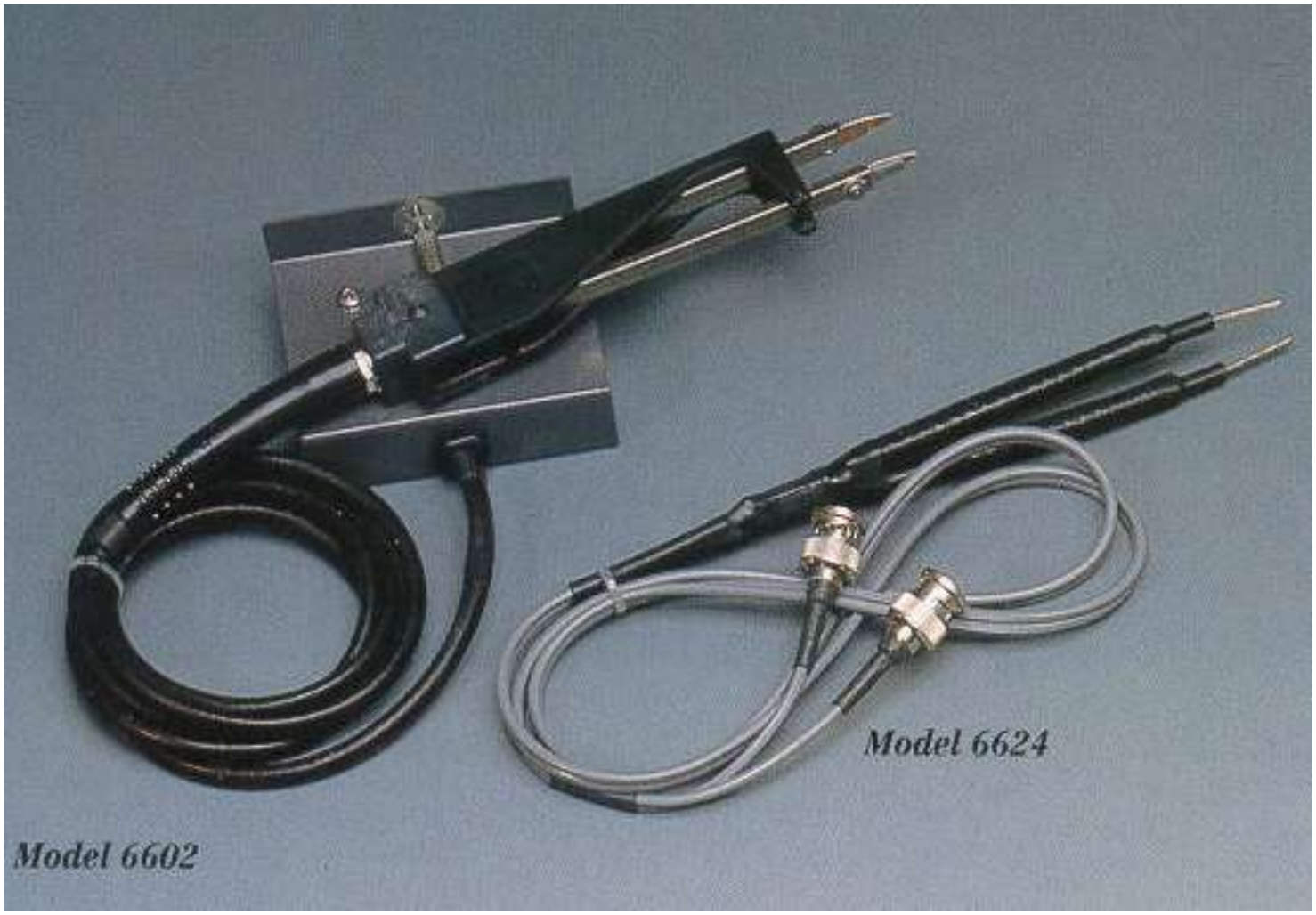
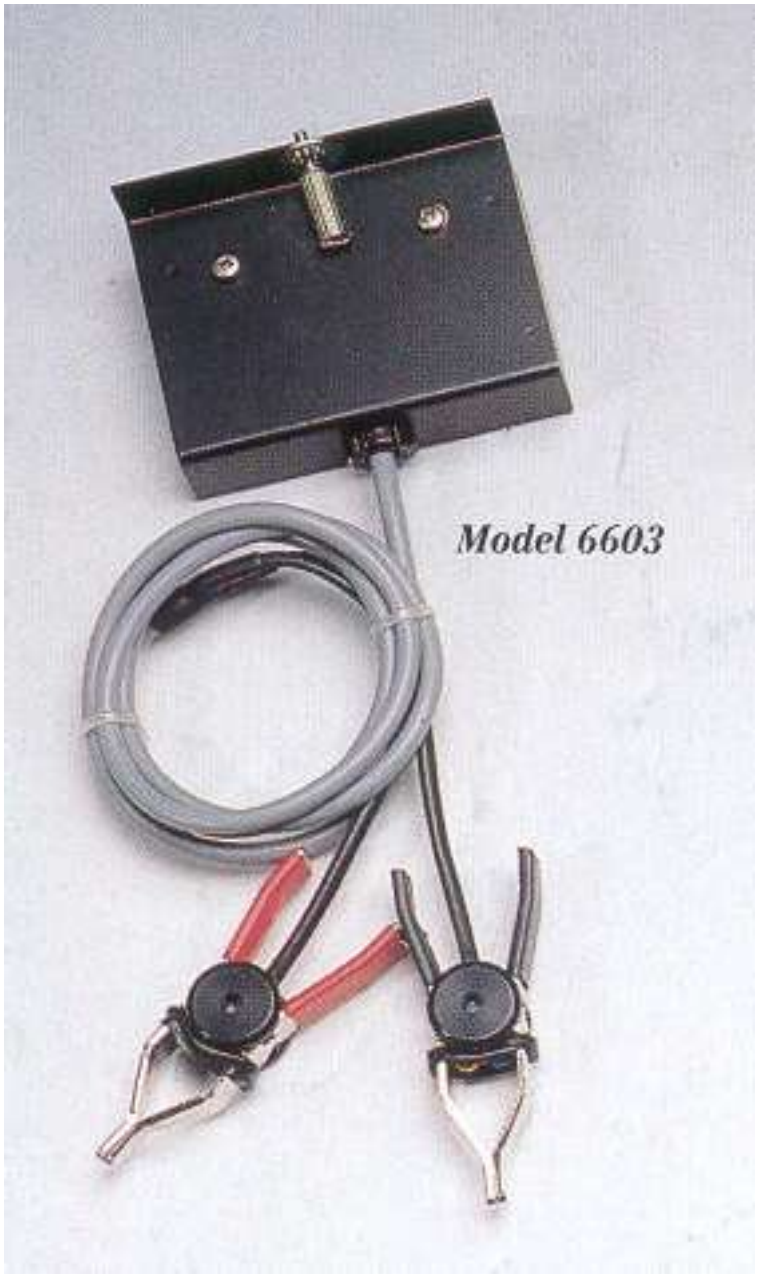
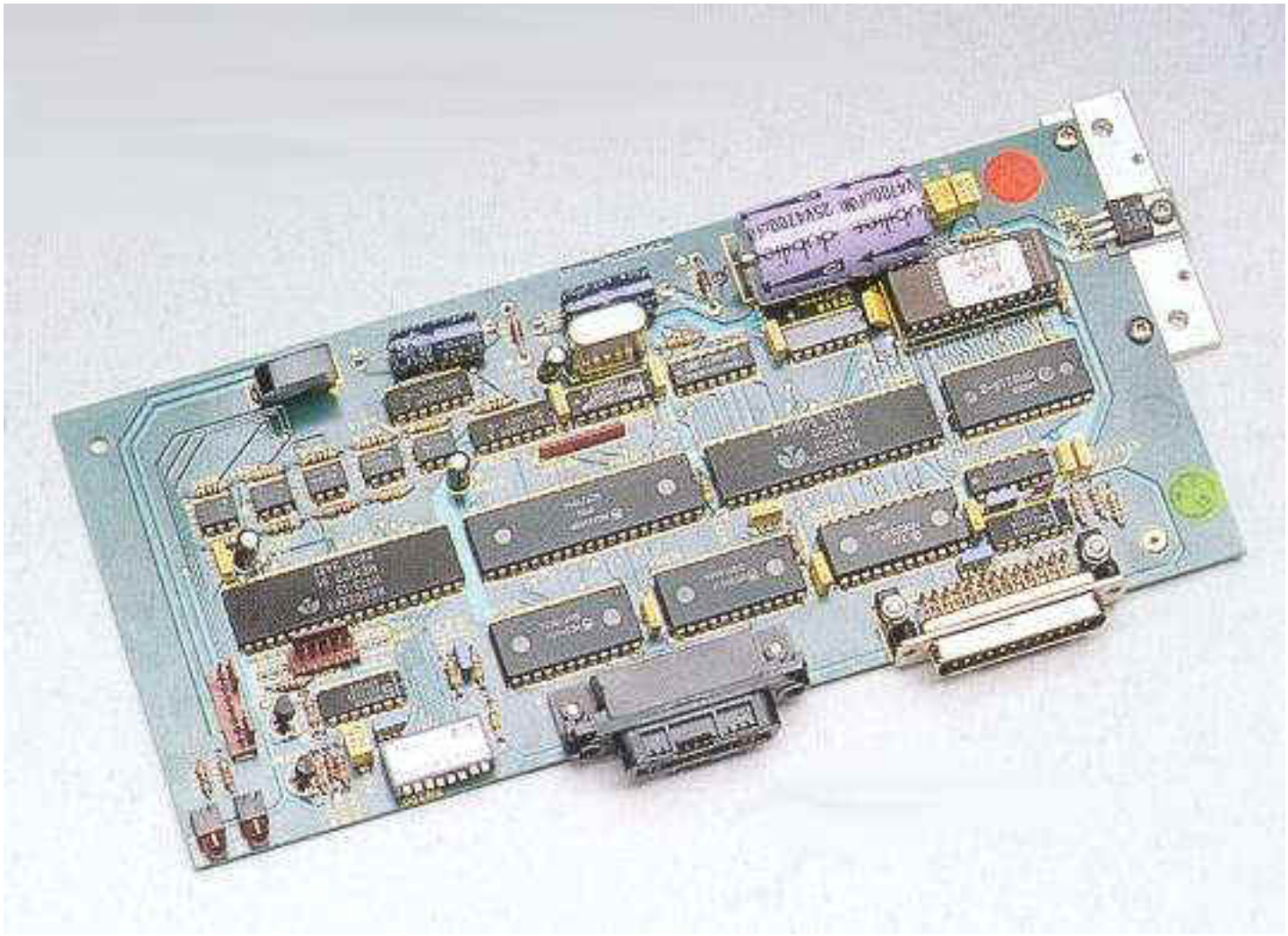

Model 6624
Model 6602


Model 6603



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Single Channel Strain Meter Model 8691

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The Model 8691 single channel direct reading digital instrument is useful in a wide range of applications for accurate measurement of strain with resistance strain gauges in ¼, ½ or full bridge configurations. Bridge Voltages and Mode are selected by push button. The instrument is housed in a two tone case incorporating adjustable carrying handles which also acts as a means of inclining the instrument for easier bench top use.

Specification	
Channels	Single

Range	± 19999 microstrain
Resolution	1 microstrain
Linearity	0.02% of Full scale
Gauge Resistance	¼ bridge: - 120Ω or 350Ω ½ bridge: - 80Ω upward Full bridge: - 120Ω upward
Gauge Factor Range	1 to 2.99 in 0.01 steps
Bridge Voltage	2V, 5V or 10V DC
Bridge Modes	¼ , ½ or Full bridge
Bridge Zero	***Coarse*** adjustment is in 9 overlapping steps up to 10,000 µstrain. ± 2% resistance imbalance is covered. ***Fine*** adjustment is by a locking 10 turn front panel control with a range of 700 µstrain.
Zero Drift	less than 0.5 microstrain/°C
Gain Drift	less than 0.005%/°C
Input Impedance	1000 MΩ
Gauge Connections	Screw terminals are at the rear and provide for ¼ , ½ or full bridge connections
Analog Output CRO	± 2V. Equivalent to ± 20,000 microstrain
Frequency Response	DC to 20 KHz
Power	Mains 115/240V AC. 50/60Hz. Slide switch at rear. BATTERY (optional). 2 x NiCad rechargeable batteries built-in, 8.4V, 1.2AH. Full charge of 40 hours approx.
Dimensions (mm)	300 x 110 x 450 mm
Weight (Kg)	5.0

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Ten Channel Strain Meter 8692

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The Model 8692 ten channel direct reading digital instrument is useful in a wide range of applications for accurate multichannel measurement of strain with resistance strain gauges in ¼, ½ or full bridge configurations. Bridge voltages and Mode are selected by push button. The instrument is housed in a two tone case incorporating adjustable carrying handles which also acts as a means of inclining the instrument for easier bench top use.

Specification	
Channels	10
Range	± 19999 microstrain

Resolution	1 microstrain
Linearity	0.02% of Full scale
Gauge Resistance	¼ bridge: - 120Ω or 350Ω ½ bridge: - 80Ω upward Full bridge: - 120Ω upward
Gauge Factor Range	1 to 2.99 in 0.01 steps
Bridge Voltage	2V, 5V or 10V DC
Bridge Modes	¼ , ½ or Full bridge
Bridge Zero	***Coarse*** adjustment is in 9 overlapping steps up to 10,000 µstrain. ± 2% resistance imbalance is covered. ***Fine*** adjustment is by a locking 10 turn front panel control with a range of 700 µstrain.
Zero Drift	less than 0.5 microstrain/°C
Gain Drift	less than 0.005%/°C
Input Impedance	1000 MΩ
Gauge Connections	Screw terminals are at the rear and provide for ¼ , ½ or full bridge connections
Analog Output CRO	± 2V. Equivalent to ± 20,000 microstrain
Frequency Response	DC to 20 KHz
Power	Mains 115/240V AC. 50/60Hz. Slide switch at rear. BATTERY (optional). Rechargeable sealed lead acid 1 .2AH 12Volt
Dimensions (mm)	420 x 150 x 355 mm
Weight (Kg)	7.0

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Coil Turns Tester Type 9600

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The Tinsley Turns Tester Type 9600 has been designed to check the number of turns on a winding immediately after it has been wound.

Quick and easy to operate, the Type 9600 provides an instant readout of turns, and performance is not affected by a normal workshop environment. In operation calibration is made against a standard coil. The coil under test is placed on the appropriate platform and the ends of the coil are connected to a pair of terminals. The number of turns on the test coil is indicated on the digital readout immediately after making the connection.

The Type 9600 Turns Tester, which has no moving parts, may be used in conjunction with any of the plug-in platforms described.

- Specification 9600
- Instrument Size 340 x 255 x 115 mm
- Instrument Weight 3.5 kg

Control Software 9600-307

The 9600-307 Control Software package has been developed to enable the 9600 Turns Tester System to be controlled via an IBM™ or fully compatible PC.

The software also allows re-calibration of the system from data which has been stored in a settings database on a PC. Measurement results are stored in a database which can easily be exported into most spreadsheet programs and subsequently used for projects such as quality analysis, test report writing and similar applications.

System requirement: 486 or above IBM™ or compatible PC with Windows™ 3.1 or above operating system.

Platform Types 9601 and 9602

The platform Types 9601 and 9602 cover the most commonly found sizes of wound bobbins or self supporting coils. Simple to use, the bobbin is placed over the probe and the termination leads, connected to the platform. The number of turns on the bobbin is then instantly displayed on the 9600 readout unit.

Specification 9601

- Probe Diameter 10mm
- Accuracy using standard coil supplied 0.5% ± 1 digit
- Accuracy using identical sample 0.2% ± 1 digit
- Will accommodate coils up to a maximum 140 mm high
- or 89 mm outside diameter
- Instrument Size 205 x 305 x 270 mm
- Instrument Weight 1.2 kg

Specifications 9602

- Probe Diameter 6 mm
- Accuracy using standard coil supplied 0.5% ± 1 digit
- Accuracy using identical sample 0.2%± 1 digit
- Will accommodate coils up to a maximum 64 mm high or 50 mm outside diameter
- Instrument Size 205 x 305 x 220 mm
- Instrument Weight 1.1kg

Platform Type 9603

The platform Type 9603 is most suited to the smaller sizes of bobbins and coils and is available with a choice of probe size. The standard ‘flat’ probe has a cross-section of 1.5 x 6.0mm. The alternative ‘square’ probe has a cross-section of 2.5 x 2.5mm. In operation the probe must be lifted to allow the test sample to be placed in the measuring position. The coil lead-outs are connected to the platform and the number of turns is read from the 9600 readout unit.

Specification 9603

- Designed for small coils
- Supplied with a removable vertical probe
- Probe Size 1.5x6 mm
- Maximum Coil Size 32 x 25 mm outside diameter
- Can be supplied with a probe 2. 5 x 2.5 mm for coils with a smaller inside diameter
- Accuracy using standard coil supplied 0. 5% ± 1 digit
- Accuracy using identical sample 0. 2% ± 1 digit
- Instrument size 205 x 305 x 220 mm
- Instrument weight 1.2k

Platform Types 9604 and 9605

The platform Types 9604 and 9605 are designed for the measurement of larger wound bobbins and self supporting coils.

In operation the probe must he lifted to allow the test sample to be positioned in the measurement area. After making electrical connection to the coil leadouts the number of turns can then he read from the 9600 readout unit.

SPECIFICATIONS 9604

- Probe Size 12.5 x 12.5mm
- Maximum Coil Size 102 x 102 x 102mm
- Instrument Size 232 x 148 x 430 mm
- Instrument Weight 3.4kg
- Accuracy using standard coil supplied 0.5% ± I digit
- Accuracy using identical sample 0.2% ±1 digit

SPECIFICATIONS 9605

- Diameter 28 mm
- Maximum Coil Size 200 x 200 x 200 mm
- Instrument Size 250 x 210 x 730 mm
- Instrument Weight 9.2 kg
- Accuracy using standard coil supplied 0.5% ± 1 digit
- Accuracy using identical sample 0.2% ± 1 digit

Platform Types 9606 and 9607

The platforms Types 9606 and 9607 are specially designed to measure toroidal wound coils. The 9606 is suitable for small cores and the Type 9607 is suitable for the larger varieties.

In operation the probe is pulled forward and the core is placed over it. After returning it to the upright position, the level is set to suit the permeability of the cores being measured.

This is done by adjusting a front panel potentiometer. Electrical connection is made between the platform and the coil lead-outs and the number of turns is read from the 9600 readout unit.

