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*Stator Test System with Patented MagMap® Coil Placement and Polarity Detection*

# STS 3800



Automation Technology Inc. manufactures a complete line of testing and process control products including:

- Armature Test Systems
- Rotor Test Systems
- Stator Test Systems
- Field Coil Test Systems
- No-load Motor Test Systems
- Patented Digitorque® Full-load Motor Test Systems
- Benchtop Surge Testers
- Scratched Wire Detectors
- Turns Counters
- Life Test Systems
- Final Product Testers
- Wire Bonding Process Equipment

# summary of tests performed

## HI POT/DIELECTRIC

*ATI utilizes the latest concepts in Hipot/Dielectric testing. Important Standard features incorporated in this test include:*

- Capacitance Compensation separates the real resistive current from the sometimes very large capacitive current which flows as a result of winding to core capacitance. This feature permits maximum leakage current limits to be set lower and provides better analysis of the Stator insulation.
- Ramped Turn-on of Hipot Voltage eliminates the high current inrush associated with the instantaneous application of high voltage to the part under test. If a ground is detected during the voltage ramp-up, Hipot power is removed before damage can occur.
- True RMS Measurement of both leakage current and applied voltage is more accurate due to the requirement to measure parameters that contain out-of-phase components.
- Arc Detection is a feature that detects arcing that is sometimes observed at the peaks of the test voltage. This arcing, because of the short duration, may not be of sufficient magnitude to cause the RMS leakage current to exceed the maximum leakage current limit.



## RESISTANCE

*To provide the greatest possible accuracy, ATI's Stator Test System utilizes a number of technical features when performing a resistance test that are not common in competitor's equipment. Following are some of these features:*

- Test current is kept to a minimum and applied for the shortest amount of time possible to avoid heating of the copper or aluminum magnet wire. Because magnet wire has a resistance temperature coefficient of approximately 0.4 %/°C, it is important to avoid heating the wire in order to produce stable, repeatable measurement values.
- Connection to the Stator lead wires or Cluster Block is made via a 4-wire Kelvin connection.
- Both test current and the resultant voltage drop are integrated over one line cycle and measured simultaneously. This integration over a power line cycle causes the voltage and current values to be extensively filtered at harmonics of the line frequency. Most electrical noise found in motor manufacturing facilities is at harmonics of the power line frequency. This is a feature not found in competitor's products.
- A sixteen-bit converter is used for the A to D measurement. Typical competitive Systems are twelve-bit.
- Ambient temperature compensation is standard. Optional, non-contact, infrared, part temperature measurement is available. This temperature compensation feature normalizes the resistance measurements back to programmable standard laboratory conditions typically 25°C.

*The combination of the above features and test methods provide the best Gage R&R of any Stator Test System available (particularly at the very low resistance ranges below 0.100 Ohms).*

# SURGE (IMPULSE)

The surge test is conducted by discharging a charged high voltage capacitor into the coil under test. The result is a decaying ringing pulse at a frequency defined as  $f=1/(2\pi\sqrt{LC})$ . Measurement of the surge data is as follows:

- ATI's high-resolution timer circuitry measures the period of this frequency to a resolution of 20 nanoseconds. (0.0000002 seconds). Typical period readings would be in the range of 50.00  $\mu$ S to 250.00  $\mu$ S. Extremely small changes in inductance such as shorted turns, incorrect turns count and incorrect turns placement can be easily detected with this method. This type of test unlike most others is not affected by small variations in test voltage.
- To avoid nuisance rejects caused by inductance or capacitance variations resulting from acceptable process variables, ATI has developed a method whereby the ratios of the period measurements within a stator are compared

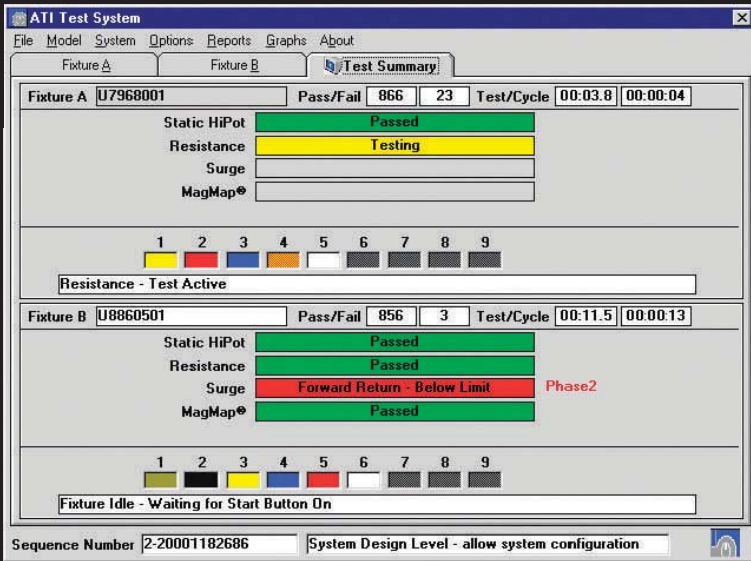
to programmable ratio limits. This permits the setting of very tight ratio limits which detects very minor winding defects without having nuisance rejects resulting from variations in the steel, in the blocking dimension, etc. Techniques used in competitive equipment do not permit this capability.

- Each winding in the stator is tested (surged) in both the forward and reverse directions. This means the high voltage surge equally stresses both ends of each winding.
- Isolated windings can be configured so that they are connected to the low surge potential to test the isolation between windings (phases).

