

Three-Phase Transformer Test Systems

Testing Applications

Perform tests on utility distribution and power transformers in accordance with IEC 60076 and ANSI / IEEE C57 standards.

- verify a manufacturer's test and design data prior to installation
- after repair or upgrade
- when a major disruptive event occurs, such as a lightning strike
- for preventive/predictive maintenance

Models Available

- TTS35
- TTS65
- TTS155
- TTS175
- TTS200
- TTS250
- TTS500
- TTS750
- TTS1000



Model TTS155



Broad Range of Test Systems

Phenix Technologies offers a complete line of Transformer Test Systems for testing distribution to small power transformers, three phase or single phase. Consisting of a variable power supply, step-up transformer, and high accuracy metering package controlled by an industrial microprocessor, the TTS series is a ready-to-test solution for a wide range of transformer testing applications.

Quality Construction Ensures Reliability

All of Phenix Technologies' Transformer Test Systems are built in our western Maryland facility. This includes fabrication of the cabinet, winding of the power transformer, regulator construction, assembling of the components, programming, and final pre-shipment testing. Our ISO9001 compliance ensures optimum standards of quality are met through each step of the process resulting in a superior test system with an excellent service life.



Perform a Wide Variety of Tests

PHENIX Transformer Test Systems are designed to perform tests in accordance with IEC 60076 and ANSI / IEEE C57.12, standards, latest edition. These tests include:

- Excitation Current Measurement
- Excitation Loss (No-Load or Core Loss)
- Impedance Voltage Measurement
- Full Load Current
- Copper Loss (Load Loss)
- Temperature Measurement (Heat Run)

Additional testing capability with optional system components include:

- Applied Potential Test
- Induced Potential Test
- Winding Resistance Measurement
- Turns Ratio and Phase Displacement
- Insulation Resistance

Design and Safety Features

- Main and control power circuit breakers
- Zero Start interlock
- Emergency off mushroom switch
- Slow-and fast-acting protective devices on power transformer, regulator, measurement system, and other critical components
- Raise and Lower pushbuttons with Off Zero indicator
- Motorized control of output voltage with adjustable rate of rise
- Motorized tap selector with indicators
- Auto-ranging wattmeter and voltmeter with direct readout
- Four-wire measurement system for accurate readings
- Test mode selector with indicator
- RMS and AVERAGE responding voltmeters, displayed simultaneously
- Provision for external security circuit with indicator
- System calibration traceable to NIST (National Institute of Standards and Technology, USA)
- Foot switch
- Flashing red warning light
- Recessed jacks for output leads
- Fork truck and overhead lifting provisions
- Two copies of operation/maintenance manual

Precision Power Regulation

The power regulating system of a PHENIX TTS varies between three different options. The system may be equipped with one of two types of variable transformers determined by the power rating of the test system; a lower power system utilizes a toroidal type regulator and a larger system utilizes a column type regulator. For additional detailed information on Voltage Regulators refer to PHENIX brochure #70106. The third option is a variable frequency power supply that can generate frequencies of 50/60 Hz as well as higher frequencies needed for induced testing.

Environmental Conditions

- 10-40°C, indoor/outdoor in fair weather
- Humidity <95% non-condensing
- Altitude <3300 ft (1000 meters)



**Model TTS155 with
Control Console and
AC Hipot Transformer**

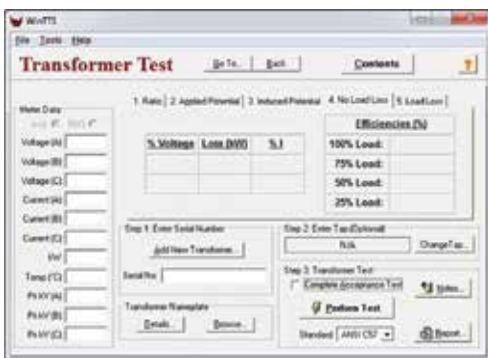


Controls and Metering

Phenix Technologies uses the latest development in computer-assisted controls. The Human Machine Interface (HMI) allows the programming of automation features of the test set. Easy step-by-step instructions guide the operator through each test procedure. Set-up maps for each test are provided to reduce costly connection mistakes. The system calculates corrected losses, efficiency, regulation, and percent impedance.

All output meters are displayed on the LCD screen. Data acquisition and report generation of the test results are performed via computer and WIN TTS testing software with all required interface cables included. The HMI eliminates a large number of relays and meter wiring which increases reliability. In addition to the test results database, the system is equipped with a recipe database that allows recall of a previously entered testing template reducing testing time and increasing efficiency.

Also included are calibration and service modes. All adjustments needed for yearly recalibration are simply made by adjusting a few numbers in the software. The service mode assists and simplifies maintenance, and helps in the diagnosis of failed components in the rare cases that may be necessary.



