

Clinical Practice: **MULTISCAN5000**

THE FUTURE OF BIOELECTRICAL IMPEDANCE SPECTROSCOPY (BIS)



www.bodystat.com


Bodystat[®]

THE FUTURE OF BIOELECTRICAL IMPEDANCE SPECTROSCOPY

MULTISCAN5000

Welcome and thank you for selecting this brochure on the MultiScan5000, one of the world's leading bioelectrical impedance spectroscopy devices for the medical profession. Inside this brochure you will find product details, medical applications with associated references to medical research papers and more, all designed to help you see the advantages to medical professionals and their patients in the accurate measurement and analysis of many clinical conditions.

Bodystat has been pioneering medical devices that utilise bioelectrical impedance analysis (BIA) for over 25 years. The basic principle of BIA is that lean tissue, which consists essentially of electrolyte-containing water, conducts the electrical current, whereas the fat acts as an insulator. The impedance of the body is therefore determined largely by the low-impedance lean tissues. Regression equations are then derived which relate impedance to fat-free mass (FFM) or total body water (TBW) measured by independent techniques. The multiple uses of this information are detailed within this brochure, but please contact us for any specific enquiries.

PRODUCT FEATURES

The MultiScan5000 has many benefits in medical applications and has been designed to be portable and simple to use. Listed below are some of the key product features and benefits:

- + Reports for hydration, physiology, body composition, health, weight loss and cardiovascular risk
- + Prediction marker and Phase Angle measure cellular health for multiple applications
- + Cole-Cole modelling – diagrams instantly visible on the device after measurement
- + Volume of fluid overload in litres (OHY)
- + BIVA vector analysis seen on display as well as in BIS software
- + Cell membrane capacitance
- + Impedance quality control graph
- + Totally non-invasive and just 6 seconds to receive the results, no waiting
- + Battery operated making the unit light and portable
- + Colour screen display and all results including graphs seen immediately after measurement
- + Colour touchscreen makes it easy to view the results on screen
- + Device will store 1000 tests, so test recall is available on the device without having to download the results into the software.

CTRICAL COPY (BIS)



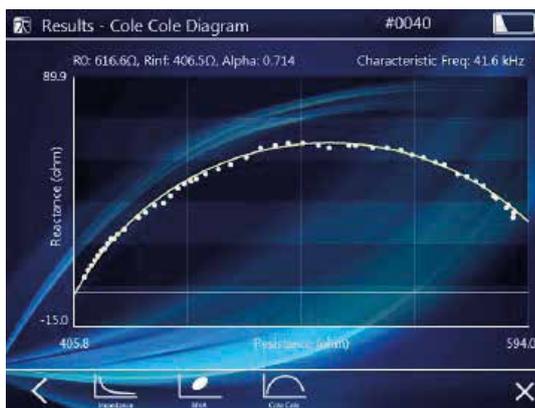
BIOELECTRICAL IMPEDANCE SPECTROSCOPY (BIS)

The **MULTISCAN5000** will measure at 50 frequencies ranging from 5 kHz to 1000 kHz and uses a method called Bioelectrical Impedance Spectroscopy (BIS).

BIS calculates body composition and hydration values using Cole-Cole analysis.

The 50 frequencies measured by the MultiScan5000 are used to produce the Cole-Cole plot. Cole-Cole Analysis is a mathematical model and the frequencies are plotted on the semi-circular Cole-Cole diagram. The diagram is then used to calculate the values for R_0 (resistance at zero kHz) and R_{inf} (resistance at infinite frequency).

Values for ECW, ICW, TBW and volume of over/ under-hydration are determined from the published scientific paper below.



RESEARCH

Moissl Ulrich M, et al (2006) "Body fluid volume determination via body composition spectroscopy in health and disease." *Physiol Meas*. **Vol 21**: 921-933

Chamney Paul W, et al (2007) "A whole-body model to distinguish excess fluid from the hydration of major body tissues." *Am J Clin Nutr* **Vol 85**: 80-89.



MEDICAL APPLICATIONS

MULTISCAN5000

DIALYSIS

Totally non-invasive measurement of over-hydration and nutrition status

The **MULTISCAN5000** is designed to measure the volume of fluid overload at the start of dialysis sessions and is used to determine dry weight. Understanding the changes in patients' bodies, particularly hydration and nutrition, is a critical element of effective clinical treatment. With our bioelectrical impedance measurements, treatment costs can be reduced and the patient's well-being improved.