SPECIFICATIONS 9606

- Maximum Coil Size: - 39 mm outside diameter and 3mm inside diameter
- Instrument Size: - 205 x 305 x 220 mm
- Instrument Weight: - 1. 1 kg

SPECIFICATIONS 9607

- Maximum Coil Size: - 125 mm outside diameter and 9mm inside diameter
- Instrument Size 205 x 305 x 240 mm
- Instrument Weight: - 1.8kg
- Accuracy: - 0. 5% ± 1 digit

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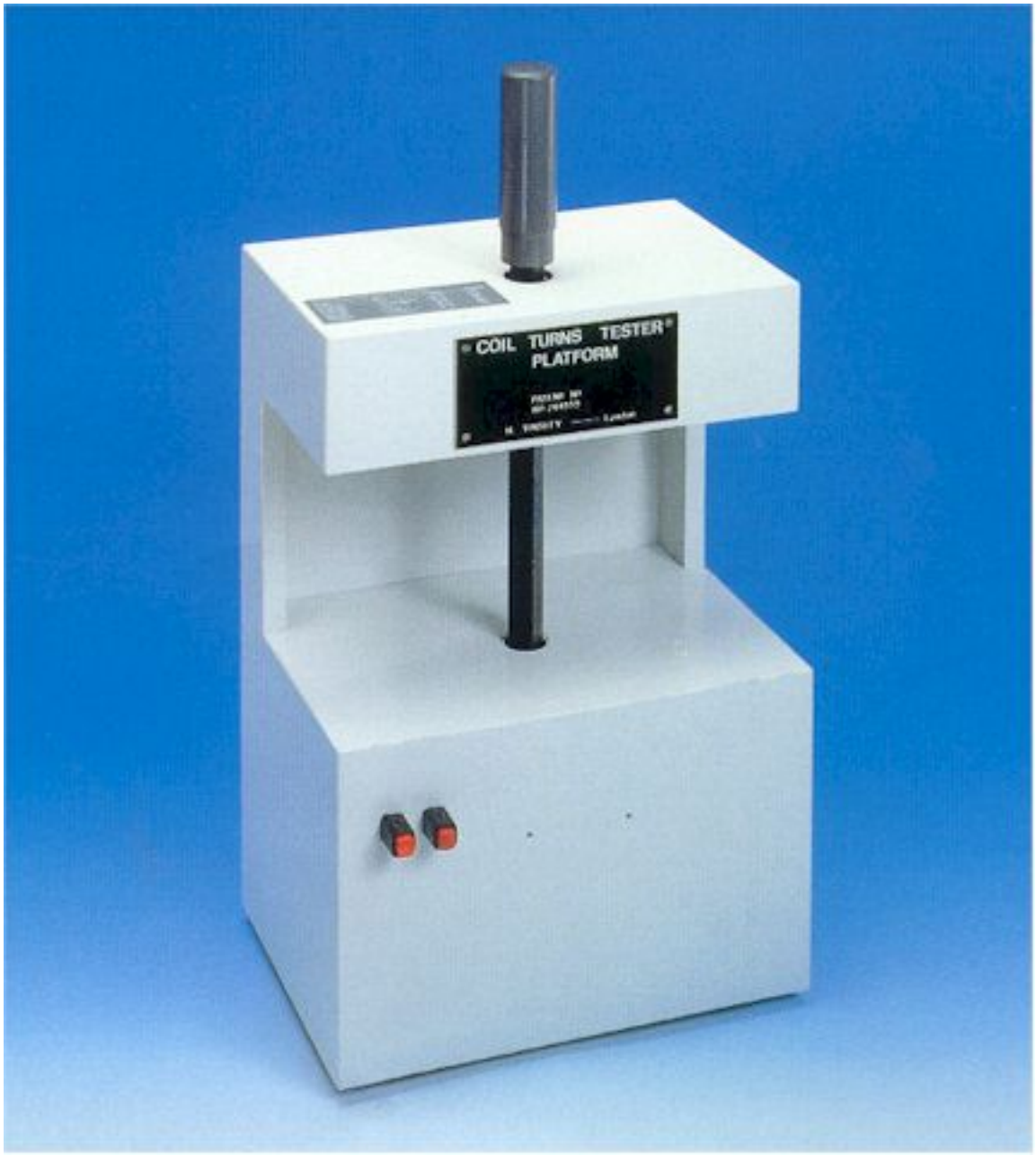
COIL TURNS TESTER
PLATFORM

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Transformer Core Tester Model 5846

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Transformer Core Tester & Platform 5846

The Type 5846 Transformer Core Tester is used to check that a transformer core will perform to specification.

Characteristics of a batch of cores may be rapidly checked by displaying the RMS magnetising force for any chosen flux density and the Volts per turn and magnetising current at that point. E & I Stacks, C Cores and Toroids can be measured.

Permeability can be determined by dividing B by H.

Specification 5846

- Digital Display Magnetising Force : - amps per metre or Oersteds.
- Flux Density ; - Telsa or Kilogauss.
- RMS Magnetising Current : - Ampere.
- Turns : - Volts per turn.
- Ranges: -
  Magnetising Force ; 0 - 1000 A/M or 0 - 12.5 Oersteds in three ranges.
- Path Lengths ; - 50 to 1000 mm
- Flux Density ; - 0 - 2 Telsa, or 0 - 20 Kilogauss.
- Area; - 0.5 to 100 sq.cm.
- Accuracy: - Accuracy just before saturation is 5%
- Absolute accuracy depends on the material being tested.
- Repeatability : - 2%
- Oscilloscope Display : -
  An Oscilloscope may be used to display an uncalibrated hysteresis loop to give an indication of the working point on the BH curve.
- Core Tester Size ; - 500 x 385 x 210 mm
- Weight ; - 20 kg
- Platform Size : - 360 x 195 x 190 mm

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Shorted Turns Tester Type 5863

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The Type 5863 Shorted Turns Tester has been designed to meet the ever increasing demand for accuracy and reliability in component manufacture.

The instrument is easy to use and will detect the presence of one or more shorted turns in a wound coil which can be of any shape, number of turns or windings.

The coil is simply placed over one of the rods mounted on the instrument and the meter reading will give a clear and immediate indication of shorted turns if they are present.

The test coil cannot be damaged as no voltage is applied to the winding. This instrument can be supplied with either 3mm or 6mm probes.

- **Specification 5863**
- Instrument Size 220 x 275 x 260 mm
- Instrument Weight 2.3 kg

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Transformer Ratiometer Type 4167C

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The Transformer Ratiometer Type 4167C measures the transformation ratio of the transformer when the primary or high voltage winding is energised at a.c. line voltage. The ratio is displayed on six decade dials.

The unwanted quadrature voltage is nulled automatically so that the measurement procedure simply consists of rotating the decade dials until the panel meter indicates zero.

Specifications

Ratio Range	1:1 to 1111.1:1
Accuracy	Range up to 300:1 0.1% Range up to 300:1 0.2%
Discrimination	Better than 0.1%
Quadrature Null	Automatic
Protection	Primary l00mA Fuse Secondary l00mA Fuse
Power Supply	240 Volts 50 Hz 117 Volts 60 Hz
Dimensions	500 x 350 x 115mm
Nett Weight	7.9kg

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Model 5895 Micro-Ohmmeter

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This Micro Ohmmeter, Type 5895, has been specifically designed for the fast measurement of the resistance of large transformers. It is equally suitable for the measurement of any resistance where a large amount of inductance is also present. An integral timer and printer are also incorporated to enable precise readings to be recorded at exact and programmed time intervals. Whilst being practical in use the instrument also has safety features to protect both the operator and the instrument from the hazards associated with this type of measurement. This instrument is suitable for the resistance measurement requirement of BS171 Part 2 or Part 1 IEC 76-5.

IEEE-488 Interface included as standard.

Speed of Measurement

Stable accurate measurements can be achieved in a fraction of the time required than when using more traditional bridge methods. For an average size distribution transformer the resistance reading is available within 10 seconds.

Typical Reading Times	10 Seconds	11KV, 220 KVA Transformer
	40 Seconds	132 KV, 240 MVA Transformet
	100 Seconds	400KV, 220KVA Transformer

Method of Operation

A high test current and unique circuitry is used to rapidly drive the core into saturation and to eliminate any oscillation of the magnetic field, thus enabling a steady reading to be obtained quickly. A large high intensity LED is illuminated when the instrument is in the “Read” mode and remains ON when the instrument is switched to “Zero” until any E.M.F.'s, generated in the transformer as the magnetic field collapses, have fallen to a safe level for the leads to be removed.

Specifications				
RANGE	**FULL SCALE**	**RESOLUTION**	**TEST CURRENT**	**ACCURACY**
100 Ω	180.00 Ω	10 mΩ	0.1 Amps	0.1%
10 Ω	18.000 Ω	1.0 mΩ	0.5 amps	0.1%
1 Ω	1.8000 Ω	0.1 mΩ	1.0 Amps	0.1%
100 mΩ	180.00 mΩ	10 μΩ	5.0 Amps	0.1%
10 mΩ	18.000 mΩ	1 μΩ	5.0 Amps	0.1%
10 mΩ	1.8000 mΩ	0.1 μΩ	10 Amps	0.2%
Supply	110/120 V 50/60 Hz		220 / 240 V 50/60 Hz	
VA Rating	500 VA			

Dimensions	460 x 460 x 150 mm
Nett Weight	16.5kg

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Model 5896 Transformer Micro-Ohmmeter

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This high current, digital, direct reading, microprocessor based transformer Ohmmeter will measure the D.C. resistance of power transformers and other electrical devices where high inductance is also present.

With a choice of single or dual measuring channels (models 5896 or 5896B), this fast initial reading Ohmmeter provides the best overall solution for low resistance testing of transformers. Small pole mounted transformers to large distribution types with 3 or 5 limb construction are easily measured using the 5896 as are notoriously difficult transformer types including 3 phase closed delta and auto-tap changers.

The 5896/5896B provides 6 ranges from 2 milli-Ohms to 190 Ohms, a choice of 2 currents per range, up to 25A on the lower 2 ranges with 0.1% accuracy .

The single or two channel measurement of primary or primary and secondary transformer windings are displayed on a large LCD screen to 4 1/2 digit resolution e.g. 19000.

An advanced, high power, wide ranging Ohmmeter for fast, accurate and sensitive measurements of transformers or other inductive loads. With built-in data storage and interfacing to PC or external printer. Suitable for a wide range of factory or on-site plant measurement and performance testing.

Applications include:

- Transformer dc winding resistance
- Generator stator/rotor resistance
- Large Motors
- Power utility sub-stations
- Transformer tap-changer operation and contact tests
- Routine plant maintenance and “Benchmarking” for fault finding
- Factory testing to International Standards.
- Transformer “Heat-run” tests
- Power connections and circuit breaker testing.

Features

- One or two independent measuring channels (5896B)
- High current (25A)
- High accuracy (0.1%)
- High resolution to 0.1µOhm
- 4 1/2 digit large display to 19000
- Wide measurement range 1 milli-Ohm to 190 Ohms
- Rapid saturation to read time on Star-Delta transformers (>30 secs)
- Hazard warning light and buzzer for high voltages
- Storage of data on internal memory
- Built-in printer for time and readings records.
- Constant current regulated supply eliminates L $^{di}/_{dt}$ effects
- 6 ranges, choice of two currents/range
- Large LCD screen for data presentation
- RS232/IEEE488 computer interface
- Over temperature protection

Technical data

The 5896/5896B fully automatic direct reading I or 2 channel precision transformer and high inductive load Ohmmeter provides an unparalleled, high performance instrument. It combines high speed, wide range, 0.1% precision, 1 part in 19,000 resolution and 25A measuring current for sensitive low noise measurements.

The instrument is based on an internal micro-processor with menu driven options via front panel membrane keypad controls. The system operating procedure includes storage of any constants or variables and a calibration mode. This enables instrument calibration against known external standards to be made/stored via front panel keys.

The 70 x 127 mm LCD display shows selected current, time, date, range and resistance value(s)

User controlled internal software allows data logging and storage of measurements in the instruments internal memory. The RS2323/IEEE488 interface enables stored data to be down loaded to a computer or external printer. The instrument may also be fully controlled via the interface.

The use of special current control circuits enables large transformers, particularly closed delta types, to be quickly saturated. This enables the initial first reading to be made within 60 seconds for most transformers. This is important when making “heat-run” tests to comply with various international standards. In addition the special circuits employed limit the Ldi/dt effects that can give rise to noise and unstable readings. When testing tap-changers, where accurate measurement of contact resistance of the taps is important, the high resolution of the 5896, to 1 part in 19,000, provides an accurate means to detect potential problems.

SPECIFICATION

Range	Nominal value	Full Range	Current High - Low	Resolution	Accuracy
1	1 mΩ	1.9000 mΩ	25/10A	0.1 μΩ	+/- 0.1% +/-1 digit
2	10 mΩ	19.000 mΩ	25/10A	1.0 μΩ	+/- 0.1% +/-1 digit
3	100 mΩ	190.00 mΩ	10/5A	10 μΩ	+/- 0.1% +/-1 digit
4	1 Ω	1.9000 Ω	5/1A	0.1 mΩ	+/- 0.1% +/-1 digit
5	10 Ω	19 .000 Ω	1/0.25A	1 mΩ	+/- 0.1% +/-1 digit
6	100 Ω	190.00 Ω	0.25/0.1A	10 mΩ	+/- 0.1% +/- digit
Measuring Time			Initial first reading (saturation time of transformers) 4 to 60 seconds Normal reading rate 2 seconds		
Accessories included			▪ Calibration certificate traceable to National Standards ▪ Soft Padded, heavy duty case for on-site protection		
Operating Temperature			6 - 40°C		
Supply Voltage			100/120/220/240V 50 to 60Hz		
Dimensions			470 x 210 x 530 mm excluding handle		
Nett weight			32 kg		

Ordering Information	
5896	Single channel instrument with RS232
5896B	Two Channel (for 2 windings) instrument with RS232
5896/IE	Single channel instrument with RS232 and IEEE488
5896B/IE	Two channel instrument with RS232 and IEEE488
5896IE	IEEE488 retrofit option
5896 2CH	Second channel option for 5896 (retrofit)
5896/C1	4 metre 4 wire 25A Cable Set
5896/C2	12 metre 4 wire 25A Cable Set
5896/C3	20 metre 4 wire 25A Cable Set
5896/PP	Printer Paper (10 Rolls)
5896/4737B	Calibration Unit

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Model 5897 Portable 100A Precision Micro-Ohmmeter

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An accurate mains/battery powered portable 100A Micro Ohmmeter. Using the 4 terminal measurement technique the Tinsley 5897 gives basic accuracy of 0.2% and an overall

resistance range of 0.1 μOhm to 40 Ohms.

With an internal mains re-chargeable battery supply the Tinsley 5897 may be used “in the field” for periods of up to 8 hours without requiring recharging. A standard RS232 computer interface is included that may be used for printing resistance values or downloading measurements that have been stored in the instrument’s memory. The Tinsley 5897 can be used fully auto-ranging or with manual range selection if required. Each of the 6 ranges has a choice of high or low measuring current. Current can be selected to be positive or negative, with the option of automatic reversal to eliminate the effect of thermal E.M.F.'s.

Control functions

- 6 measuring range controls (manual selection)
- AUTO key for auto range
- High/Low current control
- 3 Current direction measurement controls.
  + direction
  - direction
  Alternate (automatic reversal of + and -to eliminate thermal e.m.f. errors in measuring circuit)
- Supply ON/OFF
- Measure key
- Print key
- Calibration (CAL) control. Enables instrument internal reference standards to be calibrated by applying a set of external reference standards
- Menu/Enter key to access additional functions
- Time and date
- Print mode
- Baud rate
- Data logging mode
- RS232 for data and printer output
- 4 large 100A rated input terminals
- Mains input charging socket
- 2 battery charge indicators

Measurement principle

A four terminal measurement principle to eliminate lead resistance

The 100A current is pulsed with a duty cycle of approximately 10%. Measurement value displayed continuously

Power supplies

Two internal, re-chargeable, sealed, lead acid batteries are fitted for external 100A test resistance current and internal measurement supply circuits

Two charge indicators show the state of charge. The built-in battery charger has a front panel mains input supply for 115v or 230V supply with fuses

Digital display

A 4 digit 4000 count display provides resolution to 0.025% of full scale reading in a bright daylight viewing 20mm high LED display

Mechanical

A rugged, portable sealed ABS case, coloured grey

Size 460 x 380 x 160 mm

Nett Weight Approx 17Kg

Calibration

Provided with an in-house Tinsley Calibration Certificate traceable to National Standards via NPL

Specifications

Range	Resolution	Current	Accuracy		Temperature Coefficient (%reading + last digit)
			% reading	Last digits	
400μΩ	0.1 μΩ	100A/25A	+/-0.4%	+4	(0.04% +0.2)/ °C
4000μΩ	1.0 μΩ	100A/25A	+/-0.2%	+4	(0.02% +0.1)/ °C
40mΩ	10 μΩ	10A/2.5A	+/-0.2%	+4	(0.02% +0.1)/ °C
400mΩ	0.1 mΩ	1A/0.25A	+/-0.2%	+4	(0.02% +0.1)/ °C
4Ω	1.0 mΩ	100mA/25mA	+/-0.2%	+4	(0.02% +0.1)/ °C
40Ω	10 mΩ	10mA/2.5mA	+/-0.2%	+4	(0.02% +0.1)/ °C

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Model 5898 Portable 200A Precision Micro-Ohmmeter

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An accurate mains/battery powered portable 200A Micro Ohmmeter. Using the 4 terminal measurement

technique the Tinsley 5898 gives basic accuracy of 0.2% and an overall resistance range of 0.1 µOhm to 6 Ohms.

With an internal mains re-chargeable battery supply the Tinsley 5898 may be used “in the field” for periods of up to 8 hours without requiring recharging. A standard RS232 computer interface is included that may be used for printing resistance values or downloading measurements that have been stored in the instrument’s memory. The Tinsley 5898 can be used fully auto-ranging or with manual range selection if required. Each of the 6 ranges has a choice of high or low measuring current with the exception of the lowest range, which is fixed at 200 Amps. Current can be selected to be positive or negative, with the option of automatic reversal to eliminate the effect of thermal E.M.F.'s.

Control functions

- 5 measuring range controls (manual selection)
- AUTO key for auto range
- High/Low current control
- 3 Current direction measurement controls.
  + direction
  - direction
  Alternate (automatic reversal of + and -to eliminate thermal e.m.f. errors in measuring circuit)
- Supply ON/OFF
- Measure key
- Print key
- Calibration (CAL) control. Enables instrument internal reference standards to be calibrated by applying a set of external reference standards
- Menu/Enter key to access additional functions
- Time and date
- Print mode
- Baud rate
- Data logging mode
- RS232 for data and printer output
- 4 large 200A rated input terminals
- Mains input charging socket
- 2 battery charge indicators

Measurement principle

A four terminal measurement principle to eliminate lead resistance

The 200A current is pulsed with a duty cycle of approximately 10%. Measurement value displayed continuously

Power supplies

Two internal, re-chargeable, sealed, lead acid batteries are fitted for external 200A test

resistance current and internal measurement supply circuits

Two charge indicators show the state of charge.