Instrumentation

A high precision microprocessor-based measuring system is designed into the PHENIX Transformer Test System. This enables accurate measurement of output power, voltages, and currents. The metered information is displayed on the HMI. The values displayed on the HMI are performed as a function of the programmable logic controller (PLC). The following metering measurements are displayed:

Voltmeter

Six 5-digit displays showing True RMS and Average readings simultaneously
Accuracy is $\pm 0.5\%$ of reading +LSD

Currentmeter

Three 5-digit displays showing True RMS reading
Ranges: 0-1.00/10.00/100.0/1000 A(1)
Accuracy: $\pm 0.5\%$ of reading +LSD

(1) or alternatively, depending on system design

Three 5-digit displays showing True RMS reading
Ranges: 0-20.00/200.0/2000 A
Accuracy: $\pm 0.5\%$ of reading +LSD

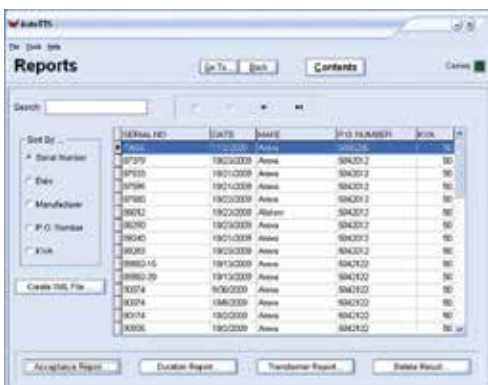
Wattmeter⁽²⁾

$\pm 0.5\%$ of reading +LSD at 1.0 pF
 $\pm 1.5\%$ of reading +LSD at 0.3 pF
 $\pm 3.0\%$ of reading +LSD at 0.1 pF

Temperature

One 4 1/2-digit display
Range: 10-120.00°C
Accuracy: $\pm 1^\circ\text{C}$

(2) Phenix Technologies also offers test systems with high measuring accuracy required for transformers that operate at very low power factors. For these types of systems, please consult with your Phenix Technologies Sales Representative.



THREE PHASE	Maximum Test Capability*	Heat Run Test Capability	Optimized for Distribution Class Transformers <34 kV Class Available Current / Voltage Taps Dry-Type Step-Up Transformer						
			1	2	3	4	5	6	7
Model	kVA	[kVA]	240V**	300V**	480V**	600V**	1000V**	1600V**	2400V**
TTS35	580	[290]	86 [43]A	69[34]A	43[21]A	34[17]A	20[10]A	13[6]A	8[4]A
TTS65	1000	[500]	156[78]A	125[62]A	78[39]A	62[31]A	37[18]A	23[11]A	15[7]A
TTS100	1650	[825]	240[120]A	192[96]A	120[60]A	96[48]A	57[28]A	36[18]A	24[12]A
TTS155	2580	[1300]	375[187]A	300[150]A	187[94]A	150[75]A	90[45]A	56[28]A	37[18]
TTS175	2900	[1450]	420[210]A	336[168]A	210[105]A	168[84]A	101[50]A	63[31]A	42[21]
TTS200	3300	[1650]	480[240]A	384[192]A	240[120]A	192[96]A	115[57]A	72[36]A	48[24]

* Based on a 6.00% transformer impedance, 5 min ON / 15 min OFF duty cycle.

** All tap voltages double during optional induced mode; example, 0-2400 V tap becomes 0-4800 V during induced mode.

Model	L x W x H Dimensions (approx.)	Weight (approx.)
TTS35	48x60x68" 1219x1524x1727 mm	2150 lbs, 975 kgs
TTS65	48x64x78" 1219x1626x1981 mm	2650 lbs, 1202 kgs
TTS100	48x64x80" 1219x1626x2032 mm	3400 lbs, 1542 kgs
TTS155	48x64x80" 1219x1626x2032 mm	3600 lbs, 1633 kgs
TTS175	48x64x80" 1219x1626x2032 mm	4000 lbs, 1814 kgs
TTS200	54x80x90" 1372x2032x2286 mm	4800 lbs, 2177 kgs

HIGH POWER THREE PHASE	Maximum Test Capability*	Heat Run Test Capability	Optimized for Small Power Transformers <72 kV Class Available Current / Voltage Taps Oil Filled Step-Up Transformer (other tap ratings available upon request)				
			1	2	3	4	5
Model	kVA	[kVA]	0.3kV**	1.5kV**	2.1kV**	3.6kV**	5.0kV**
TTS200	3300	[1650]	384[192]A	77[38]A	55[27]A	32[16]A	23[11]A
TTS250	4150	[4075]	480[240]A	96[48]A	68[34]A	40[20]A	28[14]A
TTS500	8300	[4150]	960[480]A	192[96]A	136[68]A	80[40]A	56[28]A
TTS750	12500	[6250]	1440[720]A	288[144]A	206[103]A	120[60]A	86[43]A
TTS1000	16500	[8250]	1920[960]A	684[342]A	272[136]A	160[80]A	112[56]A

* Based on a 6.00% transformer impedance, 5 min ON / 15 min OFF duty cycle.