- + Non-invasive assessment of hydration and nutritional status
- + Monitor lean body mass, rather than total body weight to determine the patient's response to nutritional programmes
- + Determine if weight gain is due to increase in lean body mass or fluid retention
- + Test can be performed at the bedside, versus other more complicated and expensive methods
- + Trend graphs available for quick evaluation for remedial action
- + Far more informative than BMI or weighing.

SURGERY

Predict potential complications of oedema post-surgery and reduce bed occupancy

Oedema as well as dehydration can have a negative impact on health and speed of recovery post-surgery. A simple test with the **MULTISCAN5000** pre-surgery will indicate the likelihood that a patient could become oedematous enabling you to put in place measures to mitigate the problem. Post-surgery tests, taking only seconds, will give an indication of the patient's health and whether or not they are sufficiently hydrated. With this information you can more suitably tailor ongoing treatment and hasten the recovery time, not only freeing up valuable resources but also improving the health and well-being of the patients.

- + Prediction Marker aids early detection of lymphoedema and post-surgical complications, fluid shifts and cell fluid leakage.
- + Muscle mass measurement is particularly useful in bedridden patients, those with minimal mobility or in ICU. Body cell mass measurements indicate the amount of cellular mass in the body and represent the general health of the patient at a cellular level.

RESEARCH

Zhou, Yi-Lun et al. (2010) "Calf Bioimpedance Ratio Improves Dry Weight Assessment and Blood Pressure Control in Hemodialysis Patients." *Department of Nephrology, American Journal of Nephrology*. **Vol 32**: 109-116

Katzarski K, et al. (1996) "Multifrequency bioimpedance in assessment of dry weight in haemodialysis." *Nephrol Dial Transplant* **Vol 11**: Suppl 2:20-3

RESEARCH

Itobi, E., Stroud M. and Elia M., (March 2006) "Impact of oedema on recovery after major abdominal surgery and potential value of multifrequency bioimpedance measurements." *Br Jnl Surgery* **Vol 93(3)**: 354-61

Singer, P. et al., (September 2008) "Body composition analysis in chronically ventilated patients: an additional tool for weaning prediction." *Presented at ESPEN in Florence, Italy*

TIONS



OBESITY

An essential tool in the management and motivation of patients

A patient's understanding of body composition is central to improving, motivating and maintaining good health. The need for more in-depth information on body make-up is essential for maintaining a healthy, well-balanced lifestyle. The **MULTISCAN5000** studies the changes in fat, muscle, fluid and cellular status.

- + Determine if weight loss is due to loss of fat mass, lean body mass or water
- + Quick, reliable, cost-effective, reproducible instant results with print-outs to enhance patient motivation
- + Trend graphs available for quick evaluation for remedial action
- + Actual results and recommended ranges displayed
- + Far more informative and detailed than BMI
- + Client motivation with detailed reports available from the software
- + Invaluable in client education and long term lifestyle change
- + Applies specific algorithm for obese population group in software.

RESEARCH

Horie, Lilian Mika, Gonzalez Barbosa-Silva, Maria Cristina, Waitzberg, Dan Linetzky et al., (2008) "New body fat prediction equations for severely obese patients." *Clinical Nutrition* **Vol 27**: 350-356

Bahadori, Babak et al. (2006) "Body composition: the fat-free mass index (FFMI) and the body fat mass index (BFMI) distribution among the adult Austrian population – results of a cross-sectional pilot study." *International Journal of Body Composition Research* **Vol 4: No. 3**: 123 - 128

PAEDIATRICS

Track body composition changes and monitor health during treatment

It can be difficult to know what is going on internally with children, especially if they are too young to be able to give accurate assessments of how they are feeling, or if they are ill. The **MULTISCAN5000** can detect small fluid shifts in the body giving an indication of whether their health status is improving. The Prediction Marker tracks change and monitors health during the administration of drugs, treatment procedures, and post-surgery or illness and is particularly effective for childhood obesity (see OBESITY).

