

AT 5000 TEST DESCRIPTIONS

END TO END DIGITAL RESISTANCE TEST

The Digital Resistance Test is capable of rejecting armatures for such discrepancies as wrong wire size, wrong number of turns, stretched wire and open coils. The following is a description of the digital resistance test concept.

A measurement is taken at points 180° apart for lap wound armatures and 90° apart for wave wound armatures. This reading represents the total difference of all windings in their series-parallel arrangement.

The connections for lap wound 12 bar armatures are shown in Figure A. These connections are made in four wire Kelvin style to eliminate the contact resistance from being measured as part of the circuit.

A DC Constant current of a known value is passed through the armature under test. This will produce a voltage drop across the armature which is proportional to its' DC resistance. The constant current supply will maintain the programmed current through the part, regardless of changes in internal wiring or contact resistance in the circuit.

The voltage measurement is made through separate contacts to the armature to high a impedance measurement circuit which also will not be effected by internal wiring or contact resistance.

The armature is electronically scanned and resistance readings are taken at each of the end to end positions (six readings for twelve bar armature). All of these readings are stored in memory. Each reading is then compared to the low and high resistance limits for this part. Any reading which fall outside these limits is rejected.

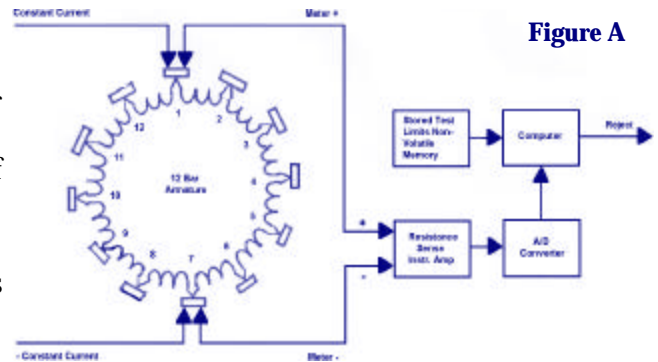


Figure A

END TO END WELD TEST

The end to end resistance readings stored in memory are scanned and the lowest and highest readings are selected. The absolute difference between the two readings are then compared to the stored end to end weld limit for this part (Figure B).

Figure B

<i>EXAMPLE</i>		
<i>TEST STEP</i>	<i>E/E RES.</i>	
1	1.455	-LOW READING
2	1.456	
3	1.468	-HIGH READING
4	1.456	
5	1.455	
6	1.456	
ABSOLUTE WELD DIFFERENCE = .013 OHMS		

BAR TO BAR WELD TEST

Bar to Bar resistance readings are made concurrently with the end to end readings. On a lap wound armature, the bar to bar resistance reading is made with the constant current feed points at 180°. One of the metering leads is always connected to the same commutator bar as one of the current leads (Figure C).

The bar to bar resistance reading is then calculated from the measured voltage drop and the current through the coil. On a good even bar armature, half the total current will flow through side A and half through side B, and the displayed reading will be the TRUE RESISTANCE of the coil.

The bar to bar resistance readings are stored in memory just as the end to end readings are. On a 12 bar armature, there will be six side A readings and six side B readings stored.

The absolute difference between each side A reading and its' corresponding side B reading is then found and compared to the stored bar to bar weld limit (Figure D).

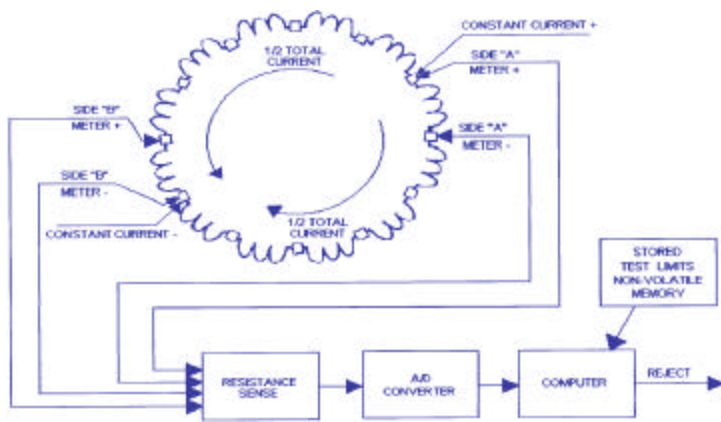


Figure C

EXAMPLE-12BAR ARMATURE

Test Step	B/B Side A	B/B Side B	Difference
1	.450	.454	.004
2	.455	.459	.004
3	.460	.466	.006
4	.465	.469	.004
5	.470	.475	.005
6	.475	.482	.007

MAXIMUM BAR/BAR WELD = .007

SURGETEST

Figure D

The surge test on the AT5000 computer based armature tester is capable of rejecting armatures for such discrepancies as shorted turns, shorted coils, mis-wired coils, shorted commutator bars, high resistance shorts and internal insulation breakdowns. The following is a description of the surge test.