The built-in battery charger has a front panel mains input supply for 115v or 230V supply with fuses

Digital display

A 4 digit 6000 count display provides resolution to 0.015% of full scale reading in a bright daylight viewing 20mm high LED display

Mechanical

A rugged, portable sealed ABS case, coloured grey

Size 460 x 380 x 160 mm

Nett Weight Approx 20Kg

Calibration

Provided with an in-house Tinsley Calibration Certificate traceable to National Standards via NPL

Specifications

Range	Resolution	Current	Accuracy		Temperature Coefficient (%reading + last digit)
			% reading	Last digits	
600μΩ	0.1μΩ	200A/50A	+/-0.4%	+6	(0.04% +0.2)/ °C
6000μΩ	1.0μΩ	200A/50A	+/-0.2%	+6	(0.02% +0.1)/ °C
60mΩ	10μΩ	20A/5A	+/-0.2%	+6	(0.02% +0.1)/ °C
600mΩ	0.1mΩ	2A/0.5A	+/-0.2%	+6	(0.02% +0.1)/ °C
6Ω	1.0mΩ	200mA/50mA	+/-0.4%	+6	(0.04% +0.2)/ °C

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Portable Transformer Ratiometer Model 4167P

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The Tinsley Transformer Ratiometer Type 4167P measures the transformation ratio of large transformers and also gives an indication of any small phase difference between the high voltage and low voltage windings (e.g. primary and secondary).

The ratio and phase difference or ratio and energising voltage are displayed on two large digital LCD displays with optional back light for use in poor light conditions.

In use the High Voltage winding of the transformer under test is connected to the “H.V. Winding” terminals of the instrument and is energised by the internal power oscillator at a nominal 60 Volts AC./50Hz. The low voltage winding (Step down) is connected to the “L.V. Winding” terminals.

The display of ratio and phase is then entirely automatic.

Measurement technique

The measurement technique is to measure the H.V. and L.V. voltages during several parts of the cycle to obtain in-phase and quadrature values from which the ratio and phase difference are calculated.

The input circuits are isolated by transformers, therefore the instrument should not be damaged by the very high voltages possible if the connections from the transformer being measured are accidentally reversed.

The measurement circuits are further protected by front panel fuses with internal surge absorbers.

Power Requirement

The 4167P is fitted with rechargeable batteries and has an internal charger. The instrument can be used connected to a mains power supply or will operate from the internal batteries for a period of up to 8 hours from a full charge.

Specification	
Ratio range	1:1 to 300:1
Accuracy	1:1 to 9.99:1 = 0.1% 10:1 to 99.99:1 = 0.1% 100:1 to 149.9:1 = 0.2% 150:1 to 300:1 = 0.5%
Resolution	The ratio is displayed in one of 4 ranges 1:1 to 9.99:1 = 0.001 10:1 to 99.99:1 = 0.01 100:1 to 300:1 = 0.1%
Phase difference	± with a resolution of 0.01 (approx. 0.5°)
Displays	LCD with optional back light Ratio 1.000 to 9998 (9999=over range) Phase ± 0.000 to 198 (199=over range)
Measurement voltage	Nominally 60V at power frequency dependent on load
Input protection	Front panel fuses and internal surge absorbers
Power supply	AC mains 50 – 60 Hz Universal input of 90 – 260 Volts AC
VA rating	Approximately 20VA

Dimensions	470 x 150 x 280mm
Nett Weight	Approximately 8kg

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Automatic Transformer Ratiometer Model 4167D

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Features

- Direct Ratio Reading from 1:1 to 9990:1
- High accuracy to 0.1% Resolution to 1 part in 10,000
- Display of phase difference indication and H.V. winding voltage
- PC interfaces (RS232; IEEE488; RS385; RS422)
- Bright red LED displays

This mains operated, automatic Digital Transformer Ratiometer, measures the transformation

ratio (primary to secondary turns ratio) and can also give an indication of any small phase difference between the high voltage and low voltage windings of transformers.

The Ratiometer can be used in factory production test areas or other locations where a suitable supply voltage exists. The model 4167D operates accurately to turns ratios of 1000:1 for power transformers. While the extended range model 4167DH operates to 9990:1, for both power transformers and many types of current transformer.

The models 4167D and 4167DH, cover a wide automated reading range from 1:1 to 9990:1, are supplied fully calibrated and offer a basic accuracy of 0.1%. Each instrument features both parallel and serial interfaces enabling their use as part of a wide range of automated control and data logging systems.

Applications include:

- Power transformer ratios
- Potential transformers
- Current transformers
- Power utility sub-stations
- Routine plant maintenance and “Benchmarking” for fault finding
- Factory testing to international standards
- Tap changer transformer defects

In use the transformer is connected with the high voltage winding wired to the H.V. terminals of the instrument and the low voltage winding connected to the L.V. terminals. The transformer high voltage winding is then energised at normal line voltage (90 to 260V, 40 to 70Hz) even if the transformer under test has a much higher voltage rating. The ratio reading is indicated on a large 7 segment LED display and is fully automatic with no range changing or tedious balancing required.

Technical Data

The model 4167D and 4167DH Transformer Ratiometers measure transformer voltage ratio, give an indication of any phase difference, or applied energising voltage on power transformers and some current transformers.

Incorporating two large bright LED displays. One display automatically provides the ratio value and the second can be selected to indicate phase difference or the energising voltage being supplied to the H.V. side of the transformer.

In normal use, the high voltage winding of the transformer is energised by the user at AC. line voltage and connected to the Ratiometer H.V. terminals. The low voltage winding (step down) is connected to the L.V. terminals of the Ratiometer. The display of ratio and phase is then entirely automatic with no switching or other manual operation required by the user.

The model 4167D is suitable for transformer ratios to 1000:1 while the 4167DH, extended range version, provides accurate ratio to 9990:1 to cover voltage and current transformers.

The automatic range changing facility enables the display to give the highest resolution for the

ratio being measured e.g. ratios 1 to 100 show 10.00 to 99.99 etc.

Measurement system

The measurement technique used is to measure the H.V. and L.V. winding voltages during several parts of the applied AC voltage cycle to obtain in-phase and quadrature values. From these values the ratio and phase difference are calculated. The inputs to the Ratiometer are isolated by transformers, fuses and surge absorbers, therefore the instrument should not be damaged by the very high voltages possible if the connections from the transformer being measured are accidentally reversed.

Computer interfacing

A very flexible computer interface system is fitted allowing IEEE488, and serial RS232, RS422 and RS485 communication with the instruments.

When using another measuring instrument with a IEEE4S8 output the 4167D/ DH can operate as a controller. This converts the IEEE488 input from the second instrument to serial format enabling its control via the 4167D/DH serial interface.

Specifications					
Range	1:1 to 9.999:1	10:1 to 99.99:1	100:1 to 300:1	100:1 to 999.9	1000:1 to 9990
Accuracy 4167D	0.1%	0.1%	0.1%	0.25%	-
Accuracy 4167DH	0.1%	0.1%	0.1%	0.1%	0.1%
Resolution 4167D & DH	0.001	0.01	0.1	0.1	1.0

Overall range

4167D 1:1 to 1000:1
4167DH 1:1 to 9990:11

Overall accuracy

4167D 0.l TO 0.25%
4167DH 0.1%

Phase Difference	± with a resolution of 0.001 (approx. 0.005°)
Displays	2 X 5 digit 17mm red LED's Ratio to 9999 Phase 0.000 to 198 with 0.001 Resolution (approx 0.050)
Measurement Voltage	H.V. input 90 to 260 Volts (40 to 70Hz) L.V. input 0.01 to 260 Volts

Inputs	2 pairs of HV and LV terminals
Input Protection	Front panel fuses and internal surge absorbers
Interfaces	IEEE 488.2 / 488.1 RS232 300 to 9600 baud RS422 or RS485 300 to 9600 baud
Power Supply	AC mains 50-60Hz Universal input of 90-260 volts AC at approximately 20VA
Dimensions	470 x 150 x 280 mm
Nett Weight	approximately 8kg.
Accessories	Calibration certificate included Model 4167T ratio test set optional

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Shunts Type 2276

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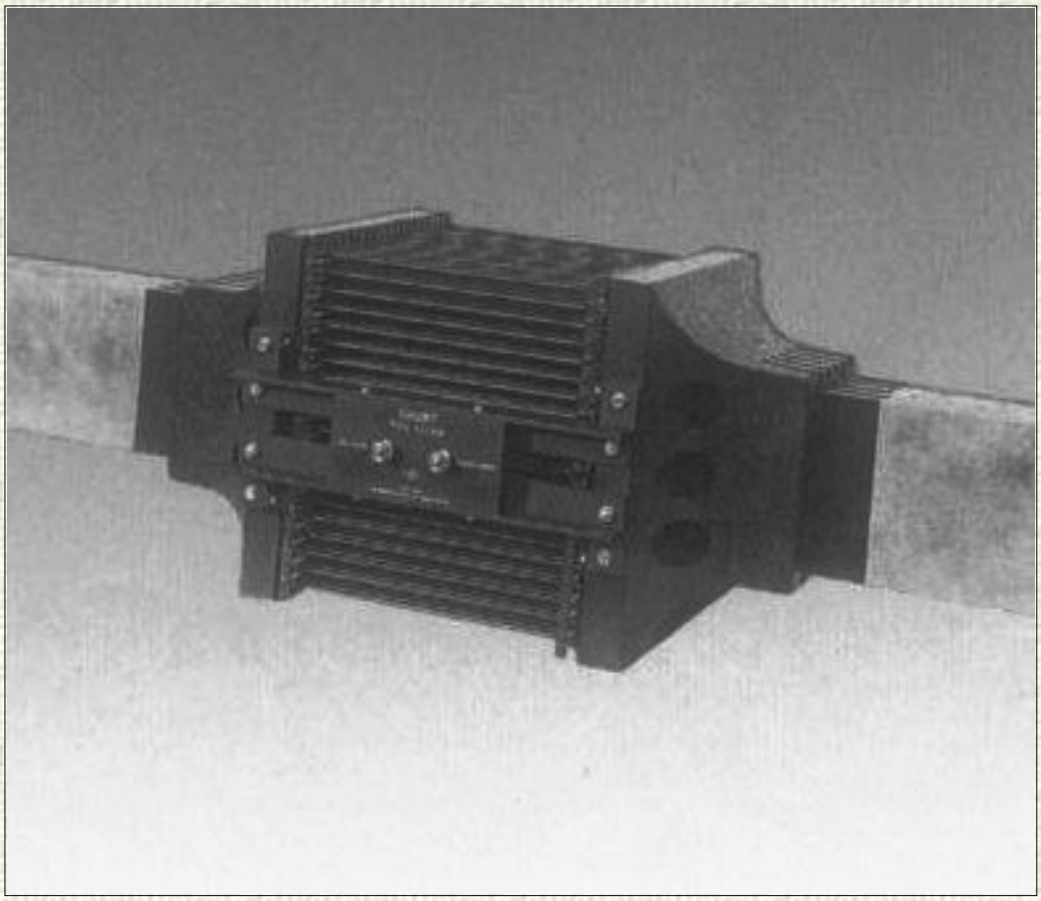

The Type 2276 range of shunts are specially designed for use up to 20,000 Amperes and maybe used on a steady D.C. load or for pulse work.

Limit of Error

Under steady condition the Type 2276 shunts keep within 0.1% up to full rated current but this figure is greatly improved if forced air is used for cooling.

Stability

The stability of these shunts under steady conditions is 0.01% or better. A typical figure, 20000 Ampere shunt was found to be better than 0.005%.

Compensation for Phase Angle Errors

When used for pulse work, the mutual inductance between the potential leads and the current path in the shunt can be set to compensate for the phase angle between the current in the shunt and the voltage between the potential points.

The self inductance of the current through the shunt depends on the arrangement of the bus bars. If the return bus bar is made to follow the contours of the shunt and is kept close to it, the value can be kept to 0.01µH or less.

Construction

The construction of the Type 2276 shunts is similar to the Type 4638 but they are usually supplied in a steel lifting frame to facilitate transporting them without distortion. They are not supplied on a base nor fitted with a protecting cover.

Specifications

Current Amperes	Resistance Ohms	Volt Drop Volts	Wattage Watts	Dimensions Millimetres (approx.)
4000	250	1	4K	2000 x 245 x 260
10000	10	0.1	1K	1200 x 330 x 330
20000	50	1.0	20K	2150 x 330 x 330

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Air Cooled Shunts Type 4638

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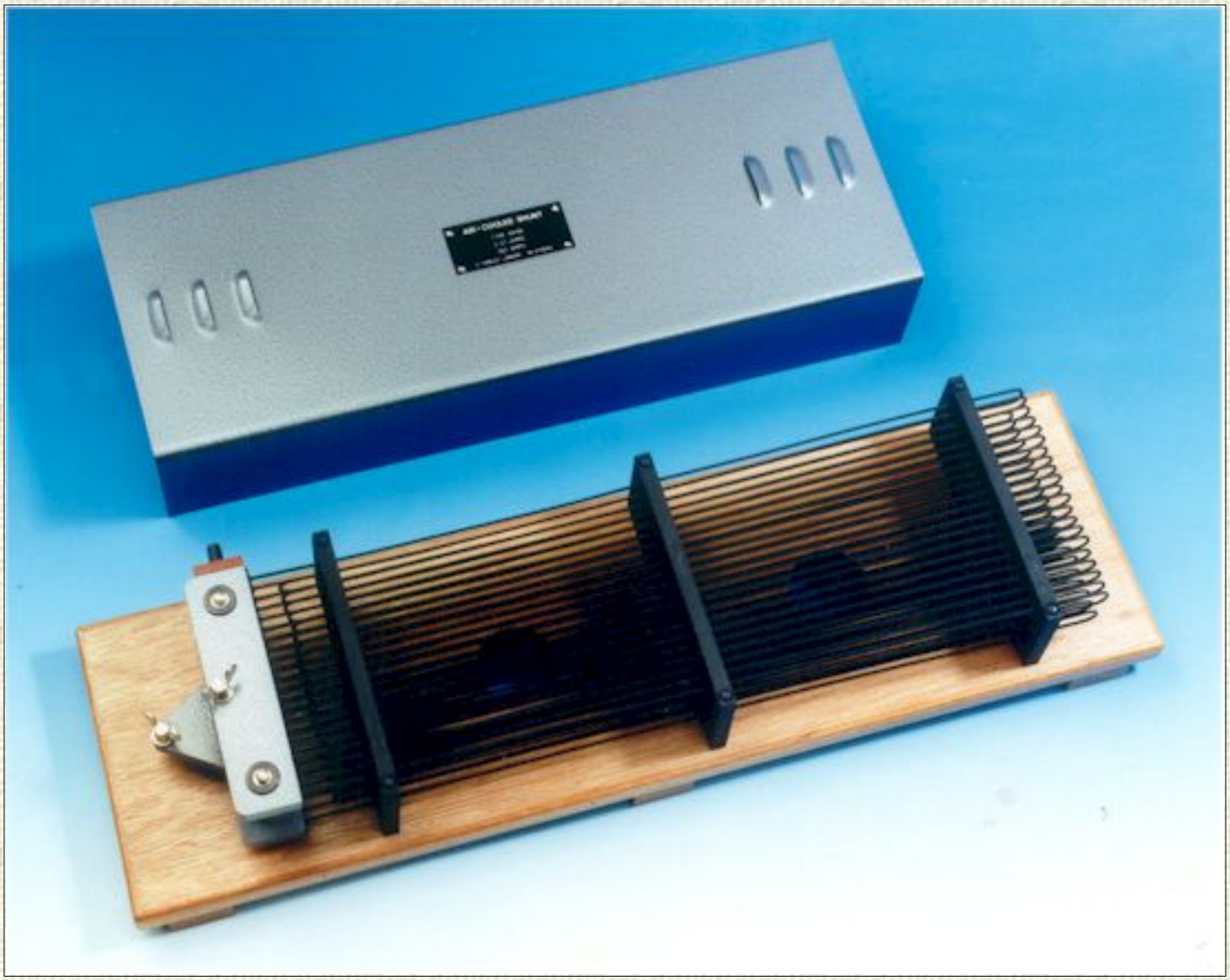

The Type 4638 shunts cover the range 1.5 to 2,000 Amperes and were designed to comply with the E.S.M. Act.

Limit of Error

The Type 4638 shunts having rated values up to 100 Amperes are calibrated to maintain resistance within 0.03% for any current up to full rated current. Between 100 and 2,000

Amperes they will keep within 0.05% for any current up to their full rating.

Stability

The stability of these shunts under steady current conditions is better than 0.01%. Their stability with time is of the same order.

Thermal Errors

Errors due to thermal E.M.F.s are less than 0.01% of the Volt drop with full rated current; and under zero current conditions will be a few micro Volts only.

Construction

The shunts are constructed of high grade Manganin, the resistive elements being solidly soldered to the current terminals and the whole assembly is mounted on a strong base and fitted with a protecting cover which allows the convection currents to circulate freely and effect cooling.

