

**TOGETHER
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DOBLE ENGINEERING COMPANY

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- **CONDITION MONITORING**
- **DIAGNOSTICS**
- **PARTIAL DISCHARGE TESTING AND MONITORING**
- **HIGH POWER TEST SYSTEMS (FIELD & LABORATORY)**
- **PROTECTION TESTING**
- **ADVANCED ELECTRICAL TESTING EQUIPMENTS**
- **ENGINEERING SERVICES**

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CONDITION MONITORING

These instruments are permanently installed on transformers and related apparatus to continuously monitor insulation and dissolved-gas condition, providing real-time alerts and trend data rather than the periodic spot measurements taken by the portable survey instruments above.

1.1 Calisto T1

All-in-One Condition Monitoring System to Prevent Transformer Failures



Test Objective

Encapsulates bushing monitoring, partial discharge monitoring, and Input/Output data recording in a single, field-configurable enclosure, bringing together data from Doble and third-party devices through one web-based user interface.

Key Features

- Scales from a single component to a comprehensive transformer monitor: PD Guard (partial discharge via bushings, neutral, and main tank), IDD (bushing leakage current, capacitance, power factor, and harmonics for up to six bushings), and iO (multi-function data recorder for current, voltage, temperature, and relay inputs).
- Built-in web server accessible from a PC, tablet, or smartphone — no proprietary software required.
- Standard Modbus and DNP3 communication protocols, with optional IEC 61850, for integration with SCADA and third-party systems.
- Configurable three-level alert management per data channel, with a built-in audit trail for post-event investigation.
- Field-upgradeable hardware — start with one module (e.g., IDD bushing monitoring) and add others (e.g., main-tank PD) later.
- Overlays and visualizes data from multiple channels/assets in a single UI for correlation and trend analysis.

Technical Details

Doble Calisto™ Condition Monitoring Calisto T1

All-in-One Condition Monitoring System

T1 BASE MODULE

CPU, MEMORY AND BUSES

Host CPU	ARMv8 1.2GHz
Memory	1 GB RAM, 32GB Flash

STORAGE

32GB eMMC Flash for application and data storage

PERIPHERALS

USB 2.0
2x Isolated RS485 (Modbus, DNP3)
10/100 BaseT Ethernet (DNP3, Modbus, HTTP)
Alert LED (Status, Info, Warning, Action)
Status Relay, 240VAC 5A (Status, Info, Warning, Action)
LDC Display 4x20 and keypad
GPS 1PPS time sync (Fibre/IRIG) option
IEC 61850 option
Enclosure climate control option

ENVIRONMENTAL

Humidity 0-95% non-condensing

TEMPERATURE*

Operating temperature	-20°C to +50°C
Extended temperature	-40°C to +60°C
Storage temperature	-20°C to +70°C

MECHANICAL DATA

Height	720mm / 28.4 in
Width	550mm / 21.7 in
Depth	363mm / 14.4 in
Weight	51kg / 113 lbs
Construction	Coated stainless steel

POWER SUPPLY

External supply 24 V DC @ 2 A

An optional power adapter can be supplied to suit global mains voltage.

* Temperature is extended when using a climate controlled enclosure.

Doble's condition monitoring has proven effective in identifying problems early and avoiding failures in bushings, transformers, tap changers, generators and more.

Access Calisto T1 from a PC, tablet, or smartphone using a standard web browser. No proprietary software is required.



Intuitive user interface showing rising composite gas levels (solid red line) overlaid with alert limits (dotted green, yellow, and red lines) and current alert state of the monitor (green, yellow, and red backgrounds). The monitor has just reached ACTION (red level alert) so the background is now red.

The sampling interval for each measurement channel can be configured in the user interface to a value appropriate to the measurement type and suspected failure models to be detected. Data from multiple channels on one or more assets can be overlaid for visual correlation and analysis.



Doble Calisto™ Condition Monitoring

Calisto T1

All-in-One Condition Monitoring System

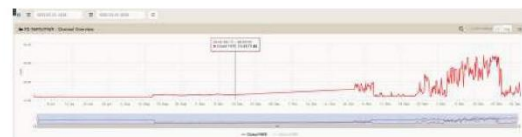
PD MONITOR

PARTIAL DISCHARGE DATA ACQUISITION	
Inputs	8 channels, multiplexed 6 built in mini-HFCTs are available for bushing monitoring; CT, UHF, VHF sensors can be connected as required.
Connector	BNC
Input impedance	50 Ω
Maximum input	+20 dBm for reading
Dynamic range	60 dB
Detection types	Peak, quasi-peak and average detector
Sweep processing	Continuous, average, max hold and differential
RFI TUNER 1	
Bandwidth	50 kHz to 50 MHz
Resolution Bandwidth	9 kHz / 120 kHz
Noise floor	Approximately -90 dBm for peak detect or -100 dBm for average detect (RBW 9 kHz)
RFI TUNER 2	
Bandwidth	50 MHz to 1000 MHz
Accuracy	± 100 kHz
Resolution bandwidth	120 kHz / 1 MHz / 6 MHz
Noise floor	Approximately -80 dBm for peak detect or -90 dBm for average detect (RBW 6 MHz)
EMI MODE	
Bandwidth	50 kHz to 100 MHz
Resolution bandwidth	9 kHz / 120 kHz
AC SYNCHRONIZATION	
Wired sync to external AC source	
MEASUREMENT MODES	
RF modes	Spectrum Oscilloscope (Time resolved) Level meter
Results output	IPwr (Integrated Power) PAPR (Peak-Average Power Ratio) PRPD (Phase Resolved PD) QIEC (IEC 60270 compliant) Quadratic rate (QR)

The PD Guard module offers eight individually configurable channels to be used with the bushing sensor, CT, or UHF probes for a comprehensive view of transformer PD.



Configurable multi-functional monitoring in a single, compact enclosure.



Configurable QIEC-equivalent calibrated PD levels in a generator before and after a core rewind indicating a rise in PD from background to intermittent high levels.

Doble Calisto™ Condition Monitoring

Calisto T1

All-in-One Condition Monitoring System

BUSHING MONITOR

BUSHING DATA ACQUISITION	
Bushing current inputs	6 channels: 2 sets of 3 bushings
Voltage reference	3x instrument transformer input option
Connector	Push-in termination
Measurement method	Leakage current/voltage raw sinusoid waveform, rms current and phase
Tap Current Range	1 - 200 mA
Bushing-Bushing Isolation	>2500 V
Bushing-Host Isolation	>2500 V
Magnitude Accuracy	± 1% of reading
Phase Accuracy	0.01 degrees
Capacitance range	0-1000 pF
Power factor range	0-100%
Resolution	0.1% of input signal peak

Doble has demonstrated that bushings may fail “gracefully” over several weeks to months, or may fail rapidly, in a few hours, with documented saves published. The Calisto T1 allows for individual alert levels for each bushing, monitoring current magnitude, phase, power factor, capacitance, harmonic distortion, using temperature correction for each bushing where available.

The Calisto T1 utilizes Relative and True Power Factor, capacitance and harmonic analysis to quickly identify and diagnose deterioration and insulation abnormalities in both bushings and reference voltage devices.

IO CARDS

DATA ACQUISITION	
Connector	Push-in termination: 4 slots available
OPTIONS	
User selects any mix of 4 of the following:	
8AI - Analog In	8 channel analog input, 4-20 mA or 0-10V. Jumper selectable.
4TI - Temperature In	4 channel input, 2/3-wire PT 100
8DI - Digital In	8 channel digital input, dry or wet contact
8DO - Digital Out	8 channel digital output, sink type only

The iO Multi-Function Data Recorder is a flexible and networkable device that captures, displays, and monitors data from any commonly available sensor or module.

The Calisto T1 provides the most cost effective and reliable condition monitoring for transformers. Contact your Doble representative or visit Doble.com for more information and documented bushing and transformer saves.

1.2 doblePRIME IDD

Bushing Monitor for Transformers



Test Objective

Provides continuous, real-time monitoring of transformer bushings and current transformers to detect insulation deterioration and abnormalities. The system issues actionable alerts, enabling proactive maintenance and preventing costly failures.

Key Features

- Captures bushing current waveforms in real time for detailed analysis.
- Calculates power factor and capacitance for each bushing.
- Records data at user-specified intervals or ad hoc to reflect failure modes.
- Displays alerts locally and remotely with three-level severity indicators.
- Embedded Expert System learns normal behavior and identifies deterioration trends.
- Built-in Alert State Machine analyzes data variations for early warnings.
- Available in 12-current, 6-current, or 6-current + 3-voltage reference versions.
- Optional armored cables and junction boxes for harsh environments.
- Provides sum current values for each bushing set.

Technical Details

Parameter	Specification
Inputs	6 or 12 channel options (models DPID 101, 102, 100)
Measurement Method	Leakage current raw waveform and relative phase
Tap Current Range	1–200 mA
Bushings Monitored	Up to 4 sets of 3 bushings
Isolation	>2500 V (bushing-bushing and bushing-host)
Accuracy	Magnitude $\pm 1\%$ of reading; Phase 0.01°
Resolution	0.1% of input signal peak
Voltage Reference	3× instrument transformer input (model 101 only)
Core CPU	ARM Cortex 180 MHz
Memory	32 MB RAM, 16 MB flash
Host CPU	ARMv8 1.2 GHz, 1 GB RAM, 4 GB flash
Storage	32 GB for application and data
Interfaces	USB 2.0, RS485 (Modbus/DNP3), Ethernet (HTTP/DNP3/Modbus), GPS 1PPS
Relay Output	240 VAC 5A (Status, Info, Warning, Action)
Operating Temperature	-20°C to +50°C (optional enclosure extends to -40°C)
Humidity	0–95% non-condensing

Parameter	Specification
Dimensions	200 × 330 × 82 mm
Weight	2 kg
Construction	Anodized aluminum
Power Supply	24 V DC @ 1 A

1.3 Calisto H1

Hydrogen Sensor for Transformers



Test Objective

Provides continuous, real-time measurement of hydrogen dissolved in transformer oil to detect spikes that are often indicative of an electrical fault, enabling cost-effective monitoring of a broader range of transformer assets.

Key Features

- Solid-state hydrogen sensor immersed directly in the oil for real-time measurement; functions over a broad temperature range.
- High EMI/RFI rating; IP68 ingress protection; Class C5M marine rated for salt-water condensing environments.
- No periodic calibration required.
- Modbus communication (isolated RS485) for data exchange with other applications; integrates with Doble's Calisto Condition Monitoring platform and doblePRIME software.
- Suitable for small distribution, vault, wind-farm, and railroad/traction transformers, as well as offshore platforms.
- Internal data storage of more than one year of hourly sensor data, including hydrogen concentration and rate of change per day/week.

Technical Details

Parameter	Specification
Measurement Range	25–5000 ppm
Accuracy / Repeatability	Accuracy: 20% of reading or 25 ppm, whichever is greater Repeatability: 10% of reading or 15 ppm, whichever is greater
Response Time	< 60 min (90% of step change)
Temperature of Insulating Liquid	Operation: -40°C to 105°C Survival: -40°C to 135°C
Communication	Isolated RS485 serial port (2-wire), Modbus, user-selectable Device ID
Power Supply	9 to 48 VDC, 10 W
Ingress Protection	IP68; 25 feet water for 14 days (IEC 60529)
Housing / Dimensions	Hard-anodized 6061 aluminum; 5.94 x 1.56 in (15.08 x 3.96 cm)

1.4 Calisto (2, 5, 9)

Dissolved Hydrogen and Water Monitor Up to 9 Gases plus Moisture

Test Objective

A high-accuracy Intelligent Electronic Device (IED) designed to continuously detect incipient transformer faults via dissolved hydrogen and to monitor insulation moisture content, for predictive maintenance and early warning of developing faults.

Key Features

- Continuous, dedicated dissolved-hydrogen monitoring via a proprietary thermal conductivity detector (TCD) cell — hydrogen is produced by all transformer fault types and provides the earliest fault indication.
- Continuous dissolved-water monitoring via an oil-immersed RS capacitive sensor, reported in ppm, %RS at 25°C, or %RS at transformer temperature.
- Two-stage temperature conditioning (passive counter-flow heat exchanger plus thermo-electric elements) eliminates baseline drift from ambient/oil temperature variation.
- Internal oil circulation via a small, 10-year MTBF solenoid pump ensures fast response to changing gas concentrations.
- Standard RS-232 (x2), isolated RS-485, and isolated 4–20 mA analog outputs; optional V90 modem, Ethernet, fiber-optic, or spread-spectrum wireless communication.
- Two programmable alarm levels each for hydrogen and water, with NO/NC solid-state relay outputs (10 A @ 250 VAC).

Technical Details

Calisto Detection Monitors:

Calisto and Calisto 2



Hydrogen
+ Moisture



Hydrogen, moisture +
carbon monoxide

Calisto Diagnostic Monitors:

Calisto 5 and Calisto 9



5 fault gases +
moisture



Complete DGA +
moisture

Calisto Monitors Offer Long-Term Reliability

- Self-calibrating
- Fully functional even in the harshest environments
- Field-proven, industrial-grade electronics
- 5kV surge isolation on all network connections
- 250 ms power interruption protection
- Best-in-industry EMC and safety ratings
- Worldwide technical service and support
- 24-hour response time

1.5 Calisto R9

Dissolved Gas Analysis (DGA) Monitor



Test Objective

Provides continuous, high-accuracy, low-maintenance on-line dissolved gas analysis of transformer insulating liquid measuring fault gases, air components, and moisture — to enable early fault detection and informed asset management decisions.

Key Features

- Measures all key Fault Gases Plus Moistures Measures
- Patented Differential Infrared Photoacoustic Spectroscopy (DIPAS) method plus proprietary thermal conductivity detection for hydrogen, enabling accurate readings of small gas concentrations.
- Water-vapor based automated on-board calibration — maintains long-term accuracy without compressed calibration-gas cylinders to manage.
- Vacuum-tolerant membrane gas extraction keeps oil and oil vapors out of the gas measurement system; built-in Ostwald solubility coefficients for common oil types.
- Intelligent bubble trap system removes air/gas bubbles before oil returns to the transformer; typical installation under 2 hours.
- Field-proven sludge-tolerant solenoid oil pump (no oil filter maintenance) with low-flow error monitoring; precision oil and gas-system temperature regulation.
- Newly designed electronics on a Linux operating system for improved reliability and cyber security; web-browser based user interface; modular design simplifies service.
- Standard digital communication ports; optional relay/analog outputs and DNP3, Modbus, and IEC 61850 protocols for smart substation integration; data ports to INSIDEVIEW / doblePRIME™.

Technical Details

APPLICATION											
Online monitoring of fault gases, air components and moisture in transformer insulating liquids.											
TECHNOLOGY											
Gas measurements	Patented photo-acoustic method with automatic self calibration										
	H2 by thermal conductivity										
	O2 by fluorescent dye sensor										
	N2 by total headspace pressure										
Gas extraction	Oil-immersed Teflon® tubing¹										
Moisture measurements	Oil-immersed relative saturation (RS) sensor										
Communications	DNP3, Modbus, IEC 61850 (option) with substation hardened IOs										
PERFORMANCE											
		H2	CO	CH4	C2H2	C2H4	C2H6	CO2	O2	N2	H2O
Lower detection limit²	ppm	5	1	1	0.5	1	1	20	100	10,000	2 ppm or 2% RS
Top of range	ppm	5000	40,000	20,000	40,000	50,000	50,000	50,000	50,000	150,000	100% RS
Accuracy³ +/- (LDL+X% of reading)	%	X=5	X=5	X=5	X=5	X=5	X=5	X=5	X=10	X=15	3 ppm or 2% RS
Repeatability +/- (LDL+Y% of reading)	%	Y=3	Y=3	Y=3	Y=3	Y=3	Y=3	Y=5	Y=5	Y=10	2 ppm or 2% RS
Resolution at LDL	ppm	1	0.5	0.5	0.5	0.5	0.5	5	50	100	1 ppm or 1% RS
Measurement interval		1 hr	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr	1 second
Step response in 1 hour	%	70%	80%	90%	90%	90%	90%	90%	40%	30%	100%
OPERATION											
Operating temperature range	-40 to +55° C standard, -50 to +40 with Cold Kit option										
Storage temperature range	-50 to +75° C										
Operating oil temperature range	-40 to +120° C										
Operating oil pressure range	Full vacuum to 40 psi										
Operating humidity range	0 - 99% RH										
Storage humidity range	5 - 95% non-condensing										
Elevation range	Up to 2500 m										
CONSTRUCTION											
Width x height x depth	Instrument: 28.4 x 26.26 x 13.5 inches (72.1 x 67 x 34.3 cm) Shipping: 33 x 30 x 17 inches (83.8 x 76.2 x 43.2 cm)										
Weight	Instrument: 125 lbs (57 kg) Shipping: 143 lbs (65 kg)										
Enclosure	Powder-coated 304L stainless steel										
Oil circulation	Anti-cavitation reciprocating pump										

CONSTRUCTION	
Oil flow monitoring	Proprietary method with low flow error
Oil lines	3/8 inch OD stainless steel; see manual for length guidelines
Air bubble elimination	Intelligent bubble trap
Enclosure temperature conditioning	Thermoelectric feedback
Oil temperature conditioning	Passive heat exchanger plus thermoelectric feedback
Cooling	Forced air
Equipment protection	Thermal cut-off fuse (77° C), over-current mains fuse
Oil sampling	External quick-connect port
INSTALLATION	
Mechanical	4 shock-mount vibration isolators
Electrical power	100-240 VAC -15% +10%, 50-60 Hz, 1 phase, 520 VA. or 110-250 VDC, 520 VA. Test report available for 240 VAC +15%.
Electrical disconnect	10A client breaker
Commissioning time	5 hours installation plus 4-12 hours for first readings
MAINTENANCE	
Visual inspection every 12 months.	
COMMUNICATIONS	
Interface	Calisto R9 Software web server
Protocols	Modbus, DNP3 Level 2, see Options below.
	Time synchronization NTP and IEEE 1588
Ports	2 copper Ethernet
	2 SFP cages for optical Ethernet
	RS-485
	USB for local connection only
Analog	3 4-20mA inputs
	12 optional 4-20mA outputs (see Options below)
Relays	2 standard plus 8 optional NO/NC, 250VAC, 1500VA; 250VDC, 140W (see Options)
Door indicators	2 LED indicators for power up, error, alarms
Data storage	10 years
DGA data management and diagnostics	Inside View software, Doble Prime (both sold separately)
REGULATORY	
CE marking	Low Voltage Directive 2014/35/EU
	EMC Directive 2014/30/EU
	WEEE Directive 2012/19/EC
	RoHS Directive 2011/65/EU, 2015/863 (RoHS 3)
Electromagnetic Compatibility and Immunity	IEC 61326-1: 2013
	IEC 61850-3: 2013
	IEC 61000-6-5: 2015
Safety	UL 61010-1:2012
	CAN/CSA C22.2 No. 61010-1-12: 2017

REGULATORY	
	IEC 61010-2-030:2017
	IEC 61010-2-081:2020
Environmental	IEC 60529:2013 IP66
	NEMA 250:2020 Type 4X
	IEC 60068-2-6: 2007 Sinusoidal Vibration
	IEC 60068-2-1: 2007 Cold Storage, Cold Start, Cold Operation
	IEC 60068-2-78: 2012 and IEC 60068-2-30: 2005 Damp Heat
	IEC 60068-2-14: 2009 Change of Temperature
	IEC 60068-2-11:1981 Salt Fog
REACH	Regulation No 1907/2006 (EU REACH of 219/223 SVHCs)
OPTIONS	
Software (license key required)	IEC 61850
Hardware	8 optional NO/NC output relays, 250VAC, 1500VA; 250VDC, 140W
	12 optional 4-20mA outputs
	Cold kit option for operating range from -50 to 40° C.
	Internal Touchscreen Display
ACCESSORIES	
	Calisto R9 mounting stand
	Calisto precision oil-temperature probe (4-20mA)
	All metal stainless-steel flexible oil lines
	Insulated oil lines for low-temperature installations
	Calisto isolation valves
	Quick-Connect Plug (to keep dust out of oil-sampling port)
WARRANTY	
30 month standard with 1, 2, and 3 year extended warranty options.	
SERVICE AND SUPPORT	
On-site commissioning service and on-site maintenance program available on request.	

1.6 GISNOVA

Global GIS Monitoring System



Test Objective

Provides non-intrusive, condition-based monitoring of Gas Insulated Switchgear by continuously monitoring partial discharges, circuit-breaker operating parameters, and SF6 gas condition — reducing the overall cost of asset management and avoiding failures caused by lack of maintenance, aging, or electrical/overload issues.

Key Features

- Modular system adaptable to already-installed and new GIS, with flexibility to use pre-existing sensors.
- Three integrated monitoring functions in one platform: Partial Discharge Monitoring, Circuit Breaker Monitoring, and SF6 Gas Monitoring.

- PD Hub MKII GIS acquisition unit connects up to 40 UHF PD sensors per hub via coaxial cable, using patented T/F Map noise rejection (scalable from 4–40 channels up to 240 channels on a 42U rack).
- EDS (Expert Diagnostic System) acquisition unit monitors circuit-breaker parameters (opening/closing times, coil currents, fault currents, breaker velocity/position, motor/heater current, battery voltage, I²t) and SF6 gas density, leakage trend, and dew point.
- Central Unit includes server, UPS, managed Ethernet switch, watchdog unit, industrial monitor, and 42U-19" server rack; connects via fiber optic or RJ45 Ethernet LAN.
- TiSCADA software provides a multi-bay real-time dashboard, parameter trees, trend graphs, comtrade waveform view, and alarms via dry contacts or digital protocols (e.g., IEC104).
- End-to-end installation, commissioning, and data analysis support provided by the TECHIMP Service Division.