- + The Prediction Marker ratio is independent of age, gender or population group and can easily be used on children or infants to track internal fluid fluctuations within the body, as well as the cellular status helping to monitor the progress of disease and treatment.
- + Nutritional index is derived from extracellular water and total body water to give an indication of the amount of nutrition a body is absorbing. As more electrolytes are absorbed (minerals and vitamins coming from administered drugs, medicine, food etc.), there will be shifts in fluid levels in the body as the cells strive to maintain a homeostatic balance.

RESEARCH

Wabitsch M, et al. (July 1996) "Body composition in 5-18-y-old obese children and adolescents before and after weight reduction as assessed by deuterium dilution and bioelectrical impedance analysis." *Am J Clin Nutr* **Vol 64(1)**: 1-6

Houtkooper LB, et al. (1992) "Bioelectrical impedance estimation of fat-free body mass in children and youth: a cross-validation study." *J. Appl. Physiol.* **Vol 72 (1)**: 366-373

MEDICAL APPLICATIONS

DIABETES

Understand, measure, manage and motivate diabetic patients

Losing weight and keeping it off is a difficult challenge for most people. But weight management and exercise play an extremely important role in the management of diabetes. Not only does exercise reduce the risk of cardiovascular disease, benefiting blood glucose levels, but it also helps to improve the body's ability to use insulin. Couple this with the correct dietary controls and you have the foundations for optimum diabetes management.

But how can you keep your client motivated? Using the **MULTISCAN5000**, you can offer constant support by accurately (and non-invasively) monitoring their body composition changes including small changes which are otherwise unnoticed. Show them improvements in their health, fat-free mass, fat mass and fluid balances, empowering you to motivate your clients and formulate custom-made sustainable dietary and fitness plans.

RESEARCH

S Fekadu, et al. (2010) "Insulin-requiring diabetes in Ethiopia: associations with poverty, early undernutrition and anthropometric disproportion." *European Journal of Clinical Nutrition* 1-7

Lee IT, et al. (January 2002) "Serial body composition by bioimpedance analysis in a diabetic subject with rapid insulin-induced weight gain—a case report." *Kaohsiung J Med Sci* **Vol 18(1)**: 45-8

ONCOLOGY

Track patient changes before, during and after treatment

By measuring cellular health, the Prediction Marker and Phase Angle in the **MULTISCAN5000** can track changes in the intra and extracellular fluid giving an indication of the strength and health of the plasma membranes of the cells. These values pick up on small changes of fluid within these compartments, thus can track change over time as a cancer patient recovers or responds to drugs or administered nutrition, an essential tool for oncology clinicians. Another benefit of measuring these values is being able to determine length of stay in a hospital.

- + Non-invasive assessment of hydration and nutritional status pre-admission, on admission, pre and post-surgery and during treatment
- + Monitor lean body mass, rather than total body weight to determine the patient's response to nutritional supplements.

RESEARCH

Fritz T, et al. (August 1990) "The predictive role of bioelectrical impedance analysis (BIA) in postoperative complications of cancer patients." *Eur J Surg Oncol* **Vol 16(4)**: 326-31

CRITICAL CARE

Essential body composition information in the care of the critically ill

Patients in critical care can experience significant shifts in fluid and fluid retention. Finding a way to measure and monitor these shifts can be challenging to the clinician. Only tetrapolar bioelectrical impedance analysis allows you to assess nutritional status and cellular health of bedbound patients. Using Bodystat's unique Prediction Marker you are also able to monitor the cellular health of the patient, over a period of time, noting the effectiveness of your intervention.

“A decrease in body cell mass is obscured by an expansion of ECW”

RESEARCH

Itobi E, Stroud M, Elia M. Br J (March 2006) "Impact of oedema on recovery after major abdominal surgery and potential value of multifrequency bioimpedance measurements" *Br Jnl Surgery* **Vol 93(3)**: 354-61

Perko MJ, et al. (February 2001) "Electric impedance for evaluation of body fluid balance in cardiac surgical patients." *J Cardiothorac Vasc. Anesth.* **Vol 15(1)**: 44-8

ELDERLY

With an increasingly elderly population, accurate measurements are vital

The instant results, simple to understand reports and non-invasive nature of the **MULTISCAN5000** is perfect for the ongoing measurement and health management of elderly patients. Many of the specific medical conditions detailed within this brochure are also highly pertinent in our aging population, from surgery to dialysis, which makes the **MULTISCAN5000** an essential tool in many of the areas of elderly health care management.