Specifications

Current Amperes	Resistance Ohms	Volt Drop Volts	Wattage Watts	Dimensions Millimetres (approx.)
1.5	1.0	1.5	2.25	230 x 100 x 100
5	0.2	1.0	5	410 x 100 x 100
15	0.1	1.5	23	410 x 130 x 110
15	0.01	0.15	2.25	230 x 130 x 110
50	0.01	0.5	25	280 x 130 x 130
50	0.02	1.0	50	580 x 130 x 140
75	0.002	0.15	11	500 x 155 x 110
150	0.01	1.5	225	860 x 255 x 180
150	0.001	0.15	2.5	500 x 255 x 110
300	0.001	0.3	90	835 x 155 x 200
500	0.0002	0.1	50	410 x 155 x 155
750	0.0002	0.15	110	700 x 210 x 200
1000	0.0001	0.1	100	450 x 210 x 260
1500	0.0001	0.15	225	675 x 210 x 260
2000	0.00005	0.1	200	860 x 245 x 260

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Air Cooled Shunts Type 4640

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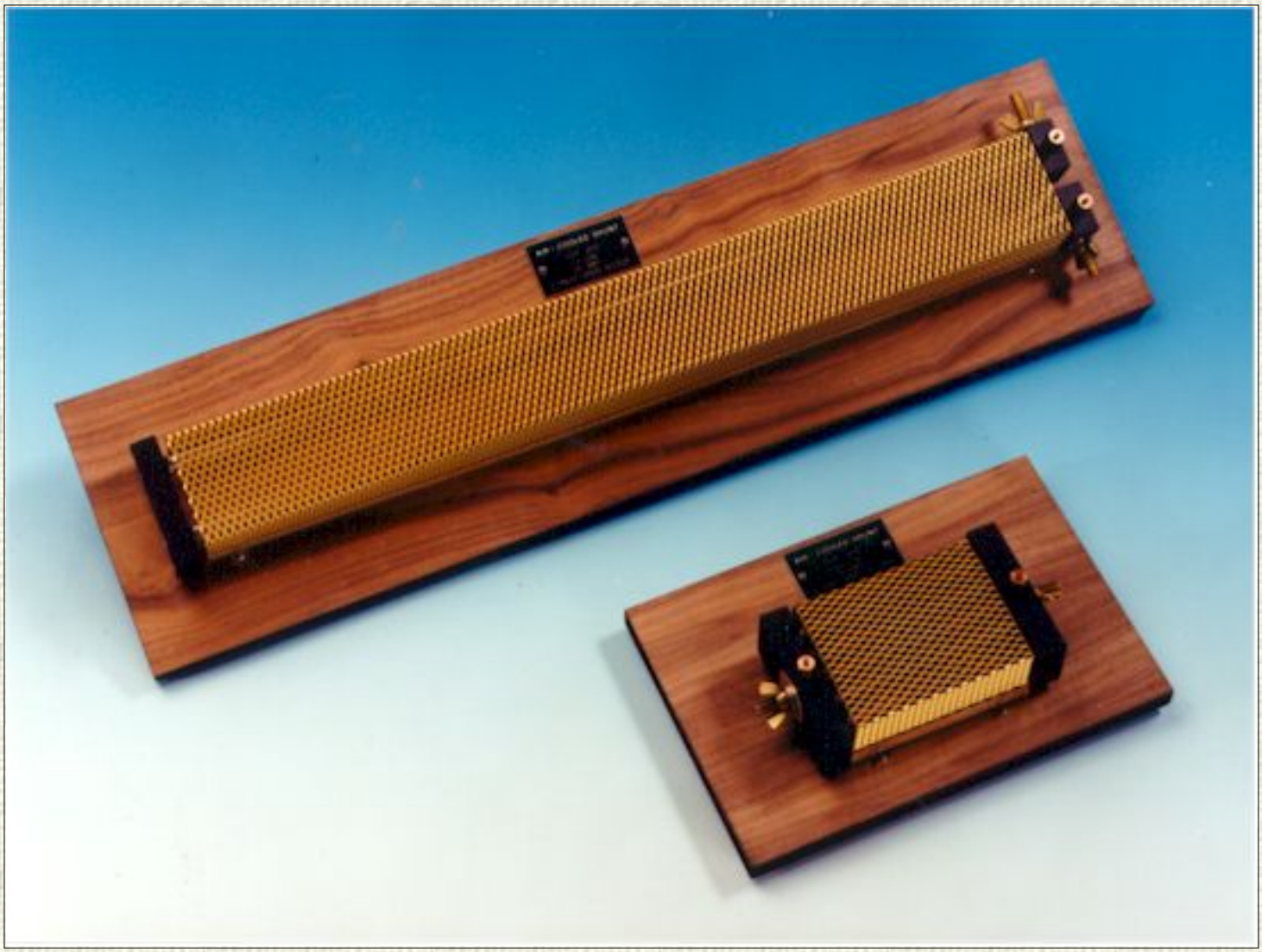

The Tinsley 4640 range of Air Cooled Shunts offers good accuracy at low cost.

Available in four resistance values and a range of Full Load operating currents from 50 Amperes to 1,000 Amperes. These instruments are manufactured from selected Manganin, specially heat treated for low temperature coefficient and long term stability. The instruments are constructed using a non-metallic base board with the elements protected by a mesh cover allowing good air flow to cool the instrument.

For prolonged use under full load conditions we recommend forced air cooling to preserve best

accuracy. These current shunts are designed to have minimum inductance and use the four terminal measurement principal.

They are suitable for use with DC and also AC at power frequencies. Instruments are supplied with a Tinsley “In house” calibration certificate.

A Tinsley UKAS calibration certificate can be supplied at extra cost.

Specifications

0.01Ω - 50 Amperes	Accuracy of Adjustment	Nominal value	±0.1%
	Measurement Uncertainty	Tinsley "In House"	±0.01%
	AC-DC Transfer Error	DC - 60Hz	±0.005%
	Load Coefficient	1 Amp to 50 Amp	±0.01%
0.001Ω - 150 Amperes	Accuracy of Adjustment	Nominal value	±0.5%
	Measurement Uncertainty	Tinsley "In House"	±0.02%
	AC-DC Transfer Error	DC - 60Hz	±0.005%
	Load Coefficient	5 Amp to 150 Amp	±0.01%
0.002Ω - 500 Amperes	Accuracy of Adjustment	Nominal value	±1%
	Measurement Uncertainty	Tinsley "In House"	±0.1%
	AC-DC Transfer Error	DC - 60Hz	±0.005%
	Load Coefficient	5 Amp to 500 Amp	±0.02%
0.0001Ω - 1000 Amperes	Accuracy of Adjustment	Nominal value	±1%
	Measurement Uncertainty	Tinsley "In House"	±0.01%
	AC-DC Transfer Error	DC - 60Hz	±0.005%
	Load Coefficient	10 Amp to 1000 Amp	±0.05%

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Decade Resistance Boxes - ZX Series

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ZX74 Series

The ZX74 Series of Decade Resistance Boxes are very high accuracy and stable six-dial instruments. There are 4 versions in the series with a maximum resistance of 1,111,111Ω. The ZX83 series adds another two Decade Boxes that extend the resistance range to 111,111,100Ω.

The resistive elements are non-inductively wound on high quality formers using a resistance wire of specially selected alloy. Each resistive element is heat treated and undergoes a

controlled ageing process to produce the very highest stability and also a low temperature coefficient.

Switches are of the highest quality with low pressure contacts for long life and reliability. Each decade switch is manufactured using a fully enclosed construction for maintenance free operation. These decade boxes are housed in attractive robust metal cases with adjustable feet and a retractable carrying handle.

The very popular ZX74 model has a lowest decade with steps of 1mΩ. This is particularly useful for Resistance Thermometer Simulation and resistance bridge networks. All models have an extra terminal connected to the electrostatic screen which may be required in AC. bridge applications.

Specifications

Basic Accuracy:

ZX74, ZX75, ZX76: (0.01% +0.002Ω) at 20ºC ±2ºC
ZX77, ZX83, ZX84: (0.05%+0.002Ω) at 20ºC ±2ºC
RH: < 75% non-condensing
Insulation Resistance: >1000MΩ at 1000V
Temp. coefficient: (-5 to +10)ppm/ºC
Power dissipation: MAX 0.2W
Shipping: Dimensions (mm): 435x136x110 - Weight (Kg): 4

Type	Total Resistance	Dials Available (NA = not available)										
	Ω	X10MΩ	X1MΩ	X100KΩ	X10KΩ	X1KΩ	X100Ω	X10Ω	X1Ω	X0.1Ω	X0.01Ω	X0.001Ω
ZX74	1,111.210						±0.01%	±0.01%	±0.05%	±0.1%	±2%	±5%
ZX75	11,111.1					±0.01%	±0.01%	±0.02%	±0.05%	±0.5%	±5%	
ZX76	111,111.0				±0.01%	±0.01%	±0.01%	±0.02%	±0.1%	±1%		
ZX77	1,111,110			±0.05%	±0.05%	±0.05%	±0.05%	±0.1%	±1%			
ZX83	11,111,110		±0.05%	±0.05%	±0.05%	±0.05%	±0.05%	±0.05%				
ZX84	111,111,100	±0.1%	±0.05%	±0.05%	±0.05%	±0.05%	±0.05%					

ZX90 Series

The ZX90 Series of Decade Resistance Boxes comprise of 10 instruments to cover a resistance range of up to 1,111,111Ω with instruments available in 4, 5, 6 and 7 Decades. Whilst they are low cost these instruments are of high quality and feature precision low contact resistance switches.

The resistive elements are made of enamelled manganin wire which is non-inductively wound onto high quality formers. Each resistive element is heat treated and undergoes a controlled ageing process to produce the very highest stability and to achieve low temperature coefficient. The instruments are housed in an attractive metal case which is both robust and dust proof.

RANGE SWITCHING			$x10^5$	$x10^4$	$x10^3$	x100	x10	x1	x0.1	x0.01	Dimensions	Weight
Type	Number of Decades	Total Resistance (Ω)	Accuracy								(mm) (unpacked)	(kg)
ZX90	4	111.1					±0.1%	±0.5%	±2%	±5%	200x95x94	0.85
ZX91	4	11,110.0			±0.1%	±0.1%	±0.1%	±0.5%			200x95x94	0.85
ZX92	5	1,111.1				±0.1%	±0.1%	±0.5%	±2%	±5%	242x95x94	1.0
ZX93	5	11,111.0			±0.1%	±0.1%	±0.1%	±0.5%	±2%		242x95x94	1.0
ZX94	5	111,110.0		±0.1%	±0.1%	±0.1%	±0.1%	±0.5%			242x95x94	1.1
ZX95	6	11,111.1			±0.1%	±0.1%	±0.1%	±0.5%	±2%	±5%	284x95x94	1.15
ZX96	6	111,111.0		±0.1%	±0.1%	±0.1%	±0.1%	±0.5%	±2%		284x95x94	1.25
ZX97	6	1,111,110.0	±0.2%	±0.1%	±0.1%	±0.1%	±0.1%	±0.5%			284x95x94	1.25
ZX98	7	111,111.1		±0.1%	±0.1%	±0.1%	±0.1%	±0.5%	±2%	±5%	327x95x94	1.35
ZX99	7	1,111,111.0	±0.2%	±0.1%	±0.1%	±0.1%	±0.1%	±0.5%	±2%		327x95x94	1.35

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Portable 9 Decade High Resistance Box Model 4720

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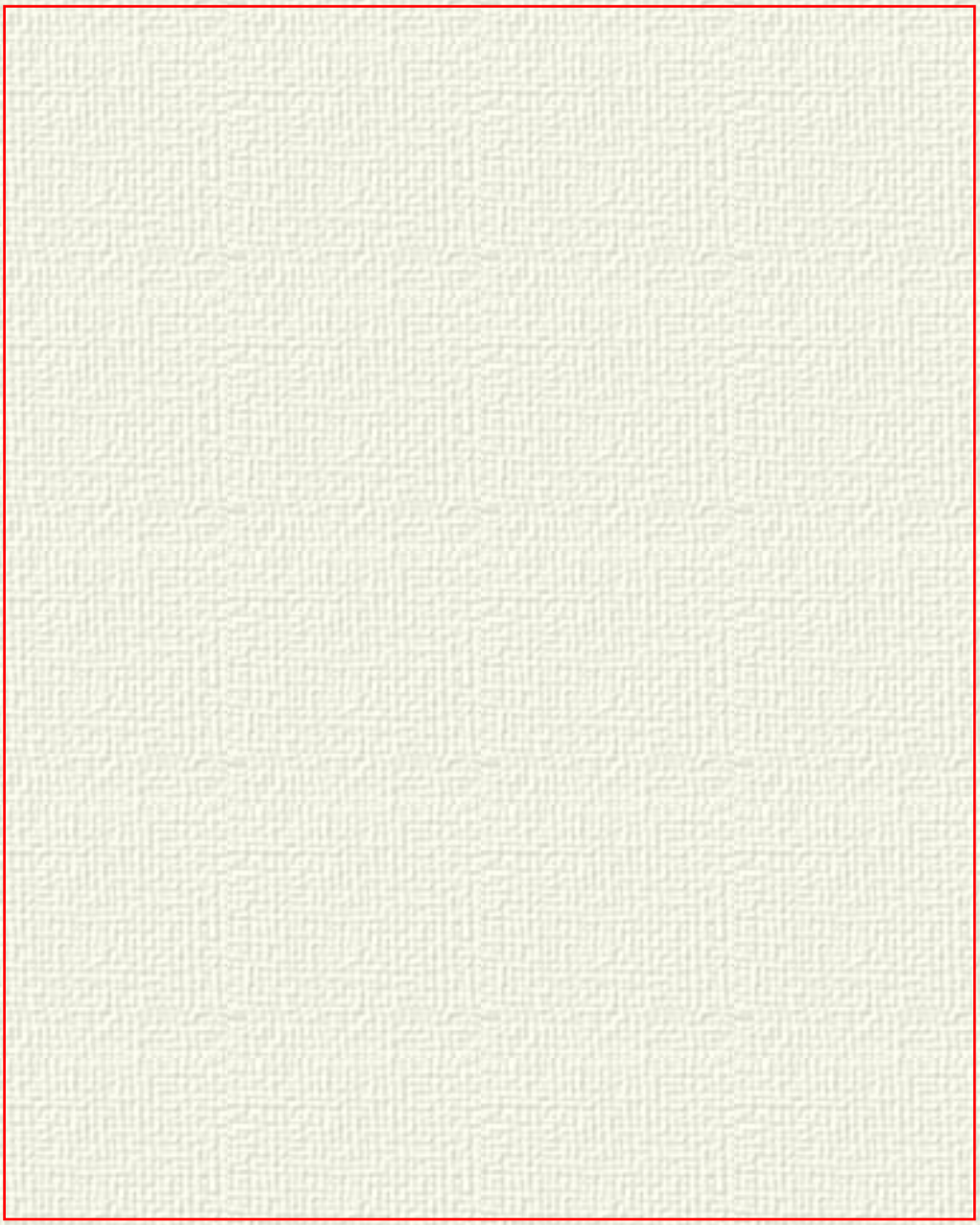

- Calibration of insulation tester
- Range 1kΩ to 611GΩ
- Resolution 1kΩ
- Voltage rating 5,000V DC

- 9 decades
- Portable field or laboratory use

Designed for the checking and calibration of insulation testers at voltages of up to 5000v DC, the Tinsley Model 4720 decade box provides up to 9 decades of resolution.

The total range covered is from 1 kΩ to 611,111,110kΩ using specially selected resistors and high quality switches mounted on an easy to read panel.

This resistance box is housed in a strong reinforced polystyrene case with lid and carrying handle to provide an ideal solution to on-site and laboratory calibration of high resistance insulation testers.

The instrument can be supplied complete with a calibration certificate provided by our own in-house calibration laboratory.

Specifications

Decade	Value	Accuracy	Max. Power	Max. V/Step	Temp. Coeff
1	I0 x 1kΩ	±0.1%	1Watt	10	±15ppm/°C
2	I0 x 10kΩ	±0.1%	1Watt	50	±15ppm/°C
3	I0 x 100kΩ	±0.1%	1Watt	150	±15ppm/°C
4	I0 x 1MΩ	±0.1%	1Watt	300	±25ppm/°C
5	I0 x 10MΩ	±0.1%	1Watt	500	±50ppm/°C
6	I0 x 100MΩ	±1.0%	2.3Watt	1,000	±100ppm/°C
7	I0 x 1GΩ	±1.0%	3.5Watt	5,000	±100ppm/°C
8	I0 x 10GΩ	±2.0%	3.5Watt	5,000	±100ppm/°C
9	5 x 100GΩ	±4.0%	1.3Watt	5,000	±2,000ppm/°C
Dimensions		46cm x 38cm x 16cm			
Weight		8.8Kg			

Accessories

A4720-1 10: Pair high voltage connecting leads fitted with suitable plugs at one end for connection to the Decade Box.

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Single, High Resistance Decade Box Model 4721

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- Calibration of insulation tester
- Range 1kΩ to 1TΩ
- Voltage rating up to 5,000V DC
- Portable field or laboratory use

The Tinsley Model 4721 decade box is designed for the checking and calibration of insulation testers at voltages of up to 5000v DC.

The total range covered is from 1 kΩ to 1TeraΩ using specially selected resistors and a high quality switch mounted on an easy to read panel.

This resistance box is housed in a strong aluminium case with lid and carrying handle to provide an ideal solution to on-site and laboratory calibration of high resistance insulation testers.

The instrument can be supplied complete with a calibration certificate provided by our own in-house calibration laboratory.

Switch Settings	Max d.c. Volts	Accuracy	Temperature Coefficient
1kΩ	10V	0.1%	0.015%/°C
10kΩ	50V	0.1%	0.015%/°C
100kΩ	150V	0.1%	0.015%/°C
1MΩ	300V	0.1%	0.025%/°C
10MΩ	500V	0.1%	0.05%/°C
100MΩ	1000V	1%	0.1%/°C
1GΩ	5000V	1%	0.1%/°C
10GΩ	5000V	1%	0.1%/°C
100GΩ	5000V	1%	2%/°C
1TΩ	5000V	1%	2%/°C
Overall Range	1 kΩ to 1 TΩ in 10 steps with open circuit on eleventh position.		
Accuracy Stated at 23°C±1°C 10 to 50%RH			
Earthing	Metal earth terminal on switch panel.		
Connections	Plug-in shielded plugs with 1 metre shielded cable (2 off High and Low)		
Dimensions	approximately 220 x 110 x 90 mm		
Nett Weight	approximately 0.8kgm.		
Supplied complete with calibration certificate and portable aluminium case with 1M leads.			

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Three Terminal Mica Dielectric Capacitor Type 4711

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The fixed mica capacitor Type 4711 is a three terminal fully screened capacitor designed for 250V at 50Hz. The standard values are as follows:-

0.001µF, 0.01 µF, 0.lµF, 1.0µF

Specifications

Value	1.0µF & 0.1µF	0.01µF	0.001µF
Accuracy of of adjustment.*	±0.1%	±0.25%	±0.5%
Power Factor in Audio Frequency Range	0.0003	0.0003	0.0006
Mean Temperature Coefficient	±0.003% per °C		
Permananence	The order of possible change of calibration over a period of one year is within the limits of adjustment		
Maximum Working Voltage	250Vrms @ 50Hz		
Dimensions	180 x 160 x 150mm		
Weight	2.2kg		

* Adjusted at 1 000 c/s with terminal E connected to screen

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Standard Self and Mutual Inductors Type 4190

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SELF INDUCTORS (fixed)

TYPES 4190A, 4190B and 4190C

Wound on marble formers, using stranded wire for the smaller values.

Type No	Self inductance	Accuracy of adjustment (%)	Dimensions	Weight

4190A	100µH to 1 mH	0.1	130 x 750 x 190mm	1.4kg
4190B	1 mH to 50 mH	0.01	210 x 100 x 190mm	3.2kg
4190C	100 mH to 1H	0.01	255 x 130 x 280mm	3.6kg

MUTUAL INDUCTORS (fixed)

TYPES 4190AM, 4190BM and 4190CM

Wound on marble formers, using stranded wire for the smaller values.

Type No	Self inductance	Accuracy of adjustment (%)	Dimensions	Weight
4190AM	100µH to 500µH	0.1	130 x 750 x 190mm	1.4kg
4190BM	1 mH to 20mH	0.01	210 x 100 x 190mm	3.2kg
4190CM	25mH to 100mH	0.01	255 x 130 x 280mm	3.6kg

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Variable Standard Mutual Inductor Type 4229

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A special feature of these units is that the capacitances between the secondary windings are very small so that capacitance errors are almost negligible, resulting in a very high degree of accuracy.

Stranded silk-covered copper wire is wound on marble formers to form a primary coil and three secondary coils having mutual inductances with the primary of 1, 3 and 6 units. Other values are obtained by positive and negative combinations of these three basic units.

For instance, 2 is given by 3-1, 5 by 6-1, 8 by 3+6-l and 10 by 1+3+6.

These combinations are produced by a special type of six-pole dual contact switch. In this way a variable mutual inductance standard is built up which covers the range from 0.1µH to 111.1mH with three units.