Technical Details

Parameter	Specification
System Type	Modular monitoring system combining Partial Discharge, Circuit Breaker, and SF6 Gas monitoring
Main Components	PD Hub MKII GIS acquisition unit; EDS acquisition unit; PD/SF6 gas/circuit-breaker sensors; Central Unit; TiSCADA software
PD Hub MKII GIS Channels	4–40 channels (acquisition box); up to 240 channels on a 42U rack; connects up to 40 UHF PD sensors via coax
PD Hub Acquisition	Wide-bandwidth electronic boards; 125 MS/s sampling rate; 12-bit resolution; sync 5 Hz–500 Hz
PD Hub Protocols / Rating	OPC UA, IEC 61850, dry contact; IP66, extended temperature range
EDS Function	Circuit breaker monitoring (status, open/close time, pole discrepancy, fault current/I ² t, motor current) and SF6 gas monitoring; modular drawer configuration
SF6 Gas Monitoring	Up to 64 gas sensors per module; instantaneous density, leakage trend/alarm prediction, dew point
PD Sensor Types	Internal UHF sensor (OEM-compatible), UHF Horn Antenna, HFCT sensor for cable connection
Central Unit	Server unit, UPS, managed Ethernet switch, watchdog unit, industrial monitor, 42U-19" server rack
Communication	Fiber optic or RJ45 Ethernet LAN to Central Unit; alarms via dry contacts and digital protocols (e.g., IEC104)

Parameter	Specification
Software	TiSCADA — multi-bay dashboard, real-time data, parameter tree, trend graphs, comtrade waveform view
Services	Installation, commissioning, and data analysis via TECHIMP Service Division

1.7 TFS 2100E

Travelling Wave Fault Location System



Test Objective

Provides fast and accurate fault location for high-voltage AC and DC networks using travelling-wave analysis. The system minimizes line outage time by automatically calculating fault distance within milliseconds and displaying results directly on the network map.

Key Features

- Composed of TDU 100E Data Acquisition Unit and TAS 2100E Analysis Software.
- Automatic fault distance calculation with accuracy better than ± 50 m (less than one tower).
- Wide-area fault location collects data from multiple substations.
- GPS synchronization embedded in TDU 100E for precise timing.
- Fast installation and easy configuration via Ethernet, Modem, or Point-to-Point connection.
- Large memory capacity (8 GB) for fault data storage.
- Compatible with DNP 3.0 and IEC 61850-8 interfaces.
- Statistical analysis tools for recurrent or intermittent fault detection.

Technical Details

Parameter	Specification
Fault Location Accuracy	± 50 m (less than one tower)
Measurement Method	Travelling-wave time-tag analysis (Type D double-ended method)
Data Acquisition Unit	TDU 100E – records current/voltage surges at up to 8 lines
Memory Capacity	8 GB fault record storage
Synchronization	Built-in GPS or IRIG-B interface
Communication	Ethernet (TCP/IP), RS-232, Modem – FTP, TELNET, HTTP protocols
Power Supply	85–264 V AC or 90–260 V DC (basic); optional 35–140 V DC or 100–300 V DC
Operating Temperature	–10 °C to +55 °C (storage –40 °C to +85 °C)
Humidity	0–90 % non-condensing
Dimensions / Weight	2U 19" rack (483 × 323 × 83 mm); < 6 kg with modules

DIAGNOSTICS

2.1 Myrkos 2 Portable DGA (9 Gases and Gas Chromatography)

Portable DGA Chromatograph



Test Objective

Provides lab-quality dissolved gas analysis (DGA) data on site, using proven gas chromatography (GC) technology, for remote-location diagnosis, confirmation of on-line monitor readings, and frequent oil testing of aging transformers.

Key Features

- Dual-channel gas chromatograph with micro-machined injectors and TCD detectors; measures all 9 key fault/atmospheric gases (H₂, CH₄, C₂H₆, C₂H₄, C₂H₂, CO, CO₂, O₂, N₂).
- Shake Test sampling and gas extraction method, recognized by ASTM D3612 Method C and IEC 60567.
- Accurate results in as little as 2 minutes; single syringe used for sampling, extraction, and measurement to minimize human error.
- Interference-free measurement across all common oil types, with lowest detection limits in its class.
- 7-hour cordless battery life; over 40 hours of operation between carrier-gas refills; daily calibration.
- Available as a Field Package (portability-focused) or Lab Package (throughput-focused for laboratory QMS integration).
- Includes PPMreport™ software for automated DGA diagnoses, PDF reporting, and data export to Inside View diagnostic software.

Technical Details

Parameter	Specification
Measurement Technology	Dual-channel gas chromatograph; micro-machined injectors and TCD detectors; Shake Test® sampling
Gases Measured	H ₂ , CH ₄ , C ₂ H ₆ , C ₂ H ₄ , C ₂ H ₂ , CO, CO ₂ , O ₂ , N ₂ (9 gases)
Gas-in-Oil Range	H ₂ : 5–60,000 ppm CO ₂ : 10–60,000 ppm Other fault gases: 1–60,000 ppm O ₂ : 60–100,000 ppm N ₂ : 500–100,000 ppm
Gas-in-Oil Accuracy	H ₂ : ± 5 ppm or ± 6% CO ₂ : ± 10 ppm or ± 6% Other fault gases: ± 1 ppm or ± 6% O ₂ : ± 60 ppm or ± 6% N ₂ : ± 500 ppm or ± 6%
Measurement Time	2 minutes per sample
Calibration	Morgan Schaffer CALGAS with NIST traceability; daily calibration
Connectivity / Software	Direct or networked TCP/IP Ethernet; PPMreport™ software (Windows)
Power Supply	100–240 VAC, 50/60 Hz, 100 W (24 VDC, 6.2 A output)
Operating Temperature	0 °C to 50 °C

Parameter	Specification
Weight / Dimensions	10 kg / 22 lbs — 250 x 155 x 420 mm (9.8 x 6.1 x 16.5 in.)
Ruggedness	Drop-tested to 1 m; cast aluminum frame, powder-coated aluminum covers
Warranty	30-month standard warranty

2.2 Myrkos Lab Package (9 Gases & Chromatography)

DGA Chromatograph Configured for Laboratory Use

Test Objective

Configures the Myrkos 2 portable gas chromatograph for high-throughput laboratory dissolved gas analysis (DGA), delivering the same lab-quality accuracy as the field package while maximizing sample throughput and minimizing cost per test for laboratory operations.



Key Features

- Delivers lab quality results consistent with the Myrkos 2 platform's proven gas chromatography (GC) technology.
- Maximizes throughput of laboratory DGA analyses for high-volume testing environments.
- Enables laboratories to optimize resources and minimize cost per sample.
- Integrates easily into any laboratory Quality Management System (QMS) and standard operating procedures.
- Provides interference-free measurement of 9 gases across all common oil types.
- Includes PPMreport™ software, which converts DGA results into transformer diagnoses, generates PDF reports, and exports data to Doble's Inside View diagnostic software.

Technical Details

Parameter	Specification
Measurement Technology	Dual-channel gas chromatograph; micro-machined injectors and TCD detectors; Shake Test® sampling
Gases Measured	H ₂ , CH ₄ , C ₂ H ₆ , C ₂ H ₄ , C ₂ H ₂ , CO, CO ₂ , O ₂ , N ₂ (9 gases)
Gas-in-Oil Range	H ₂ : 5–60,000 ppm CO ₂ : 10–60,000 ppm Other fault gases: 1–60,000 ppm O ₂ : 60–100,000 ppm N ₂ : 500–100,000 ppm
Gas-in-Oil Accuracy	H ₂ : ± 5 ppm or ± 6% CO ₂ : ± 10 ppm or ± 6% Other fault gases: ± 1 ppm or ± 6% O ₂ : ± 60 ppm or ± 6% N ₂ : ± 500 ppm or ± 6%

Measurement Time	2 minutes per sample
Calibration	Morgan Schaffer CALGAS with NIST traceability; daily calibration
Connectivity / Software	Direct or networked TCP/IP Ethernet; PPMreport™ software (Windows)
Power Supply	100–240 VAC, 50/60 Hz, 100 W (24 VDC, 6.2 A output)
Operating Temperature	0 °C to 50 °C
Weight / Dimensions	10 kg / 22 lbs — 250 x 155 x 420 mm (9.8 x 6.1 x 16.5 in.)
Ruggedness	Drop-tested to 1 m; cast aluminum frame, powder-coated aluminum covers
Warranty	30-month standard warranty

PARTIAL DISCHARGE TESTING AND MONITORING

3.1 Spark P3

Partial Discharge (PD) and Electromagnetic Interference (EMI) Analyzer

Test Objective

Provides insulation-system diagnostics for high-voltage assets in the field or laboratory. Identifies characteristics of insulation deterioration that could lead to equipment failure, using any sensor capable of detecting PD across

9 kHz–2 GHz.



Key Features

- Comprehensive detector suite: IEC 60270 integrative charge, Ultra-Wide-Band (0.1–60 MHz), CISPR16 EMI, Narrowband HF (<60 MHz) and UHF (60 MHz–2 GHz), and Acoustic Emission (<500 kHz).
- Freely adjustable gain/attenuation and measurement filters; total dynamic range > 120 dB.
- Spectrum, Time Resolved, Phase Resolved, and Bar Graph acquisition modes (detector-dependent).
- Guided "Wizard Mode" for inexperienced operators; "Expert Mode" for full configurability.
- Applicable to rotating machines, power transformers, instrument transformers, GIS/AIS switchgear, and cables/accessories.
- Battery-operated; benchtop (lab) or Pelicase (site) form factor; integrates with Doble Pulse™ software.

Technical Details

DOBLE IN-SERVICE TESTING & ASSESSMENT

SPARK P3

PD and EMI Analyzer

Benefits

- Automatic data acquisition methods help inexperienced operators to obtain reliable results
- Guided measurements
- Automatic measurements and test plans (can be edited)
- Suits most PD/EMI applications
- Lightweight battery operated device (suitable for cabin and hold air travel)

Guidance for Inexperienced Users

A “Wizard Mode” guides users new to the subject through the measurement and data acquisition procedure, limiting functionality and other elements to the minimum required to conduct the task. More experienced personnel can select “Expert Mode” to configure the system to perform measurements in any desired form.

MECHANICAL	
Dimensions (WxHxD)	47 x 35.7 x 17.6 cm 18.50 x 14.06 x 6.93 in
Weight	9 kg/19.8 lbs
ENVIRONMENTAL	
IP Classification	IP 67 (closed case) IP 40 (open lid outside of case)
Operating temperature	-20° to + 50°C -4° F to 122° F
Storage temperature	-20° to + 70°C/ -4° F to 158° F
POWER SUPPLY	
	115-230 VAC 50-60 Hz 2A
Battery	7.2V 20Ah
Capacity	6 hours
Charging time	3 hours

Manage Test Plans and Data

Doble’s Spark measurement systems will integrate with Doble’s Pulse™ companion PC software which enables the user to manage measurement data, edit test plans and asset information, visualize measurement data, and export individual data sets or entire test plans to report templates.

SPARK P3 TECHNICAL SPECIFICATIONS

SPECIFICATIONS	
HF Tuner	9 kHz to 56 MHz
gain stages	-20dB, 0dB, 20dB
total dynamic range	>120dB
RBW	9 kHz switchable 120 kHz, 1 MHz
VHF/UHF Tuner	56 MHz to 2 GHz
gain stages	-20dB, 0dB, 20dB, 40dB
total dynamic range	>120dB switchable 12V DC offset for external sensor amplifiers
Tuner Sensitivity UHF	1uV
RBW	6 MHz
UWB Detector	integrative charge measurement, including IEC 60270 compliant
gain stages	-20dB, 0dB, 20dB
total dynamic range	>120dB
detection level (Qiec)	<110fC
fmin	= 100 kHz
fmax	= 60 MHz
Acoustic Emission Detector	
gain stages	0dB, 20dB switchable 28V DC offset for sensors with integrated amplifiers
Frequencies	1 kHz-1.1 MHz
Reference voltage input	DC to 500 kHz
gain stages	-40dB, -20dB, 0dB, 20dB
Input Channel Configurations	Channel Groups: 2 Group Configurations: BNC 1: UHF BNC 2: HF/UWB/EMI/Acoustic BNC 3: Sync/Acoustic
Detector modes	Spectrum analysis (Peak, Average, Quasi-Peak) Time resolved (zero span) Phase resolved Acoustic
Number of PD input channels	2
Number of reference voltage/ acoustic emission channels	2
Power supply	100-240V 2A

3.2 Spark P2

Universal Hand-Held Partial Discharge Surveyor



Test Objective

A universal hand-held Partial Discharge (PD) and Radio Frequency Interference (RFI) insulation system and substation survey tool. Utilizes a wide range of PD and RFI detectors and analysis methods to identify PD across a wide range of test objects, from switchgear and GIS to transformers, cables, and rotating machines.

Key Features

- Universal hand-held device with 7-hour battery life; no PC required for operation.
- Wizard Mode enables reliable, automatic data acquisition without PD expertise; Expert Mode gives subject matter experts full control of every detector and setting.
- UHF antenna RFI surveys with a narrow-band tuner significantly more sensitive than frequency-shifter methods, suited to substation walk-downs, GIS, and transformers.
- Transient Earth Voltage (TEV) surveys for identifying PD in air-insulated switchgear compartments.
- High Frequency Current Transformer (HFCT) surveys for cable accessories, transformers, and circuit breakers.
- Acoustic Emission (AE) testing using ultrasonic microphones to identify PD in liquid- and gas-filled insulation systems.
- Built-in, software-controlled signal conditioning and sensor power — no external amplifiers, attenuators, or filters required.

Technical Details

DOBLE IN-SERVICE TESTING & ASSESSMENT

SPARK P2

Universal Hand-Held Partial Discharge Surveyor

Specifications	
UHF Detector	Detector Bandwidth 56 MHz to 2GHz Gain Stages -20dB, 0dB, 20dB, 40dB Total Dynamic Range > 120dB Narrow-Band Tuner Bandwidth / RBW 6MHz Special Features Switchable 12VDC offset for external UHF sensor amplifiers
HF Detector	Detector Bandwidth 9 kHz to 56 MHz Gain Stages -20dB, 0dB, 20dB Total Dynamic Range > 120dB Narrow-Band Tuner Bandwidth /RBW 9kHz, 120kHz, 1MHz
UWB Detector	Integrative Charge Measurement Gain Stages -20dB, 0dB, 20dB Total Dynamic Range >120dB Detection Level (QIEC) <150fC f_{min} 100 kHz f_{max} 60 MHz
Acoustic Emission Detector	Gain Stages 0dB, 20dB f_{min} 1kHz f_{max} 1MHz Special Features Switchable 28VDC offset for sensors with integrated amplifiers
Reference Voltage Input / Sync	Gain Stages -40dB, -20dB, 0dB, 20dB f_{min} 0Hz (DC measurement) f_{max} 800Hz Special Features Radio frequency dongle sync (RF module plugged into 120V/230V AC to derive line sync, optional) Internal Sync Configurable oscillator (variable frequency)
Input Channels (BNC)	1x UHF 1x HF/UWB/Acoustic 1x Sync
Power Supply	110v/230V 2A to 12Vdc
Input Protection	50VAC

DOBLE IN-SERVICE TESTING & ASSESSMENT

SPARK P2

Universal Hand-Held Partial Discharge Surveyor

Mechanical	
Dimensions (WxHxD)	10 x 8 x 3.5 inches 25.4cm x 20.3cm x 8.9cm
Weight	Approximately 6 lbs / 2.7 kg

Environmental	
IP Rating	IP 67 (closed in travel case) IP 53 (outside of case)
Operating Temperature	-20° to + 50°C
Storage Temperature	-20° to +70°C

Power Supply	
	115-230 VAC 50Hz/60Hz, 1A (to 12VDC, 2A)
Battery	4 Li-ion batteries at 2 cells, 7.2 Volts, 3.35 Ah, 25Wh each Total capacity: 100 Wh

3.3 AQUILA

High Performance Partial Discharge Diagnostic System



Test Objective

A robust, compact, all-in-one portable PD detection station for on-field diagnostic sessions and periodic/semi-permanent assessment of cables and cable accessories, generators and motors, power and measurement transformers, GIS/AIS switchgear, and outdoor insulators (pollution assessment).

Key Features

- Up to 6 PD channels with full support for UWB TECHIMP T/F-Map technology (expandable from 3).
- Multiple connectivity: Wi-Fi (IEEE 802.11g) with Ethernet Fiber Optics for monitoring, Bluetooth for instrument setup, and USB for maintenance/firmware upgrade.
- Stands up to 8 hours of full working conditions per monitoring session; can also serve as a power source/battery charger for laptops.
- Fuzzy logic diagnostic tools and statistical processing; comes with PD Pro software for acquisition control and diagnostic visualization.
- Can be used to install a permanent monitoring system while maintaining ingress protection; fiber-optic connection allows networking multiple acquisition units.
- Wide range of compatible sensors and signal-conditioning kits, suitable for HVAC/MVAC/HVDC cable, motor, generator, PWM VSD, GIS/GIL/GIB, switchboards, MV/HV transformers, and TA/TV.

Technical Details

Parameter	Specification
PD Technology	UWB — PRPD / TF Map
PD Channels	3 biased UWB channels, expandable to 6
Bandwidth	16 kHz – 30 MHz, built-in UWB filter
Resolution / Dynamic Range	10 bit / 75 dB
Max. Sampling Frequency	100 MS/s
Input Voltage Range / Sensitivity	1–4000 mVpp / < 1.0 mVpp
Input Impedance	50 Ohm
Recording Time / Connectors	1 μ s (min) – 20 μ s (max) / BNC
Sync Channel	0.2–200 Vrms, 0.1–1000 Hz, 10 MOhm, BNC connector
Connectivity	WiFi (802.11g) + Ethernet Fiber Optics (monitoring); Bluetooth (setup); USB (maintenance/FM upgrade)

Casing	410 x 345 x 205 mm; < 12 kg; IP42 (closed) / IP30 (open)
Power Supply	100–240 VAC, 50/60 Hz; battery 2 x 10.8 V, 8 Ah with smart diagnostic system; autonomy > 8 hours
Accessory Outputs	5 V (max 5 W) via USB-A; 12 V (max 5 W) connector
Operating Environment	Temperature 0–60 °C (0–45 °C while charging); Humidity 90%, non-condensing
Software	PD Pro software platform for acquisition, visualization, and diagnostics

3.4 microAQUILA Portable

Ultimate Portable Solution for PD Assessment



Test Objective

Provides a complete, practical all-in-one PD detection station for on-field diagnostic campaigns, supporting both on-line testing (equipment in service, any voltage level) and off-line testing (with a 50/60 Hz generator connection) across MV/HV cables, power and distribution transformers, motors and generators, and GIS/MV switch gear.

Key Features

- Partial Discharge testing for all major asset types, using the right combination of sensors and filters.
- Innovative and patented T/F-Map software for PD recording and advanced analysis.
- Ultra Wide Band (UWB) fast integrated processing capability.
- Compact and lightweight PD pulse detector (under 10 kg).
- Connection via WiFi and Fiber Optics; independent power supply by power bank.
- Robust design suited to the toughest outdoor conditions, with simple, fast setup allowing measurements within minutes.

Technical Details

Parameter	Specification
PD Technology	UWB — PRPD / TF Map
PD Channels	3 based UWB channels, with power supply for active sensors
Bandwidth	16 kHz – 30 MHz, built-in UWB filter
Resolution / Dynamic Range	10 bit / 75 dB
Max. Sampling Frequency	100 MS/s
Input Voltage Range / Sensitivity	1–4000 mVpp / < 1.0 mVpp
Input Impedance	50 Ohm
Recording Time / Connectors	1 μs (min) – 20 μs (max) / BNC
Sync Channel	0.2–200 Vrms, 0.1–1000 Hz, 10 MOhm, BNC connector

Connectivity	Fiber Optics, WiFi
Casing	305 x 270 x 144 mm; < 10 kg; IP42 (closed) / IP30 (open)
Operating Environment	Temperature 0–60 °C (0–45 °C while charging); Humidity 90%, non-condensing
Power Supply	Power bank or external charger; USB-A accessory output 5 V (max 5 W)
Certifications	IEC 60270, EN 61326-1, EN 61010-1

Comparison: microAQUILA vs. AQUILA

Both instruments share the same core UWB PD-Technology and patented T/F-Map platform, but AQUILA scales up channel count, connectivity, and on-board power autonomy for longer or more demanding monitoring sessions.

Attribute	microAQUILA Portable	AQUILA
PD Channels	3 UWB channels (fixed)	3 UWB channels, expandable to 6
Casing / Weight	305 x 270 x 144 mm, < 10 kg	410 x 345 x 205 mm, < 12 kg
Power Supply	Power bank or external charger only	100–240 VAC mains; built-in rechargeable battery (2 x 10.8 V, 8 Ah), > 8 hours autonomy
Connectivity	Fiber Optics, WiFi	WiFi + Ethernet Fiber Optics (monitoring), Bluetooth (setup), USB (maintenance)
Extra Capability	None beyond core PD detection	Can power/recharge external laptops; can be used for a permanent monitoring installation
Software	T/F-Map® recording and analysis	PD Pro platform with fuzzy logic diagnostic tools and statistical processing
Best Fit	Lightweight, quick-turnaround field PD assessment	Extended monitoring sessions, semi-permanent assessment, wider sensor/application range

3.5 Falcon 4

On-Line Partial Discharge Monitoring



Test Objective

Provides continuous on-line PD monitoring for Condition Based Maintenance (CBM) of medium-voltage distribution electrical assets — switchgears, cables, transformers, and motors — giving early fault detection and minimizing costly unplanned outages.

Key Features

- Fast, reliable, and cost-effective continuous PD monitoring with non-intrusive installation.
- Automatic configuration, automatic PD-source separation, and automatic alarms — no need for expert skills.
- Exploits the patented TECHIMP T-F Map filter technology for pulse-shape based noise rejection and PD classification (internal PD, surface PD, noise).
- Compact, compact 4-channel acquisition unit with onboard diagnostics and onboard web-application GUI.
- Complete sensor set: HFCT sensor (high-frequency current transformer clamp, installable without taking equipment out of service) and TEV Antenna (maximizes sensitivity and ease of installation).
- Digital communication via RJ45 with IEC 62451 (OPC-UA) and IEC 61850 Ed. 1 protocols for integration with substation automation systems.

Technical Details

Parameter	Specification
Target Asset	Medium voltage assets: switchgears, cables, transformers, and motors
Measurement Type	Continuous on-line monitoring
PD Channels	4 channels; amplitude range 0.001–10 Vp; bandwidth 0.02–30 MHz; 12-bit resolution; 125 MSa/s sampling; 50 Ω input impedance; 5 MHz selectable high-pass filter; power over coax 9 Vdc, 0.2 A selectable
Sync Channel	1 channel; amplitude range 1–30 Vrms; bandwidth 5–500 Hz; 16-bit resolution; 1 MSa/s sampling; min. input impedance 1 M Ω
Communication	RJ45 port; protocols IEC 62451 (OPC-UA) and IEC 61850 Ed. 1
Power Supply	12–24 Vdc, max current 2 A
Dry Contacts	NC/NO configuration; max ratings 24 Vdc, 1 A
Graphical User Interface	Onboard web application
Sensors	HFCT sensor (current transformer clamp); TEV Antenna

3.6 PD3U

Partial Discharge Detector & RIV Testing System



Test Objective

Performs advanced partial discharge (PD) detection and radio interference voltage (RIV) measurements in high-voltage equipment. Enables precise insulation condition evaluation and defect localization even in noisy environments.

