

RØI RED PHASE INSTRUMENTS

MODEL 590D-1 P.T. FULL LOAD TESTER



KEY FEATURES:

The 590D-1 is the successor to the 590D and now has an integrated solid state HF transformer, eliminating the need for an external isolation transformer.

This is an accessory to the Model 590G/G-V2 for the full load testing of inductive P.T.s. It has a high power switch mode (typically 1.2kW) source for full load performance testing of P.T.s under simulated load conditions to 0.1% accuracy. It uses the existing measuring circuitry and micro-processor of the 590G/G-V2 to the greatest extent possible but also has a microprocessor to monitor and control its operation in conjunction with the 590G/G-V2. Communication between the two units is via a serial link.

The unit connects to the 590G/G-V2 and Inductive P.T. under test & measures:

- Primary & Secondary winding resistance.
- Secondary winding admittance with primary short circuited.
- Primary winding admittance calculated from turns ratio.
- Turns ratio/No load voltage ratio.
- Secondary admittance with primary open circuit.
- Finally the microprocessor calculates the P.T. errors from the measurements.

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2, P.T. TESTING METHODOLOGY.

2.1. RESISTANCE TEST.

The primary side resistance, R_p , is measured. It is typically 5kohm to 50kohm. Usually a voltage of up to 5V DC is used and due to the inductance of the winding, it can take 1 minute to charge up the winding to steady state. A capacitor can sometimes be connected across the primary terminals to aid stabilizing the voltage. The applied voltage is ramped up and down to prevent voltage spikes.

The secondary winding resistance, R_s , is very small and is typically in the range 0.2 to 2.0 ohms.

The resistance test confirms the value Z_s measured in the short circuit test later.

The core is de-magnetized during the short circuit test.

2.2. SHORT CIRCUIT TEST.

The primary is shorted and a low voltage applied to the secondary. The voltage is adjusted to give 20 – 50% of rated current injection into the secondary. Due to the turns ratio, the primary current will be very small.

Rated current is typically 0.25A to 2A. This typically requires a voltage of 0.05V to 0.5V. In this test the voltage and current are measured to calculate the secondary series winding impedance, Z_s , in ohms.

Further, from Z_s the primary winding impedance, Z_p , is calculated using nominal turns ratio.

2.3. VOLTAGE RATIO TEST.

The voltage ratio is measured by applying 450V to the primary and measuring the secondary voltage. This gives a no load voltage ratio.

2.4. ADMITTANCE TEST.

The primary is open circuited, and voltage injected into the secondary. This allows the measurement of an impedance, Y_s , which is the sum of the primary series impedance and the core admittance.

This test is performed at or near the rated voltage for the error calculations as the core admittance varies with excitation voltage.

Caution is required in this test since the rated high voltage appears on the primary side. The voltage will typically be 80%, 100% and 120% of rated voltage or whatever is required by the relevant regulations. At 120% rated voltage the

current will typically be from 0.1A to 15A and admittance 0.02mS to 1mS.

From Y_s the primary side admittance, Y_c , is calculated using nominal turns ratio.

2.5. NO LOAD ERRORS.

(Due to magnetizing current in primary producing less secondary output voltage than determined by absolute turns ratio).

No load errors,

$$\Delta + j\delta = 0.1 \times Y_c \times Z_p.$$

Where:

Δ = Ratio error in %.

δ = Phase error in crad.

Y_c = Core admittance measured on primary side in mS.

(Note, Y_s is admittance measured from secondary side).

Z_p = Primary winding 50Hz impedance in ohms. (Calculated from Z_s and nominal turns ratio, where Z_s is the secondary winding 50Hz impedance.)

The Model 590G/G-V2 already measures the output of the P.T. with the primary energized at 450V and gives an error which is the percentage deviation of the actual output from the output calculated from the P.T. nameplate ratio.

The absolute turns ratio may not be the same as the nameplate ratio, since the turns ratio can be varied to give the desired performance under load.

The information from the 590G /G-V2 test can be used to calculate the absolute turns ratio.