- + Understand and manage nutritional status
- + Core cellular health measurements give early prediction of failing health
- + Important device for elderly dialysis patients
- + Essential tool for dietary and exercise measurement, management and motivation.

RESEARCH

Reilly JJ, et al, (September 1994) "Improve estimation of body composition in elderly subjects by use of age-specific prediction equations" *The European Group for Research into Physical Activity for the Elderly II International Conference*

Farman CA, et al, "Gender and obesity interactions in Echocardiographic image quality" *British Society of Echocardiography*

LYMPHOEDEMA

Minimise the risk of lymphoedema with early prediction

Bioelectrical impedance analysis offers an early indication in the likelihood of patients suffering from post-operative lymphoedema, enabling the clinician to instigate preventative measures. This is also beneficial in the morbidly obese and cancer patient. For the cancer patient in particular, this can have benefits in the management of their psychological state too as the constant measurement of small changes in their cellular health offers reassurance.

- + Quick, non-invasive, easy to use and extremely cost effective
- + The **MULTISCAN5000** measures extracellular water (ECW), total body water (TBW), intracellular water (ICW), nutrition index, BMI, FFMI, BFMI, fat % , lean & dry lean mass, metabolic rates, waist/hip ratio.

RESEARCH

Cornish BH, et al, (1996) "Bioelectrical impedance for monitoring the efficacy of lymphoedema treatment programmes" *Breast Cancer Res Treat* **Vol 38(2)**: 169-176

COPD (CHRONIC OBSTRUCTIVE PULMONARY DISEASE)

Help to achieve the optimal body composition in COPD patients

Weight loss is an important clinical feature in patients with COPD and can be a predictor of mortality. Body composition instead of BMI (Body Mass Index) should be used to give an accurate assessment of lean and fat mass in these patients. Being overweight increases stress on the heart and lungs and fat in the abdominal cavity crowds the diaphragm, making it difficult to fully expand the lungs. Being under lean makes breathing more difficult, muscles work harder, burn more calories and therefore the potential for further emaciation. Correct nutrition and body composition, especially increasing lean mass, are key to the maintenance of health in COPD patients.

RESEARCH

Hopkinson, Nicholas S. et al, (November 2012) "Quadriceps wasting and physical inactivity in patients with COPD" *Eur Respir J*. **Vol 40(5)**: 1115-1122

Hopkinson, Nicholas S. et al, (2-4 December 2009) "Multiple-frequency bioelectrical impedance analysis and quadriceps strength in COPD patients" *Presented as an Abstract at the British Thoracic Society (BTS) Winter Meeting, London*

MULTISCAN5000

APPLICATION, RESULTS & ANALYSIS

MULTISCAN5000 APPLICATION

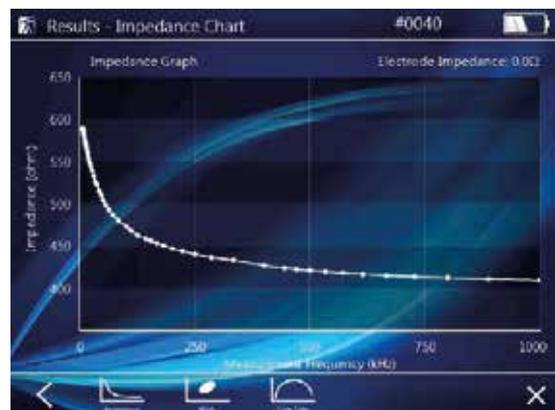
Diuretics, accurate fluid monitoring and the inevitable decrease of lean muscle mass are all concerns for patients, nurses and doctors alike. Bioelectrical impedance technology will meet all these needs non-invasively, giving accurate and reliable measurements for fluid, lean muscle mass, nutritional status and overall cellular health.

Bioelectrical impedance technology has been used successfully in dialysis wards to measure the volume of fluid over-hydration to help determine dry weight, as well as in IC wards to assess nutritional status, recovery rate and hydration levels.

In addition, the **MULTISCAN5000** may be used to detect malnutrition in patients with normal or high body fat by an assessment of body cell mass. Body cell mass can easily be obscured by an expansion of extracellular fluid which will not be detected by looking at an overall increase in total body weight.