Type	Mutual Inductance Range	Limit of error
4229	0.1µH to 1.111mH	1µH
4229B	1µH to 11.11mH	2µH
4229A	10µH to 111.1mH	10µH

The secondary is made in two equal parts which may be linked externally. The secondary is thus of constant resistance and has a centre tap which makes it suitable for use in Heaviside-Campbell or Carey Foster Bridge networks.

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7 Dial Inductive Voltage Divider Model 5560

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This unit is a very high precision ratio standard which may be used as the ratio arm of an A.C. bridge or as an ~ accurate A.C. voltage divider.

The inductive divider offers a permanence of ratio at least two orders better than can be obtained by the most stable resistive ratios.

In cases where measurement by alternating currents is permissible the Inductive Voltage Divider may well offer considerable advantages in stability and resolution over traditional methods.

The coils of this divider are wound upon super-high permeability ring cores; under ideal conditions they have a stability approaching one part per hundred million.

The divider is suitable for operation over a wide frequency range. The accuracy of the ratio is better than five parL in ten million if the frequency is within 20% of the nominal value (400Hz.)

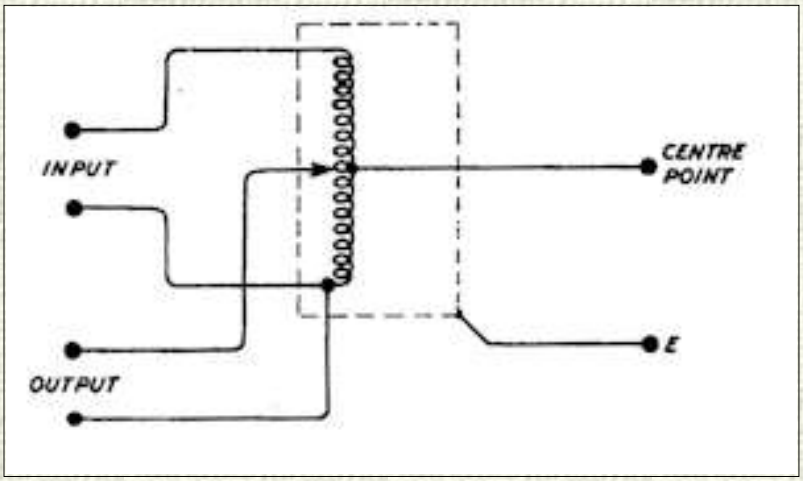
Switches

These are fitted with devices to suppress switching transient effects.

Terminals

The input winding is centre-tapped and connected to the three input terminals. The output winding is switched and connected to the two output terminals. The metal case is connected to the earth terminals.

Connections



SPECIFICATION.	
Frequency range	50Hz to2KHz for a ratio accuracy of 1 part in 10^6
Resolution	1 part in 10^7
Limit of error	2 parts in 10^7 at design frequency ±10%.
Minimum input impedance	70KΩ at 1000Hz.
Maximum output impedance	3Ω approx, at 1KHz and 20μH effective series inductance.
Maximum input voltage	0.2 x frequency up to 200V maximum.
Dimensions	575 x205 x 145 mm.
Weight	9.7 Kg.
Accessories	A.C. Detector Type 5715.

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Precision Two Stage Inductive Voltage Divider Model 5560K

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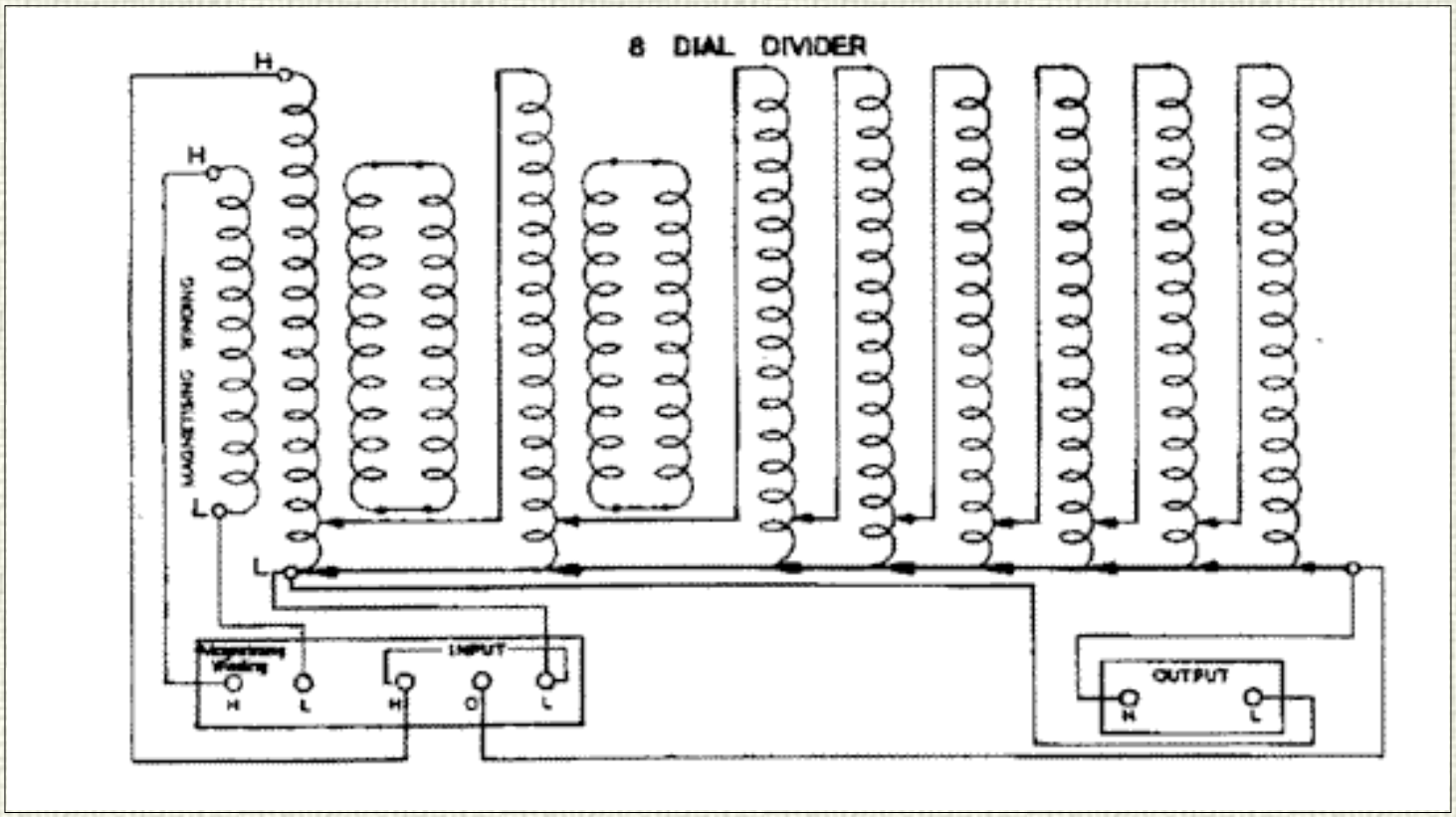
The 8 Dial Inductive Voltage Divider Type 5560K uses the two stage system and is based on work carried out at the National Physical Laboratory.

High quality mumetal cores are used for the toroidal windings and the whole assembly is magnetically shielded. The ratio range is from 1 to -10^{-5} through zero in steps 10^{-8}. The first four dials are calibrated 0 to 9 and the last four -1 to 10 through zero, providing an overlapping

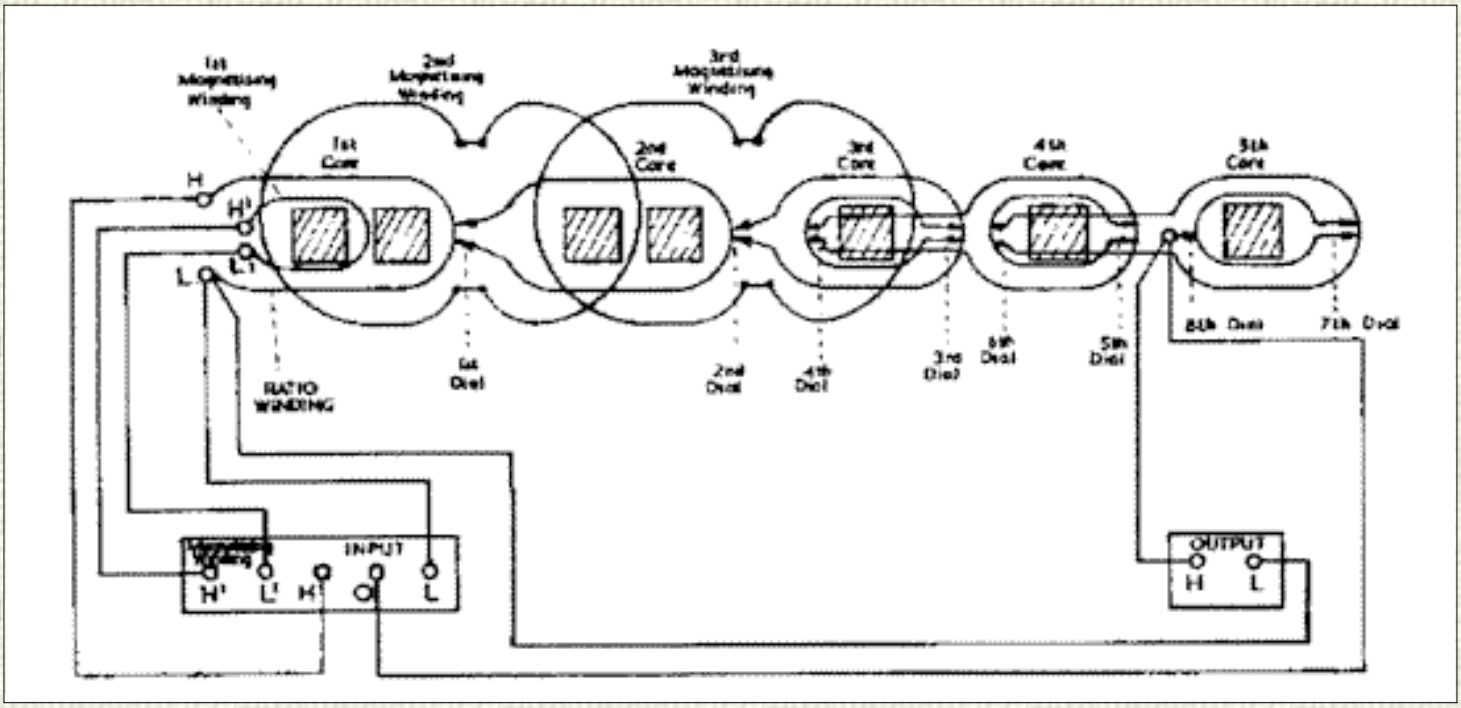
of dials on the low end. The frequency range is from 30 to 1000 Hz.

The accuracy of the device is within 5 parts in 10^8 of the output. The maximum input voltage is 20% of the frequency, the frequency being expressed in Hz, for example: at 1000Hz the maximum input voltage is 200Volts and at 30Hz it is 6Volts. The input impedance is approximately 1MOhm, the out impedance approximately 2.5 Ohms. Terminals are provided for the magnetic winding, the measuring winding output and earthed screen which is a mumetal box enclosing the cores.

The instrument is mounted in a teak case and fitted with a grey metal top panel with clear engraving and index windows for each dial.



Connections



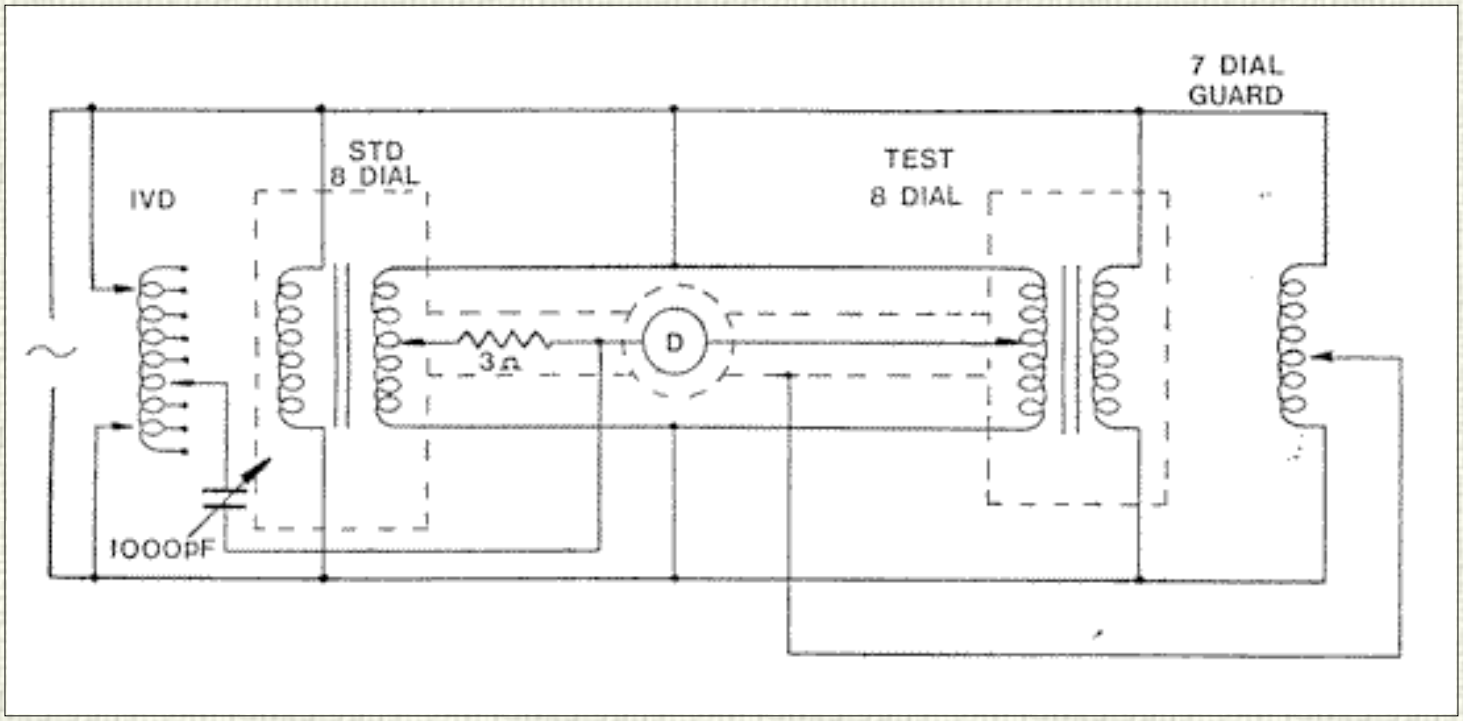
Schematic of winding of the cores

Specifications

Ratio Range	-0.00001111 through zero to 1.00001110 on 8 Decades. The first four dials are calibrated 0 to 9, the last four -1 to 10 providing an overlapping of dials at the low end
Frequency Range	30-1000Hz
Maximum Input Voltage	0.2 x frequency
Input Impedance	Approximately 1 MOhm
Output Impedance	Approx. 2.5 Ohms
Dimensions	700 x 274 x 210 mm
Weight	Approx. 12 Kg

Typical Application

Checking the accuracy of an eight dial Divider



Notes

The measuring winding has a very high input impedance when the energising winding is supplied with a voltage equal to that applied to the measuring winding.

For highest accuracy the measuring winding should be connected to the precise point in the circuit which defines the required ratio, thus avoiding errors due to voltage drop in the connecting leads.

The shield terminal is driven by the magnetising winding to a potential equal to the ratio shown on the first dial plus 0.05. i.e. When the first dial reads 0.3 the shield is held at the potential corresponding to 0.35. This may be used to drive a fully screened circuit and will not load the measuring

In any circuit measuring to very high resolution it will be necessary to null the inevitable quadrature component to obtain high accuracy. Whatever method is used it is essential to ensure that there is no phase defect which may cause appreciable error.

If two pure resistors are being compared, a differential air capacitor will provide quadrature compensation but in more complex circuits it may be necessary to inject the quadrature compensation into the detector via a suitable transformer.

The terminal marked CASE should be taken to ground to avoid disturbance due to hand capacitance.

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Precision High Voltage Resistance Divider Type 5573A

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The Divider has been designed in co-operation with the Electrical Research Association. It consists of 1MΩ resistors arranged in a spiral about 30cm in diameter. The high voltage

terminal consists of a tapered plug inside a domed cap. The insulation is of Perspex and is of the order of 20 x10^6MΩ between sections. All connections are smooth and of uniform diameter to avoid any sharp points of high potential at which corona might occur.

The Divider is designed to have a resistance of 1000 Ohms per Volt and is made in 50 kV sections. The illustration shows one 50kV section mounted upon an earthed base with low voltage tappings.

Each 1MΩ unit is wire wound and hermetically sealed. This construction provides resistors stable to a few parts per million with a temperature coefficient less than 10 parts per million per degree centigrade. The low voltage ratio coils are fitted inside the metal base to provide tappings at zero, 1V and 10V. The limit of error in the ratios is less than one part in 10,000. The divider is suitable for DC or power frequency work 50-60Hz.

A safety device is fitted so that in the event of a high voltage flashover, the measuring equipment will be immediately earthed and the charge will go to earth and to the grading ring, preventing damage to the resistance network.

Dimensions:

BASE: 61cm x 61cm x l2.5cm

MAXIMUM VOLTAGE	HEIGHT	DIAMETER OF GRADING RING
50 kV	48cm	38cm
100 kV	81cm	46cm

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Portable Wheatstone Bridge

Model QJ23E

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The Tinsley QJ23E is a stable and accurate Wheatstone bridge for resistance Measurements.

The 4 Rheostat decades may also be used as an adjustable 4-dial decade resistance box.

Self-contained with built-in galvanometer and batteries, the QJ23E is housed in a lightweight, durable carrying case.

SPECIFICATIONS	
Range	1Ω€ to 9.999MΩ
Accuracy	± 0.1% at 10KΩ range
	± 0.2% at 10MΩ range
Galvanometer	Built in
Galvanometer Sensitivity	better than1µA/mm
Power	Built in Dry cells 3x 1.5V, or external
Dimensions	240 x 180 x 140 mm
Weight	<2kg

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Portable Precision Wheatstone Bridge

Model QJ49E

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The Tinsley QJ49E is a highly stable, precision Wheatstone Bridge for the precision measurement of meters, components, windings and other instruments.

It also be used as an adjustable 5-dial decade resistance box.

Self-contained with built-in galvanometer and batteries, the QJ23E is housed in a lightweight, durable carrying case.

SPECIFICATIONS	
Range	1Ω€ to 1.1111MΩ
Accuracy	Typically ± 0.05%
Galvanometer	Built in
Galvanometer Sensitivity	better than 3µV/mm
Power	Built in Dry cells 3x 1.5V
Dimensions	308 x 240 x 150 mm
Weight	4.5kg

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Portable Wheatstone/Kelvin Bridge

Model QJ31E

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Wheatstone and Kelvin configurations are combined in the QJ31E portable bridge, achieving a wide overall measurement range from 0.0001Ohm to 1 Megohm.