Key Features

- Integrated spectrum analyzer, PD detector, and RIV meter in one instrument.
- Selectable frequency range from 10 kHz to 10 MHz in 10 kHz steps.
- 4-channel measurement capability with MUX4 multiplexer.
- Noise-resistant PD measurements using frequency-band selection.
- Built-in voltage measurement and TTL gating for triggered noise cancellation.
- Complies with IEC 60270-2000, IEEE C57.12.90, and NEMA/CISPR standards.
- Stand-alone or computer-operated via USB interface.

Technical Details

Parameter	Specification
Input Power	100–240 VAC, 50/60 Hz (25 VA)
Temperature Range	10 °C – 40 °C
Dimensions / Weight	236 × 295 × 133 mm (9 3/8 × 11 1/2 × 5 1/4 in); 3 kg (7 lbs)
Reference Voltage Input	100 MΩ / 200 pF; Max 120 V rms; 10–500 Hz
PD Signal Input Impedance	50 Ω (without RPA preamplifier)
Display	Backlit LCD 240 × 128 dots
Synchronization	Internal (50/60 Hz) or External (10–500 Hz)
Interface	USB (up to 921 kB/s)
Measurement Modes	Spectrum, Scope, Meter, HVM
Built-in Functions	Voltage measurement, RIV reference input, auto-range, data storage
Accessories	RPA1 preamplifier, quadrupoles, CAL-4U calibrator, CT1 current transformer, DA1 disturbance antenna

3.7 PD2U

Partial Discharge Detector & RIV Testing System



Test Objective

Provides accurate, non-destructive evaluation of electrical insulation through partial discharge (PD) and radio interference voltage (RIV) measurements. Enables fast, reliable condition assessment for transformers, cables, motors, and other high-voltage equipment.

Key Features

- Compact, stand-alone design with push-button interface and LCD display.
- Multiple display modes: PD charge meter, phase-resolved PD pattern, and scope-like waveform view.
- Voltage measurement with waveform display and automatic calculation of $\hat{U}$, $\hat{U}/\sqrt{2}$, U_{rms} .
- Computer connectivity for screenshot capture and remote control.
- Optional modules: DSO board for cable PD fault location (100 M sample rate) and MUX4 for 4-channel testing.
- Complies with IEC 60270 standard for PD measurement.

Technical Details

Parameter	Specification
Input Power	100–240 VAC, 50/60 Hz (25 VA)
Temperature Range	10 °C – 45 °C
Dimensions / Weight	236 × 295 × 133 mm (9 3/8 × 11 1/2 × 5 1/4 in); 3 kg (7 lbs)
Reference Voltage Input	1 MΩ / 200 pF; Max 120 V rms; 20–510 Hz
PD Signal Input Impedance	50 Ω (without RPA preamplifier)
Frequency Cutoff	Low: 40–100 kHz
Display	Backlit LCD 240 × 128 dots
Synchronization	Internal (50/60 Hz) or External (15–510 Hz)
Interface	USB (up to 921 kB/s)
Environmental Conditions	10–40 °C, < 95 % RH non-condensing, altitude < 1000 m

HIGH POWER TEST SYSTEMS (FIELD/LABORATORY)

4.1 HIGH VOLTAGE TEST SETS

i. AC High Voltage Test Sets (15-200 kV)

Test Objective

Suitable for dielectric testing a wide range of electrical apparatus in the field or the laboratory. The 6CP and 6CB line offer a complete, mobile test system with a combination control/regulator enclosure and a separate high voltage section, ready to use with all power and interconnect cables included.



Key Features

- A premier line of AC dielectric test sets with ratings from 15 to 200 kV AC.
- Lightweight and ruggedly constructed for years of field use, with simple set-up and operation.
- Low partial discharge output (<10 pC standard, optional <3 pC up to 100 kV).
- Available with easy-to-read digital meters (6CP models) or a full-color touch screen display with data acquisition (6CB models).
- 6CP models feature advanced digital metering, Zero Start interlock, overload circuit adjustable from 10-110% of rated current, and guard mode for accurate current measurements.
- 6CB models feature a 7" full-color touch-screen display, USB data acquisition, WiFi control from PC, auto-ranging meters, breakdown/maximum voltage memory voltmeters, and adjustable rate of rise.
- High voltage section uses a specially designed oil-insulated transformer with a corona-free aluminum shielding electrode for superior PD performance.
- ISO 17025 calibration available upon request; backed by long-term warranty.

Technical Details

Parameter	Specification
Model Range	6CP/6CB 30/15-3, 50/10-3, 100/50-7.5, 120/60-7.5, 100/50-10, 120/60-10, 200/100-10
Voltage/Current (example: 200/100-10)	≈0-100 kV, 100 mA / ≈0-200 kV, 50 mA
Metering Accuracy	0.8% of reading + 0.2% of range
PD Level	<10 pC standard; optional <3 pC up to 100 kV
Duty Cycle (5 min ON/15 min OFF)	3 kVA to 10 kVA depending on model
Total Unit Weight (largest model)	660 lbs (300 kg) for 200/100-10
Environmental Conditions	10-40°C, indoor/outdoor in fair weather; humidity <95% non-condensing; altitude <3300 ft (1000 m)
Cables Included	Power, interconnect, meter, and ground cables included; lengths vary by model (10'-30')

ii. AC Dielectric Test Systems (0-500 kV)

Test Objective

Suitable for dielectric testing a wide range of electrical apparatus in the field or the laboratory.

The 6CP and 6CB line offers a complete, mobile test system with a combination control/regulator enclosure and a separate high voltage section, ready to use.

Key Features

- A premier line of AC dielectric test sets with ratings from 15 to 200 kV AC.
- Lightweight and ruggedly constructed for years of field use, with simple set-up and operation.
- Low partial discharge output (<10 pC standard, optional <3 pC up to 100 kV).
- Available with easy-to-read digital meters (6CP models) or a full-colored touch screen display with data acquisition (6CB models).
- 6CP models feature advanced digital metering, Zero Start interlock, overload circuit adjustable from 10-110% of rated current, and guard mode for accurate current measurements.
- 6CB models feature a 7" full-color touch-screen display, USB data acquisition, WiFi control from PC, auto-ranging meters, breakdown/maximum voltage memory voltmeters, and adjustable rate of rise.
- High voltage section uses a specially designed oil-insulated transformer with a corona-free aluminum shielding electrode for superior PD performance.
- ISO 17025 calibration available upon request; backed by long-term warranty.



Technical Details

Up to 100 kV

Power Ratings kVA 1 Hr ON / 1 Hr OFF (5 Min ON/15 Min OFF)	Voltage Rating kV	Output Current mA	Tank Type				Cylinder Type			
			Length inches mm	Width inches mm	Height inches mm	Weight lbs kgs	Length inches mm	Width inches mm	Height inches mm	Weight lbs kgs
7.5 (10)	30	250 (300)	28 712	28 712	47 1200	717 325	27 685	27 685	28 712	452 205
	50	150 (200)	28 712	28 712	47 1200	717 325	27 685	27 685	28 712	452 205
	75	100 (133)	34 850	28 712	49 1250	827 375	27 685	27 685	30 762	474 215
	100	75 (100)	36 902	28 712	54 1375	937 425	27 685	27 685	30 762	507 230
20 (30)	30	667 (1000)	28 712	28 712	47 1200	772 350	X	X	X	X
	50	400 (600)	31 790	28 712	47 1200	838 380	X	X	X	X
	75	267 (400)	34 864	28 712	52 1310	1058 480	X	X	X	X
	100	200 (300)	38 970	31 787	53 1350	1200 544	36 910	36 910	46 1170	1014 460
40 (60)	30	1333 (2000)	30 762	28 712	47 1200	1058 480	X	X	X	X
	50	800 (1200)	30 762	28 712	47 1200	1058 480	X	X	X	X
	75	533 (800)	36 927	35 890	52 1325	1874 850	X	X	X	X
	100	400 (600)	38 965	35 890	61 1550	2039 925	39 990	39 990	46 1170	1500 680
60 (85)	30	2000 (2833)	35 890	28 712	47 1200	1257 570	X	X	X	X
	50	1200 (1700)	34 864	32 813	52 1310	1433 650	X	X	X	X
	75	800 (1133)	41 1053	36 927	56 1430	1951 885	X	X	X	X
	100	400 (850)	41 1053	38 965	61 1550	2403 1090	39 990	39 990	50 1270	2094 950
100 (140)	30	3000 (2000)	38 977	34 876	47 1200	1984 900	X	X	X	X
	50	2000 (2800)	36 902	32 813	49 1250	1984 900	X	X	X	X
	75	1333 (1867)	40 1016	38 965	59 1500	2810 1275	X	X	X	X
	100	1000 (1400)	50 1270	46 1170	65 1650	3858 1750	43 1100	43 1100	57 1450	2976 1350
200 (280)	50	4000 (5600)	48 1220	38 965	52 1310	2866 1300	X	X	X	X
	100	2000 (2800)	50 1270	50 1270	65 1650	4519 2050	X	X	X	X
300 (420)	100	3000 (4200)	50 1270	50 1270	65 1650	4519 2050	X	X	X	X

Above 100 kV

20 (30)	150	133 (200)	47 1200	32 813	98 2500	2425 1100	41 1040	41 1040	58 1470	1808 820
	200	100 (300)	83 2100	42 1066	98 2500	4300 1950	41 1040	41 1040	61 1550	2315 1050
40 (60)	150	266 (400)	80 2030	36 927	95 2415	3153 1430	52 1325	52 1325	61 1550	3748 1700
	200	200 (300)	112 2844	44 1118	106 2695	4850 2200	52 1325	52 1325	61 1550	3748 1700
60 (85)	150	400 (566)	65 1651	40 1016	96 2438	3748 1700	58 1475	58 1475	62 1575	4189 1900
	200	300 (425)	134 3400	46 1170	84 2134	5511 2500	58 1475	58 1475	62 1575	4189 1900
	300	200 (283)	83 2120	54 1360	160 4075	10,582 4800	58 1475	58 1475	90 2290	5511 2500
100 (140)	150	667(933)	103 2616	46 1170	81 2060	4795 2175	50 1270	50 1270	64 1625	3637 1650
	200	500 (700)	152 3850	55 1385	69 1750	7385 3350	57 1450	57 1450	77 1950	5400 2450
	300	334 (467)	145 3685	60 1525	162 4125	14,000 6350	65 1660	65 1660	88 2240	7937 3600
200 (280)	200	1000 (1400)	128 3260	57 1460	113 2870	10,692 4850	70 1780	70 1780	81 2050	8377 3800
	300	667 (933)	111 2825	63 1590	172 4370	14,991 6800	70 1780	70 1780	95 2420	10,141 4600
	400	500 (560)	246 6240	72 1820	138 3500	21,825 9900	84 2130	84 2130	122 3100	16,755 7600
300 (420)	200	1500 (2100)	128 3260	57 1460	113 2870	10,692 4850	70 1780	70 1780	81 2050	8818 4000
	300	1000 (1400)	175 4450	69 1760	151 3830	21,164 9600	70 1780	70 1780	95 2420	10,582 4800
	400	750 (1050)	146 3708	72 1820	237 6010	24,250 11000	84 2130	84 2130	122 3100	16,755 7600
	500	600 (840)	102 2600	114 2900	326 8280	41,888 19000	87 2210	87 2210	170 4320	25,794 11700
400 (585)	300	1333 (2000)	228 5800	72 1820	201 5100	20,945 9500	73 1850	73 1850	98 2500	13,007 5900
	400	1000 (1426)	228 5800	72 1820	201 5100	24,250 11000	84 2130	84 2130	126 3200	21,164 9600
	500	800(1170)	107 2720	115 2920	326 8280	46,297 21000	87 2210	87 2210	170 4320	28,660 13000
500 (710)	500	1000 (1420)	115 2920	115 2920	326 8280	50,706 23000	87 2210	87 2210	170 4320	31,967 14500

iii. Portable DC Hipots

Test Objective

Perform accurate DC hipot (dielectric withstand) testing of electrical switchgear, cables, motors, generators, and protective equipment, across a 40–160 kV output range.

Key Features

- High voltage generated by a filtered high voltage doubler circuit (built by Phenix), equivalent to full-wave rectification, with very low ripple (<2% RMS at full output).
- All high voltage components are housed in an oil-filled, aluminum-sealed, grounded dead tank; shielded high voltage output cable for safe connection to the test object.
- High mA charging current standard on all models, allowing quick, efficient charging of large capacitive loads; a solenoid-operated discharge switch rapidly discharges the load after testing.
- Digital multi-range metering (3½ digit, 0.5% of full scale) for output voltage and leakage current, plus an analog meter dedicated to leakage-current reading; meters calibrated with NIST-traceable standards.
- Safety features: circuit breaker protection, external interlock provision, HV ON/OFF pushbuttons with indicators, zero-start interlock, adjustable overload circuit with indicator/reset, slow- and fast-acting transient protection, guard mode for accurate current measurement, and a built-in discharge circuit.
- Negative output, positive ground on all models; all control and power cables included, along with cable storage provision.
- Options: GS100-2 (100 kV) or GS160-2 (160 kV) ground stick, DS100-2 discharge stick (100 kV, 100 kΩ, 50 kJ), safety foot switch, positive polarity output, custom cable lengths, hand cart (for 4120-10 and 4160-5), and calibration certificate with data.



Technical Details

Model	DC Output	Continuous Charging	Internal Discharge	Weight (Controls)
440-20	0–40 kV, 20 mA	20 mA	3 kJ	50 lbs (23 kg)
475-20	0–75 kV, 20 mA	20 mA	6 kJ	59 lbs (27 kg)
4100-10	0–100 kV, 10 mA	10 mA	6 kJ	98 lbs (44 kg)
4120-10	0–120 kV, 10 mA	10 mA	12 kJ	33 lbs (15 kg)
4160-5	0–160 kV, 5 mA	5 mA	12 kJ	33 lbs (15 kg)

iv. DC Dielectric Test set

Stackable, Air-Insulated DC Hipot Systems, 100-600 kV

Test Objective

Performs precise DC hipot testing of electrical switchgear, cables, motors, generators, and protective equipment. Offers modular DC hipots with 1 to 6 stackable modules mounted on a mobile base, generating DC voltage in 100 kV increments up to 600 kV DC.



Key Features

- Lightweight and rugged design for ease of mobility, with an expandable, air-insulated architecture.
- Each module rated for 5 mA, air insulated, with AN (Air-Natural, Convection) cooling; both models offer reversible polarity.
- Each system includes a base with casters, corona rings, a control cabinet, a regulator cabinet, and the required number of modules for the desired voltage.
- Stackable modules use a unique spring-loaded contact design with no wires between modules.
- Zero Start interlock, external interlock provision, and motorized control of output voltage.
- Multi-range digital metering with a guard circuit to eliminate stray leakage current from the specimen under test; ripple less than 5%.
- Large 10" full-color touch screen display with Ethernet port for remote PC automation.
- Optional accessories include computerized controls, discharge device, HV series resistor, ground stick, discharge stick, and reusable shipping containers.

Technical Details

Parameter	Specification
Models Available	4100-5ST-100, 4200-5ST-100, 4300-5ST-100, 4400-5ST-100, 4500-5ST-100, 4600-5ST-100 (100-600 kV DC)
Output per Module	5 mA, air insulated, reversible polarity
Ripple	<5%
Accuracy	$\pm(0.8\% \text{ of reading} + 0.2\% \text{ of range} + \text{LSD})$
Duty Cycle (Capacitive Loads)	30 minutes ON / 60 minutes OFF at full rated output
Duty Cycle (Resistive Loads)	5 minutes ON / 15 minutes OFF at full rated output
Environmental Conditions	10-40°C, indoor/outdoor in fair weather; humidity <95% non-condensing; altitude <3300 ft (1000 m)
Cables Included	Power interconnect 50' (15 m), meter interconnect 50' (15 m), control interconnect 50' (15 m); input power cable optional

v. Ultra-High Voltage DC Dielectric Test Systems

Cascaded, Stackable DC Power Supplies for HVDC Testing (up to 1500 kV)

Test Objective

Provides ultra-high voltage DC dielectric test systems and power supplies for insulation testing of cables, transformers, insulators, bushings, and HVDC valves, as well as utility HV power supply applications such as R&D testing, miscellaneous evaluations, and educational demonstrations. Suitable for HVDC withstand testing and partial discharge measurements on HVDC transmission equipment.



Key Features

- Stackable multiple modules in 300 kV or 500 kV increments, enabling configurations up to 1500 kV.
- Low partial discharge (PD) specification for clean, accurate HVDC testing.
- High charge current ratings and low ripple voltage output via a cascaded full-wave voltage doubler design.
- Fast motorized polarity reversal for efficient bipolar testing.
- Internal voltage divider for direct voltage measurement per IEEE Standard 4 and IEC 60060-2.
- Combination divider, discharge, and grounding device, with optional discharge device, grounding switch, and PD measurement capacitors.
- Output series resistor included as standard; castors or air pallet available for mobility.
- Available with smooth-surface FRP insulator housing (laboratory use) or ribbed composite housing (industrial environments).
- PC software package included for data acquisition and report generation.

Technical Details

Parameter	Specification
Model 4CC300-20	300 kV, 1 module (300 kV), up to 20 mA / 10 mA continuous, 12' height, 1.5 t
Model 4CC500-20	500 kV, 1 module (500 kV), up to 20 mA / 10 mA continuous, 15' height, 2 t
Model 4CC600-20	600 kV, 2 modules (300 kV each), up to 20 mA / 10 mA continuous, 25' height, 3 t
Model 4CC1000-20	1000 kV, 2 modules (500 kV each), up to 20 mA / 10 mA continuous, 32' height, 4.5 t
Model 4CC1200-20	1200 kV, 4 modules (300 kV each), up to 20 mA / 10 mA continuous, 27' height, 5 t
Model 4CC1500-20	1500 kV, 3 modules (500 kV each), up to 20 mA / 10 mA continuous, 41' height, 8 t
Model 4CC500-50	500 kV, 1 module (500 kV), up to 50 mA / 20 mA continuous, 15' height, 3.5 t
Model 4CC1000-50	1000 kV, 2 modules (500 kV each), up to 50 mA / 20 mA continuous, 27' height, 7 t
Model 4CC1500-50	1500 kV, 3 modules (500 kV each), up to 50 mA / 20 mA continuous, 41' height, 10.5 t

Vi. Combined AC/DC High Voltage Test Set Test Set

50 kV AC/70 kV DC or 100 kV AC/120 kV DC Mobile Dielectric Test Systems

Test Objective

Performs both AC and DC dielectric testing of a wide range of electrical apparatus using a mobile, 3-piece design with hand cart, ruggedly constructed for indoor and outdoor use with simple set-up and operation.



Key Features

- Mobile 3-piece design with hand cart; ruggedly constructed for both indoor and outdoor use.
- Simple set-up and operation, with ISO 17025 calibration available upon request.
- Circuit breaker protection, external interlock provision, and Zero Start Interlock.
- High voltage On/Off pushbuttons with indicator and manual control of output voltage.
- Adjustable overload circuit with output overload indicator and reset switch.
- Slow and fast-acting transient protection on all meters and relays.
- Digital timer with audible alarm and Emergency Off pushbutton with key lockout.
- Guard mode for accurate current measurements and direct metering of the output.

Technical Details

Parameter	Specification
Model 46CP50/70-2/10 Output	~0-50 kV AC, 40 mA / ~0-70 kV DC, 10 mA; negative output, positive ground
Model 46CP100/120-3.75/10 Output	~0-100 kV AC, 37.5 mA / ~0-120 kV DC, 10 mA; negative output, positive ground
Metering Accuracy	±(0.8% of reading + 0.2% range)
Duty Cycle	5 min ON / 15 min OFF at 2 kVA (50/70 model) or 3.75 kVA (100/120 model)
Total Unit Weight	278 lbs (127 kg) for 46CP50/70-2/10; 348 lbs (158 kg) for 46CP100/120-3.75/10
Cables Included	Input power 30' (9 m); power, meter, and divider interconnects 20' (6 m); ground (2) and return 20' (6 m)
Environmental Conditions	10-40°C, indoor/outdoor in fair weather; humidity <95% non-condensing; altitude <3300 ft (1000 m)
Options	KVM metering head, positive polarity output, ISO 17025 calibration, flashing light options, ground stick



4.2 High Current Test Sets

Test Objective

Test virtually any low voltage, molded case, or metal-clad direct-acting AC circuit breaker by simulating overload and fault conditions; test current transformers and thermal or magnetic motor overload relays; and, when configured in series, support substation maintenance and primary injection testing on high voltage circuit breakers and protective relays. Output range: 12,000–75,000 A.

Key Features

- Fully automated testing via WIN HC software with database and report capabilities, test duplication/recall, and current waveform display.
- Precise, repeatable current pulses with minimal distortion and DC offset, achieved by combining highly reliable SCRs with a computer-controlled, programmable phase-angle firing system.
- Five testing modes: Normal (manual), Jog-to-Hold, Jog-to-Trip, Current Hold (within 1% of set amps), and Memory (recalls sensitivity pickup current when stopped).
- Continuously variable output across the entire test range via a motorized vernier and programmable tap selector, supporting both auto-jog and current-hold operation.
- Current waveform display allows visual detection of DC offset or contact bounce; offset can be corrected by adjusting the firing phase angle.
- Safety features: circuit breaker protection, interlock-open indicator, Emergency Off push button, and a digital AC voltmeter for monitoring input/output/external voltage up to 600 VAC.
- Standard HCSS1 and HCSS2 output stabs supplied; six additional optional stab styles (HCSS3–HCSS8) accommodate different breaker terminal geometries.
- ISO17025 calibration available upon request; optional multi-tap input autotransformer, stab plate adapter for series connection, external printer, and protective dust cover.