** All tap voltages double during optional induced mode; example, 0-3.6 kV tap becomes 0-7.2 kV during induced mode.

Model	Power Regulator		Oil-Filled HV Transformer			
	Dimensions (approx.)	Weight (approx.)	Dimensions (approx.)		Weight (approx.)	
TTS200	70x102x98" 1778x2591x2489 mm	6800 lbs, 3084 kgs	60x50x84" 1524x1270x2134 mm	7500 lbs, 3402 kgs		
TTS250	70x102x102" 1778x2591x2591 mm	7000 lbs, 3175 kgs	65x58x90" 1651x1473x2286 mm	8200 lbs, 3720 kgs		
TTS500	76x104x102" 1930x2642x2591 mm	7500 lbs, 3402 kgs	68x75x98" 1727x1905x2489 mm	17000 lbs, 7711 kgs		
TTS750	92x116x102" 2337x2946x2591 mm	11000 lbs, 4990 kgs	70x80x104" 1778x2032x2642 mm	19000 lbs, 8618 kgs		
TTS1000	96x130x102" 2439x3302x2591 mm	14000 lbs, 6350 kgs	90x104x110" 2286x2642x2794 mm	25000 lbs, 11340 kgs		

NOTE: The tables above list the kVA rating of a standard system and the maximum kVA rating of the transformers that may generally be tested by each system. The maximum kVA rating to be tested is based on a transformer impedance of 6.00%. The power ratings are based on a 25% duty cycle (5 min ON/ 15 min OFF). Other duty cycles and custom higher taps are available. Please consult Phenix Technologies for your specific requirements.

Optional System Components



CAPACITIVE COMPENSATION BANK

To extend the testing range of the TTS, PHENIX can provide capacitive compensation banks. Usually connected between the transformer under test and the test system, PHENIX offers a variety of solutions with manual or automatic capacitor selection.

APPLIED POTENTIAL TESTING

PHENIX offers a complete line of AC dielectric transformers with a variety of ratings available to meet any need. Applied potential testing is necessary to verify insulation integrity in reference to ground. PHENIX can also integrate an existing hipot with a transformer test system. For detailed specifications, refer to PHENIX brochure #60404.



Hipot for Applied Potential Testing



Motor Generator Set for Induced Potential Testing

INDUCED POTENTIAL TESTING

A motor generator or electronic power supply can be integrated with the test system to increase the output frequency to perform induced testing. Detection of turn-to-turn insulation integrity is verified. The induced system typically uses the main transformer at double the 50 or 60 Hz tap rating, thus reducing the need for an additional transformer when performing induced testing. Stand-alone induced test stations are optionally available.



Turns-Ratio Metering

URNS-RATIO AND PHASE DISPLACMENT METERING

The model PATTR-03D three-phase, automatic turns ratio and phase displacement meter has outstanding accuracy and is easily integrated with the testing software for complete remote control and data acquisition. For detailed specifications, refer to PHENIX brochure #20900.

Winding Resistance Measurement



WINDING RESISTANCE MEASUREMENT

Quickly and accurately measure winding resistance. The unit has 10 A of charging current. For detailed specifications, refer to PHENIX brochure #20701. The software also supports many other models.

INSULATION RESISTANCE MEASUREMENT

PHENIX offers a complete line of manual or fully automated insulation resistance meters. For detailed specifications, refer to PHENIX brochure #10306.

PARTIAL DISCHARGE MEASUREMENTS

PHENIX test systems equipped with an oil-insulated step-up transformer and optional high voltage filters are capable of being used as a source for sensitive partial discharge measurements. The typical PD specification is <math>< 50 \text{ pC}</math> at rated voltage but can be enhanced upon request. Additionally, PHENIX offers a complete line of single- or three-phase Partial Discharge Detectors, RIV Meters, and Coupling Capacitors.

CONTROL CONSOLES

PHENIX offers an optional remote console that contains all instrumentation and controls. This option will allow the controls to be placed in protected area or climate-controlled room. For detailed specifications, refer to PHENIX brochure #90103.



Control Console with rack-mounted Turns Ratio Meter



Automated Distribution TTS



Large Power TTS

AUTOMATED DISTRIBUTION TRANSFORMER TEST SYSTEMS

For the customer interested in increasing production while decreasing labor costs, Phenix Technologies can provide fully-automated distribution transformer test systems designed for high volume testing. The automated test systems are custom-designed and built for the individual needs of the customer. Multiple test stations with single connection hook-ups can be configured to simultaneously perform the customer's desired testing protocol on each transformer. The industrial micro-processor based test system with HMI has proven to be highly reliable under stringent testing applications. Operator training time is minimal. Both manufacturers and repair facilities benefit greatly from the efficiency of automated test systems. Total test time can be reduced to as low as 90 seconds or less per transformer depending on the tests being performed and the testing sequence.

LARGE POWER TRANSFORMER TESTING SOLUTIONS

Manufacturers and repair facilities that work with very large power transformers face unique challenges when testing is required. Phenix Technologies offers a variety of options such as power supplies, switches, and high accuracy components that can be integrated into a complete test system to meet the customer's needs.

ON-SITE SERVICES AND CALIBRATION

Long-term customer support is provided from our fully experienced and knowledgeable staff. Phenix Technologies' service department offers on-site installation and operator training. We support our customers worldwide with a full-line of additional services such as on-site calibration, maintenance, upgrades and repair. Please contact your Phenix Sales Representative or Service Representative for further details.



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