As well as laboratory measurements and calibration, the unit is ideal for the measurement of resistance of motors, coils and transformers etc..

SPECIFICATIONS	
Range - Wheatstone Bridge	10Ω€ to 1MΩ
Range - Kelvin Bridge	0.0001Ω€ to 100Ω

Accuracy	Typically ± 0.1%
Galvanometer	Built in
Galvanometer Sensitivity	Approximately 3µV/mm
Power	Built-in Dry cells 6x 1.5V
Dimensions	315 x 265 x 165 mm
Weight	4.5kg

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Portable DC Double Bridge

Model QJ42E

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The Tinsley QJ42E is a low cost portable dc double bridge for low resistance measurement below 11Ω.

SPECIFICATIONS	
Range	0.0001Ω€ to 11Ω
Accuracy	± 1%
Galvanometer	Built in
Galvanometer Sensitivity	2μA/mm

Power	Built in Dry cells 6x 1.5V
Dimensions	230 x 200 x 140 mm
Weight	Approximately 6kg

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Portable Precision DC Kelvin Bridge

Model QJ57E

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The Tinsley QJ57E is a self-contained portable DC Kelvin Bridge for high precision measurements of low resistance, conductivity and calibration of other instruments.

Suitable for laboratories, workshop and on-site, in the field applications.

SPECIFICATIONS	
Range	$10^{-8}\Omega$€ to 1111.1Ω
Accuracy	Typically ± 0.03%

Galvanometer	Built in
Galvanometer Sensitivity	better than 0.8µV/mm
Power	Built in Dry cells 2 x 1.5V
Dimensions	315 x 265 x 165 mm
Weight	Approx. 6kg

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Portable Multi-Purpose DC Potentiometer

Model UJ33E

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The Tinsley UJ33E is a portable, precision potentiometer which is convenient and capable of performing a variety of potentiometric measurements including DC resistance and current.

In addition the UJ33E can be used as a calibrated potential source.

A low cost, precise test and measurement instrument for laboratory, workshop and field use.

SPECIFICATIONS	
Range	1µV to 1.0555V

Accuracy	Better than 0.05% ± 1µV up to ±0.05% ± 50µV
Power	Built in Dry cells
Dimensions	310 x 240 x 170 mm
Weight	Approximately 5kg

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Portable DC Millivolt Potentiometer

Model UJ36E

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The Tinsley UJ36E is a portable, DC Millivolt Potentiometer for routine checking of thermocouples, indicators, recorders and controllers etc.

The UJ36E can also be used as a calibrated potential source.

It is a robust and durable instrument for field use as well as laboratory and workshop applications.

SPECIFICATIONS	
Range	10µV to 120mV
Accuracy	Better than ±0.1% ±10µV to ±0.1% ± 50µV
Power	Built-in dry cells
Dimensions	285 x 230 x 160 mm
Weight	Approximately 4.5kg

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Model 5685 AC/DC Standard Resistors

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The design of these Standard Resistors is based on work carried out over several years with co-operation of the National Physical laboratory. The design originated with F. J. Wilkins of the N.P.L. and has evolved as the result of many tests on stability and temperature coefficient using both a.c. and d.c. Some of the original design features have been discarded in the interests of simplicity, notably the horns which are no longer considered necessary.

The aim has been to produce four-terminal Standard Resistors to the highest specification, suitable for a.c. and d.c. work up to a frequency of 1592 Hz. 1 Ohm to 10,000 Ohms. The Resistors are made from a specially selected alloy having a low temperature coefficient mounted in a strain free manner on formers made from material or low dielectric loss but of

high mechanical stability. All the connections are welded. Prolonged heat treatment of the elements ensures long term stability and low temperature coefficient of resistance.

The elements are hermetically sealed in stainless steel containers which are filled with dry oil (Castro! Whitemor WOM14). Provision is made for inserting a thermometer but the resistors are intended to be used in an oil bath which is temperature controlled.

Maximum dissipation for the Resistors is 1 Watt but the highest performance will be obtained with a dissipation of 10 milli-Watts which is the ideal working condition. No harm will occur if the dissipation is increased to 1 watt but self heating will take effect after a few minutes. Since the introduction of these Standard Resistors they have been adopted by National and Major Industrial Standards Laboratories as their primary standards. Information obtained from these laboratories over the past twenty five years indicate their exceptional high stability. For example, tests have shown that resistors of this type are stable to within 1 ppm over a period of ten years.

SPECIFICATION		
Type 5685A	Values : 1, 10, 25, and 100 Ohms	
Type 5685B	Values : 1,000 and 10,000 Ohms	
Calibrated accuracy	3ppm for 1, 10, 100, 1,000 and 10,000 Ohms 5ppm for 25 Ohms	
Accuracy of adjustment	+/- 20ppm	
Stability	2ppm / year	
Temperature Coefficient of Resistance	typically 2ppm /°C	
Recommended Dissipation	10milli-Watts	
Maximum Dissipation	1 Watt	
Approximate Load Coefficient	6ppm / Watt	
AC/DC Transfer Error up to 1592 Hz	5ppm for 1 Ohm 1ppm for values 10 to 10,000 Ohms	
Construction	Element: - Strain free, immersed in dry oil Top Panel: - High Quality Bakelite with PTFE inserts	
Terminals	Current	0BA copper
	Potential	4BA copper
	Earth	6BA brass screw
Dimensions	Container: - 114 x 76 mm diameter Overall: - 140 x 83 mm diameter	
Nett Weight	0.7kg approximately	

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Standard Resistors Type 5615 and 5686

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5615 High Value Resistance Standards

These high resistance value Standard Resistors are of similar appearance to the Type

5685/5686 Series, but of higher resistance value.

The resistance elements are specially wound in a strain-free manner from selected precision resistance alloy. These resistors can be supplied with a NAMAS Certificate.

SPECIFICATION		
Value	Accuracy	Temperature Coefficient
100kΩ	+/-0.005%	10ppm
1MΩ	+/-0.005%	20ppm
10MΩ	+/-0.005%	20ppm
Dimensions	140 x 83mm diameter	
Nett Weight	0.6kg approximately	

5686 Low Value Resistance Standards

These four-terminal Standard Resistors are for direct current use and have three nominal values: 0.001, 0.01, 0.1 Ohms. They are sealed into stainless steel cases and oil filled.

These resistors are suitable for air cooling or for use in a temperature controlled enclosure or oil bath for greater stability.

The resistance elements are made from selected manganin which is heat treated to improve stability and to reduce temperature coefficient. Joints are silver soldered with copper being used for connections to the terminals. The insulating material is high grade phenolic and the panel is fitted to the stainless steel can by means of an ‘0’ ring.

For most accurate work the recommended wattage dissipation is 10 milli-watts but up to 1 Watt may be dissipated without harm to the elements. (In the case of the 0.001 Ohm Resistor the current should not exceed 10 amperes, 100 milli-watts).

SPECIFICATION			
Value	0.001 Ohm	0.01 Ohm	0.1 Ohm
Limit of Error	0.02%	0.01%	0.002%
Calibrated Accuracy	60 ppm	30 ppm	10 ppm
Maximum Dissipation	0.1 Watts	1.0 Watts	1.0 Watts
Recommended Dissipation	10 milli-watts	10 milli-watts	10 milli-watts
Temperature Coefficient of Resistance at 20°C	50 ppm/°C	+/- 10 ppm/°C	+/- 10 ppm/°C
Appropriate Load Characteristic	100 ppm / Watt	20 ppm / Watt	20 ppm / Watt

A.C Characteristic at 50 Hz	50 ppm	50 ppm	50 ppm
Dimensions	Can: - 114 x 76 mm Overall: - 140 x 83mm		
Nett Weight	0.6kg approx.		

A Test Certificate giving the actual resistance value to the limit of error and temperature coefficient at 20°C will be supplied with each Standard Resistor.

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Low Cost Standard Resistors Type 1660

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SPECIFICATION		
Resistance	Maximum Current	Measuring range
Ohms	Amps	Amps
0.01	5	0-5
0.02	5	0-5
0.1	1. 5	0-1
0.2	1	0-0.5
1	0.5	0-0.1
10	0.15	0-0.01
100	0.05	0-0.001
Limit of Error		+/- 0.05%
Dimensions		115 x 55 x 63 mm
Nett Weight		0.1 kg

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Precision Non-Inductive Standard Resistors
Grade 1 AC/DC Oil filled
Types 1659, 1682 and 3111

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These Resistance Standards are primarily designed for use with altering currents at power frequencies. They are equally suitable for use from d.c. to 1 kHz.

The range of resistors available is from 0.0001 ohm to 10,000 ohms. For constructional reasons these resistors have been divided into four groups. The units of each group are of similar mechanical design and dimensions which have been determined with consideration for a common upper limit for heat dissipation and current carrying capability.

The resistance material is manganin (Cu-Ni-Mn alloy). The resistors are built into cylindrical metal containers for oil immersion to ensure uniformity of temperature, the 10 and 50 watt units are air cooled and fitted with a hand operated mechanical oil stirrer. The 200 watt units are water cooled and provided with a pulley to drive the mechanical oil stirrer.

The 500 watt units are also water cooled but are fitted with a motor for direct drive of the stirrer.

The terminal arrangements provide for separate current and potential terminals for use with a potentiometer or DVM.

The available standard ranges and electrical performance data are set out in Table 1. Modified resistance units can be quoted to meet special requirements. Dimensional and other details are shown in Table 2.

N.B. - These standards are not filled with oil when supplied. The recommended oil is Castrol Whitemor WOM14 or if not obtainable any high quality non- corrosive oil can be used such as high quality Transformer Oil.

Table 1

Standard Range							
Type	**R**	**I**	***n***	**L/R**	**W (Oil Filled)**	**C**	**S**
1659	10000	0.03	0.02	1×10^{-6}	10	air	hand
1659	5000	0.045	0.02	1×10^{-6}	10	air	hand
1659	1000	0.1	0.02	1×10^{-6}	10	air	hand
1659	200	0.22	0.02	1×10^{-6}	10	air	hand
1659	100	0.3	0.02	1×10^{-6}	10	air	hand
1659	10	1.0	0.02	1×10^{-6}	10	air	hand
1659	5	1.4	0.02	1×10^{-6}	10	air	hand
1659	2	2.2	0.02	1×10^{-6}	10	air	hand
1659	1	3.0	0.02	1×10^{-6}	10	air	hand
1659	0.5	4.5	0.03	1×10^{-6}	10	air	hand
1659	0.2	7.0	0.03	1×10^{-6}	10	air	hand
1682	0.2	15	0.03	1×10^{-6}	50	air	hand
1682	0.1	22	0.03	1×10^{-6}	50	air	hand
1682	0.05	30	0.03	1×10^{-6}	50	air	hand
1682	0.02	50	0.03	1×10^{-6}	50	air	hand
3111	0.02	100	0.03	1×10^{-6}	200	water	pulley

3111	0.01	140	0.05	3 x 10^{-6}	200	water	pulley
3111	0.005	200	0.05	3 x 10^{-6}	200	water	pulley
660M	0.001	700	0.05	3 x 10^{-6}	500	water	motor
5576M	0.0005	1,000	0.05	3 x 10^{-6}	500	water	motor
5576M	0.0001	2,250	0.05	3 x 10^{-6}	500	water	motor

Key to Symbols

R	Nominal resistance in Ohms at 20°C	**W**	Normal rating in Watts (overload capacity for not more than 10 minutes is 25% * when oil filled
I	Full rated or 'normal' current in Amps	**C**	Method of cooling. (2 gals/min for minimum water cooling)
n	Maximum resistance error in percent of nominal resistance for any current up to full rated current	**S**	Method of mechanical stirring (Pulley to be driven at approx. 1,000rpm) Motor : - 240v 50Hz.
L/R	Time constant in seconds measured at 1kHz.	*	if this current is exceeded the calibration may be affected

Table 2

SPECIFICATION		
TYPE	**DIMENSIONS**	**NETT WEIGHT**
1659	95x150mm	1.8kg
1682	140x230mm	3.6kg
3111	230x330mm	10kg
660M	340 x 254 x 600 mm	25.8 kg
5576M	340 x 254 x 600mm	25.8 kg

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Standard Resistors Grade 2 Type 4405

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(Awaiting photo)

A low cost rugged resistor for use where highest accuracy not required. There is a wide range available, wound in manganin and of 4 terminal construction.

Specifications	
Resistance Values	0.001 to 2MΩ
Accuracy1Ω to l0kΩ	€±0.1%
Accuracy for Values above 10 K Ω and below 1Ω	±0.5%
Current Rating	1 Watt for Values 1Ω to 10kΩ
Dimensions	95 x 150 mm
Nett Weight	550 gram

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Standard Resistance Unit Type 4737B

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The Standard Resistor Type 4737B has been specifically designed to calibrate Tinsley Micro Ohmmeters or other instruments with a similar resistance range. This avoids having to send the Micro Ohmmeter away for calibration checks, so enabling the instruments to be kept in continuous use.

This Standard Resistor can be supplied with a NAMAS Calibration Certificate.

Specification		
RESISTANCE	**MAX CURRENT**	**ACCURACY**
1 KΩ	0.01A	0.05%
l00Ω	0.1A	0.05%
10Ω	0.5A	0.05%
1Ω	1.0A	0.05%
100mΩ	5A	0.05%
10mΩ	5A	0.10%
1mΩ	10A	0.10%
Dimensions	220 x 150 x 80mm	
Nett Weight	800 grams	

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Thermometer Accessories

Model 5840 Selector Switches

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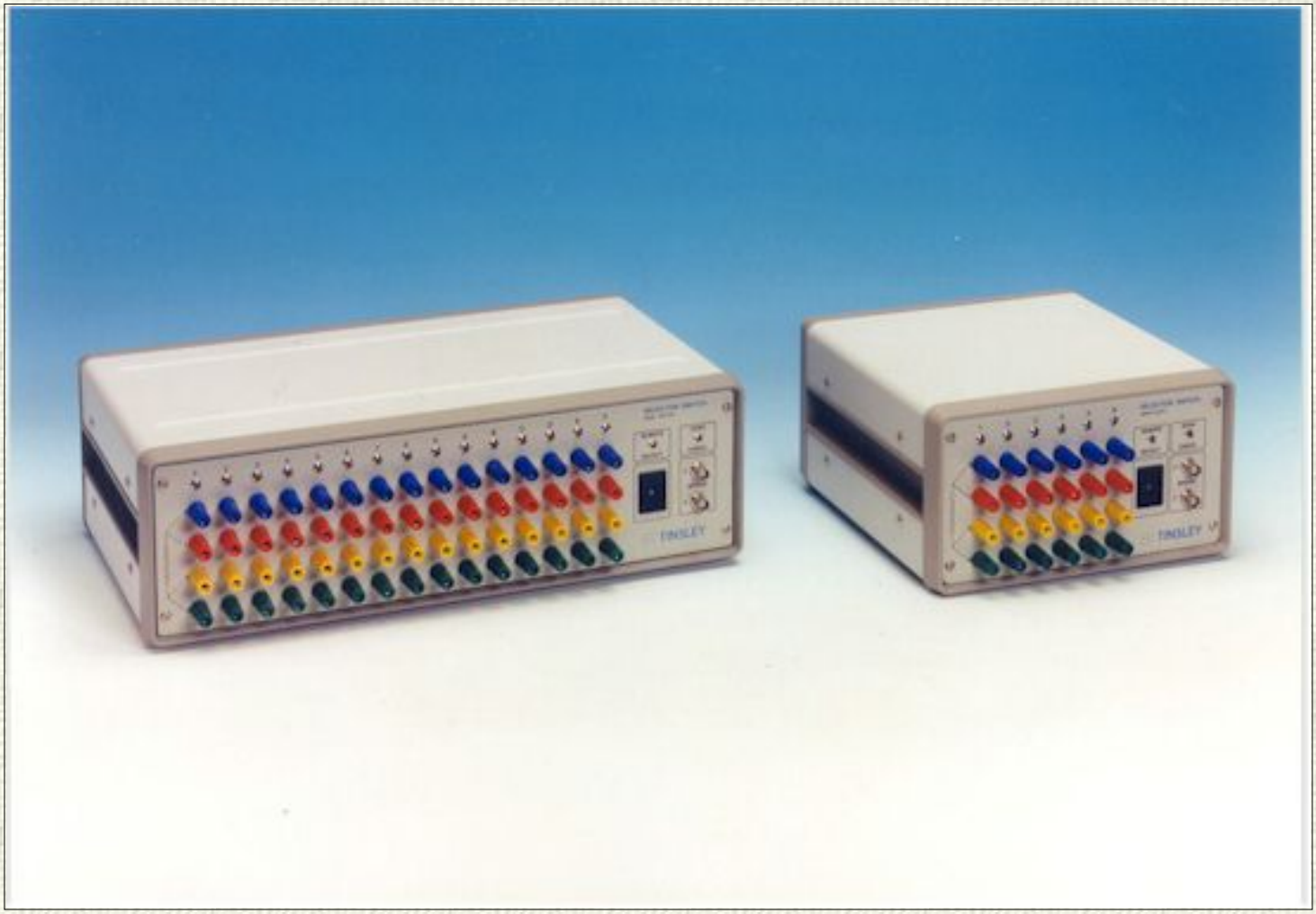

Tinsley Thermometer Selector Switches may be operated either manually or remotely via the Thermometer Bridge or computer. The Type 5840CS/6 accepts up to 6 thermometers and the Type 5840C5/15 will accept up to 15 thermometers.

A standby current of 1 milliamp is available on all positions. This enables thermometers when not selected to be energised continuously to avoid a warming up period when selected. Units can be supplied with terminals or BNC sockets and should be specified when ordering.

Specification

Type	5840C/15T (terminals)	5840CS/6T (terminals)
	584CC/15B (BNC)	5840CS/6B (BNC)
Dimensions	480x300x1 50mm	260x300x1 50mm
Nett weight	8.6Kg	3.3Kg

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Model 5648 Temperature Controlled Enclosure

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This enclosure has been specially designed to accommodate a single precision resistor of the following types: 5685A, 5685B, 5685 or 5615 enabling improved stability when used in a non temperature controlled environment. These enclosures are factory set at 36°C, However, they

can be supplied to operate at other temperatures.

SPECIFICATION	
Temperature	Nominal 36°C ± O.1°C
Power Requirements	110/230 Volt 50-60Hz
Dimensions	192 x 142 x 245 mm
Nett Weight	2.1kg excluding standard resistor 2.8kg including standard resistor

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Digital Resistance Test Instrument Model QJ84

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The QJ84 provides resistance measurement over seven selectable ranges from 20mΩ to 20kΩ.

A high sensitivity specification makes the QJ84 highly suitable for the precision measurement of low resistance. Practical and easy to use, the instrument is ideal for laboratory and test environments. A four-terminal measurement feature eliminates errors which can occur due to the resistance of the test leads. The special circuitry of the QJ84 achieves measurements in a fraction of the time possible when using more traditional bridge techniques. The instrument is fitted with safety features to give protection when measuring inductive devices such as transformers and electric motors.