Technical Details

Model	Input	No. of Taps	Continuous (Parallel/Series)	1 sec ON/2 min OFF (Parallel/Series)
HC-1	120 VAC, 20 A 230 VAC, 10 A	4	N/A (1,000 A overload)	N/A
HC-2	120 VAC, 20 A 230 VAC, 12 A	4	N/A (2,000 A overload)	N/A
HC-3	230 VAC, 25 A	4	N/A (3,000 A overload)	N/A
HC-5	230 VAC, 50 A	3	N/A (5,000 A overload)	N/A
HC-12C	240 V, 60 A, 60 Hz	3	1,200 A / 600 A	12,000 A / 6,000 A
HC-20C	240 V, 150 A, 60 Hz	4	2,000 A / 1,000 A	20,000 A / 10,000 A
HC-40C	240 V, 320 A, 60 Hz	6	4,000 A / 2,000 A	40,000 A / 20,000 A
HC-75C	480 V, 400 A, 60 Hz	8	7,500 A / 3,750 A	75,000 A / 37,500 A

4.3 Transformer Test Systems

Test Objective

Verify a manufacturer's test and design data prior to installation, confirm condition after repair or upgrade, assess a transformer following a major disruptive event (e.g., a lightning strike), and support preventive/predictive maintenance. Standard tests include excitation current measurement, excitation loss (core loss), impedance voltage measurement, full load current, copper loss (load loss), and temperature measurement, performed to ANSI C57 / IEC 76 (60076) standards.



Key Features

- Consists of a variable power supply, step-up transformer, and high-accuracy metering package controlled by an industrial microprocessor / PLC — reprogrammable rather than requiring rewiring when features change.
- Optional additional testing capability: Applied Potential Test, Induced Potential Test, Winding Resistance Measurement, Turns Ratio (and Phase Displacement), and Insulation Resistance.
- Voltage regulation uses a toroidal-type regulator on smaller systems and a column-type regulator (Phenix CTVT) on larger systems; a variable-frequency power supply option supports higher frequencies needed for induced testing.
- Safety features: zero-start interlock, Emergency Off mushroom switch, slow/fast-acting protective devices, foot switch, external security circuit provision, flashing red warning light, and recessed jacks for output leads.
- Instrumentation: 4½–6-digit True RMS/Average voltmeters and ammeters ($\pm 0.5\%$ of reading + LSD), auto-ranging wattmeter (accuracy degrading at low power factor: $\pm 0.5\%/\pm 1.5\%/\pm 3.0\%$ at PF 1.0/0.3/0.1), and a 4½-digit thermometer ($\pm 1^\circ\text{C}$).
- WIN TTS Windows-based software builds a database of transformer test results, generates final test reports, and includes a recipe database to recall previously used test templates.
- Optional system components include capacitive compensation banks, motor-generator sets for induced potential testing, AC dielectric transformers for applied potential (hipot) testing, PATTR-03D turns-ratio/phase-displacement meters, winding resistance ohmmeters, and remote control consoles.
- Fully automated test systems are available for high-volume distribution transformer testing, reducing total test time to as low as ~90 seconds per transformer.

Technical Details — Single/Three-Phase TTS

Model	Phase	Max Testing Capability	Dimensions (WxDxH)	Weight
TTS30-1	1-phase	500 kVA	48x63x73"	2,400 lbs (1,090 kg)
TTS50-1	1-phase	833 kVA	48x63x77"	2,700 lbs (1,225 kg)
TTS100-1	1-phase	1,667 kVA	58x84x98"	5,400 lbs (2,455 kg)
TTS35	3-phase	500 kVA	48x63x73"	2,600 lbs (1,180 kg)
TTS65	3-phase	1,000 kVA	48x63x77"	3,000 lbs (1,365 kg)
TTS100	3-phase	1,500 kVA	58x84x98"	5,400 lbs (2,452 kg)
TTS155	3-phase	2,500 kVA	58x84x98"	6,000 lbs (2,725 kg)

Table 7 — TTS model range (brochure 20203). Ratings based on 6.25% transformer impedance, 25% duty cycle (5 min ON / 15 min OFF).

Model Comparison — Three-Phase Transformer Test Systems

Model	Class	Heat Run Test Capability (kVA)	Max Test Capability (kVA)	Approx. Weight
TTS35	Distribution <34 kV	290	580	2,150 lbs (975 kg)
TTS65	Distribution <34 kV	500	1,000	2,650 lbs (1,202 kg)
TTS100	Distribution <34 kV	825	1,650	3,400 lbs (1,542 kg)
TTS155	Distribution <34 kV	1,300	2,580	3,600 lbs (1,633 kg)
TTS175	Distribution <34 kV	1,450	2,900	4,000 lbs (1,814 kg)
TTS200	Distribution / Power <72 kV	1,650	3,300	4,800 lbs (2,177 kg)
TTS250	Power <72 kV	4,075	4,150	regulator + oil transformer (see brochure)
TTS500	Power <72 kV	4,150	8,300	regulator + oil transformer (see brochure)
TTS750	Power <72 kV	6,250	12,500	regulator + oil transformer (see brochure)
TTS1000	Power <72 kV	8,250	16,500	regulator + oil transformer (see brochure)



4.4 Liquid Dielectric Test Sets

Test Objective

Measure the breakdown voltage of insulating liquids used in transformers, capacitors, bushings, and related high voltage equipment, in accordance with ASTM D1816, ASTM D877, IEC 60156, BS 148, VDE 0370, and other applicable standards.

Key Features

- Semi-automatic operation: the oil sample is placed in the test cell, loaded into the interlocked test compartment, the rate of rise is selected, and the unit automatically raises voltage until breakdown; a memory voltmeter holds the breakdown voltage reading.
- Lightweight, ruggedly constructed cases suited to years of field or lab use; transparent, limit-switch-interlocked compartment cover for operating safety.
- Selectable rate of rise (500 / 2,000 / 3,000 V/sec, or variable, depending on test cell type/standard).
- Center-tapped high voltage transformer, fast-acting relay for immediate cutout at flashover, zero-start interlock, and dedicated AC-power and breakdown-indicator lamps.
- Interchangeable test cells available for each standard: Type TC/DE (ASTM D877), TC/VDE (ASTM D1816, motorized with stirrer), TC/IEC (IEC 60156), and TC/BS (BS 148), each with its own electrode geometry, gap setting, and rate of rise.
- Optional Liquid Dielectric Comparison Unit (LDCU) — a passive-analog-voltmeter accessory used to verify LD voltmeter calibration before testing or as a periodic standard.
- ISO17025 calibration available upon request.

Technical Details

Model	Output Voltage	Max Voltage to Earth	Weight	Shipping Weight
LD60	0–60 kV @ 500 VA	30,000 V	51 lbs (23 kg)	63 lbs (29 kg)
LD75	0–75 kV @ 500 VA	37,500 V	120 lbs (54 kg)	220 lbs (100 kg)
LD100	0–100 kV @ 500 VA	50,000 V	135 lbs (61 kg)	230 lbs (104 kg)



4.5 ACR Test Sets

Test Objective

Verify the proper operation of automatic circuit reclosers under simulated fault conditions, efficiently test virtually all single- or three-phase direct-acting reclosers and sectionalizers, and perform primary injection testing of electronically controlled reclosers.

Key Features

- Complete computer control provides fully automated test procedures, with the WIN RCL software and desktop computer included.
- Performs and records five distinct tests: Minimum Trip Current, Time/Current Characteristics, Sequence of Operations, Operating Times, Reclosing Times, Total Clearing Time, and a Sectionalizes Lockout Test.
- High-accuracy measurement of circuit behavior with full waveform representation and true RMS value of the current pulse.
- Template library lets the operator re-use common recloser test settings (including tap and vernier position), eliminating manual output-current adjustment for every unit tested.
- Electronic storage of all recloser/sectionalizes test history, with sortable/searchable results and on-screen report preview before printing.
- Safety features: circuit breaker protection, overload and over-temperature protection, short-circuit protection, red/green output current indicator, automatic output termination if lock-out time is exceeded, and an Emergency Off pushbutton.
- Optional TCC (Time-Current-Curve) software compares test results to factory specifications for instant go/no-go results; ISO17025 calibration available on request.

Technical Details

Spec	RCL-19	RCL-47
Power rating	19 kVA	47 kVA
Input (typical)	208–220 V / 100 A, 60 Hz	440 V / 125 A, 60 Hz
Highest tap output	0–7.5 VAC @ 2,500 A	0–7.5 VAC @ 2,500 A
Lowest tap output	0–600 VAC @ 32 A	0–600 VAC @ 78 A
Dimensions (LxWxH)	57x30x44"	61x34x48"
Weight	1,500 lbs (680 kg)	1,835 lbs (832 kg)

4.6 Insulating Material Test Sets

Automatic Dielectric Breakdown Test Set for Insulating Materials

PLC-Controlled AC/DC Dielectric Breakdown Test System, up to 100 kV



Test Objective

Designed to measure dielectric breakdown and dielectric strength of a wide range of solid electrical insulating materials, at commercial power frequencies, within the ASTM D149 and IEC 60243-1 standards as well as other comparable international standards.

Key Features

- Standard output voltages up to 100 kV AC and DC, housed in a rugged, mobile steel cabinet with an integrated test chamber.
- Programmable Logic Controller (PLC) and Operator Terminal control all aspects of test sequences, with selectable automatic or manual operating modes.
- Programmable rate of rise, over-voltage preset, and peak-reading memory voltmeter.
- Test chamber includes a safety interlock, stress relief shielding, and a transparent door; circuit breaker protection plus fast-acting and thermal overload protection.
- Over-current trip point adjustable from 10% to 110% of rated output current.
- 600C Series controls provide auto-ranging voltage/current display ($\pm 0.8\%$ of reading + 0.2% of range + LSD), failure memory voltmeter, auto-step and auto-cycle functions, motorized regulator, variable ramp rate, Ethernet port, and graphic display.
- Software package allows test parameters or previous test “recipes” to be entered or recalled for easy duplication, with graphical display and storage of real-time voltage, current, dwell, and duration results (computer not included).
- A wide variety of test fixtures (TF1-TF6) with electrodes are available, including opposing cylinders, cylinder rods, flat plates, and hemispherical electrodes.
- Options include non-heated or heated oil bath for test fixtures, combination AC/DC or DC-only units, ground stick, and discharge stick (100 kV, 100 k Ω , 50 kJ).

Technical Details

Parameter	Specification
Models Available	AC: 6CC20-0.8/D149, 6CC50-2/D149, 6CC100-5/D149; AC/DC: 6TC4100-10/50-2/D149; DC: 4TC40-10/D149, 4TC100-10/D149
AC Output (6CC series)	6CC20-0.8: $\approx 0-20$ kVAC, 40 mA / $\approx 0-3$ kVAC, 100 mA — 6CC50-2: $\approx 0-50$ kVAC, 40 mA / $\approx 0-5$ kVAC, 100 mA — 6CC100-5: $\approx 0-100$ kVAC, 50 mA / $\approx 0-10$ kVAC, 100 mA
AC/DC Output (6TC4100-10/50-2)	$\approx 0-50$ kVAC, 40 mA / $\approx 0-100$ kVDC, 10 mA
DC Output	4TC40-10: $\approx 0-40$ kVDC, 10 mA — 4TC100-10: $\approx 0-100$ kVDC, 10 mA
Input (6CC series)	6CC20-0.8: 120 V, 12 A / 230 V, 7 A — 6CC50-2: 120 V, 23 A / 230 V, 13 A — 6CC100-5: 230 V, 25 A; single phase, 50 or 60 Hz
Duty Cycle (6CC series, 1 hr ON/1 hr OFF)	0.8 kVA (6CC20-0.8), 2.0 kVA (6CC50-2), 5.0 kVA (6CC100-5) — continuous for breakdown testing

Parameter	Specification
Overall Dimensions & Weight (6CC series)	6CC20-0.8 & 6CC50-2: 52" L x 30" W x 68" H, 550-600 lbs (249-272 kg) — 6CC100-5: 62" L x 35" W x 68" H, 1050 lbs (476 kg)
Test Chamber Dimensions (6CC series)	6CC20-0.8 & 6CC50-2: 29" L x 26" W x 22" H — 6CC100-5: 34" L x 31" W x 22" H
Duty Cycle (AC/DC & DC series, 1 hr ON/1 hr OFF)	6TC4100-10/50-2: 2.0 kVA — 4TC40-10: 400 W — 4TC100-10: 1000 W
Standards Compliance	ASTM D149 and IEC 60243-1, plus other comparable international standards

4.7 Resonance Test Sets

AC Resonant Test Systems

Test Objective

Measure the dielectric breakdown and dielectric strength of electrical equipment and insulating materials at commercial power frequencies, for loads that are largely capacitive with low loss such as power cables, gas insulated switchgear, generator windings, motors, and dry tests of insulator strings.



Key Features

- Ratings from 15 kV to over 2,000,000 V, at 50 or 60 Hz.
- Variable Inductance systems and Variable Frequency systems covering 20 to 300 Hz.
- High Q ratings for low input current requirements; Dead Tank and Insulated Cylinder reactor designs.
- Series and Parallel Resonance configurations; computer-assisted controls with user-friendly software.
- Stand-alone systems for factory/laboratory use, or transportable skid- or truck-mounted systems for outdoor use.
- All systems consist of two main components, a High Voltage Reactor and a Regulator, with controls contained in the regulator cabinet or a separate console; an adjustable electronic overload circuit, input circuit breaker, and backup overload protection guard against flashovers and short circuits.
- Major advantages over conventional AC dielectric test sets: much lower input power (input power required = output power / test circuit quality factor “Q”, often > 100 at full load in GIS testing), low fault energy compared to transformer sources, low distortion test voltage (typically < 1% total harmonic distortion), excellent mains noise rejection for PD measurements, and reduced test equipment size and weight.
- Options include partial discharge testing and tan δ measurements; transportable variable-frequency versions are available for field testing of installed power cables or generator windings.

Technical Details

Parameter	Specification
Voltage Rating	15 kV to over 2,000 KV
Frequency	50 or 60 Hz (Variable Inductance); 20–300 Hz (Variable Frequency)
Reactor Design	Dead Tank or Insulated Cylinder
Resonance Configuration	Series or Parallel
Main Components	High Voltage Reactor and Regulator
Mounting	Stand-alone (factory/lab) or transportable skid-/truck-mounted (outdoor)
Total Harmonic Distortion	Typically < 1%

4.8 Cable Heat Cycling Test Sets

Test Objective

Perform type testing of power cable samples in accordance with applicable international standards (IEC, IEEE, IPCEA, AEIC, VDE, EDF) using low voltage, high current inductive heating of cable samples and accessories; heated cable can be simultaneously stressed with DC or AC high voltage as well as impulse voltage with necessary options or additional equipment.



Key Features

- Standard models available up to 6,000 Amps, with indoor/outdoor units, automated controls, and temperature regulating controls.
- Computerized controls (industrial microprocessor, HMI, and communications port) implement metering, timing, and setpoint functionality, allow programming of complex custom sequences, and support data acquisition and report generation with a PC.
- Heating transformers are constructed of high quality grain-oriented laminated core steel with copper primary windings protected by barriers from the cable under test; carts cool via natural air convection.
- SCR (Silicon Control Rectifier) systems offer faster rise time, instantaneous return to zero, and a compact, easily maneuvered design, but are not compatible with capacitive compensation; Regulator (variable autotransformer) systems produce a true sine wave over the full output range, operate at very low impedance, support master-slave setups, and accept capacitive compensation to lower input power and cost.
- Three temperature-regulation methods: Method 1, thermocouple bonded to the outer insulation with conductor temperature previously calculated; Method 2, an optional fiber optic probe in physical contact with the center conductor; and Method 3, a shorter control loop (no applied high voltage) paired with a longer test loop, with the control system holding the same current in both loops.
- Safety and design features: input circuit breaker, precision output metering, zero start interlock, thermal overload protection, overcurrent protection, on/off pushbuttons, heavy duty casters for mobility, and an operation and maintenance manual.
- For long testing loops (cable accessories such as splices, terminations, and joints can require loops in excess of 200 m), multiple carts can be connected in series — for example, 5 x LVTS20-5000 carts to make a 100 V, 5,000 A loop.

- Options: transformer cart upgrade with painted fiberglass covers for outdoor operation, a removable top yoke so cable can be laid into the window instead of fed through it, and rectifiers for DC output at typically lower output voltages.
- Rated for 10–40°C, indoor/outdoor in fair weather, humidity < 95% non-condensing, altitude < 3,300 ft (1,000 m).

Technical Details

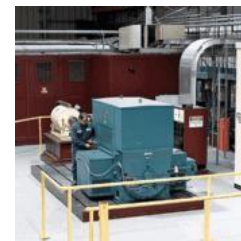
Model	kVA	Current	Voltage (60 Hz)	Voltage (50 Hz)	Cart Weight
LVTS15-2000	30/36	0–2000 A	0–18 V	0–15 V	602 lbs (273 kg)
LVTS30-3000	90/108	0–3000 A	0–36 V	0–30 V	1,280 lbs (580 kg)
LVTS25-4000	100/120	0–4000 A	0–30 V	0–25 V	1,435 lbs (650 kg)
LVTS20-5000	100/120	0–5000 A	0–24 V	0–20 V	1,708 lbs (775 kg)
LVTS17-6000	100/120	0–6000 A	0–20 V	0–17 V	1,708 lbs (775 kg)

4.9 Motor Test Sets

High Power Motor Test Set

Test Objective

Perform load and no-load testing of AC and DC motors, including traction motors, synchronous motors, induction motors, and shunt-, compound-, and series-wound motors. Systems are scalable from fractional horsepower up to 50,000 HP, serving motor manufacturers, motor service shops, industrial plants, electric utilities, and government installations.



Key Features

- AC, DC, or AC/DC test system configurations with medium or low voltage input options and output power up to 10,000 kVA.
- Configurations allow testing of a 10,000 HP motor at full load and 50,000 HP at no load.
- Precision voltage regulation via the Phenix Column Type Variable Transformer (CTVT) — no sliding contacts to wear or bind, and no sensitive power electronics that can fail and damage windings.
- “R2” design provides uninterrupted full-range voltage regulation, so the motor does not slow down during tap changes (critical when starting motors above 10,000 HP).
- Independent, automated three-phase voltage balancing is standard on MTS-R2 units and optional on standard MTS-R units — essential for accurate efficiency measurements.
- Manual operation through fully automated testing, with PHENIX WINMTS software for customer/motor database storage, test result storage, display, and printout; compatible with ACS motor shop software.
- Standard control functions: main/control power breakers, HV ON/OFF and Emergency OFF pushbuttons, ground fault reset, raise/lower voltage, ramp speed control, tap select, HV interlock key-switch, regulator overload protection, and thermostatically controlled cooling fans.
- Instrumentation accuracy of $\pm 0.5\%$ of range $\pm$ least significant digit on standard 5-digit voltage/current meters; optional DC armature/field metering, three-phase wattmeter, vibration monitor (0–10.00 mil / 0–0.3 in/sec, $\pm 1\%$), temperature meter (0–200°C, $\pm 1^\circ$), and tachometer (0–9,999 RPM, ± 1 RPM).

- Heavy-duty NEMA 1 steel cabinet with removable panels, lifting eyes, and fork-lift slots; ISO 9001 compliant design-through-production quality process.
- Options: additional output taps, AC phase reversal switch, DC armature/shunt field and series field power supplies, synchronous motor shorting switch, wattmeter, remote control console, remote output cubicle, swivel jib boom, and dynamometer interface.

Standard MTS-R Series vs. MTS-R2 Series

The Standard MTS-R Series covers low voltage input (up to 600 VAC) applications up to 2,500 kVA / 12,500 HP no-load, while the MTS-R2 Series is built for medium voltage input (up to 14.4 kVAC) and very high power applications up to 10,000 kVA / 50,000 HP no-load. Sizing rule of thumb: approximately 1 HP per kVA for full-load testing and 5 HP per kVA for no-load testing.

Model	Full Load (HP)	No Load (HP)	Max Tap Voltage (V)	Max Tap Current (A)
MTS300R	300	1,500	14,400	400
MTS500R	500	2,500	14,400	800
MTS750R	750	3,750	14,400	1,200
MTS1000R	1,000	5,000	14,400	1,200
MTS1250R	1,250	6,250	14,400	1,200
MTS1500R	1,500	7,500	14,400	1,200
MTS2000R	2,000	10,000	14,400	1,200
MTS2500R	2,500	12,500	14,400	1,200

Table 1 — Standard MTS-R Series (AC testing capability; input 600 V max, low voltage service). DC testing capability is available as an option at reduced HP ratings.

Model	Full Load (HP)	No Load (HP)	Max Tap Voltage (V)	Max Tap Current (A)
MTS2000R2	2,000	10,000	14,400	1,200
MTS3000R2	3,000	15,000	14,400	1,200
MTS3750R2	3,750	18,750	14,400	1,200
MTS5000R2	5,000	25,000	14,400	1,200
MTS6500R2	6,500	32,500	14,400	1,750
MTS7500R2	7,500	33,000	14,400	1,750
MTS10000R2	10,000	40,000	14,400	1,750

Table 2 — MTS-R2 Series (very high power; medium voltage input up to 15 kV L-L, output up to 14.4 kV L-L).

Motor Core Loss Test Set



Test Objective

Determine whether a motor has damaged core iron by performing core loss testing on stators, rotors, and armatures — both before winding removal (to detect existing core damage) and after removal (to verify the core was not damaged during winding removal). Also performs hot-spot testing to identify localized shorted laminations that cause hot spots and insulation failure. Covers motors from fractional up to 20,000 HP.

Key Features

- Continuously variable, low-distortion, low-voltage/high-current power supply independent of load and output setting, ensuring accurate and repeatable results.
- Fully automated operation with data acquisition: the operator connects test leads, enters test parameters, and the unit automatically ramps voltage, records results, performs calculations, and ramps back down.
- True sine wave output for accurate, repeatable results; 0.2% of reading transducer accuracy with 0.4% system accuracy (10–100% of range).
- Ethernet interface and an updated controller (current generation “B” models).
- Precision control via 3–5 ranges per output tap, giving 3–5× greater regulation resolution; PLC-based control (Programmable Logic Controller) reduces circuitry and improves reliability/serviceability.
- Computer-based meter calibration — no need to remove panels; duty cycle allows overexcitation to heat the core sufficiently for hot-spot detection.
- Safety features: main power circuit breaker, fused control circuits, Emergency Off pushbutton, zero-start interlock, external interlock provision, thermal/transient overload protection, and a motorized voltage regulator with variable rate of rise.
- Smaller models (CL10B, CL25B, CL60B, CL125B) include casters, lockable cover, and storage hook for portability.