SURGE POWER SUPPLY

The surge power supply is a capacitor discharge system with adjustable output voltage up to 1500 volts DC peak (see Figure E). The charge/discharge cycle is controlled by the power line frequency (50 or 60 Hz). During the positive half of the line cycle, the discharge capacitor C1 will charge to the peak output voltage of T1 through the path of T1, C1, D1 and R1. At this time, Thyatron V1 is biased off by the grid circuit consisting of T2, C2, C3, D2, R3 and R4. During the negative half of the line cycle, the Thyatron will fire and capacitor C1 will discharge through the path of C1, V1, the control relay CR1 and the armature. The maximum discharge energy from the capacitor is .562 watts seconds (joules) at the 1500 volt surge setting.

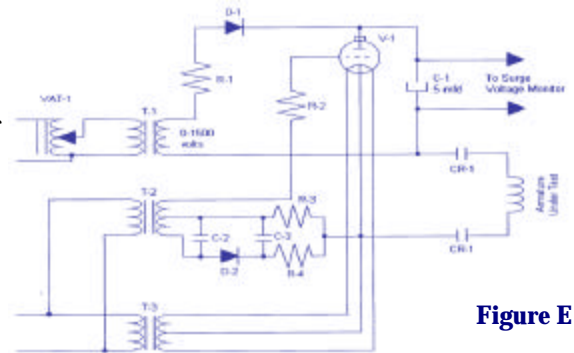


Figure E

The surge voltage across C1 is monitored and displayed on the CRT screen (Figure E).

END TO END SURGE TEST

The surge voltage is applied to the armature at two points, 180° apart (Figure G, bars 1 and 7 on the 12 bar armature).

The steep high voltage surge pulse will produce a characteristic ringing waveform from the armature under test (see Figure F).

The portion of the waveform containing the reflected energy from the armature is then integrated into a DC value by the end to end sensing circuitry. The DC value derived from a good standard armature is set into the surge null reference circuit and stored in the limit memory for the particular armature. Once this "Good" null voltage value is set, all successive tests will be compared to this value. Any changes in the armature coil characteristics such as shorted turns, etc., will produce a different waveform and a different DC value, which will be compared to the standard value set and rejected.

The end to end surge test is electronically switched around the armature and the test repeated until all the 180° points are tested (six test steps on a twelve bar armature).

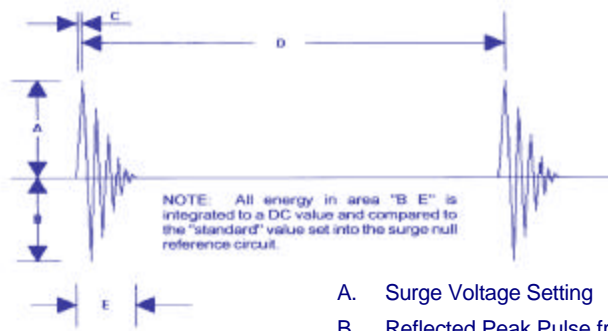


Figure F

- A. Surge Voltage Setting
- B. Reflected Peak Pulse from Armature Under Test
Typical Values: GOOD ARMATURE = 90% OF "A"
ONE TURN SHORT ARMATURE = 80% OF "A"
- C. Rise time of surge pulse (Typically 200NS.)
- D. Repetition Rate of Surge Pulse = $\frac{1}{\text{LINE FREQUENCY}}$
60 Hz=16.67 MS
50 Hz=20 MS
- E. Ringing Time of Armature
Typical Values: GOOD ARMATURE = 1.2MS
ONE TURN SHORT ARMATURE = .8MS

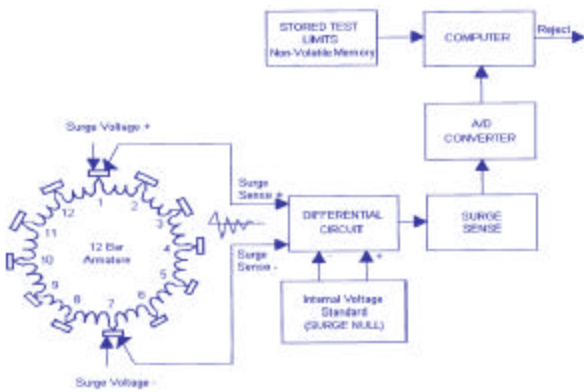


Figure G

BAR TO BAR SURGE TEST

The bar to bar surge test is done at the same time as the end to end surge test (Figure H). As the armature is being surged, the waveforms across the two opposite coils are compared in a differential circuit. The output of the differential circuits is a DC value corresponding to the difference between the two waveforms. This DC value is compared to the bar to bar surge limit set in memory. If it exceeds the limit set, the part will be rejected.