2.6. LOAD EFFECT.

(Change in errors due to loading effect of external burden. These are errors which are additional to the no load errors).

Load errors

$$\Delta + j\delta = 0.1 \times Y_b \times (Z_s + Z_p/K_n^2)$$

Where:

Δ = Ratio error in %.

δ = Phase error in crad.

Y_b = Load admittance (of external burden) in mS.

Z_s = Secondary winding 50Hz impedance in ohms.

Z_p = Primary winding 50Hz impedance in ohms. Calculated from Z_s and K_n .

K_n = Nominal primary to secondary winding ratio.

3. TEST PROCEDURE & RESULTS

3.1. TYPICAL PT TEST

Isolate P.T. primary and secondary from supply and connect as shown in Fig.1.

Test data for the P.T. is keyed in. This includes Serial no, Primary and Secondary voltages/ nominal ratio, Phase to Phase or Phase to Neutral primary connection and VA rating.

Start the test

Prompt for primary winding connection and Primary winding resistance R_p is measured.

Prompt for secondary winding connection and the

PRIMARY RESISTANCE TEST	#88
$R_p = 966 \text{ ohms}$	t

Secondary winding resistance R_s is measured
The 50Hz secondary winding impedance is measured.

SECONDARY RESISTANCE TEST	#89
$R_s = 126 \text{ mohms}$	t

The no load voltage ratio is measured at 450V.

K_a is the open circuit voltage ratio and Y_s the

SHORT CIRCUIT TEST	#90
$Z_s = 1.982 + 1.364j \text{ ohms}$	t

open circuit admittance referred to the secondary. Y_s is measured at the secondary voltage corresponding to 450V on the primary and at 120, 100

VOLTAGE RATIO TEST	#91
$K_a = 99.743 \text{ (ERR=2.57e-3)}$	t

and 80% of the rated primary voltage. The results are then displayed.

In some instances manufacturers add compensation capacitors and in order to measure the effect of this and the inherent inter-winding capacitance and inductance, the admittance measurement is made a five different frequencies between 40 to

MEASURING Y_s K_a	#92
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120% $Y_s = 3.72 \text{ } 2.56j \text{ mS}$	
100% $Y_s = 3.62 \text{ } 2.47j \text{ mS}$	t

80%V $Y_s = 3.72 \text{ } 2.56j \text{ mS}$	
K_a $Y_s = 4.89 \text{ } -3.22j \text{ mS}$	t

60 Hz, These are denotes as LF (low frequency), MLF (middle low frequency), NOM (nominal frequency i.e. 50Hz), MHF (middle high frequency) and HF (high Frequency).

The results are displayed as follows:-

Finally the ratio and phase errors are calculated and displayed.

LF $Y_s = 2.36 \text{ } +0.03j \text{ mS}$	
MLF $Y_s = 2.19 \text{ } +0.03j \text{ mS}$	▼

3.2 . MULTIPLE SECONDARY WINDING

NOM $Y_s = 2.19 \text{ } +0.03j \text{ mS}$	
MHF $Y_s = 2.06 \text{ } +0.02j \text{ mS}$	▼

HF $Y_s = 2.07 \text{ } +0.02j \text{ mS}$	▼
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Testing of Dual secondary windings is also possible by making the appropriate selection.

80%V		0.8PF	+0.32%	-5.6'		#93
25%VA		1.0PF	+0.29%	-6.3'		t

80%V		0.8PF	-0.22%	-7.6'		s #93
100%VA		1.0PF	-0.24%	-8.3'		t

100%V		0.8PF	+0.31%	-5.8'		s #93
25%VA		1.0PF	+0.27%	-6.5'		t

100%V		0.8PF	-0.25%	-7.9'		s #93
100%VA		1.0PF	-0.28%	-8.6'		t

120%V		0.8PF	+0.28%	-6.0'		s #93
25%VA		1.0PF	+0.25%	-6.7'		t

120%V		0.8PF	-0.28%	-8.2'		s #93
100%VA		1.0PF	-0.31%	-8.8'		t

3.3. NULL TEST

For improved accuracy, a null test can be done if the PT ratio is available on the 590D-1