Technical Details

Model	Approx. Max Capability	Input kVA	Wattmeter Range	Weight
CL10B	500 HP	10	0–10 kW	605 lbs (274 kg)
CL25B	1,250 HP	25	0–25 kW	845 lbs (383 kg)
CL60B	2,500 HP	60	0–60 kW	1,500 lbs (680 kg)
CL125B	5,000 HP	125	0–125 kW	2,100 lbs (953 kg)
CL300B	12,000 HP	300	0–300 kW	4,800 lbs (2,177 kg)
CL500B	20,000 HP	500	0–500 kW	6,750 lbs (3,062 kg)



4.10 Rubber Glove and Sleeve Test Sets

Test Objective

Manufactures a complete line of Protective Rubber Goods Test Systems for testing utility worker safety gear — including gloves, sleeves, blankets, overshoes/boots, hoses, hoods, and switch sticks. Test systems are designed for fast, accurate, and safe testing, using a user-friendly HMI combined with Programmable Logic Controls (PLC) to perform specified tests from pre-programmed test parameters at the touch of a button.

Key Features

- Configurable in many ways for optimal efficiency; multiple test stations can be powered from one power supply.
- Each test station uses an optically isolated control network for reliability and safety.
- WINRGTS software allows data storage on a separate PC and generation of test reports.
- Comply with all the latest IEC and ASTM standards.
- Cabinets are constructed of 12-gauge cold-rolled steel, primed and painted with two urethane topcoats for rust prevention; panel and access doors are electrically interlocked to shut down power on attempted entry during operation.
- Superior ozone removal system with 1100 CFM exhaust fans and direct free air intake/circulating system.
- Power Supply module houses the high voltage transformer, regulator, and control panel; can be configured with AC, DC, or both AC and DC power supplies, with computer interface.
- A single power supply module can power several test units via an optional HV transfer switch; two power supply modules can be joined to double simultaneous testing capacity.
- Modular Design separates test chambers from the power supply and control panel, allowing flexible L-shape or straight-line configurations.
- Control Panel HMI allows instant parameter changes, switching between product types (e.g., gloves to sleeves or blankets), and adjusting requirements for different rubber classes, with immediate failure notification at a specific test station.

Technical Details

System / Module	Key Specifications
Glove and Sleeve Testers	1 to 16 test positions; AC, DC, or AC/DC testing capability; meets IEC and ASTM standards for rubber class 00 through class 4; dual testing chambers available; sleeves tested in straight or hammock method; optional Chemical Pump and Filter System for dielectric fluid transfer/filtering; superior ozone removal system.
Blanket Testers	1 to 4 test positions per module; tests class 0 to class 4 rubber and EPDM blankets; tests solid and split blankets up to 46" (1168 mm) square; easy-loading drawers with roller slides; test drawer lock/grounding system for safety; superior ozone removal system.
Hose and Hood Testers	Fixtures available for all types and styles; 1 or 6 test positions; tests hoses from 4' (1.2 m) to 6' (1.8 m) long; large, see-through bi-fold doors for easy access; superior ozone removal system.
Switch Stick Testers	1 to 6 test positions; tests switch sticks up to 14' (4.24 m), or up to 21' (6.4 m) sticks; maximum voltage 75 kV per 12" (305 mm) section; large, see-through bi-fold doors for easy access.

System / Module	Key Specifications
Rubber Goods Washer	Automated wash cycle with rotating drum design; constructed entirely of 316 stainless steels; two drum sizes available — 22" (559 mm) diameter x 84" (2134 mm) long, or 30" (762 mm) diameter x 96" (2438 mm) long; handles large quantity loads of all rubber goods types.
Rubber Goods Dryer	Dries rubber products such as gloves, hoses, hoods, blankets, boots, and overshoes; static-type design helps prevent pinches and tears common in tumble-type dryers; heat cycles on and off for even heating; built-in temperature controller.

4.11 Variable Voltage Power Supply Sets



Test Objective

Provide a multi-purpose AC, DC, or AC/DC power source for energizing a wide variety of circuits and components during troubleshooting and repair — checking contactors, test-running small motors, operating circuit breakers, DC field voltage-drop testing, powering up substation relays, and unregulated charging of substation batteries.

Key Features

- Rugged, high-impact plastic case built for years of field use, with both voltage and current output simultaneously read and monitored on highly accurate digital meters.
- Separate output terminals for AC and DC voltage provide convenient hookup configurations depending on the type of component being tested.
- Main power circuit breaker with indicator lamp and independent overloads for AC and DC.
- Output via binding posts and multilam jacks; fine adjustment Vernier control standard on Model VMS-1 only.
- High accuracy digital metering (3½ digit LED display) and two copies of the operation/maintenance manual included with every unit.
- Rated for 10–40°C, indoor/outdoor operation in fair weather, with humidity < 95% non-condensing.

Technical Details

Model	Input	AC Output	DC Output
VMS-1	110–120 VAC, 10 A, 1-phase, 50/60 Hz	≈ 0–120 VAC, 10 AAC max (binding posts)	≈ 0–300 VDC, 10 ADC max (binding posts)
VMS-2	220–240 VAC, 25 A, 1-phase, 50/60 Hz	≈ 0–220 or 240 VAC*, 25 AAC max (multilam jacks)	n/a
VMS-3	110–120 VAC, 10 A, 1-phase, 50/60 Hz	≈ 0–110 or 120 VAC*, 10 AAC max (binding posts)	≈ 0–150 VDC, 5 ADC max (binding posts)
VMS-4	220–240 VAC, 25 A, 1-phase, 50/60 Hz	n/a	≈ 0–100 VDC, 40 ADC max (binding posts)



4.12 Ground Jumper Test Set

Test Objective

Perform in-service testing of temporary grounding jumper assemblies used on de-energized electric power lines and equipment, as specified by ASTM Standard 2249-20E1, using the portable Model JT-200.

Key Features

- Equipped with separate voltage sensing leads to avoid problems related to contact resistance between the test set and the jumper under test.
- Voltage tables developed from values given in ASTM Standard 2249-20E1 and the Terman formula for calculating loop inductance; more complex jumper assemblies can be tested by adding the known voltage drop at 200 A across them to the value obtained from the table.
- Portable, lightweight, and ruggedly constructed for years of field and shop use, with simple setup and operation.
- Safety and design features: main power circuit breaker, on/off pushbutton switches, backup circuit breaker for regulator/transformer protection, output via interchangeable terminals with voltage sense leads, and a zero-start interlock.
- Includes an operation/maintenance manual.

Technical Details

Parameter	Specification
Input	120 VAC, 60 Hz, single phase, 5 Amps
Output	0–3 VAC, 200 Amps
Metering Accuracy	3½ digit, 1% of reading $\pm$ 5 counts
Voltmeter Range	0–3 VAC
Currentmeter Range	0–200 AAC
Dimensions (L x W x H)	20.5" x 17" x 9" (521 x 432 x 229 mm)
Weight	45 lbs (20 kg)

PROTECTION TESTING

5.1 F8000-Series (F8200 / F8300)

Power System Simulators — Modular Protection Testing Platform

Test Objective

A modular platform that performs both analog and digital (IEC 61850) protection testing, scaling from single-phase relay calibration to full three-phase and digital-substation scheme commissioning, working seamlessly with Protection Suite and Doble RTS test procedures.



Key Features

- Chassis and module configurations (Voltage, Current, and Logic I/O modules) tailored to specific test applications.
- Color-programmable LED light rings on analog ports for visual recognition of sources and logic.
- Embedded Command Module: 3 x Ethernet, 1 x 40 W PoE, 2 x SFP (copper & fiber), 2 x USB 3.0 (A & C).
- Time synchronization: IRIG-B (modulated/unmodulated), IEEE 1588 / IEC 61850-9-3 PTP, GPS at 1 PPS.
- IEC 61850: Sampled Values (IEC 61869-9 / 61850-9-2LE, publishing) and GOOSE (publishing & subscribing).
- Built-in battery simulator (6–300 V at 90 W) in every chassis; rugged bumpers for field use or 19" rack mounting.

Technical Details — Chassis & Modules

F8200	Compact, four-module test set. Includes Command Module + Battery Simulator. Four standard configurations for single-phase conventional/digital schemes.
F8300	Expanded, seven-module test set. Includes Command Module + Battery Simulator. Five standard configurations for three-phase and digital protection testing.
HVA Current Module	Two 25 A / 150 VA sources; 50 A / 300 VA when paralleled; transient mode to 90 A / 300 VA (30 s); DC output 50 A.
HVA Voltage Module	Two 150 V / 150 VA sources, or one 300 V / 300 VA source in parallel; optional Convertible Mode to high-VA/low-range current.
Low-Density Logic I/O Module	Four pairs of programmable input/output ports with LED status rings; optional DC Meter upgrade for transducers/Class 2 meters.

F8200 Standard Configurations

Config 1	1 LD Logic I/O + 1 HVA Voltage + 2 HVA Current — modern F2253 replacement; single-phase electromechanical/microprocessor relay testing.
Config 2	1 LD Logic I/O + 2 HVA Voltage + 1 HVA Current — 3-phase directional voltage testing.
Config 3	4 LD Logic I/O — digital substation and hybrid digital-analog scheme testing.
Config 4	1 LD Logic I/O + 3 HVA Current — single/multi-phase, parallel amplifiers for high single-phase current.

F8300 Standard Configurations

Config 1	1 Logic I/O + 3 HVA Voltage + 3 HVA Current — 3 phases of 300 V L-N + 6 currents; ideal for differential testing.
Config 2	1 Logic I/O + 4 HVA Voltage + 2 HVA Current — 4 phases of 150 V L-N; ideal for generation-station testing.
Config 3	2 Logic I/O + 2 HVA Voltage + 3 HVA Current — 4 phases 150 V, 8 logic I/O, 6 currents; transmission & robust scheme testing.
Config 4	3 Logic I/O + 2 HVA Voltage + 2 HVA Current — 12 logic I/O, 4 voltages, 4 currents; Ph-Ph transformer protection.
Config 5	1 Logic I/O + 2 HVA Voltage + 4 HVA Current — 4 phases at 150 V; transmission and transformer differential testing.

5.2 F6150sv

Power System Simulator



Test Objective

Tests IEC 61850-based protection devices and schemes at both the process level and station level, using IEC 61850 9-2LE sampled values and GOOSE messaging, alongside conventional analog relay calibration and verification.

Key Features

- Simulates three streams of IEC 61850 9-2LE sampled values via one fiber-optic and one copper (RJ45) port (requires F6870 option).
- Publishes and subscribes to IEC 61850 GOOSE messages across multiple IEDs (requires F6860 option).
- Highest output current of any simulator in its class, in a single box.
- Full VA power delivery with resistive, inductive, and capacitive loads at maximum current rating.
- State simulation and transient testing; tests 0.2-class metering CTs and transducers.
- End-to-end testing of communications-based schemes with GPS time synchronization.
- Up to 12 high-level analog sources (six voltage, six current); optional Wi-Fi.

Technical Details

Available Models	F6150sv (Premier), F6150sv-SGD (Grid Distribution), F6150sv-IEC (IEC/IntelliRupter)
Max. Analog Sources	12 high-level (Premier); 8 (SGD); 12 low-level (IEC)
Amplifiers	6 AC/DC (Premier); 3 x 150 VA voltage & 3 x 150/225 VA current
AC Voltage Ranges	1 x 600 V, 3 x 300 V, 6 x 150 V
AC Current Ranges	1 x 180 A, 3 x 60 A, 6 x 30 A (up to 1 x 210 A with F6005 option)
Options	F6870 (Sampled Values), F6860 (GSE Configurator), F6005 (Enhanced Rating)

5.3 F6150e

Power System Simulator



Test Objective

A versatile, conventional (non-IEC 61850 process bus) solution for testing protection relays and schemes — from a single component to an entire scheme — covering standard relay calibration and verification of high-burden and microprocessor relays.

Key Features

- Analog testing of 1 A and 5 A protection devices.
- State simulation and transient testing; tests 0.2-class metering CTs and transducers.
- End-to-end testing of communications-based schemes with GPS time syncing.
- Up to 12 sources (six voltage, six current) configurable for bench testing and proof-of-concept testing.
- Full VA power with resistive, inductive, and capacitive loads (6x35, 3x70, 1x210 A at max rating).
- Tablet control of all sources for basic, manual protection testing; optional Wi-Fi.
- High-precision measurements for energy meter and transducer testing.

Technical Details

Available Models	F6150e (Premier), F6150e-D (Distribution), F6150e-SP (Single Phase), F6150e-IRC (IntelliRupter)
Max. Analog Sources	12 high-level (Premier); 8 (D); 4 (SP); 12 low-level (IRC)
Amplifiers	6 AC/DC (Premier); 3 x 150 VA voltage & 3 x 150/225 VA current
AC Voltage Ranges	1 x 600 V, 3 x 300 V, 6 x 150 V
AC Current Ranges	1 x 180 A, 3 x 60 A, 6 x 30 A (up to 1 x 210 A with F6005 option)

Comparison: Protection Testing Simulators

All three product lines run on the same Protection Suite / Doble RTS software ecosystem. The table below compares their defining characteristics.

Attribute	F6150sv	F6150e	F8000-Series (F8200/F8300)
Primary Use	IEC 61850 process/station bus testing (sampled values + GOOSE) plus analog	Conventional analog relay & scheme testing (1A/5A)	Modular analog + digital (IEC 61850) testing platform
Form Factor	Single fixed chassis	Single fixed chassis	Modular chassis (F8200 compact / F8300 expanded)
Max. High-Level Sources	12 (Premier model)	12 (Premier model)	Varies by configuration (up to 4 voltage + 3 current modules)
Sampled Values / GOOSE	Yes (F6870 / F6860 options)	No	Yes (native Command Module: publish SV, publish & subscribe GOOSE)
Time Sync	GPS time syncing	GPS time syncing	IRIG-B, IEEE 1588/PTP, GPS 1 PPS
Best Fit	Digital substation & complex scheme testing, highest current output	General-purpose relay calibration/verification, budget-scalable	Scalable three-phase, transmission, differential & digital-substation testing

5.4 DRTS 66

6 Current / 6 Voltage — Top-of-range model



Test Objective:

Automatic and manual testing of the full range of protective relays (electromechanical, solid-state, numerical and IEC 61850 — including demanding schemes such as three-winding transformer differential protection and busbar protection that require six independent current channels simultaneously — plus energy meters, transducers and power-quality meters. Covers IEEE device types 21, 25, 27/59, 32, 40, 46, 47, 48, 50, 51, 55, 60, 64, 67, 78, 79, 81, 85, 86, 87, 91, 92 and 94.

Key Features

- 6 Current + 6 Voltage generators + 1 battery simulator, all simultaneously available.
- High current outputs: 6×32 A, 3×64 A, or 1×128 A; high power outputs: 6×430 VA, 3×860 VA, $1 \times 1,000$ VA.
- Output accuracy is better than 0.05%; distortion 0.05% typical.
- IEC 61850 protocol interface (GOOSE and 9-2 Sampled Values, optional); internal GPS and IRIG-B interface for end-to-end synchronized testing.
- USB, Ethernet and pen-drive interfaces; 256 Mb internal memory (~2,000 results); optional rugged Local Touch Control tablet.
- Weight 18 kg; dimensions $150 \times 466 \times 423$ mm.

5.5 DRTS 64

6 Current / 4 Voltage



Test Objective:

Same relay-testing scope and accuracy class as DRTS 66, sized for schemes that need the full six-current capability (e.g., two-winding transformer differential, busbar zones) but do not require six independent voltage channels.

Key Features

- 6 Current + 4 Voltage generators + 1 battery simulator.
- Same high-current outputs as DRTS 66: 6×32 A, 3×64 A, or 1×128 A; same power ratings.
- Voltage outputs: $4 \times 0-300$ V plus $1 \times 0-600$ V; same 0.05% accuracy class as DRTS 66.
- Identical IEC 61850, GPS/IRIG-B, USB/Ethernet and TDMS ecosystem as DRTS 66.
- Weight 18 kg; same enclosure and display as DRTS 66.

5.6 DRTS 34

3 Current / 4 Voltage



Test Objective:

Standard relay test set for typical distance, feeder, synchronizing and over-current protection schemes that need three current channels and four voltage channels (three-phase plus reference/neutral).

Key Features

- 3 Current generators (0–32 A) plus $1 \times 0-96$ A high-current output; $1 \times 1,000$ VA at 64 A.
- 4 Voltage generators (0–300 V) plus $1 \times 0-600$ V; same 300 V / 600 V ranges as the larger models.
- Full IEC 61850, GPS/IRIG-B (optional), USB/Ethernet connectivity and TDMS software support.

- Compatible with AMI 332 / AMI 632 external current amplifiers for higher-current or multi-winding schemes.
- Weight 18 kg; same operator interface and accuracy class as DRTS 66/64.

5.7 DRTS 33

3 Current / 3 Voltage — Entry-level model



Test Objective:

Cost-effective relay test set for standard three-phase over-current, under/over-voltage and directional protection testing where a fourth voltage channel is not required — suited to routine field maintenance and simpler protection schemes.

Key Features

- 3 Current generators (0–32 A) plus 1 × 0–96 A high-current output; 3 Voltage generators (0–300 V) plus 1 × 0–600 V.
- Same 0.05% typical output accuracy and DSP-based generation technology as the rest of the family.
- IEC 61850, internal GPS synchronizer and USB/Ethernet interfaces available as options.
- Full compatibility with the family's current boosters (HPB 400/600, IN2-CDG) and external amplifiers.
- Weight 18 kg — the lightest entry point into the DRTS platform.

Technical Details — DRTS 66 / 64 / 34 / 33

Specification	DRTS 66	DRTS 64	DRTS 34	DRTS 33
Current generators	6 × 0–32 A	6 × 0–32 A	3 × 0–32 A	3 × 0–32 A
High-current option	3×64 A / 1×128 A	3×64 A / 1×128 A	1 × 0–96 A	1 × 0–96 A
Voltage generators	6 × 0–300 V	4 × 0–300 V	4 × 0–300 V	3 × 0–300 V
6th / extra voltage ch.	+1 × 0–600 V	+1 × 0–600 V	+1 × 0–600 V	+1 × 0–600 V
Max current power	6×430 VA / 3×860 VA / 1×1000 VA	6×430 VA / 3×860 VA / 1×1000 VA	3×430 VA / 1×1000 VA	3×420 VA / 1×1000 VA
Max voltage power	3×100 / 4×85 / 1×200 VA	3×100 / 4×85 / 1×200 VA	3×100 / 4×85 / 1×200 VA	1×200 / 1×200 VA
Battery simulator	0–260 V DC / 1 A	0–260 V DC / 1 A	0–260 V DC / 1 A	0–260 V DC / 1 A
Binary inputs / outputs	12 / 4	12 / 4	12 / 4	12 / 4
Weight	18 kg	18 kg	18 kg	18 kg
Typical use case	Full 3-phase differential & distance schemes	3-phase, reduced 4-V budget schemes	Simple 3-I / 4-V feeder & distance relays	Entry-level 3-I / 3-V relay testing

5.8 RFD-200 S3

Portable Relay Test Set



Test Objective

Verify the performance of electromechanical, electronic, and microprocessor-based protective relays in their operating installation by applying controlled current/voltage and precisely timing the relay's response.

Key Features

- Built-in digital timer with independent start/stop triggers Internal, Dry-Contact, or Wet-Contact measuring elapsed time in ms and cycles.
- AC current source with three outputs (10 A, 40 A, 100 A), synchronizable with the timer; latched current reading protects relay coils from overheating.
- AC voltage source to 250 Vac and DC voltage source 0–300 Vdc, both timer-synchronizable.
- Volt meter 0–600 V; two ampere meters (internal + external 6 A input).
- Three built-in auxiliary supplies (24 Vdc, 48 Vdc, 124 Vdc) for solid-state/microprocessor relays, plus built-in power resistors for fine current adjustment.
- NO/NC auxiliary output contact changes state on test initiation; RS-232C PC interface.

Technical Details

Timer resolution/accuracy	1 ms to 100 ms depending on range; $\pm(1 \text{ ms} + 0.01\%)$ best case
Ampere meter range	0–250 A internal, $\pm 2\%$ of reading $\pm 10 \text{ mA}$
Volt meter range	0–600.0 V; 1% (AC) / 0.5% (DC) of reading
Input power	100–120 Vac or 200–240 Vac (factory pre-set), 50/60 Hz
Dimensions / Weight	17"W x 12.5"H x 12"D; 35 lbs (15.9 kg)

5.9 T 1000 PLUS

Secondary Injection Relay Test Set



Test Objective

Provides precise, microprocessor-controlled testing of protection relays and transducers. Offers high-power outputs, phase-angle shifting, and frequency generation for comprehensive secondary injection testing in substations and industrial environments.

Key Features

- Three independent generators: AC/DC main, auxiliary AC, and auxiliary DC voltage.
- Phase-angle shifter and frequency generator (15 Hz – 550 Hz).
- Oscilloscope functions for current and voltage waveforms.
- Automatic timer for make/break and reclosing tests.
- Local memory for up to 500 test results and 10 test settings.
- USB interface for data transfer and TDMS software integration.
- Compact aluminum case with handle and optional heavy-duty transport case.
- Conforms to CEI EN 61010-1 and EEC directives for EMC and Low Voltage instruments.

Technical Data

Parameter	Specification
Input Power	230 V $\pm$ 15 % (50–60 Hz) or 120 V $\pm$ 15 % (50–60 Hz)
Main AC Current Output	Up to 250 A (1000 VA max)
Main AC Voltage Output	Up to 250 V (750 VA max)
DC Voltage Output	Up to 300 V (500 W max)
Auxiliary AC Voltage Output	65 – 260 V (40 VA max)
Phase Angle Adjustment	0° – 360° (1° resolution)
Frequency Range	15 Hz – 550 Hz (1 mHz resolution)
Timer Range	0 – 999.9 s (1 ms resolution)
Measurement Accuracy	$\pm$ 1 % for current and voltage
Dimensions / Weight	380 $\times$ 300 $\times$ 240 mm; 19 kg
Operating Temperature	0 °C – 50 °C (5 – 95 % RH non-condensing)
Interface	USB connection for TDMS software
Memory Capacity	500 results + 10 settings stored locally

ADVANCED ELECTRICAL TEST EQUIPMENTS

6.1 Multifunction Transformer and Substation Test Set

STS 5000/STS 4000

Multifunction Substation Maintenance & Commissioning Test System



Test Objective:

A single, fully automatic platform for acceptance and maintenance testing of current transformers, voltage transformers, power transformers/OLTC, circuit breakers, capacitor banks, ground grids and overhead line impedance. It covers ratio/polarity, burden, excitation (knee-point), winding resistance, voltage withstand, vector group, short-circuit impedance, tan delta/capacitance (with the TD 5000 option), ground resistance/resistivity, step-and-touch voltage, and line impedance — 28 distinct test routines in total, per IEC 61869-2/3, EN 60044 series, ANSI/IEEE C57.13.1 and C57.12-90.