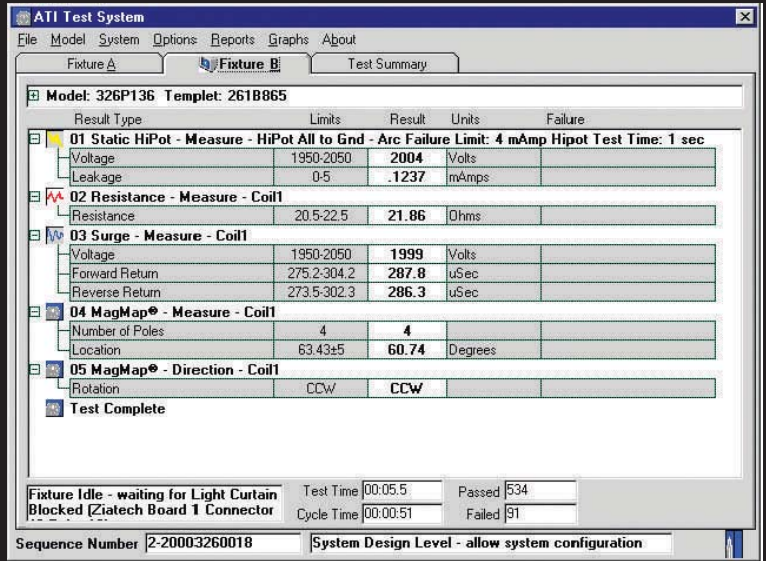
# CORONA

ATI's corona test is conducted by detecting any very high frequency disturbance while conducting a surge test at a voltage equal to the desired corona inception voltage (CIV). The detection circuitry is contained in the low impedance circuitry of the surge circuit. This enables the corona detection to be very immune to radiated noise often found in motor manufacturing facilities. Competitive equipment utilizes antennas to pick up the partial discharge that results when corona becomes excessive. Unfortunately,

this method also picks up radiation from other sources such as variable speed conveyors, welders, etc. Other methods look for voltage variations in the high voltage surge pulse. This technique again, only picks up corona when it becomes excessive. Corona testing is not only necessary to qualify motors intended for inverter applications but is also a useful tool in determining the quality of the varnish process and materials used in the varnish process.



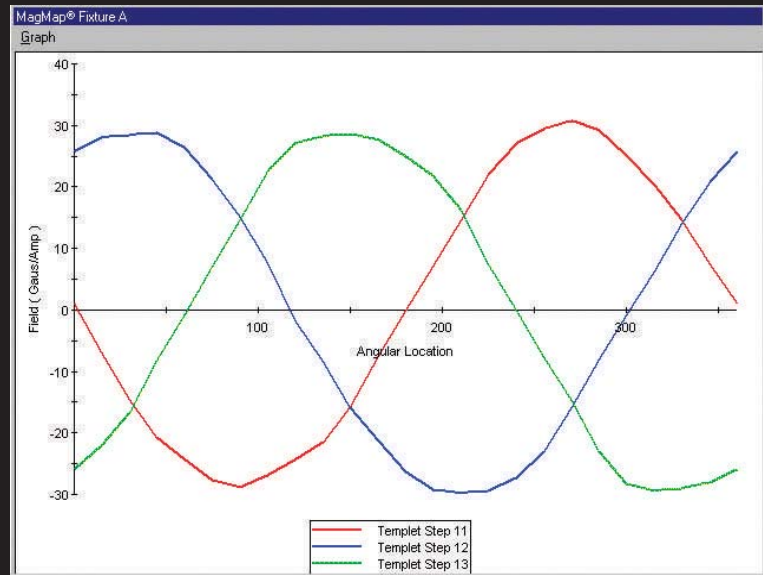
Test Summary Screen: This screen displays the model being tested in each fixture, the connection color and/or number sequence and the result of each test performed.



Fixture Detail Screen: There are two of these screens that can be selected, one for Fixture A and one for Fixture B. These screens display actual numerical measured data for each test being conducted.

## COIL POSITION & POLARITY

ATI's Patented MagMap® (Magnetic Mapping) test is conducted by inserting an array of hall effect sensors in the core of the stator under test. The sensors are placed near the teeth of the core. While a DC current flows through a winding, the resultant magnetic field strength and polarity at each sensor is measured and used to map the magnetic field for that winding. The measured data is stored in the computer's memory. This process is repeated for each winding in the stator. The data is then analyzed by the computer to determine the correct number of poles, correct angular position and correct polarity for each pole as well as correct phasing from winding to winding. This is the most extensive test of coil placement and phasing conducted by any equipment available.



MagMap® graph of two pole, three phase stator.

manual  
or automated  
fixturing

ATI offers a complete range of system configurations from manual to fully automatic. Systems can be integrated into new or existing manufacturing lines. Standard fixtures include hardened/plated Kelvin connections for long contact life and reliability. Safety interlocked light curtains are also used whenever possible to speed load/unload time for maximum throughput.

standard  
& optional  
features

### STANDARD FEATURES:

- Industry Leading Two-year Limited Warranty
- Requires Only 120V AC Single Phase Power Input
- Automatic Setting of HiPot, Surge and Corona Test Voltage
- Easy to Use Windows® Operating System
- Ambient Temperature Compensation
- Results Management (Statistical Analysis)
- Comprehensive Diagnostics Utilities
- Inkjet Data Printer
- Dual Hard Drives with Automatic File Backup Software

- Modem and Software to Provide Remote Diagnostics
- Power Regulation and Power Transient Protection
- Learn Mode with Percentage or Standard Deviation Tolerances and Adjustable Thresholds for Resistance, Surge and **MagMap®**
- Capable of Network Interface
- Simultaneous Testing on Dual Fixtures for Maximum Throughput

### OPTIONAL FEATURES:

- Reject label Printer
- Bar Code Reader
- Touch Screen
- Infrared Temperature Compensation
- Automatic Passed Part Marker
- Automatic Terminal Release

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