Precision manufactured components give a high degree of accuracy. The QJ84 measures directly in Ohms and resistance is displayed on a large LED screen to 4½ digit resolution The instrument comes complete with Kelvin type test leads.

Applications include:

- Cable joints
- Earth bonds
- Switches
- Motors
- Transformers
- Generators

Features:

- High sensitivity
- Wide measurement scope
- Four wire measurement
- Internal calibration
- Rapid reading time
- Small temperature coefficient
- Long term stability

Range	Nominal value	Full Range	Display Resolution	Current	Accuracy
1	20mΩ	0-19.999mΩ	1μΩ	1A	± 0.5%
2	200mΩ	0-199.99mΩ	10μΩ	1A	± 0.2%
3	2Ω	0-1.9999Ω	100μΩ	100mA	± 0.1%
4	20Ω	0-19.999Ω	1mΩ	100mA	± 0.05%
5	200Ω	0-199.99Ω	10mΩ	10mA	± 0.05%
6	2kΩ	0-1.9999kΩ	100mΩ	1mA	± 0.05%
7	20kΩ	0-19.999kΩ	1Ω	0.1mA	± 0.05%

Supplies

- Mains input socket
- 115V or 220V ±10% 50-60 Hz

Environment

- Working: 5 to 40°C : RH > 80% non-condensing
- Storage: -5 to 50°C : RH > 95% non- condensing

Dimensions

- 250mm x 110mm x 285mm

Weight

- 2.2kg

Input connections

- 4mm sockets for current and potential

Calibration

- Internal digital calibration
- Supplied with Certificate of Conformity

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Digital Milli-Ohmmeter Model PC9

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The PC9 provides resistance measurement over six selectable ranges from 20mΩ to 2kΩ. It is equally suitable for resistance measurement where inductance is also present.

A high sensitivity specification makes the PC9 highly suitable for the precision measurement of low resistance. Practical and easy to use, the instrument is ideal for laboratory and test environments. The four-terminal measurement method used eliminates errors due to the resistance of the test leads. Special circuitry achieves measurements in a fraction of the time possible when using more traditional bridge techniques. In addition the PC9 offers a range holding facility which further reduces measurement time for components of similar values.

Use of precision manufactured components enables a high degree of accuracy. The PC9 measures directly in Ohms and resistance is displayed on a large LED 4 digit screen. The instrument comes complete with Kelvin type test leads.

Applications include:

- Cable joints
- Earth bonds
- Switches
- Motors
- Transformers
- Generators

Model PC9 Features:

- High sensitivity
- Wide measurement scope
- Four terminal measurement
- Rapid reading time
- Small temperature coefficient
- Long term stability

Specifications

Range	Nominal value	Resolution	Current	Accuracy
1	20mΩ	10μΩ	625mA	± 0.1%
2	200mΩ	100μΩ	625mA	± 0.1%
3	2Ω	1mΩ	100mA	± 0.1%
4	20Ω	10mΩ	100mA	± 0.1%
5	200Ω	100mΩ	10mA	± 0.1%
6	2kΩ	1Ω	1mA	± 0.1%

Supplies

- Mains input
- External mains - 9 volt DC adapter

Environment

- Working: 5 to 40°C : RH > 80% non-condensing
- Storage: -5 to 50°C : RH > 95% non-condensing

Dimensions

- 250mm x 95mm x 255mm

Weight

- 1.8kg

Input connections

- 4mm sockets for current and potential

Calibration

- Internal digital calibration
- Supplied with Certificate of Conformity

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Digital Micro-Ohmmeter Model ZY9858

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With a maximum test current of 10 Amperes. The ZY9858 provides resistance measurement over seven selectable ranges from 2mΩ to 2kΩ.

The high sensitivity specification offers a resolution of 0.1μΩ making the ZY9858 highly suitable for the precision measurement of low resistance.

Practical and easy to use, the instrument is ideal for laboratory and test environments. The four-terminal measurement method used eliminates errors which can occur due to the resistance of the test leads. Special circuitry is employed to achieve measurements in a fraction of the time possible when using more traditional bridge techniques. The instrument is fitted with safety features to give protection when measuring inductive devices such as transformers and electric motors.

Precision manufactured components give a high degree of accuracy. The ZY9858 measures directly in ohms and resistance is displayed on a large LED screen to 4½ digit resolution. The instrument comes complete with Kelvin type test leads.

Applications include:

- Cable joints
- Earth bonds
- Switches
- Motors
- Transformers
- Generators
- Conductor resistance

Features

- High sensitivity
- Wide measurement scope
- Four terminal measurement
- Internal calibration
- Rapid reading time
- Small temperature coefficient
- Long term stability

Specifications

Range	Nominal value	Full Range Display	Resolution	Current	Accuracy
1	2mΩ	0-1.9999mΩ	0.1μΩ	10A	± 0.5%
2	20mΩ	0-19.999mΩ	1μΩ	1A	± 0.5%
3	200mΩ	0-199.99mΩ	10μΩ	1A	± 0.2%
4	2Ω	0-1.9999Ω	100μΩ	100mA	± 0.1%
5	20Ω	0-19.999Ω	1mΩ	100mA	± 0.05%
6	200Ω	0-199.99Ω	10mΩ	10mA	± 0.05%
7	2kΩ	0-1.9999kΩ	100mΩ	1mA	± 0.05%

Supplies

- Mains input socket
- 115V or 220V ±10% 50-60 Hz

Environment

- Working: 5 to 40°C : RH > 80% non-condensing
- Storage: -5 to 50°C : RH > 95% non-condensing

Dimensions

- 250mm x 110mm x 285mm

Weight

- 2.2kg

Input connections

- 4mm sockets for current and potential

Calibration

- Internal digital calibration
- Supplied with Certificate of Conformity

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The Type 5890 Micro Ohmmeter

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The Type 5890 Micro Ohmmeter is a true 4 terminal d.c. resistance measuring instrument. It will give accurate measurements regardless of connecting lead length and is therefore ideal for use when the instrument cannot be brought close to the item to be tested.

Model Availability

- TYPE 5890 Basic
- TYPE 5890C with Comparator
- TYPE 5890 IE with IEEE-488

- TYPE 5890 CIE with Comparator and 1EEE488
- TYPE 5890 R with Recorder output 0-2 Volts

An additional facility now fitted to the 5890 is temperature compensation. A socket is fitted to the front panel to enable a 100 Ohm Platinum Resistance Thermometer to be connected when Temperature Compensation is required. Also included is a switch to select compensation for Copper or Aluminium.

Seven ranges are selected by means of push button switches giving a maximum resistance range of 1900.0 Ohms down to 1 milli-Ohm with a resolution of 0.1 micro-Ohm on the lowest range. Another important feature of this instrument is that it incorporates automatic zeroing which is very important when measuring very low d.c. resistance.

Application

The Type 5890 has been designed for use where 4 terminal low resistance measurements are essential. Typical users are manufacturers of Cable, Wire, Switchgear, Electric Motors, Small Transformers and other applications where the accuracy and reliability of low resistance readings are of the utmost importance.

Manual Zeroing

In this mode of operation the switch marked ZERO is depressed, this switches the current off through the object under test and any thermal E.M.F's present in the circuit are then balanced out automatically with zero indicated on the digital display. When the READ switch is operated the current is switched on and the true resistance value is indicated.

Auto Zeroing

When the AUTO ZERO switch is operated the instrument will display the reading of the object under test, and approximately every 10 seconds the zero is automatically updated. The resistance reading is frozen while the zero is being revalidated.

Fitted with Comparator

The comparator is a very useful option for batch measurement of components etc. The upper and lower limits can be set by means of thumb wheel switches. When the resistor under test is within the set limits a green L.E.D. is illuminated. Separate red L.E.D's indicate readings above or below the set limits. The comparator also incorporates relays thus enabling output signals to operate remote control devices. Connection to these relays is made via the back panel of the instrument.

Specification				
RANGE	**SPAN - OHMS**	**RESOLUTION**	**ACCURACY**	**TEST CURRENT**
1	0 - 1900.0	100 mΩ	0.05% of reading +/- 2 digits	1mA

2	0 -199.99	10 mΩ	0.05% of reading +/- 2 digits	1mA
3	0 - 19.999	1 mΩ	0.05% of reading +/- 2 digits	1mA
4	0 - 1.9999	100 Ω	0.05% of reading +/- 2 digits	10mA
RANGE	**SPAN - MILLI-OHMS**	**RESOLUTION**	**ACCURACY**	**TEST CURRENT**
5	0 -199.99	10 μΩ	0.05% of reading +/- 2 digits	300 mA
6	0 - 19.999	1 μΩ	0.1% of reading +/- 2 digits	3.3A
7	0 - 1.9999	0.1 μΩ	0.1% of reading +/- 2 digits	3.3A

Measurement Range	1 μΩ to 1900 Ω in seven ranges
Method	Four Terminal D.C.
Display	4 1+2 Digits (1.9999 Full Scale)
Power Requirements	115/230 Volts 50-60 Hz
Dimensions	460 x 440 x 150 mm
Nett Weight	10.5 kg (unpacked)

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Model 5893 Digital Micro-Ohmmeter

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An advanced microprocessor based and battery powered micro-Ohmmeter in a sealed ABS case. The 5893 provides 0.1µOhm resolution resistance measurements in 6 selectable ranges from 600 µOhms to 60 Ohms. Designed with a wide range of useful features the 5893 will meet the requirements of many International Testing Standards. Ideal for laboratory and test area use as well as “on site - field tests”.

The microprocessor technology provides many advanced features which include, internal digital calibration, a 6,000 count scale length and 6 resistance ranges displayed on bright easy to read LEDs.

Lead resistance errors are eliminated by the use of a true 4–terminal, 4–wire Kelvin/Thompson circuit. Forward and reverse current with averaging is employed to remove any thermal EMF errors.

Automatic measurements and data recording can be performed via the RS232 port to a PC or printer. A “Remote operation” socket for foot or hand switching with a “Print last reading” control, facilitates use in inaccessible and confined working positions. Portability of the 5893 can be enhanced with an optional battery powered computer and printer that can be housed in the lid of the instrument and is ideal for on-site calibration reports and certificates.

An optional PT100 temperature probe input provides resistance measurement of either copper or aluminium samples automatically temperature compensated relative to 20ºC.

Two internal re-chargeable batteries provide the test current and the supply for the measurement circuitry. The charging circuit has independent charge indicators for each battery with fast charging to 90% of capacity and automatic switching to trickle charge, for prolonged charging. Battery power is sufficient to provide up to 1 hour of operation on the two 10A ranges and up to 20 hours on all other ranges.

Features

- High accuracy (0.15% to 0.2%)
- High resolution to (0.1µOhm to 0.01 Ohm)
- Wide measurement range (600.0 µOhm to 60.0 Ohm)
- 10 Amp measuring current
- Fast reading rate (0.5secs)
- 20mm high LED daylight viewing display
- 6000 count wide display range
- Computer output of display (RS232)
- PT 100 remote temperature compensation option
- 4 Wire measurement system (eliminates lead resistance errors)
- Forward and reverse current measurement
- Auto average of forward and reverse currents
- Battery and mains power operation
- Internal digital calibration

A versatile, practical and simple to use low resistance measurement instrument, offering computer/palm top recording of data to cover a wide range of applications

Applications

- Cable resistance tests
- Small transformer windings
- Small motor windings
- Small generator windings
- Fuses
- Heating elements
- Earth bonding

- Bus-bars
- Switchgear contacts
- Circuit breaker contacts
- Relay contacts
- Electrical connections
- Crimped joints
- Cable joints
- Wire wrap joints
- Solder joints

Specification					
Range	Resolution	Current	Accuracy (1 Year)		Temperature Coefficient (%reading + last digit)
			% reading	Last digits	
60 Ω	10 mΩ	1mA	+/-0.15%	+3	(0.004% +0.18)/ °C
6 Ω	1.0 mΩ	10mA	+/-0.15%	+3	(0.004% +0.18)/ °C
600 µΩ	100 µΩ	100mA	+/-0.15%	+3	(0.004% +0.18)/ °C
60 µΩ	10 µΩ	1A	+/-0.15%	+3	(0.004% +0.18)/ °C
6 µΩ	1.0 µΩ	10A	+/-0.2%	+6	(0.004% +0.18)/ °C
600 µΩ	0.1 µΩ	10A	+/-0.2%	+12	(0.004% +1.5)/ °C
Calibration		Supplied with certificate, Internal digital calibration (security key protected)			
Input Connections		4 x 6mm binding posts for spade terminals and 4mm banana plugs			
		Socket for model 5893G foot/hand switch for remote reading			
		Socket for model 5893A external ambient PT100 probe input			
Output Connections		R5232 output of display at selected 75 to 19200 baud rate			
Supplies		2 internal sealed lead acid batteries supplied			
		100/120/220/240V. +10% -13% 47 to 63 Hz at 80VA max. Input protection 415V.RMS			
Environment		Working: 0 to 40ºC. at 80% RH max non condensing			
		Storage: (-20C to +40ºC)			
Dimension		356mm x 270mm x 155mm high			
Weight		8.2Kg			

Ordering Information

5893	Instrument with mains lead, instruction manual, test certificate, batteries, case with internal accessory bag
5893A	As 5893 includes temperature compensation and probe
5893B	4 x 1 metre 4mm plug leads and 4 push on clips
5893C	Standard 3 metre 4 wire 10A Kelvin leads
5893D	15 metre 4 wire 25A, Kelvin leads
5893E	Heavy duty clip on clamp Kelvin leads (3M 10A)
5893F	Heavy duty clip on clamp Kelvin leads (15M 25A)
5893G	External start foot switch
5893H	Portable PC and printer
5893J	Standard resistor calibration/test box (6 values)

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The Senator Multi-Range Automatic Thermometer Bridge Type 5840D

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- 3 Ranges
- Choice of currents
- Direct reading in Ohms
- Readout in temperature K or °C (via computer)
- IEEE-488 interface
- 1μΩ resolution
- Low frequency operation 75Hz
- Recorder output

- Self balancing
- Ratio Mode

The Tinsley SENATOR Thermometer Bridge is a multi-range Automatic Resistance Thermometer Bridge. Using the well proven inductive division principle with unique circuitry, the SENATOR provides accurate AC measurement of resistance up to 1100 Ohms for high precision temperature applications to 1 millidegree. No initial setting-up is required and calibration may be readily verified using suitable certified resistance standards such as the Tinsley 5685 range.

Resistance - Temperature Readout

Precise true resistance measurement is clearly displayed on the high-stability digital readout with a resolution of 1µOhm on the 10 Ohms range. The reading can also be transferred over the IEEE-488 interface to a computer controller for temperature conversion. The resultant temperature calculation is then sent back for display on the SENATOR front panel in units of K or C. Suitable software is available from Tinsley to convert the AC resistance measurement into temperature and to calculate the constants of 25 Ohms Platinum Thermometers from ITS-90 Resistance-Temperature data.

3 Resistance Ranges - Applications

The built-in range selection of 10 Ohms, 100 Ohms and 1 kOhm is very desirable and renders the SENATOR ideal for use in a wide range of applications for high precision temperature measurements.

1. The 10 Ohms range is ideal for use with Rhodium Iron Thermometers, Tinsley type 5187U and 5187W and for capsule 25 Ohms Platinum Thermometers, Tinsley type 5187L.

2. The 100 Ohms range is the most suitable for long stem 25 Ohms Platinum Thermometers such as Tinsley type 5187SA.

3. The 1000 Ohms range is selected for 100 Ohms Platinum Thermometers above 0°C.

Specifications

RANGE		**CURRENT** ma +/- 1%	**ACCURACY** relative to Calibration Standard	**Resolution**
Selected	**Measured**			
10Ω	0 to 16Ω	0.2 0.5 1.0 2.0 5.0 10.0	5ppm+/- 5µ 3ppm+/- 3µ 2ppm+/- 2µ 2ppm+/- 2µ 2ppm+/- 2µ 2ppm+/- 2µ	1 µ

100Ω	0 to 160Ω	0.2 0.5 1.0 2.0	2ppm+/- 20µ 1ppm+/- 10µ 1ppm+/- 10µ 1ppm+/- 10µ	10 µ
1000Ω	0 to 1600Ω	0.2 0.5 1.0	5ppm+/- 100µ5ppm+/- 100µ 5ppm+/- 100µ	100 µ

'Self Heating Check' Current - 1.414 X Selected current	**Internal Standards -** 10Ω, 100Ω. and 1000Ω with trim adjusters for calibration to a certified standard resistor.
Zero Stability - Minimal drift with time and temperature	**External Standards -** The bridge will read ration Rx to 10Ω, 100Ωand 1000Ω standard resistors.
Calibration Drift - 2ppm / month - Internal Standards, 2ppm / year - External Standards	**Quadrature Balance -** Fully automatic balance of thermometer reactance with visual indication if overloaded.
Self-Balance Speed - 10 seconds from unknown resistance to 1ppm accuracy. (100Ω range)	**Power Requirements -** 115/230 Volts; 50/60 Hz, 250 VA.
Accuracy - Better than 0.5 millidegree at 0°C (for 25Ω PRT's)	**Nett weight -** 16Kgs; **Dimensions -** 480 X 160 X 400mm.