Key Features

- Six internal output generators: high/low AC current, high/low DC current, high/low AC voltage; primary injection up to 800 A standard (up to 7,000 A with the BUX 5000/3000/2000 booster options).
- Variable output frequency 15–500 Hz; 2,000 V AC high-potential (hi-pot) withstand test.
- IEC 61850-9-2 Sampled Values support for testing conventional and non-conventional CT/VT and Merging Units.
- Large graphic LCD, local menu-driven control, USB and Ethernet interfaces; Test Plan Editor stores up to 64 automated test sequences.
- Optional TD 5000 module extends the platform to capacitance / Tan Delta / power-factor testing up to 12 kV, including rotating-machine testing with the RCTD compensating reactor.
- Optional STCS / STCS Plus switch modules automate power-transformer ratio-per-tap, vector group, winding resistance and OLTC dynamic tests with a single connection.
- Optional STLG + STSG modules extend ground-grid resistivity, step-and-touch, and line-impedance testing to higher currents with a dedicated safety-grounding module.
- TDMS data-management software and optional PADS software for remote control, automated reporting and test-plan management.
- Housed in a transportable aluminium case; weight 29 kg; dimensions 450 × 400 × 230 mm.

Application

The following table lists the tests that can be performed on CTs, VTs, PTs and ground grid.

N.	TEST	TEST DESCRIPTION	N.	TEST	TEST DESCRIPTION
1	CT	Ratio, Voltage mode	16	PT	Ratio per TAP
2	CT	Ratio, polarity and burden with high AC current*	17	PT	Vector group

N.	TEST	TEST DESCRIPTION	N.	TEST	TEST DESCRIPTION
3	CT	Burden, secondary side; ALF/ISF	18	PT	Static and dynamic resistance of Tap Changer contacts
4	CT	Excitation curve	19	PT	No-load current
5	CT	Winding or burden resistance	20	PT	Magnetic Balance
6	CT	Voltage withstand	21	PT	Short-circuit impedance
7	CT	Rogowski coil transformers	22	PT	Tan Delta measurements
8	CT	Low power transformers	23	CB	Tan Delta measurements
9	CT	Tan Delta measurements	24	CB,RELAY	Current threshold and timing*
10	VT	Ratio; polarity	25	R	Ground resistance and resistivity
11	VT	Burden, secondary side	26	R	Step and touch voltages
12	VT	Ratio, electronic transformers	27	L	Measurement of line impedance and of the related parameters
13	VT	Voltage withstand	28	Capacitor banks	Measurement of the capacitance
14	VT	Remote polarity check			
15	VT	Tan Delta measurements			

Example of Test Plan Editor for CT Tests

Current Transformer - Header / Nominal Values

Description: I Secondary Standard: IEC

Measuring: Accuracy Class: 0.1 VA Rating: 20.0VA ALF: 20.0 Power Factor: 0.7

Tolerances: C1 (HV-Capacitive tap) On: 0.300mF TOn: 0.500m C2 (Capacitive Tap-GND) On: 0.300mF TOn: 0.500m

#	Name	I Prim (A)	Norm Ik (VA)	Norm Ik (V)
1	IS1-IS2	800.0	50.000m	400.000
2	IS1-IS3	400.0	50.000m	200.000
3	IS1-IS4	200.0	50.000m	100.000
4	IS1-IS5	100.0	50.000m	50.000

Nominal values window: from these nominal data, the program computes the nominal saturation knee

Current Transformers - Header and Nominal Values

Description: Nominals Tolerances

Substation: CT SUB Bay: CT BAY Phase: PHASE A Location: CT LOC Operator: CT OPERATOR Manufacturer: CT MAN Model: CT MOD Serial Number: CT SERIAL

Buttons: Set as Default Header, Reload Default Header, Test

Tests header window: test reference data

Current Transformers - Header and Nominal Values

Tolerances: All Tolerances checked

- Ratio: ± 5.00% Meas Vx: > Norm Vx
- Polarity: ± 15.00% Ie (B Norm Vx): < Norm Ik
- Burden (VA): < VA Rating Resistance: < Nominal
- Burden (cos φ): ± 0.990 Capacitance: ± 2.000mF
- Current Clamp: ± 2.00% DF (tan δ): ± 0.1%

Buttons: Set as Default Header, Reload Default Header, Test

Tolerances window allows setting the tolerances for each of the available tests

Current Transformers

Header / Nominal Values Tests Test Plan / Results

Test Type	Tap #	Result
Manual Measure		
Ratio Polarity and Burden		
Ratio (Current)	1-4	
Burden Secondary Side	1-4	
Excitation Curve	1-4	
Winding Resistance	1-4	
Voltage Withstand	1-4	
Ratio (Voltage)	1-4	
Rogowski (Ratio)		
Low Power (Ratio)		

Buttons: Add to Test Plan, Open Test Plan, Save Test Plan, Exit CTs

Test selection window: it allows selecting the test to be performed

Comparison Table of the STS Family Tests

NO.	TEST OF	TEST DESCRIPTION	STS 5000	STS 4000	TDX 5000
1	CT	Ratio, Voltage mode	✓	✓	NOT AVAILABLE
2	CT	Ratio, polarity and burden with high AC current	✓	WITH BUX 3000	NOT AVAILABLE
3	CT	Burden; secondary side	✓	✓	NOT AVAILABLE
4	CT	Excitation curve	✓	✓	NOT AVAILABLE
5	CT	Winding or burden resistance	✓	✓	NOT AVAILABLE
6	CT	Voltage withstand	✓	✓	NOT AVAILABLE
7	CT	Remote polarity check	✓	NOT AVAILABLE	NOT AVAILABLE
8	CT	Rogowski coil transformers	✓	WITH BUX 3000	NOT AVAILABLE
9	CT	Low power transformers	✓	WITH BUX 3000	NOT AVAILABLE
10	CT	Tan(δ) measurements	WITH TD 5000	WITH TD 5000	✓
11	VT	Ratio; polarity	✓	✓	NOT AVAILABLE
12	VT	Burden, secondary side	✓	✓	NOT AVAILABLE
13	VT	Ratio, electronic transformers	✓	✓	NOT AVAILABLE
14	VT	Voltage withstand	✓	✓	NOT AVAILABLE
15	VT	Remote polarity check	✓	NOT AVAILABLE	NOT AVAILABLE

NO.	TEST OF	TEST DESCRIPTION	STS 5000	STS 4000	TDX 5000
16	VT	Tan(δ) measurements	WITH TD 5000	WITH TD 5000	✓
17	PT	Ratio per TAP	✓	✓	NOT AVAILABLE
18	PT	Static and dynamic resistance of Tap Changer contacts	✓	✓	NOT AVAILABLE
19	PT	Excitation current	WITH TD 5000	WITH TD 5000	✓
20	PT	Magnetic Balance	✓	✓	NOT AVAILABLE
21	PT	Short circuit impedance	✓	✓	NOT AVAILABLE
22	PT	Tan(δ) measurements	WITH TD 5000	WITH TD 5000	✓
23	CB	High DC current micro-Ohmmeter test	✓	NOT AVAILABLE	NOT AVAILABLE
24	CB	Tan(δ) measurements	WITH TD 5000	WITH TD 5000	✓
25	VT CB RELAY	Current threshold and timing	✓	✓	NOT AVAILABLE
26	R	Ground resistance and resistivity	✓	✓	NOT AVAILABLE
27	R	Step and touch voltages	✓	✓	NOT AVAILABLE
28	L	Measurement of line impedance and of the related parameters	✓	✓	NOT AVAILABLE
29	Capacitor Banks	Measurement of the capacitance	WITH TD 5000	WITH TD 5000	✓

6.2 Transformer Testing

i. M7100™

High-Voltage Asset Analyzer



Test Objective

A comprehensive high- and low-voltage testing solution that automates multiple traditional tests (previously requiring several instruments) into a single dual-lead system — cutting testing time from about seven hours to roughly one and a half hours while improving technician safety.

Key Features

- Patented dual-function HV lead design — both source and measurement capability within each HV lead.
- Built-in low-voltage/high-current multi-frequency source; true 4-terminal measurements.
- Test capabilities: Power Factor/Tan-Delta (fixed & variable frequency), demagnetization, 3-phase and 10 kV turns ratio, short-circuit impedance/leakage reactance (1Ø, 3Ø), 3-phase winding DC resistance, 3-phase 10 kV exciting current & loss.
- Reduces ladder trips by up to two-thirds versus single-lead systems, improving field safety.
- Pairs with Doble Test Assistant (DTA), DTAWeb, and the DUCe rugged controller for asset-lifecycle management.
- Standard two-year warranty and two-year calibration interval.

Technical Details

Parameter	Specification
Supported Standards	IEEE C57.152/13/13.6/19.01/286; IEC 60076-1, 60137, 61850-9-2-Ed.2B; IEC/TR 60894; NETA 2011/2007
Future Enhancements	OLTC Dynamic Resistance Measurement (DRM); Capacitor Bank testing
Included Cables	2 High Voltage, 4 Low Voltage, 3 Measurement, plus OLTC control, USB, Ethernet, AC power
Optional Accessories	M7 Truck, MFL Liquid Insulation Test Cell, Type C Resonator (up to 12 kV), Doble Universal Controller

ii. M4100

Capacitance & Tan Delta Test Set for High Voltage Apparatus



Test Objective

The industry-standard instrument for commissioning, diagnostic, and scheduled maintenance testing of power apparatus insulation — primarily Power Factor / Tan-Delta and capacitance testing to confirm insulation integrity and quality.

Key Features

- Power Factor/Tan-Delta testing to confirm insulation integrity and quality; capacitance testing for physical apparatus changes.
- HV turns-ratio testing (shorted turns/winding damage) and leakage reactance/short-circuit impedance testing (winding deformation).
- Single-phase excitation current testing and capacitor-bank testing.
- Generates its own precise sine-wave test signal; self-calibrating in the field.
- Patented Line Frequency Modulation eliminates the effect of varying electrostatic interference.
- FRANK™ (First Response Analytics Knowledgebase) instantly analyzes results with recommendations; dual safety switches, strobes, and ground-earth relay interlocks.

Technical Details

Parameter	Specification
Source Output	3 kVA, 25 V to 12 kV; continuous 100 mA @ 10 kV (up to 300 mA for 4 min)
Power Factor/Tan-Delta	Range 0 to $\pm 100.00\%$, resolution 0.01% (0.0001), typical accuracy $\pm 0.005\%$
Capacitance Measurement	0 to 100 μF , resolution 0.01 pF
Software	DTA6 Basic (Doble Test Assistant)
Weight / Dimensions	95 lb / 43 kg — 10.3H x 20W x 25.3D in (26 x 50.8 x 64.1 cm)
Power Input	95–264 VAC auto-sensing, 47–63 Hz; accommodates inverters/portable generators

iii. TDX 5000

Capacitance & Tan Delta Diagnostic System for High-Voltage Apparatus and Rotating Machines



Test Objective:

A dedicated, stand-alone high-voltage diagnostic unit for capacitance, Tan Delta (dissipation factor), power factor, impedance, inductance and excitation-current measurement on transformers, bushings, CTs, VTs, PTs, circuit breakers, capacitor banks and — using the RCTD reactor option — rotating machines (generators and motors). It does not perform primary current injection or ratio/burden testing; it is a specialist complement to STS 5000 / T 2000 rather than a direct substitute.

Key Features

- Output voltage from 12 V up to 12 kV; variable frequency 1–500 Hz, which makes results immune to external line-frequency noise.
- Patented measurement circuitry with an internal 200 pF reference capacitor (Tan Delta < 0.005%) and a precision resistor bridge (< 0.01% accuracy, < 1 ppm/°C drift).
- Test modes: Ungrounded (UST-A, UST-B, UST-A+B) and Grounded (GST, GSTg-A, GSTg-B, GSTg-A+B).
- Capacitance range 1 pF – 200 μF ; Tan Delta 0–100%+; impedance 1 k Ω – 1,400 M Ω ; power measurement up to 1 MW.
- Optional RCTD compensating reactor (2 $\times$ 40 H, extendable to 4 inductors) for rotating-machine Tan Delta testing at higher test currents.
- Optional STOIL cell for dielectric-oil Tan Delta testing and CAP-CAL calibration module with an ISA-lab-certified reference capacitor.
- Weight 39 kg; dimensions 450 $\times$ 530 $\times$ 215 mm.

Technical Details

Parameter	Specification
Main Supply	100–230 V $\pm$ 15% (85–264 V); 47–63 Hz; Max supply current: 16 A
Display	640 x 480 pixel color TFT LCD; View area: 132 x 99 mm; Backlit
Interfaces	USB (Slave), USB Port (for pen drive), Ethernet
Operating Conditions	Temperature: -10°C to 55°C; Relative Humidity: 0–95% (non-condensing)
Safety & Standards	IP2X (Inputs/Outputs), IP4X (HV Output); Conforms to 2014/30/UE (EMC) & 2014/35/UE (LVD)
Dimensions & Weight	450 (W) x 530 (H) x 215 (D) mm; Weight: 39 kg

iv. M5500

Sweep Frequency Response Analyzer (SFRA)



Test Objective

Provides rapid and highly repeatable sweep frequency response analysis (SFRA) to detect hidden mechanical faults in transformers, reactors, and other winding-based equipment. Confirms winding movement, core displacement, and structural integrity after faults, transport, or routine maintenance.

Key Features

- Lightweight, rugged portable instrument for field and lab use.
- Fast sweep speeds (15–30 s typical) reduce testing time.
- Wide frequency range: 10 Hz – 25 MHz (default 20 Hz – 2 MHz).
- Dynamic range > 150 dB with adaptive filtering.
- Two simultaneous measurement channels with 100 MS/s sampling.
- USB and wireless connectivity to controlling PC.
- Includes SFRA v6 software for advanced analysis and reporting.
- Complies with IEC 60076-18 and international EMC, safety, and RoHS standards

Technical Data

Parameter	Specification
Excitation Source	1 channel, 10 Hz – 25 MHz, 10 V or 2.5 V pk-pk
Measurement Channels	2 channels, simultaneous sampling
Sampling Rate	100 MS/s
Input Impedance	50 Ω
Data Points	Default 1045; up to 32,000 (linear)
Dynamic Range	> 150 dB (20 Hz – 2 MHz)
Export Formats	CSV, IEC, CIGRE, SFRA v5
Analysis Tools	Difference, cross-correlation, leakage channel, ratio
Dimensions / Weight	31 × 24 × 9.4 cm; 3.2 kg (7 lbs)
Power Supply	24 VDC (40 W universal AC adapter)
Operating Temp	–25 °C to +55 °C
Storage Temp	–40 °C to +85 °C
Humidity	0–95 % non-condensing
Test Leads	Integrated 3-lead system, 18 m standard / 30 m optional

v. ATRT-01/01B S3

Automatic Transformer Turns Ratio Tester



Test Objective

Provides fast, accurate measurement of transformer turns ratio, excitation current, polarity, and phase angle using the IEEE C57.12.90 method. Designed for utility and industrial applications, it ensures reliable transformer diagnostics in the field or lab.

Key Features

- Measures turns ratio from 0.8 – 15,000:1 with high accuracy.
- Selectable test voltages: 4 Vac and 40 Vac.
- Displays excitation current, winding polarity, and phase angle.
- Calculates percentage error against nameplate values automatically.
- LCD display (128 × 64 pixels) viewable in sunlight and low-light.
- Stores up to 128 records internally and 999 records on USB flash drive.
- Windows-based Transformer Analysis Software (TTRA S2) included for remote control, data retrieval, and reporting.
- Battery-powered ATRT-01B S3 model offers up to 4 hours continuous operation.

Technical Details

Parameter	Specification
Turns Ratio Accuracy	0.8–1,000: ±0.08%
Test Voltages	ATRT-01 S3: 4 Vac @ 1.0 A, 40 Vac @ 0.6 A
Phase Angle Measurement	0–360°
Excitation Current Range	0–2 A
Polarity Reading	In-phase or out-of-phase indication
Display	Back-lit LCD, 128 × 64 pixels
Data Storage	Internal: 128 records
Interfaces	RS-232C, USB
Dimensions / Weight	30.4 × 25.4 × 20.3 cm
Operating Voltage	ATRT-01 S3: 120/240 Vac, 50/60 Hz
Battery (ATRT-01B S3)	SLA, 6 V, 7 Ah
Operating Temp	–10 °C to +50 °C
Storage Temp	–30 °C to +70 °C
Humidity	90% RH @ 40 °C, non-condensing
Altitude	Up to 2,000 m
Safety Compliance	IEC/EN 61010-1, EN 61326-1, UL 61010A-1, CSA-C22.2

vi. ATRT-03 S2

Automatic 3-Phase Transformer Turns Ratio Tester



Test Objective

Determine transformer turns ratio, excitation current, and phase angle using the IEEE C57.12.90 method for utility power-substation transformer testing, with automatic transformer-type/vector-group detection.

Key Features

- Ratio range 0.8 to 15,000 : 1.
- Three test voltages — 8 Vac, 40 Vac, 100 Vac — suitable for CTs, PTs, and power transformers.
- Auto-detects 130 vector groups (ANSI, CEI/IEC, Australian standards).
- Built-in LTC/voltage-regulator tap control; built-in safety ground-fault detection on the AC input.
- RS-232C and USB PC interfaces; optional 4.5" thermal printer; 112 test records, 128 test plans.

Technical Details

Parameter	Specification
Dimensions / Weight	18"W x 7"H x 15"D; 20 lbs (9.0 kg)
Typical turns-ratio accuracy (40 Vac)	$\pm 0.05\%$ (0.8–1,000) to $\pm 0.2\%$ (4,001–15,000)
Phase-angle accuracy	± 0.2 degree
Input power	100–240 Vac, 50/60 Hz

vii. TRF-100

Automatic 100 Vac 3-Phase Transformer Turns Ratio Test



Test Objective

The TRF-100 is Vanguard's third generation, microprocessor-based, automatic, three phase, transformer turns-ratio tester. This lightweight, portable unit is designed for testing transformers at utility power substations. The TRF-100 determines the transformer turns-ratio using the IEEE C57.12.90 measurement method. The transformer turns-ratio (ranging from 0.8 to 50,000) is determined by precisely measuring the voltages across the unloaded transformer windings. To ensure accuracy, the TRF-100's measuring circuitry self-calibrates before each measurement. It requires neither adjustment nor temperature compensation. The TRF-100's turns-ratio measurement accuracy is 0.1% or better.

Key Features

- Ratio Range: 0.8 – 50,000 to 1
- Capable of detecting 130 different 3-phase transformer types defined by ANSI, IEC, and Australian standards
- 3 test voltages: 4Vac, 40Vac, and 100Vac
- Phase angle and excitation current measurement
- USB PC interfaces
- 4.5-inch wide thermal printer (optional)

Technical Details

Turns Ratio Range	0.8 to 50,000
Accuracy	±0.1% or better
Test Voltages	4 Vac, 40 Vac, 100 Vac
Excitation Current Measurement	Measured in milliamperes (mA)
Display	Backlit LCD screen (20 characters × 4 lines)
PC Interface & Data Export	USB port; compatible with S2 PC software (exports to Excel, PDF, XML)
Input Power	100–240 Vac, 50/60 Hz, 3 Amps
Dimensions	17" W × 7" H × 13" D (43.2 cm × 17.8 cm × 33.0 cm)
Weight	~14 lbs (6.35 kg)

viii. TRF-250

Automatic 3-Phase Transformer Ratio Finder



Test Objective

Determine the turns ratio, excitation current, phase angle, and winding polarity of a 3-phase power transformer (or CT/PT) using the IEEE C57.12.90 measurement method, with a higher 250 Vac test voltage for improved accuracy on very large transformers fitted with a load tap changer (LTC).

Key Features

- Ratio range 0.8 to 50,000 : 1.
- Four test voltages — 4 Vac, 40 Vac, 100 Vac, and 250 Vac — the 250 Vac level keeps percentage error below 0.5% on 600 MVA-class transformers with the LTC in the lowest position.
- Auto-detects 130 vector groups defined by ANSI, IEC/CEI, and Australian standards.
- Built-in load-tap-changer control raises/lowers tap positions remotely.
- Bluetooth and USB PC interfaces; optional 4.5" thermal printer; 112 test records, 128 test plans; TTRA S2 software exports to Excel/PDF/XML.

Technical Details

Dimensions / Weight	18"W x 5"H x 12"D; 20 lbs (9.1 kg)
Turns-ratio accuracy (250 Vac)	±0.1% (0.8–2,000) down to ±1.2% (15,001–50,000)
Phase-angle accuracy	±0.2 degree
Input power	100–240 Vac, 50/60 Hz

ix. TRM-20

Automatic 25 Adc Winding Resistance Test Set with LTC Test, Auto Discharge and Demagnetization



Test Objective

The TRM-20 is Vanguard Instruments' third generation transformer winding resistance meter. The TRM-20 is designed specifically to measure DC resistance values of transformer windings, rotating machine windings, or any dc resistance of an inductive device. The TRM-20 features dual resistance-reading input channels that can measure two winding resistances simultaneously (primary and secondary windings of a transformer). It can provide a fast and stable reading of very large transformers by utilizing a 60Vdc power supply. The TRM-20 is capable of outputting a selectable test current from 1A to 25A. Since the TRM-20 can accurately measure resistance values from 1 micro-ohm to 2,000 Ohms, it can be used as micro-ohm meters to measure EHV circuit breaker contact resistance, or for any low resistance measuring application. The TRM-20 can automatically demagnetize the inductive device under test, eliminating the manual task of demagnetizing the transformer core after a resistance test.

Key Features

- Auto-discharge circuit for operator safety
- Demagnetizes transformer after test
- Selectable test current from 1A to 25A
- RS-232C, USB, and Bluetooth computer interfaces
- Built-in thermal printer

Technical Details

Parameter / Feature	Technical Specification Details
Resistance Reading Range	1 $\mu\Omega$ to 2,000 Ω
Selectable Test Current	1 A to 20 A DC (adjustable in 1 A increments)
Test Voltage	60 Vdc maximum charging / 18 Vdc measurement
Accuracy (1 $\mu\Omega$ to 19,999 $\mu\Omega$)	$\pm(0.2\%$ reading + 0.1% F.S.)
Accuracy (20 mΩ to 999 mΩ)	$\pm(0.3\%$ reading + 0.1% F.S.)
Accuracy (1 Ω to 2,000 Ω)	$\pm(0.5\%$ reading + 0.1% F.S.)
Display	128 $\times$ 64 pixels backlit LCD (sunlight readable)
Interfaces	USB, RS-232C, Bluetooth, and USB flash drive support
Input Power	100–240 Vac, 50/60 Hz
Dimensions (W $\times$ H $\times$ D)	21" $\times$ 17" $\times$ 9" (53 cm $\times$ 43 cm $\times$ 24 cm)
Weight	33 lbs (15.4 kg)

x. TRM-40

Automatic 40 A dc Winding Resistance Test Set with LTC Test, Auto Discharge and Demagnetization



Test Objective

The TRM-40 is Vanguard Instruments' third generation transformer winding resistance meter. The TRM-40 is designed specifically to measure DC resistance values of transformer windings, rotating machine windings, or any dc resistance of an inductive device.