Each of the coils are tested as the surge test is electronically switched around the armature. The bar to bar surge test is very accurate on even bar, double flyer wound armatures in which the opposite coils are identical. Because the bar to bar surge test compares coils on the same armature, it will not respond to changes that affect both coils equally such as wrong wire size on both flyers or core loss.

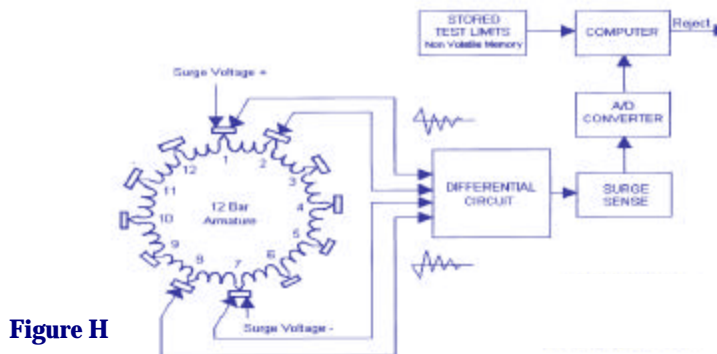


Figure H

HIPOT TEST

The hipot test is capable of rejecting armatures for such discrepancies as excessive leakage or breakdown between insulated components such as the commutator, shaft, and stack. The following is a brief description of the hipot test.

A high level AC voltage, programmable from 0-2000 volts, is applied to the armature between the commutator and the stack and shaft (Figure I). The voltage applied at the zero crossover point on the sine wave to prevent a voltage surge. The resultant leakage current flow is measured and compared to the low and high test limits stored in memory for this part. Any reading which falls outside these limits is rejected.

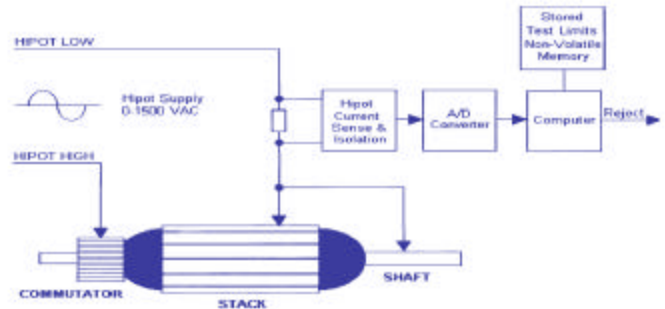
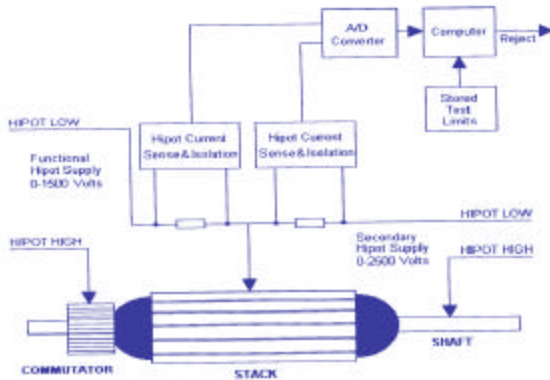


Figure I

DOUBLE HIPOT TEST

Both the functional leakage current and the secondary leakage current are compared to their low and high stored test limits for this part.

Two high level AC voltages are applied to the armature. The functional hipot voltage, adjustable from 0-2000 VAC is applied to the armature between the commutator and the stack. The secondary hipot voltage, adjustable from 0-3000 VAC, is applied to the armature between the stack and the shaft. The combined potential, up to 5000 VAC, is applied to the armature between the commutator and the shaft. Both voltages are applied at the zero crossover point on the sine wave to prevent a voltage surge. Two solid state hipot sense modules monitor the armature for any excessive leakage from the instant the voltage is applied.



If excessive leakage is detected, the hipot voltage is immediately removed to prevent further damage to the armature. The operator is protected by a safety interlocked slide cover.

The test time for the hipot test is adjustable from .25 to 10.0 seconds. The hipot sense modules have an adjustable trip point from .1 milliamps to 10 milliamps.

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