SELECT FULL PT TEST	#96
1) SINGLE 2) DUAL	

URNS RATIO TEST TYPE	#97
1) RATIO TEST 2) NULL TEST	

4. CASE DETAILS, SIZE AND WEIGHT.

The 590D-1 uses the well known "Pelican" brand injection moulded plastic case. The case offers high resistance to impact, thermal shock, moisture, weather and corrosion. There is an internal aluminium chassis and aluminium front panel with a finished surface and a reverse screened "Lexan" polycarbonate finish.

4.1. An ABS plastic transit case is also provided as standard. This is foam lined, with a hinged lid, carry handles and protects the Model 590D-1 while it is being transported to and from site.

4.2. The Model 590D-1 case size is 615mm X 530mm x 230mm.
The transit case size is typically 670mm X 590mm X 290mm.

4.3. The weight of the Model 590D-1 is 24kg.
The transit case and test leads are 10kg extra.

5.0 PROTECTION FEATURES.

5.1 Circuit breaker.

5.2 Flashing LED when terminals are live.

5.3. Buzzer for hazardous voltage warning and to indicate error conditions.

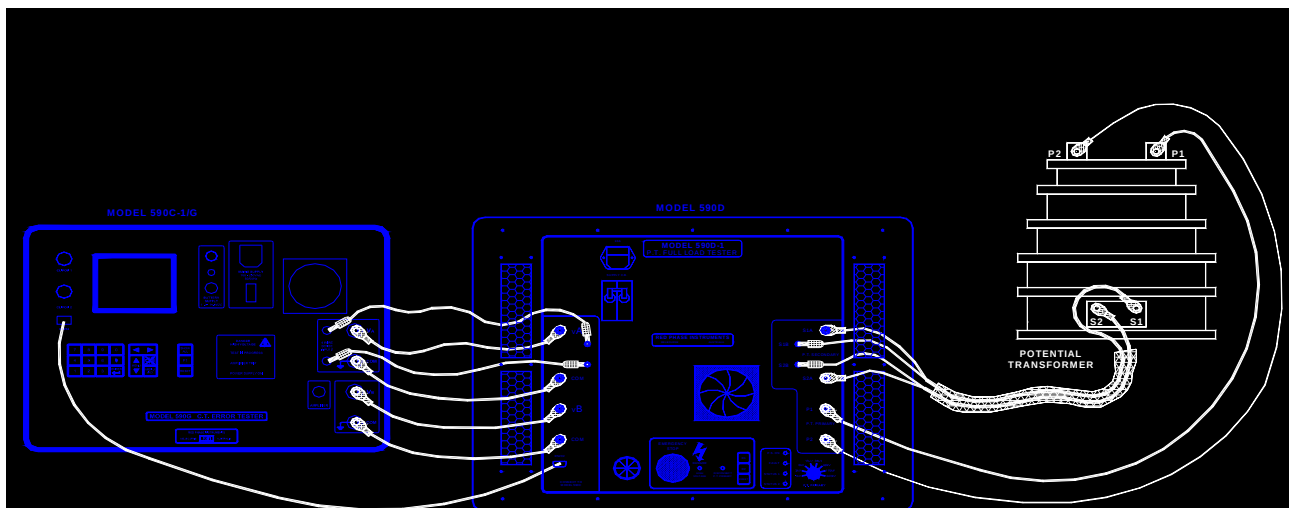
5.4. Emergency Stop pushbutton to stop a test.

5.5 Over temperature cut-out.

6. RS232 PORT.

This is for connection to a Model 590G/G-V2, use a straight thru RS232 cable with 9 pin "D" connectors with all pins connected.

Fig. 1. TYPICAL TEST CONNECTION



Every care has been taken to ensure that the above data is correct at the time of printing. Always refer to the latest data sheet when purchasing. RED PHASE INSTRUMENTS reserves the right to alter specifications without notice.