Key Features

- Auto-discharge circuit for operator safety
- Demagnetizes transformer after test
- Selectable test current from 1A to 40A
- RS-232C, USB, and Bluetooth computer interfaces
- Built-in thermal printer

Technical Details

Parameter / Feature	Technical Specification Details
Resistance Reading Range	1 $\mu\Omega$ to 2,000 Ω
Selectable Test Current	1 A to 40 A DC
Test Voltage	60 Vdc maximum charging voltage / 18 Vdc measurement
Accuracy (1 $\mu\Omega$ – 19,999 $\mu\Omega$)	$\pm(0.2\% \text{ reading} + 0.1\% \text{ F.S.})$
Accuracy (20 m Ω – 999 m Ω)	$\pm(0.3\% \text{ reading} + 0.1\% \text{ F.S.})$
Accuracy (1 Ω – 2,000 Ω)	$\pm(0.5\% \text{ reading} + 0.1\% \text{ F.S.})$
Display	128 $\times$ 64 pixels backlit LCD (sunlight readable)
Interfaces	USB, RS-232C, Bluetooth, USB Flash Drive
Input Power Supply	100–240 Vac, 50/60 Hz
Dimensions (W $\times$ H $\times$ D)	21" $\times$ 17" $\times$ 9" (53 cm $\times$ 43 cm $\times$ 24 cm)
Weight	~35 lbs (15.8 kg)

xi. TRM-403

Automatic 40 A dc 3-Phase Winding Resistance Test Set with LTC Test, Auto Discharge and Demagnetization



Test Objective

The TRM-403 is a three phase transformer winding resistance meter that allow the user to connect all test cables to the transformer bushings. The unit will then measure the transformer resistance value for each of the phases without the need to disconnect and reconnect cables for each phase. The TRM-403 can provide a fast and stable reading of very large transformers by utilizing a 60Vdc power supply. It is capable of outputting a selectable test current from 1A to 40A. Since the TRM-403 can accurately measure resistance from 1 micro-ohm to 500 Ohms, it can be used as a micro-ohm meter to measure EHV circuit breaker contact resistance, or for any low resistance measuring application.

Key Features

- Perform three phase test on a transformer without the need to switch cables
- Can provide individual Delta winding resistance values
- Can provide individual Wye (with no neutral) winding resistance values
- Demagnetize transformer after test
- Selectable test current from 1A to 40A
- Computer control via RS-232C, USB, or Bluetooth interface
- Built-in 2.5" wide thermal printer

Technical Details

Parameter / Feature	Technical Specification Details
Type	Portable 3-Phase Transformer Winding Resistance Meter
Resistance Reading Range	1 $\mu\Omega$ to 500 Ω
Selectable Test Current	1 A to 40 A DC (adjustable in 1 A increments)
Test Voltage	60 Vdc max charging / 18 Vdc max measurement
Accuracy (1 $\mu\Omega$ – 19,999 $\mu\Omega$)	$\pm 0.5\%$ reading, ± 1 count
Accuracy (20 m Ω – 999 m Ω)	$\pm 1.0\%$ reading, ± 1 count
Accuracy (1 Ω – 500 Ω)	$\pm 1.5\%$ reading, ± 1 count

Input Channels	4 resistance measuring input channels
Display	240 x 128 pixels backlit graphic LCD (sunlight readable)
Printer	Built-in 2.5" thermal printer
Internal Storage	256 static test records (up to 111 readings each) & 120 dynamic test records
External Storage	Up to 999 test records via USB Flash Drive port
Computer Interfaces	RS-232C, USB, and Bluetooth
Input Power	100–240 Vac, 50/60 Hz
Dimensions (W × H × D)	21" × 17" × 9" (53 cm x 43 cm x 24 cm)
Weight	~35 lbs (15.8 kg)

6.3 Circuit Breaker Testing

i. CT-8000 S3

Digital Circuit Breaker Analyzer



Test Objective

Fully analyze a high-voltage circuit breaker's performance in a single test session main and resistor contact timing, contact stroke/velocity/over-travel/bounce-back, dynamic contact resistance during the open/close operation, and OPEN/CLOSE coil current “fingerprinting.”

Key Features

- 3 or 6 dry-contact timing channels (P/N 9103-UC / 9104-UC); detects main and insertion-resistor contact time.
- Built-in 200 A DC supply for dynamic contact resistance testing ($1\ \mu\Omega$ – $1,999\ \mu\Omega$) to reveal contact erosion during operation.
- 3 digital travel-transducer channels (stroke, velocity, over-travel, bounce-back) plus 3 resistor-type transducer inputs; “Slow-Close” test mode.
- 3 voltage monitoring channels (V1 supply/coil voltage; V2/V3 auxiliary-switch presence) with graphical and tabulated reporting.
- Built-in solid-state breaker initiator: OPEN, CLOSE, OPEN-CLOSE, CLOSE-OPEN, OPEN-CLOSE-OPEN.
- Hall-effect sensor records OPEN/CLOSE coil current waveform as a diagnostic “fingerprint.”
- USB / optional Bluetooth interface; 4.5" thermal printer; 200 internal test records, 100 test plans; PC software exports to Excel/PDF/XML.
- Options: on-line (in-service) timing mode, dual-ground testing mode, Bluetooth interface.

Technical Details

Parameter	Specification
Dimensions / Weight	16"W x 11"H x 14"D; 22 lbs (9.98 kg)
Timing accuracy	0.05% of reading $\pm$ 0.05 ms @ 1 sec duration
Resistance range	0.1–1,999 $\mu\Omega$; accuracy $\pm$ 2% of reading, $\pm$ 5 $\mu\Omega$
Breaker initiate capacity	30 A, 250 V ac/dc max
Travel transducer range	0.0–60.0 in linear ($\pm$ 0.01 in); 0–360° rotary ($\pm$ 0.36°)
Input power	10 A, 100–240 Vac, 50/60 Hz

ii. TDR900

Circuit Breaker Test System



Test Objective

Provides efficient and accurate timing and motion measurements for all types of circuit breakers. Designed for substation environments, it ensures reliable detection of mechanical issues and contact timing errors, supporting preventive maintenance and diagnostics.

Key Features

- Tests breakers with up to 4 breaks per phase.
- Supports 3 motion channels, 3 auxiliary contact channels, and 3 analog channels.
- Trip/Close initiation control with multiple operating sequences (Trip, Close, Reclose, Tripfree, O-CO, Slow Close, First Trip).
- Patented digital rotary and linear transducers for precise motion analysis.
- Rugged, single-box solution combining lab accuracy with field durability.
- User-friendly PC interface with T-Doble software for configurable reports.
- Complete test reports exportable in Excel, Word, and PDF formats.
- Immune to interference from harsh substation conditions.
- Control via Doble Universal Controller (DUC), tablet, or PC.

Technical Data

Parameter	Specification
Phases / Breaks	3 phases, up to 4 breaks per phase
Resolution	100 μ s
Resistor Detection Range	10 Ω – 10 k Ω

Trip/Close Control	±25 A, ±300 V input
Motion Channels	3 channels, 15-pin “D” connector
Analog Channels	±300 V input, 1 MΩ impedance, ±1% accuracy
Auxiliary Contact Channels	Voltage/Contact sense, ±300 V input
Transducer Range	Linear: 0–1000 mm
Transducer Accuracy	±0.1% of value
Velocity / Acceleration	Linear: 15 m/s, 1200 g
Recording Duration	25 s (max resolution), up to 30 min (reduced)
Communication	USB or Ethernet
Dimensions / Weight	61 × 39 × 22 cm; 10 kg (22 lbs)
Power Supply	100–240 V, 50/60 Hz
Operating Temp	0 °C – 50 °C
Storage Temp	–25 °C – +70 °C
Humidity	Up to 95% RH, non-condensing

iii. TDR9100

Circuit Breaker Test System



Test Objective

Provides efficient and accurate timing, motion, resistance, and capacitance measurements for all types of circuit breakers. Designed for substation environments, it ensures reliable detection of mechanical issues, contact timing errors, and resistor/capacitor performance.

Key Features

- Tests breakers with up to 4 breaks per phase.
- 3 motion channels and 6 event channels (expandable to 9 motion and 18 event channels with ganged units).
- Flexible configuration – gang 2 or 3 units to test up to 12 breaks per phase.
- Sampling rates up to 20 kHz with expanded analog ranges.
- Pre-insertion resistor and capacitance measurement capability.
- Patented digital rotary and linear transducers for precise motion analysis.
- Rugged, single-box solution combining lab accuracy with field durability.
- User-friendly T-Doble software interface with configurable reports.
- Complete test reports are exportable in Excel, Word, and PDF formats.
- Immune to interference from harsh substation conditions.
- Control via Doble Universal Controller (DUC), tablet, or PC.

Technical Details

Parameter	Specification
Breaker Configurations	OCB: 3 contacts
Resolution	50 μ s at max sample rate
Sample Rate	Up to 20 kHz
Resistor Detection Range	10 Ω – 10 k Ω
Resistor Value Accuracy	$\pm 10\%$
Capacitance Detection Range	75 – 10,000 pF ($\pm 10\%$)
Trip/Close Control	± 100 A, ± 300 V input
Motion Channels	3 (expandable to 9)
Event Channels	6 (expandable to 18)
Analog Channels	± 300 V input, 1 M Ω impedance, $\pm 1\%$ accuracy
Auxiliary Channels	Voltage/Contact sense, ± 300 V input
Recording Duration	25 s (max resolution), up to 87 min (reduced)
Communication	USB or Ethernet
Power Supply	100–240 V, 50/60 Hz
Operating Temp	0 $^{\circ}$ C – 50 $^{\circ}$ C
Storage Temp	–25 $^{\circ}$ C – +70 $^{\circ}$ C
Humidity	Up to 95% RH, non-condensing
Dimensions / Weight	61 $\times$ 39 $\times$ 22 cm; 11 kg (24 lbs)

iv. CBA 3000

All-in-One Circuit Breaker Analyzer — Top-of-range model



Test Objective:

Complete off-line testing of MV/HV circuit breakers per IEC 62271-100: operating-time measurement (O, C, O-C, C-O, O-C-O and custom sequences), motion/speed/travel analysis, and simultaneous static and dynamic main-contact resistance measurement — including Both-Sides-Grounded (BSG) testing of GIS breakers without any extra external module.

Key Features

- Up to three built-in 200 A DC micro-ohmmeter, allowing up to six simultaneous static/dynamic contact-resistance measurements (multi-break breakers).
- 16 (optionally 24) fully configurable Main/PIR and auxiliary contact inputs; 2, 4 or 6 Open/Close coil commands.
- Safe Both-Sides-Grounded (BSG) testing built in — no additional external safety module required.
- Three-phase first-trip measurement (with optional AC/DC current clamps); 3 analog/rotary + 3 digital transducer inputs for motion and speed analysis.
- 7" color touch display, 800 × 480 pixels; internal memory for ~1,000 results and 256 stored Test Plans.
- Optional Minimum Voltage Trip Coil module and internal thermal printer; weight 15 kg.

v. CBA 2000

HV Circuit Breaker Analyzer and Micro ohmmeter — Mid-range, portable

Test Objective:

Complete timing and motion analysis of HV/EHV circuit breakers, with an optional built-in 200 A pure-DC micro-ohmmeter for static and dynamic contact-resistance testing, in a lighter, battery-capable package suited to field mobility.



Key Features

- 6 main + 6 resistor contact inputs standard, expandable in option to 12 or 18 (3 groups of up to 6); 2 coil circuits standard, optionally 4.
- Optional single 200 A DC micro-ohmmeter module for static/dynamic contact-resistance testing, including BSG capability.
- Optional three-phase first-trip test using AC/DC current clamps, for in-service breaker friction diagnostics.
- Operates from mains (AC/DC) or an internal rechargeable NiMH battery — useful where site power is unreliable.
- Large sunlight-readable graphical display (122 × 92 mm); USB and RS232 PC interfaces; ~500 stored results (256 MB).
- Weight 13 kg basic unit, 15 kg with the micro-ohmmeter module fitted.

vi. CBA 1000

Circuit Breaker Analyzer and Micro ohmmeter — Entry-level, compact

Test Objective:

Standard MV/HV circuit breaker timing, motion and single-channel static/dynamic contact-resistance testing in the lightest and most cost-effective unit of the family, for routine maintenance where BSG and first-trip capability are not required.



Key Features

- 6 Main + 6 Resistor contact inputs (2 breaks per phase); 2 coil circuits standard, optionally 4 (3 Open, 1 Close).
- Optional single built-in 200 A DC static/dynamic resistance module with 10 m test cables.
- Optional Minimum Trip Voltage test module (250 V/4 A or 70 V/10 A) and internal or external thermal printer.

- Operates from mains (AC/DC) or internal rechargeable battery; sunlight-readable display, USB and RS232 interfaces.
- ~250 stored results (128 MB); weight 10 kg basic unit, 11 kg with the micro-ohmmeter module.

Technical Details — CBA 3000 / 2000 / 1000

Specification	CBA 3000	CBA 2000	CBA 1000
Positioning	All-in-one, top of range	Mid-range, portable	Entry-level, portable
Built-in micro-ohmmeter	Up to 3 × 200 A DC (6 breaks)	1 × 200 A DC (optional)	1 × 200 A DC (optional)
Main/PIR contact inputs	16 (24 optional)	6, optional up to 18	6 (2 breaks/phase)
Auxiliary event inputs	Shared with main inputs (config.)	4 (optional 8 or 12)	4
Coil (Open/Close) commands	2, 4 or 6	2 (optional 4)	2 (optional 4)
Both Sides Grounded (BSG) test	Yes — no external module needed	Yes, via micro ohmmeters	No
Three-phase first-trip test	Yes (optional current clamps)	Yes (optional current clamps)	No
Motion/transducer inputs	3 analog + 3 digital	3 analog + 3 digital	1–2 analog
Timing accuracy	± 20 µs (internal trigger)	50 µs ± 0.025%	100 µs ± 0.025%
Local display	7" color, 800 × 480	Sunlight-readable graphical	Sunlight-readable graphical
Internal memory	~1,000 results (256 MB)	~500 results (256 MB)	~250 results (128 MB)
Power source	Mains only	Mains + internal battery	Mains + internal battery
Weight	15 kg	13 kg (15 kg with micro-ohmmeter)	10 kg (11 kg with micro ohmmeter)

vii. MCCB-250

Molded Case Circuit Breaker Tester



Test objective

The MCCB-250 is a programmable, high-current source designed specifically for testing molded-case circuit breakers as well as thermal, magnetic, or solid-state overload motor-protection relays.

Key Features

- Built-in timer tests time-delay characteristics of protection relays and molded-case circuit breakers; current source and timer start automatically at the next AC zero-crossing point.
- Timer stops on a change in dry contact or voltage input, or on removal of test current; results shown in milliseconds and fractions of a cycle.
- 4 current-source outputs: 5 A @ 120 Vac, 25 A @ 24 Vac, 120 A @ 6 Vac, 250 A @ 3 Vac.
- External current input (0–10 A); internal and external readings viewable simultaneously.
- Back-lit LCD screen (20 characters x 4 lines), viewable in bright sunlight and low light.
- RS-232C interface for factory calibration and diagnostics.

Over-Current and Duration Table

% Rated Current	Max On Time / Max Off Time
100% (1x)	30 minutes / 30 minutes
200% (2x)	3 minutes / 5 minutes
300% (3x)	30 seconds / 4 minutes

Technical Specifications

Specification	Detail
Dimensions	17"W x 12.5"H x 10.5"D (42.6 x 32 x 27 cm)
Weight	46 lbs. (21 kg)
Output Currents	0–5 A @ 120 Vac max; 0–25 A @ 24 Vac max; 0–120 A @ 6 Vac max; 0–250 A @ 3 Vac max
Instantaneous Current	700 A
Internal Current Meter Range	100 mA – 1000 A; accuracy: 1% of reading, ± 20 mA
External Current Meter Range	10 mA – 10 A; accuracy: 1% of reading, ± 20 mA
Measurement Method	Isolated CT for both internal and external current meters
Input Voltage	100–120 Vac or 200–240 Vac (factory pre-set), 50/60 Hz
Timer Stop Inputs	Voltage input (24–300 V, dc or peak ac), dry contact input, or removal of primary current
Timer Reading Range	1 ms – 2 hours; accuracy: 0.1% of reading ± 1 ms
Display	Back-lit LCD (20 characters x 4 lines)
Computer Interface	RS-232C port for factory calibration and diagnostics
Safety	IEC61010 (1995), UL61010A-1, CSA-C22.2
Operating Temperature	-10°C to +50°C (+15°F to +122°F)
Storage Temperature	-30°C to +70°C (-22°F to +158°F)
Humidity	90% RH @ 40°C (104°F), non-condensing
Altitude	2,000 m (6,562 ft) to full safety specifications
Cables	Power cord, ground cable, 10-ft #4 AWG current cable set, 10-ft #10 AWG current cable set
Options	Shipping case
Warranty	One year on parts and labor

viii. Auto-Ohm 10

Low Resistance Micro-Ohmmeter



Test Objective

Provides precise low-resistance measurements for circuit breaker contacts, bushing joints, welding joints, and transformer windings. Designed for field portability, it ensures reliable diagnostics with high-capacity batteries and built-in safety features.

Key Features

- Battery powered (Li-Ion) – up to 2,900 tests per charge at 10 A/2 s.
- Built-in charger and line-power option for continuous operation.
- Two test modes: Contact Resistance and Transformer Resistance.
- Selectable test currents: 1 mA to 10 A.
- Selectable test times: 1 s to 60 s.
- Bi-directional and Auto test modes for enhanced accuracy.
- Back-lit LCD (128 × 64 pixels) viewable in sunlight and low-light.
- Protected to 600 V for operator safety.
- Lightweight design – only 7.8 lbs (3.54 kg).

Technical Data

Parameter	Specification
Resistance Range	1 $\mu\Omega$ to 5,000 Ω
Accuracy	$\pm 0.2\%$ + resolution (varies by current)
Test Currents	1 mA, 10 mA, 100 mA, 1 A, 5 A, 10 A
Transformer Resistance Mode	100 mA – 10 A
Display	Back-lit LCD, 128 × 64 pixels
Dimensions / Weight	36 × 19.4 × 30.4 cm; 7.8 lbs (3.54 kg)
Power Supply	100–240 Vac, 50/60 Hz
Battery	4× Li-Ion, 3.7 V, 3400 mAh
Operating Temp	–10 °C to +50 °C
Storage Temp	–30 °C to +70 °C
Humidity	90% RH @ 40 °C, non-condensing
Altitude	Up to 2,000 m

ix. Auto-Ohm 200 S4

True DC Micro-ohmmeter



Test Objective

Precisely measure low-resistance values principally EHV circuit-breaker contact resistance, bushing contact joints, and welding joints using a true DC test current per the IEEE C57.09-1999 (5.15) requirement, without inducing transients into the breaker's current transformers.

Key Features

- Selectable true DC test current, 1 A–200 A, with controlled rise/fall time (5–30 s) to avoid inductively tripping bus-differential relays.
- Auto Test mode starts automatically when sense leads are applied across the points of interest speeds sequential multi-point testing.
- Compares readings against preset limits and flags Pass/Fail automatically.
- Optional Dual Ground mode measures contact resistance with both sides of the bushing grounded, using an external current sensor to null out ground-strap current.
- 128 internal records (64 readings each); up to 999 records on USB flash drive; optional built-in 2.5" thermal printer; PC software exports to PDF/Excel/XML.

Technical Details

Parameter	Specification
Dimensions / Weight	18"W x 7"H x 15"D; 19.8 lbs (8.9 kg)
Resistance range	1 $\mu\Omega$ – 5 Ω (0.1 $\mu\Omega$ resolution above 5 A)
Typical accuracy	$\pm(0.15\%$ of reading + 0.15% FS) @ 10–200 A
Cables supplied	30 ft (9.1 m), #1 AWG test cables
Input power	100–240 Vac, 50/60 Hz
Safety Compliance	IEC 61010, UL 61010A-1, CSA-C22.2
Accessories	15 ft cable set with alligator clamps (included); optional hand probes, pistol grip probes, shipping case

x. VBT-75 S2

Vacuum Bottle Tester



Test Objective

Verify the dielectric integrity of a circuit-breaker vacuum interrupter (“vacuum bottle”) in the field or shop by applying a high-voltage DC withstand test and monitoring leakage current for flashover/failure.

Key Features

- Selectable test voltage 10 kV dc–75 kV dc in 5 kV steps; hold time 5 seconds to 2 minutes.
- Automatic Pass/Fail: leakage current is compared to a programmable threshold (100/200/300 μ A); flash-over immediately cuts voltage and flags Failure.
- Operator safety: audible tone + illuminated HIGH VOLTAGE LED during test; “ARM” switch must be held down to apply voltage; 3-second max internal discharge time.

- Very portable at 10 lbs (4.53 kg); back-lit LCD (20 x 4); field-upgradable firmware via USB.

Technical Details

Dimensions / Weight	17"W x 10.5"H x 6.5"D; 10 lbs (4.53 kg)
Output voltage	10–75 kV dc in 5 kV steps; accuracy $\pm 1.5\%$
Cables	One 10 ft high-voltage cable, one 10 ft return cable, ground cable
Input power	90–240 Vac, 2 A, 50/60 Hz

xi. VBT-75P S2

75 k Vdc Vacuum Bottle Tester with Printer and Keypad data entry



Test Objective

The Doble/Vanguard VBT-75P S2 is engineered primarily to verify the vacuum integrity and dielectric withstand strength of medium-voltage vacuum interrupters in both field maintenance and shop testing environments. It accomplishes this by applying a precise high-voltage DC potential ranging from 10 kV DC up to 75 kV DC across open breaker contacts to ensure the vacuum seal has not degraded due to mechanical stress or aging. During this period, which can be programmed from 5 seconds to 2 minutes, the instrument continuously monitors the internal leakage current against a user-selected threshold of 100, 200, or 300 microamps. If the insulation breaks down or an internal flashover occurs, the unit immediately shuts down the test voltage to prevent equipment damage and protect personnel, displaying a clear failure state. Additionally, the integral thermal printer and internal memory allow field technicians to generate immediate hard-copy test documentation and store up to 84 records for long-term asset management and trend analysis.