QUALITY CONTROL CHECK FOR MEASUREMENT ACCURACY

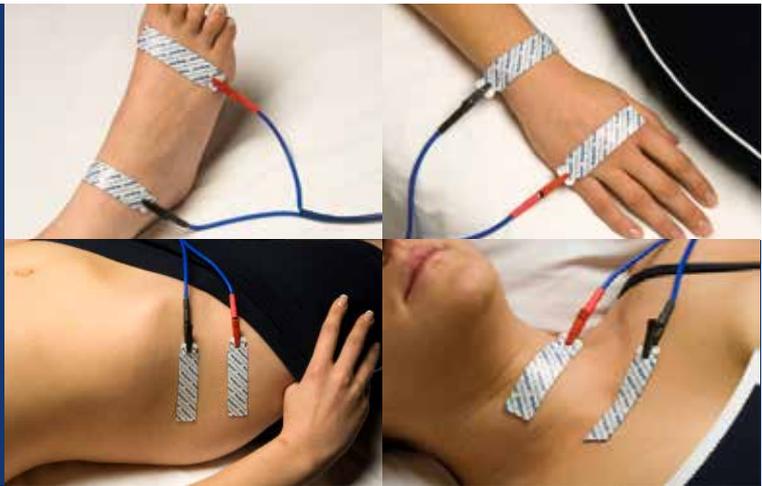
Immediately following a measurement, an impedance graph will be displayed. The impedance graph should be viewed to ensure that there are no bumps and that the measurement was successful. If the test has a bump and does not look smooth, then the test can be rejected by clicking the **Reject/Retest** option and repeating the measurement process again. If the test looks correct, click **Accept** to view the body composition and hydrational results and pie charts.



DISPLAY RESULTS RESULTS TABLE

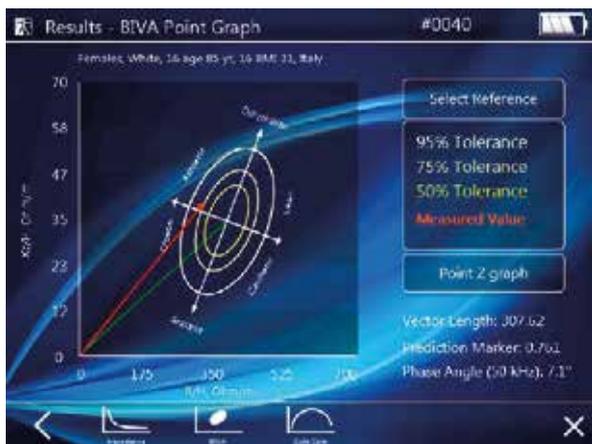
The summary page displays all the body composition and hydration measurements, each of which can be viewed as pie charts, Cole-Cole or BIVA, as well as viewing them as trends within the software.

Result	Value	TBW (l)	Lean (kg)	Weight (kg)
ECW (l)	16.2	40.9	52.4 (50 - 55)	69.0 (66.0 - 72.0)
ICW (l)	24.8	(35 - 41)		
CHY (l)	-0.2			
Dry Lean (kg)	15.2			
Fat (kg)	16.6 (14 - 19)			
Result	Percentage	TBW (%)	Lean (%)	Normal Range
ECW (%)	23.4	59.3	76.0	20.0
ICW (%)	35.9	(50 - 60)	(73 - 79)	30.0
CHY (%)	-0.2			-
Fat (%)	24.0			(21 - 27)



BIVA – BIOELECTRICAL IMPEDANCE VECTOR ANALYSIS

BIVA represents a quick pictorial method of showing hydration and nutritional status of a subject in comparison to their population group. It can also be referred to as the “Rxc graph”. Developed by Professor Antonio Piccoli in 1994, BIVA simply uses Resistance (R) and Reactance (Xc) at 50 KHz, measured to the subject’s height (not requiring the subject’s weight). The results are shown in the form of a dot on the vector graph. The positioning of the dot reflects the subject’s health status in comparison to their relevant population group.



OVER-HYDRATION – DIALYSIS

The MULTISCAN5000 uses spectroscopy to calculate the volume of fluid overload in a patient about to undergo dialysis. This is of particular importance when assessing or monitoring dry or target weight for individual dialysis patients.



Please note: dehydration will show itself as a minus number, as per the image showing -0.4 OHY.