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The Consort Automatic Programmable AC Thermometer Bridge Type 5840E

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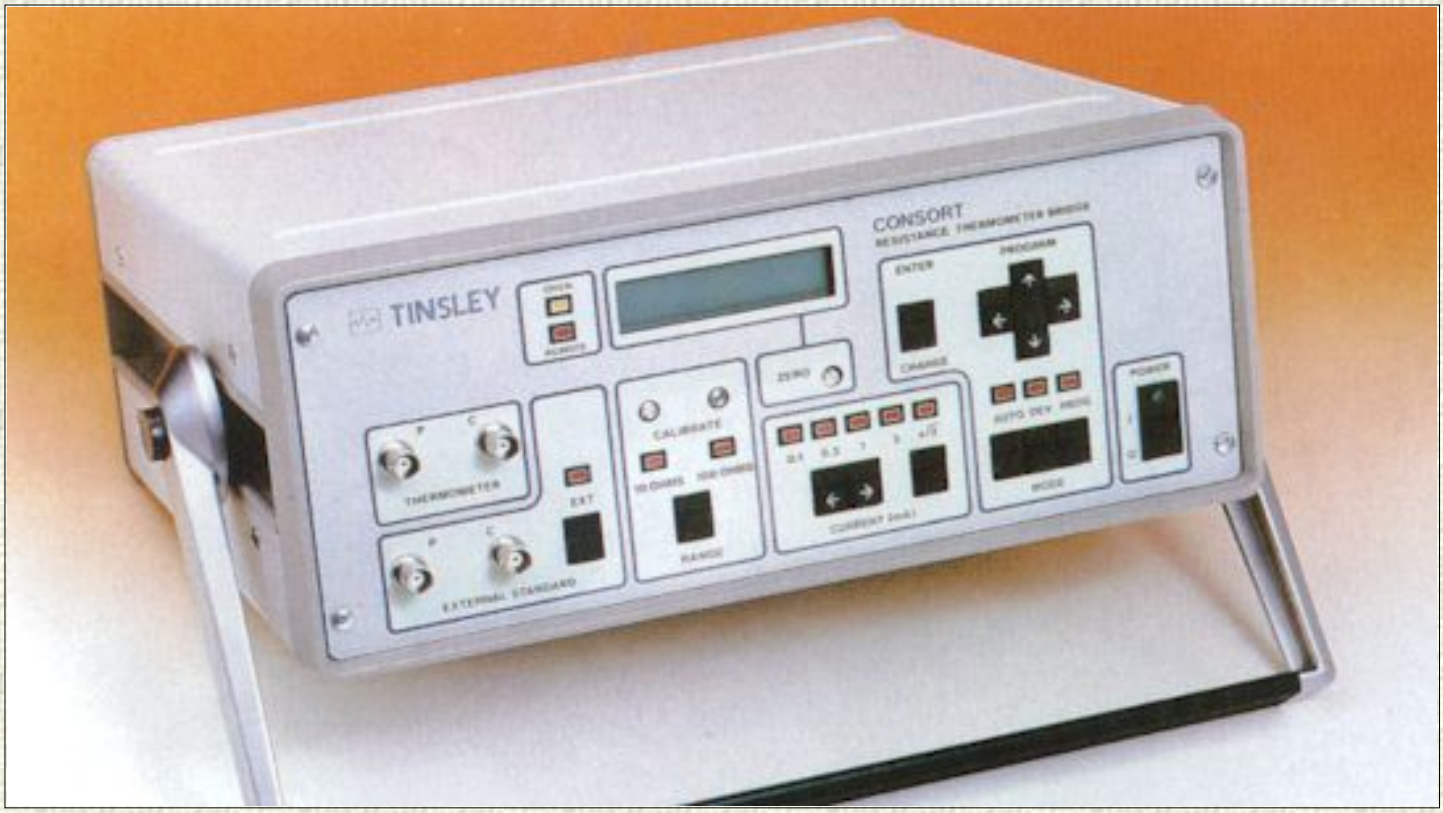

The Tinsley CONSORT is an easy to use high precision programmable automatic AC Resistance Bridge. The inherently stable 4 terminal AC Bridge measurement technique is combined with a state of the art microprocessor to provide direct temperature readout for up to 15 Platinum Resistance thermometers or Rhodium Iron thermometers from 0.5K to 660° C. The thermometers' constants are loaded into the memory from the front panel keys.

Specifications

Range	**Resistance**: 10 Ohms internal standard 0-15.99999 Ohms. 100 Ohms internal standard 0-350.0000 Ohms **Thermometers**: Ro 2.5-100 Ohms	**Ratio R(tp)** 10 Ohms external standard 0-1.599999 100 Ohms external standard 0-3.50000

Accuracy	**Ratio R(tp)**: <±5ppm. **Resistance:** <±5ppm. and Temp: <±5 millidegrees. (over -200°C to +650°C **Sensor:** Class 1 NPL Calibration ± 0.001°C at O°C. to 100°C. ± 0 005°C max @ 630°C.
Resolution	**Resistance:** On 100 Ohms range =10^{-4}Ohm. On 10 Ohms range =10^{-5}Ohm **Temperature:** 0.01°C
Stability	Negligible drift with time and temperature
Internal Reference Rs	100 Ohms ± 0.01% trimmed T.C. =± 0.02ppm/°C 10 Ohms ± 0.02% trimmed T.C. = ± 0.02ppm/°C
Measurement Frequency	75Hz at 50Hz supply and 90Hz at 60Hz supply. Automatic Switching 50/60Hz.
Sensor Current	0.1, 0.3, 1.0, 3.0 mA ± 1%. Constant current source.
Self Heating check	1.414 X selected currents
Sensor cables	20 Ohms max series R; 5nFmax shunt capacity, typically 100metres coaxial cable.
Display Units	Ratio, Ohms, °C, and K
Analogue O/P	1V 1Hz Bandwidth
Digital O/P	RS232 - Standard. IEEE-488 optional.
Operating temperature range	+10 °C to +30 °C
Supply	210-250V/105-125V. 50/60Hz. 15OVA
Dimensions	400 x 155 x 350mm
Nett Weight	10Kg.

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MODEL 5885 SERIES
Precision Digital Thermometer with PRT & Thermocouple Inputs

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- Accuracy 0.01 °C
- Resolution 0.001 °C
- 2 Models and many options
- Linearised for 10 thermocouple and 1 PRT types
- Displays temperature readings plus mV / Ohmic values
- Memory stores up to 4000 readings

- Automatic current reversal for RTD measurements
- Half power measurement for RTD's to assess self heating effect
- Entry of probe calibration data for enhanced accuracy
- 2 channel measurement A, B, A-B, plus Maths functions
- Digital calibration with pass code entry
- RTD & Thermocouple Inputs
- RS232 / IEEE-488 Interface options
- Mains / rechargeable battery operation with built in charger.

The 5885 Series is by any standard, an impressive range of precision Digital Thermometers. The two models in this series have the same accuracy of 0.01°C and resolution of 0.001°C with options and features available to suit most applications and budgets.

Both instruments have 2 Channel inputs and will display A, B or A-B on a large, backlit, LCD graphics display. The most commonly used functions are selected with dedicated front panel keys and the enhanced features by easy-to-use menus.

To ensure that the very best measurements are achieved, PRT probe characteristics may be entered and stored. The measuring current may also be reduced by x 0.707 to determine self-heating of the probe, and the measuring current may be reversed automatically, displaying the average value.

TECHNICAL DATA

Display

LCD Graphics Panel, 240 x 64 Dot, with LED backlight contrast control via keyboard

Inputs

Thermocouples via 4mm sockets in copper block on 19mm pitch adapter plug for direct connection of thermocouple wire.

Reference Junction Compensation -Automatic with internal sensor, or with external Pt100 probe or by manual input of value.

PRT's via 6 pin Lemo socket, also used for external RJ measurement

Data Logging

The 5885 thermometers come complete with a data logging function, enabling up to 4000 single channel (2000 dual channel) readings to be stored together with a date and time stamp. The stored values can be recalled to the instrument display and scrolled through using the keyboard, alternatively these values may be down loaded to a PC file or printer.

Limits

The limit function is included in all instruments permitting Hi and Lo limits to be set from the front panel, a visual and audible alarm will be given if these limits are exceeded. For those wishing to have an output for their limits, a factory fitted option is available giving potential free

contacts.

Filter

Selectable filtering of n samples displaying mean values, Max/Min values, and standard deviations.

Maths

Displays A as % of B
Null A and B
Null A-B
Manually offset A and B

Analogue Output

This is a factory fitted option comprising of a single BNC socket fitted to the rear panel. The function is as per the main value display and is scaled I mV/°C. A 12 bit D/A converter is used and the resolution is 0.5°C

Scanner Option

The scanner option may be fitted to a slot in the rear panel, two types are available for thermocouple or RTD Scanning. The scanner port will also support an external scanner box.

Interfaces

The interface cards are available as an option, only one card may be fitted.
RS232 To specification ANS/EIA/TIA/-232-E-1991
RS485 Similar to RS232 TXD & RXD only -0 XON/XOFF protocol Addressable
IEEE-488 Conform to ANS1-IEEE Std 488.1 -1987
The interface performs the following functions:
SHI, AHI, T5, TEO, L3, LEO, SR1. RL1, PPO, DC1, DT1, Co, E2.
The interface can also be set to a talk only mode to permit stand alone printer output.

Calibration

Digital, security code protected

Battery

Sealed lead acid, rechargeable cell giving approximately 8 hours continuous operation. Internal battery charger

Working temperature

0°C - 40°C; Relative Humidity 80% max. Non condensing

Storage temperature

-20°C to+50°C

Mains supply

100 / 120 / 220 / 240 volts +10% - 13%, 47. .63Hz max. 40VA

Dimensions

219 x 315 x 110.3mm

1/2 19" rack, 2.5U high

Weight

5.5Kg approx.

Safety

EC1010-1 (Amend.1)

Safety Class 1

EMC

Complies with Generic Standard EN5081-1 & EN5082-1

Features of the 5885 Series	**5885A**	**5885**
Uncertainty of RTD measurement 0.01°C	Yes	Yes
Uncertainty of *TIC* measurement 0.1°C	Yes	N/A
1 Millikelvin resolution for RTDs	Yes	Yes
10 Millikelvin resolution for T/C	Yes	N/A
2 measuring inputs	Yes	Yes
10 thermocouples B,E,J,K,L,N,R,S,T,U	Yes	No
T/C Reference Junction internal or external	Yes	N/A
Pt100	Yes	Yes
Input of RTD characteristics	Yes	Yes
Probe self-heat check	Yes	Yes
Automatic current reversal for RTDs	Yes	Yes
Suitable for 3 and 4 wire RTDs	Yes	Yes
Units °C, °F, °K, mV, Ohms	Yes	No
Units °C, °F, °K, Ohms	Yes	Yes
Maths functions max/mm, std. deviation	Yes	Yes
Digital Filter	Yes	Yes
Data logging 4000 values	Yes	Yes
Scanner card for RTDs	Yes	Yes

Scanner card for Thermocouples	Option	Option
Analogue output	Option	Option
RS232 talk/listen	Option	Option
RS485 talk/listen	Option	Option
IEEE-488 talk/listen	Option	Option
Hi/Lo limits visual/audible display	Yes	Yes
Hi/Lo limits output relays	Option	Option
Digital calibration	Yes	Yes
Rechargeable sealed lead acid battery	Yes	Yes

Thermocouple Type linearised as per NIST 175, ITS 90 (Models 5885/5885A) Types U & L to DIN 43710

Type	Range °C	Resolution °C, °F or K	Resolution Volts	Uncertainty Typically
B	+250 to +1000	0.01	1µV	0.1°C
E	-250 to +1000	0.01	1µV	0.1°C
J	-210 to +1200	0.01	1µV	0.1°C
L	-200 to +900	0.01	1µV	0.1°C
K	-200 to +1372	0.01	1µV	0.1°C
N	-200 to +1300	0.01	1µV	0.1°C
R	-50 to +1768	0.01	1µV	0.1°C
S	-50 to +1768	0.01	1µV	0.1°C
T	-200 to +400	0.01	1µV	0.1°C
U	-200 to +400	0.01	1µV	0.1°C

RTD Type linearised to ITS-90 (Model 5885 & 5885A Pt. 100 only)

Conforms to IEC751/BS1904/DIN43760
Pt100 Nominal R_0 = 100 and “Alpha” = 0.00385 plus “High Alpha” probes 0.003916

Type	Range °C	Resistance	Current	Resolution °C, °F or K	Resistance	Uncertainty Typically
Pt100	-200 to +1000	0 to 440Ω	0.5 mA	0.001	0.001Ω	0.01°C

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High Precision Platinum Resistance Thermometer Type 5187SA

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This four terminal thermometer is designed to realise, with the highest accuracy, the International Temperature Scale ITS-90 over the range -189°C to 66O°C. The design is the result of many years practical experience and cooperation with the National Physical Laboratory, Teddington

Construction

The resistance element is of pure platinum coiled and mounted in a strain free construction. The former is of fused silica and great care is taken to ensure freedom from contamination. All the joints are welded, the four leads from the element to the seal in the thermometer head are heavier gauge platinum thereby avoiding the generation of thermal e.m.f.'s at the junction with the element. The leads are brought through a hermetic seal at the head of the thermometer and joined via low loss terminals to copper flex in a specially constructed cable with four

conductors. The cable is made with PTFE insulation to ensure low dielectric loss so that the thermometer may be used with either d.c. or a.c. measuring systems. The terminations are gold plated copper spade tags. The thermometer tube is specially treated to avoid radiation loss by the piping effect in its walls. Each thermometer is supplied with a purpose-made carrying case.

Stainless Steel Sheath

To reduce the possibility of damage the Type 5187SA thermometer may be supplied with a protective stainless steel sheath, outside diameter 8-9mm, fitted into the thermometer head by means of three screws. The thermometer is calibrated without the sheath and when this is in position the response time is increased to about 20 seconds.

Specifications	
Temperature Range: -189°C to 660°C	**Calibration:** Suitable for calibration to ITS-90 up to max temp 660.323°C (F.P.Aluminium)
Resistance at 0°C (Rtp): 25 Ohms +/- 0.5Ohm	**R(Ga)/R(tp):** Ratio not less than 1.11807 **R(Me)/R(tp):** Ratio not greater than 0.844235
Reproducibility: +/-0.001°C	**Gas Filling:** Dry air at 1/3 atmosphere
Basic Accuracy: +/-0.001°C	**Dimensions:** Sheath - diameter 6.5 to 7.5 length 480 mm Head - diameter 23 mm length 60 mm Overall length: 540 mm Immersion depth: 300mm
Self heating: 0.002°C to 0.003°C with 1mA and the thermometer bulb immersed in unstirred water	**Leads:** Supplied with 4 metres of PTFE insulated cable fitted with gold plated copper spade tags.
Case Size: 67 x 16 x 7 cm	**Nett Weight:** Including thermometer 1.15kg

Calibration					
CALIBRATION OF PLATINUM RESISTANCE THERMOMETERS TO INTERNATIONAL TEMPERATURE SCALE (ITS-90)					
The table below sets out the types of calibration available from NPL and their uncertainties					
Point	**Temperature°C**	**Uncertainty °C**			
		Range 1	**Range 2**	**Range 3**	**Range4**
TP argon	-189.3442		0.002	0.002	0.002
TP mercury	-38.8344	0.0005	0.0005	0.001	0.002
TP water	0.01	0.0005	0.0005	0.001	0.002
MP Gallium	29.7646	0.0005			
FP indium	156.5985		0.001		
FP tin	231.928		0.001	0.001	0.002
FP zinc	419.527			0.001	0.002
FP aluminium	660.323				0.004

The Type 5187SA Platinum Resistance Thermometer maximum calibration will be 660.232°C.
Note: TP - Triple point, MP -Melting point, FP - Freezing point.

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Helium Filled Platinum Sheath Thermometer Model 5187L

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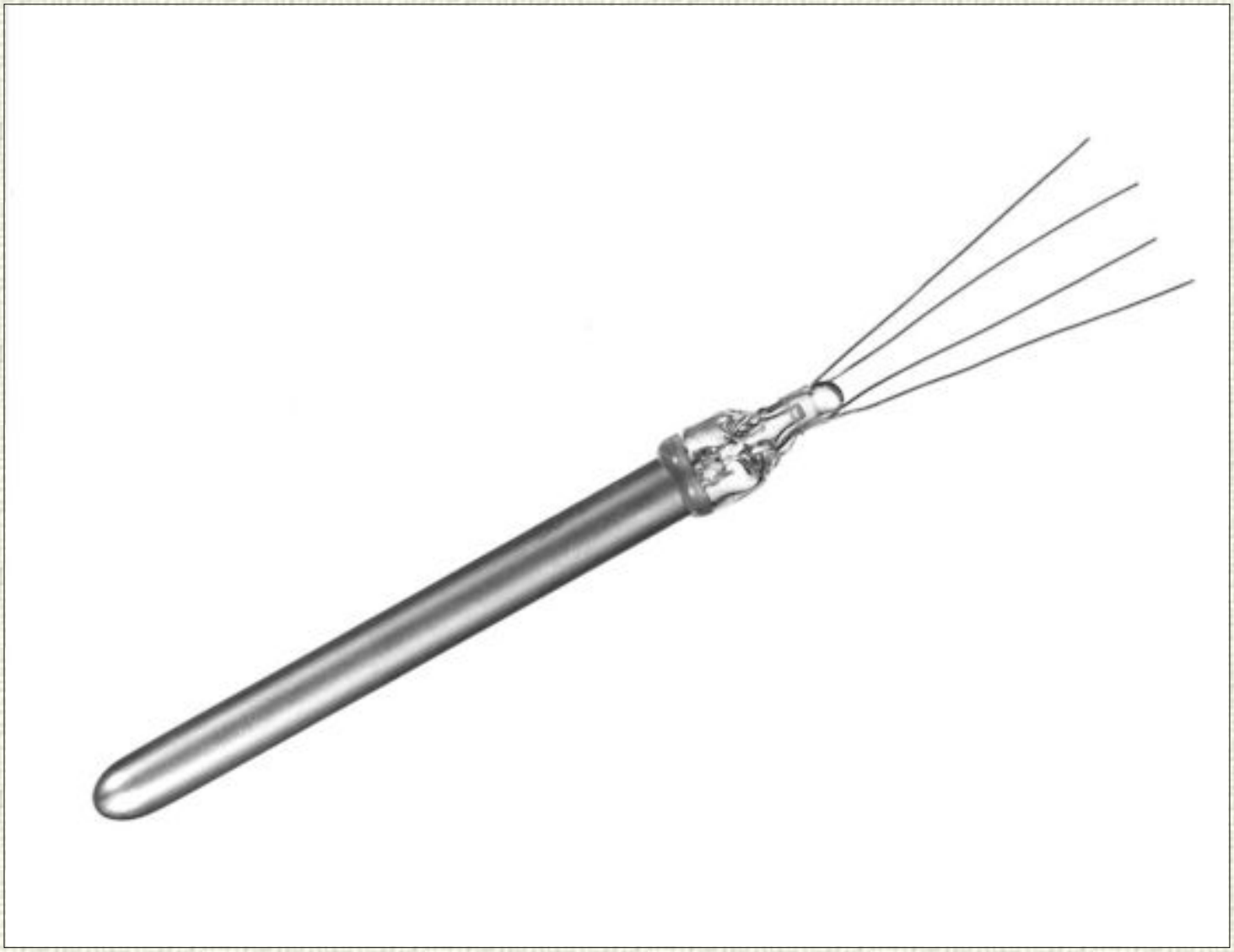

- This thermometer is constructed in a 5.2 mm platinum sheath 47 mm long with platinum leads passing through a glass seal making the overall length approximately 65 mm.

Construction

The element is constructed from a high purity platinum wire and is formed and processed to

produce a strain free construction. This is then introduced into a platinum sheath which is helium filled to approximately 1/3 atmosphere at 20°C to reduce the response time to approximately 2 seconds.

Application

The thermometer is suitable for use in the temperature range 13.08K to 330K and may be used totally immersed in a liquid, provided the liquid is a good electrical insulator.

Specification	
Temperature range: -	13.8K to 303K (M.P. of Gallium).
Resistance at 0 °C	R(tp) 25 Ohms +/- 0.5 Ohms
Reproducibility	+/- 1mK
Accuracy	+/- 2mK
R Ga/Rtp	Ratio not less than 1.11807
Response time	2 seconds.
Gas Filling	Helium at 1/3 atmosphere at 20 °C
Calibration	NPL Calibration available
Dimensions	Length 65mm, Sheath length 47mm Sheath Diameter 5.2mm
Shipping Specification	
Case size	160 x 55 x 120 mm
Nett weight	including thermometer 268 grams
Suitable for use with Tinsley type 5840D SENATOR Bridge	

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