Key Feature

- 10 kV dc to 75 Kv dc in 1 Kv steps
- 100, 200, 300 micro-amperes programmable test current
- Displays test voltage and test current
- “Pass/Fail” indicator and message
- Very lightweight
- Shipping case included
- Built-in 2.5” thermal printer
- Can store up to 84 records of 16 readings in Flash EEPROM

- USB Flash drive interface

Technical Specification

Parameter	Specification
INPUT POWER	90 – 240 Vac, 2 A, 50/60 Hz
OUTPUT VOLTAGE	10 kV – 75 kV DC in 1 kV steps; accuracy: 1.5%
OUTPUT RIPPLE VOLTAGE	3% max
DISCHARGE TIME	maximum discharge time for internal high voltage is 3 seconds
DISPLAY	back-lit LCD (20 characters x 4 lines); viewable in bright sunlight and low-light levels
FAILURE INDICATOR	failure indicator LED illuminates when test current exceeds 100 μ A, 200 μ A, 300 μ A (programmable)
KEYPAD	rugged membrane keypad (10 alpha-numeric keys, 6 function keys)
INTERNAL DATA STORAGE	stores up to 84 records of 16 readings each
PRINTER	built-in 2.5" thermal printer
PC SOFTWARE	Windows®-based software is included with purchase price
COMPUTER INTERFACE	USB Flash drive port for test record storage and firmware updates
TEMPERATURE	Operating: -10°C to +50°C (+15°F to +122°F) Storage: -30°C to +70°C (-22°F to +158°F)
HUMIDITY	90% RH @ 40°C (104°F) non-condensing
ALTITUDE	2,000 m (6,562 ft) to full safety specifications
CABLES	one 10-foot high-voltage cable, one 10-foot high voltage return cable, one ground cable, one power cord
FURNISHED ACCESSORIES	shipping case
WARRANTY	one year on parts and labo
PHYSICAL SPECIFICATIONS	Dimensions: 17"W x 10.5"H x 6.5" D (42.7 cm x 26.9 cm x 16.5 cm) Weight: 12 lbs. (5.44Kg)

6.4 Instrument Transformer Testing

i. iCT1

Fully Automatic CT, VT & Combined-Transformer Test Set



Test Objective:

Single-connection, fully automatic testing of current transformers, voltage transformers, and combined transformers: ratio & phase error, excitation (knee-point), winding/burden resistance, ALF/ISF, leakage current, and full accuracy verification at 120/100/20/5/1% of rated current, per IEC 61869-x / IEC 60044 series and IEEE C57.13.1.

Key Features

- 5-TAP integrated switchbox — the device is wired to the transformer once, and all taps/tests are executed without re-cabling.
- CT saturation testing up to 2 kV directly, and up to 30 kV via a safe low-voltage (150 V DC) indirect 'DC method' that models transformer behaviour at different frequencies and burdens (advanced version, code 10183).
- 'CT Explorer' function automatically identifies missing or illegible CT nameplate data from test results.
- Integrated demagnetizer to remove residual core magnetism after winding-resistance testing.
- 7" touch-screen display; Ethernet (wired or Wi-Fi) and USB connectivity; Test Plan Editor for automated CT/VT sequences.
- Compact and lightweight: 410 × 340 × 205 mm, 16 kg; power consumption under 1 kW.

Technical Details

Output Characteristics

Main generator

The main generator has 5 outputs:

- High AC voltage
- Low AC current
- Low DC current
- Low AC voltage
- Low voltage for DC method test

High AC voltage

- MAX Voltage 2000 V
- MAX Current 1 A

Low AC current

- I_{max} 6A AC
- V_{max} 100V AC
- Max Power 200VA

Low DC current

- I_{max} 6A DC
- V_{max} 30V DC
- Max Power 180W

Low AC voltage

- Maximum output voltage: 180V AC
- Maximum output current: 3.5A AC
- Maximum output power:
 - Supply 230V : 400 VA (Power values with $\cos\phi < 0.225$)
 - Supply 110V : 350VA (Power values with $\cos\phi < 0.175$)

Low voltage for excitation curve DC method

- Maximum output voltage: 200V DC
- Maximum output current: 2Arms, 15A peak

Output frequency

- Frequency: 15Hz – 400Hz
- Frequency resolution: 10mHz
- Frequency accuracy: < 100 ppm; output voltage > 200 V

Other features of main outputs

- Zero crossing control: the generation starts and stops on the zero crossing
- Over-current: alarm message
- Thermal protection for: Power supply, Power amplifier, Power transformer. The operator is alerted by a message.

Input / Outputs Measurements

Input	Range	Resolution	Typical Error		Guaranteed Error	
			[<%rdg]	[<%rg]	[±%rdg]	[±%rg]
AC current	10 A	1 mA	< 0,025 %	< 0,025 %	± 0,05 %	± 0,1 %
	1 A	0,1 mA	< 0,025 %	< 0,025 %	± 0,10 %	± 0,05 %
	0,1 A	0,01 mA	< 0,025 %	< 0,025 %	± 0,15 %	± 0,05 %
DC current	15 A	1 mA	< 0,025 %	< 0,025 %	± 0,05 %	± 0,05 %
	1,5 A	0,1 mA				
	0,15 A	0,01 mA				
AC voltage primary side	300 V	15 mV				
	30 V	1,5 mV	< 0,02 %	< 0,02 %	± 0,05 %	± 0,05 %
	3 V	0,15 mV				
	300 mV	0,015 mV				
AC voltage secondary side	2100 V	100 mV				
	200 V	10 mV	< 0,02 %	< 0,02 %	± 0,05 %	± 0,05 %
	20 V	1 mV				
	2 V	100 µV				
DC voltage	200 V	10 mV	< 0,025 %	< 0,025 %	< 0,05 %	< 0,05 %
	20 V	1 mV	< 0,025 %	< 0,025 %	< 0,05 %	< 0,05 %
	2 V	100 µV	< 0,025 %	< 0,025 %	< 0,05 %	< 0,05 %
	200 mV	10 µV	< 0,025 %	< 0,025 %	< 0,05 %	< 0,05 %
	20 mV	1 µV	< 0,05 %	< 0,05 %	< 0,01 %	< 0,01 %

Type of measurement
True RMS for AC outputs DC component for DC outputs
Metering temperature coefficient
± 0,05 % / °C of the value ± 0,02 % / °C of the range

Ratio test

Accuracy for CT ratio measurements:

Ratio range	Typical accuracy	Guaranteed accuracy
0,8 ÷ 2000	± 0,02 %	± 0,05 %
2000 ÷ 5000	± 0,03 %	± 0,10 %
5000 ÷ 20000	± 0,05 %	± 0,20 %

Accuracy for VT ratio measurement

Ratio range	Typical accuracy	Guaranteed accuracy
1 ÷ 400	± 0,03 %	± 0,2 %
400 ÷ 1000	± 0,05 %	± 0,3 %
1000 ÷ 2500	± 0,05 %	± 0,5 %

Winding resistance test

Source	Resolution	Typical accuracy	Guaranteed accuracy
Low DC current 6 A max	0,1 mΩ	< 0,05 %	0,1 % 1 mΩ

Phase Angle

Metering range	Resolution	Accuracy (cosφ 0.8 - 1)
0° ÷ 360.0°	0.01° (< 1 minute)	< 4 minutes (maximum) For amplitudes more than 10% of the metering range

ii. EZCT

Current Transformer Test Set



Test Objective

Perform CT excitation, current-ratio, and winding-polarity tests on current transformers in their field-mounted configuration, eliminating the need to remove bushings or CTs from the host equipment.

Key Features

- Excitation test per ANSI/IEEE C57.13.1 / IEC 60044-1; variable AC test voltage up to 1,200 Vac; plots up to 10 excitation curves with IEEE-30/45 and ANSI/IEC 60044-1 (10/50) knee-point calculations.
- Ratio and polarity determined per ANSI/IEEE C57.12.90; current-ratio range 0.8–5,000; polarity shown as +/– with phase angle in degrees.
- Back-lit 4-line x 20-character LCD; 16-key alpha-numeric membrane keypad; selectable test-voltage switch (50 V / 200 V / 1,200 V).
- Stores 128 test records (up to 10 curves/record); built-in 4.5" thermal printer; RS-232C and USB PC interfaces; results exportable to Excel.

Technical Details

Parameter	Specification
Dimensions / Weight	16.8"W x 12.6"H x 12"D; 55 lbs (25 kg)
Output test voltages	0–50 Vac @ 2A; 0–200 Vac @ 2A; 0–1,200 Vac @ 1.5A (5 min on / 10 min off)
Current-ratio accuracy	0.8–99: $\pm 0.5\%$; 100–999: $\pm 1.0\%$; 1,000–5,000: $\pm 2\%$
Phase angle accuracy	± 1.0 degree over 0–360°
Input power	100–120 Vac or 200–240 Vac (factory pre-set), 50/60 Hz

6.5 Battery Testing

i. BTS 200 MKII

Test Objective:

Determination of standby-battery capacity through a controlled discharge cycle, for batteries supplying protective relays, circuit breakers, measuring equipment and telephone exchanges in power plants and substations.

Key Features

- Discharge current up to 130 A stand-alone (rating varies 70–130 A depending on nominal battery voltage: 24–240 V DC), extendable to 1,300 A using up to nine external ELU 200 MKII active loads.
- Selectable load patterns: constant current, constant power, current profile (up to 20 steps), power profile, or fully manual control.
- Graphical back-lit LCD showing battery voltage, discharge current/power/profile, Ah discharged, elapsed time and the discharge curve in real time.
- Automatic stop on minimum-voltage threshold, maximum capacity, time-out (up to 9 h 59 min) or system alarm.
- External current measurement via optional clamp or shunt, allowing testing without disconnecting the battery from its live load.

USB and CAN-bus interfaces (CAN-bus for external-load control); PC software for Windows for setup, live monitoring and reporting.



Technical Details

Parameter	Specification
Device Model	ISA BTS 200 MKII (High Power Battery Test System)
Display	Large back-lighted graphical LCD display
Interfaces	USB, CAN-BUS (for external loads control)
Internal Memory	Non-volatile memory for 8 discharging sequences
Power Supply Options	100–240 V AC (50/60 Hz), 100–270 V DC, or directly from the battery under test (110–240 V DC)
External Load Expandability	Connects up to 9 ELU 200 MKII external loads (up to 1300 A max discharge)
Operating Temperature	0°C to 40°C (Storage: -25°C to 70°C)
Applicable Standards	CEI EN 61010-1 (Low Voltage), EN 61326-1+A1+A2 (EMC)
Dimensions	283 x 700 x 420 mm
Weight	32 kg (without optional transit case)

6.6 Lighting Asserter Testing

i. LCM500

A distinct in-service instrument focused on surge arresters rather than PD/EMI survey; included here for completeness of the in-service testing line.

Test Objective

Assesses the condition of in-service metal-oxide surge arresters by measuring leakage current, helping manage the risk of arrester failure without removing the arrester from service.

Key Features

- Portable, battery-operated instrument for regular condition assessment of surge arresters.
- Unique ID per arrester; stores up to 1,000 arrester IDs and field measurements.
- Uses well-proven third-order harmonic analysis with compensation, per IEC 60099-5.
- Automatically normalizes readings to standard ambient temperature (+20°C) and 0.7x rated arrester voltage.
- Wireless current probe and field antenna; software supports group/regional arrester evaluation.
- Inspection takes under 15 minutes per arrester, on location, arrester remaining in service.

Technical Details

Measuring Range	Total leakage current: 200–16,000 μ A Resistive current: 0–9,000 μ A
Accuracy	$\pm 5\%$ or $\pm 5 \mu$ A
Frequency Range	47–63 Hz (50/60 Hz systems)
Battery	9.6 V, 2,600 mAh — 8 hours capacity, 1.5 hours charge
Weight	7.5 kg / 16.5 lbs
Enclosure Rating	IP67 (closed case) / IP40 (open lid)





ii. SCAR 10

Test Objective:

On-line (in-service) diagnostic of metal-oxide surge arresters (MOSA) installed on HV/MV transmission and distribution networks, per IEC 60099-5 Annex A1, Methods B1 and B2 without taking the arrester out of service.

Key Features

- Non-intrusive measurement of ground-leakage current via a screened clip-on current transformer (C 47-IS, ratio 1000:1); analyses total current (true-RMS and peak) and third-harmonic content, whose growth indicates arrester ageing/deterioration.
- Optional third-harmonic voltage compensation probe, used mainly on MV networks where system-voltage distortion can otherwise mask the arrester's own third-harmonic signature.
- Screened, pre-amplified clamp with the amplifier mounted on the clamp handle to minimise sensitivity to nearby electric/magnetic fields.
- Built-in calibration output (triangular 1 mA-peak waveform with known RMS and third-harmonic content) to verify instrument accuracy in the field.
- Compact, battery-powered (4 × AA), backlit LCD instrument (0.75 kg) plus clip-on transformer (0.9 kg) in a lightweight carry case (3 kg total).

Technical Details

Parameter	Specification
Device Model	ISA SCAR 10 (Surge Arrester Test Set)
Display	3.5-digit back-lighted LCD display with LED range indicators
Power Supply	4 x AA alkaline penlight batteries (Battery life: 25 to 50+ hours)
Current Measurement Ranges	Total current (rms & peak): 1.999 mA or 19.99 mA; 3rd Harmonic: 199.9 μA or 1999 μA
Measurement Accuracy	$\pm 5\%$ (50/60 Hz total current), $\pm 10\%$ (150/180 Hz 3rd harmonic)

Parameter	Specification
Current Clip-on Transformer	Model C 47-IS (1000:1 ratio, 54 mm max tightening diameter, 0.9 kg)
Calibration Test Output	Triangular waveform generation (1 mA peak, 0.606 mA rms $\pm 5\%$)
Operating Temperature	0°C to 50°C (Storage: -25°C to 70°C)
Applicable Standards	IEC 60099-5 A1 (Method B1/B2), EN 61326:2006 (EMC), CEI EN 61010-1 (Low Voltage)
Dimensions (Instrument)	200 x 112 x 65 mm
Weight (Instrument / Complete Kit)	0.75 kg (instrument alone) / 3 kg (complete carry case kit)

6.7. Power Cable Testing:

i. AC VLF Fault Locator

Cable Testing & Fault Location System



Test Objective

Provides comprehensive cable hi-potting, fault locating, and fault burning capabilities using very low frequency (VLF) AC power supplies and optional high-power DC burn supplies. Designed for medium- and high-voltage feeders, it ensures safe, accurate diagnostics and operator protection.

Key Features

- Utilizes cosine-rectangular VLF waveform for accurate hi-pot testing.
- Tests feeders from 4 kV to 33 kV with up to 25 μ F cable capacitance load at maximum voltage.
- Systems available for up to 138 kV class.
- Internal grounding and discharge devices for operator safety.
- Automated systems with data acquisition and report generation.

- Optional high-power DC burn supplies (20 A).
- Provides up to 7500 J discharge energy.

Ground & Discharge Sticks

For operator safety during high-voltage testing.

Model	Type	Rating
GS30	Ground Stick	30 kV AC/DC
GS100-2	Ground Stick	100 kV AC/DC
GS160-2	Ground Stick	160 kV AC/DC
DS100-2	Discharge Stick	100 kV DC
GSDS30	Combination Ground/Discharge Stick	30 kV AC/DC

ii. TCT-30

Tracing Current Transmitter Test Set



Test Objective

Provides reliable continuity testing and phase sequence identification in manholes or vaults. Designed for feeder systems, it ensures accurate tracing of electrical paths between two points with up to 30 A pulse current.

Key Features

- Performs continuity tests to prove electrical path integrity.
- Assists in phase sequence identification in manholes/vaults.
- Provides up to 30 A pulse current.
- Different pulse train for each phase for clear identification.
- Solid-state switching for durability and reliability.
- Suitable for long cable applications.
- Works seamlessly with GALV and PMT units.

Technical Details

Parameter	Specification
Device Model	Phenix Technologies TCT-30 (Tracing Current Transmitter Test Set)

Parameter	Specification
Primary Function	Performs continuity tests to prove electrical path between two points on a feeder
Pulse Current	Up to 30 A
Pulse Characteristics	Different pulse train for each phase
Switching Type	Solid state switching
Application Capabilities	Identifies phase sequence in manholes or vaults; suitable for long cables
System Compatibility	Operates with GALV (Galvanometer) and PMT (Pick Method Tester) units

6.8 Primary Current Injection

PCI-600

Primary Current Injection Device



Test Objective

The PCI-600 is a programmable AC high-current source designed specifically for utility-substation applications. It is well suited for primary injection testing of protective relays, and can also test thermal, magnetic, and solid-state motor-protection relays and molded case circuit-breakers, as well as any application requiring a high-current source.

Key Features

- Built-in timer tests time-delay characteristics of protection relays and molded-case circuit-breakers; current source and timer start automatically at the next AC zero-crossing point.
- Timer stops on a change in dry contact or voltage input, or on removal of test current; results shown in milliseconds and fractions of a cycle.
- Test currents from 10 to 600 amperes, set via rotary dial knob on the control panel.
- External current input (0–10 A); internal amplitude and external readings viewable at the same time.
- Back-lit LCD screen (20 characters x 4 lines).
- RS-232C interface.

Output Current and Duration Table

Output @ 120 Vac / @ 240 Vac	Time
5.6 Vac @ 100A / 9.5 Vac @ 100A	1 hour
5.3 Vac @ 200A / 9.4 Vac @ 200A	5 minutes
4.9 Vac @ 300A / 9.0 Vac @ 300A	2 minutes
4.6 Vac @ 400A / 8.2 Vac @ 400A	1 minute
4.2 Vac @ 500A / 7.5 Vac @ 500A	30 seconds
3.9 Vac @ 600A / 7.0 Vac @ 600A	20 seconds

Technical Specifications

Specification	Detail
Dimensions	17"W x 12.5"H x 10.5"D (42.6 x 32 x 27 cm)
Weight	46 lbs. (21 kg)
Test Current Range	10 A to 600 A (rotary dial set)
Internal Meter Range	100 mA – 1,000 A; accuracy: 1% of reading, ± 20 mA; isolated CT
External Meter Range	10 mA – 10 A; accuracy: 1% of reading, ± 2 mA; isolated CT
Input Power	100–120 Vac or 200–240 Vac (factory pre-set), 50/60 Hz
Timer Stop Input	Voltage input (24–300 V, dc or peak ac), dry-contact input, or removal of primary current
Timer Reading Range	1 ms – 2 hours; accuracy: 0.1% of reading ± 1 ms
Safety	IEC61010 (1995), UL 61010A-1, CSA-C22.2
Operating Temperature	-10°C to +50°C (+15°F to +122°F)
Storage Temperature	-30°C to +70°C (-22°F to +158°F)
Humidity	90% RH @ 40°C (104°F), non-condensing
Altitude	2,000 m (6,562 ft) to full safety specifications
Cables	10-ft (3.05m) #1/0 AWG test leads, power cord, ground cable
Options	Shipping case
Warranty	One year on parts and labor

ENGINEERING SERVICES

7.1 Doble Service Agreement (DSA)

DESCRIPTION OF ANNUAL SERVICES	Silver	Gold
Free registration at Doble client conferences: - Annual International Conference of Doble Clients (Boston) - Regional events – EuroDoble, IndiaDoble, LATAMDoble - Protection & Control Seminar - Australia Protection Testing User Group	Up to 5 persons	Up to 10 persons
Participation in the activities of the Technical Client Committees held twice per year (spring and fall events), and Regional Technical Committees	Up to 5 persons	Up to 10 persons
Discounted registration for paid for Doble training events including: - Life of a Transformer Seminar (LOATS) - Circuit Breaker Seminar	10% off registration fee	20% off registration fee
Technical application support (phone, email) to address client questions and queries, support for reviewing test data and technical application support for questions related to Doble test equipment.	10 Hours	40 Hours
Access to MyDoble client entitlement level web-portal including: - Proceedings of the International Conference of Doble Clients through 1958 - Access to Library of Doble Committee Transactions, including technical questionnaires, apparatus surveys and special projects. - Knowledge base of on demand access to recorded Webinars - Doble Client Forum, bulletin boards Q&A with Doble Client Community related to Safety, Power Apparatus, Protection, and Cyber Security - Doble Online Center for technical support, FAQs on apparatus testing, Doble instruction manuals, apparatus guides and tutorials	Up to 5 persons	Unlimited
Access to select training on MyDoble Learning e-learning platform	N/A	Unlimited
Attendance via web conference to Doble Monthly Webinar series on apparatus testing (recordings available on MyDoble)	Up to 5 persons	Unlimited
Receipt of Doble Annual Transformer Oil Purchase Survey (TOPS).	NO (optional price)	YES
Training on the application of Doble test equipment and analysis of test. Pick from a wide range of training options. Travel and subsistence expenses billed at cost.	NO	3 Days on site OR 20 hrs virtually in minimum of 4 hr blocks

7.2 Consulting & Testing Services

Doble has been a trusted name in diagnostic solutions for over a century. Today, many companies are increasingly looking to outsource for answers to their toughest engineering problems. Doble Engineering Company's Consulting and Testing Services group leverages Doble's KnowledgeBase and team of more than 70 engineers with extensive experience in transformer, substation, rotating machinery and power systems engineering applications. You can trust Doble's expert consulting, condition assessment and laboratory services for unbiased diagnosis and assessment of critical assets.

Why Doble Engineering Consulting Services?

Extensive Global Experience

Doble has more than 40 consulting engineers each with extensive experience in power systems engineering applications.

Independent Expert Opinion

Trust Doble's expert consulting & testing services for unbiased diagnosis and assessment of critical assets.

Doble Peer Review Process

When you hire Doble, you are hiring the shared experience of our entire engineering team.

Doble KnowledgeBase

The knowledge and data accumulated over a hundred years underpins our recommendations and analysis.

7.3 Online Partial Discharge Testing Services

- EMI (Electromagnetic Interference) Online Diagnostics for Generators, IsoPhase Bus, Non-Seg Bus and MV Motors
- Partial Discharge Detection / Location for Large Power Transformers
- Power Transformer Health Assessment Services
- Power Transformer Procurement Services
- Electrical Apparatus RCA Forensic Failure Analysis
- Training



7.4 Post-Sales Support of all Doble Products including spares, maintenance and calibration.

THANK YOU FOR YOUR TIME AND ATTENTION