THE MULTISCAN5000 MEASURES:

OPTIONS DISPLAYED ON THE MULTISCAN UNIT	
Fat %* & Normal Range	BMR/Body Weight*
Fat Weight* & Normal Range	Est. Average Requirement*
Lean %* & Normal Range	Body Mass Index (BMI) & Normal Range
Lean Weight* & Normal Range	BFMI (Body Fat Mass Index) & Normal Range
Water %* & Normal Range	FFMI (Fat-Free Mass Index) & Normal Range
Total Body Water* & Normal Range	Waist/Hip Ratio
Dry Lean Weight* e.g. Lean minus Total Body Water	Prediction Marker
Skeletal Muscle Mass (SMM)*	Impedance Values at 50 frequencies ranging from 5 kHz to 1000 kHz
ECW %* & Normal Level	Resistance at 50 frequencies ranging from 5 kHz to 1000 kHz
ECW Volume*	Reactance at 50 frequencies ranging from 5 kHz to 1000 kHz
ICW %* & Normal Level	Phase Angle at 50 frequencies ranging from 5 kHz to 1000 kHz
ICW Volume*	BIVA Vector Graph including population reference selection*
Body Cell Mass*	Cole-Cole Diagram
Volume of Over-Hydration (OHY)*	Cell Membrane Capacitance*
Nutritional Index	Characteristic Frequency*
Basal Metabolic Rates*	

SPECIFICATION

MEASUREMENT	
Technology	Bioelectrical Impedance Spectroscopy (BIS) Lock-In Signal Conversion Technology
Impedance Measuring Range	20 - 1300 ohms
Accuracy	Impedance 2-3 Ω Resistance (50 kHz): +/- 2 Ω Reactance (50 kHz): +/- 1 Ω Phase Angle (50 kHz): +/- 0.2°
Test Current	200 Micro-Amps R.M.S. (Root Mean Square)
Frequency	50 frequencies ranging from 5 kHz to 1000 kHz (KiloHertz)
Calibration	A calibrator is supplied for independent verification from time to time.
Configuration	2 lead wires (removable)
Computation Time	6 seconds
PC Communication	Wi-Fi Interface
GENERAL	
Operating Temperature	+ 5 °C to + 40 °C
Storage Temperature	0 °C to + 60 °C
Relative Humidity	70% less up to +60 °C non-condensing. It should not be used in an area where condensation could form on the inside of the unit housing.
Atmospheric Pressure	860 hPa to 1060 hPa
Internal Power Source	QSBP Battery Pack 14.4V 2200mAh
Battery Charger	QSBP Medical Battery Charger
Dimensions	274mm L x 195mm W x 39mm H (10.8" L x 7.6" W x 1.5" H)
Weight	Unit weight - 1574 grams
Service	There are no servicable parts
Quality Standards	Manufactured to strict ISO 13485-2003 quality standards. Fully accredited by the Medical Devices Directive (MDD) with its CE0120 marking and for EN60601, also FDA cleared.

CLASS-LEADING TECHNOLOGY

THE BODYSTAT STORY

For 25 years, we have been producing medical devices and software that utilise bioimpedance technology in the measurement of core cellular health to the critical acclaim of clinical physicians and international research institutions. But for us, this success is only one part of our story.

At the heart of the Bodystat story is a driving ambition and passion to make a difference to the general health and well-being of all nations, large and small. Our fundamental belief is that with more accurate and earlier detection of cellular changes, clinicians around the world can make earlier diagnosis and thereby improve patients' chances of a faster recovery.

Of course, without our partners in the medical and research fields, none of this would have been possible. For over quarter of a century we have developed deep and long-lasting relationships which have helped evolve our thinking, and the development of bioelectrical impedance technology and analysis for the betterment of all. To all our friends and partners, thank you. Together, we are making the world a better place.



MULTISCAN5000



QUADSCAN4000 TOUCH SCREEN



QUADSCAN4000



BODYSTAT1500 / 1500 MMD

CE0120

ABOUT BODYSTAT

Bodystat Ltd, based on the Isle of Man (British Isles), has been established since 1990 and is a registered ISO 13485:2003 company. We specialise solely in BIA Technology and are dedicated to expanding the knowledge of this to improve health and well-being. We have an extensive range of research papers (available on our website) dedicated solely as non-commercial, free materials for educators.

Our devices are manufactured in Europe, made to the highest specifications and use only the best electrical components. The high quality of our devices ensures accurate results that are both reproducible and reliable.

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