

Knowledge Domain: Power Supply

Unit: Transformer

Skill: Diagnosing a transformer that needs to be rewound

Tools and Parts Required:

- 1) Transformer
- 2) Insulating gloves (or Latex gloves)
- 3) Multimeter with ohmmeter and voltmeter

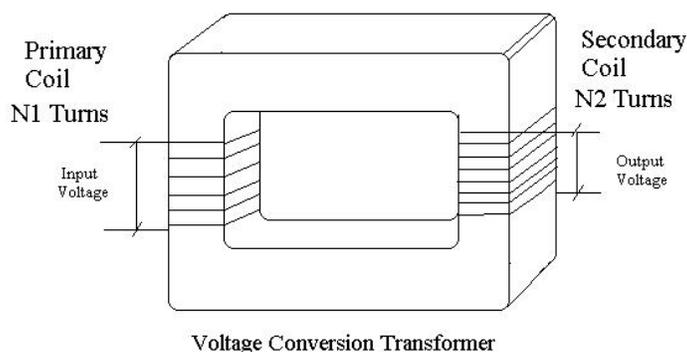
Introduction

A transformer is an electronic device. A transformer is made of two coils of wire. The first coil is the primary coil. The second coil is the secondary coil. The primary coil and secondary coil are electrically insulated from each other. These coils are typically wrapped around an iron core. An AC Voltage is placed across the primary coil. Current in the primary coil induces current in the secondary coil. The output voltage is the voltage produced by the secondary coil. The number of turns in the coils determines the ratio of input voltage to output voltage.

$$\frac{\text{Output Voltage}}{\text{Input Voltage}} = \frac{\text{Number of turns in secondary coil}}{\text{Number of turns in primary coil}}$$

Example

Below is a picture of an iron core transformer.



Identification and Diagnosis

A transformer is used in many electronic instruments. Sometimes, equipment is used in a different country than it was manufactured for. External transformers are used to adapt the equipment to the mains voltage difference. External transformers are also called wall transformers. The secondary voltage generated by an external transformer is a three phase AC voltage.

A malfunctioning transformer may not have visible damage. Items plugged into a defective transformer may not work correctly or the items may not turn on. A transformer must be matched for input to the mains voltage available and output voltage to the voltage desired for the equipment. Specifications of a transformer must be checked before connecting the transformer. Note the expected output voltage from the specifications. The measured value for the transformer must match the expected value.

To verify a malfunctioning transformer, first look for visible damage to the coils. Look for wires that appear to have been scratched or bent.

If there is no visible damage connect the transformer to the correct input voltage and check the output voltage. If the voltage is zero or lower than the expected voltage, check if the coils are in working condition.

Procedure

Do not touch the primary coil when it is plugged in. Wear gloves. Insulating gloves can protect you. Latex gloves may be used for voltages up to 10kV.

Connect the transformer to a working power outlet. This procedure will only be useful for a transformer with input voltage the same as the mains voltage available. Use the voltmeter to measure the output voltage. The transformer specifications should indicate the desired output voltage.

Next, you may need to verify the coil resistances. Use the following steps to measure the resistance of the transformer coils:

Primary Coil Resistance: Before you begin, always disconnect the transformer from the power supply. Locate connection points for the primary coil of the transformer. Measure the resistance of the primary coil using a multimeter. The resistance should be less than 100 Ω but not zero. Zero ohms may indicate a shorted primary coil. A low resistance indicates that the primary coil of the transformer is not broken anywhere inside the transformer frame.



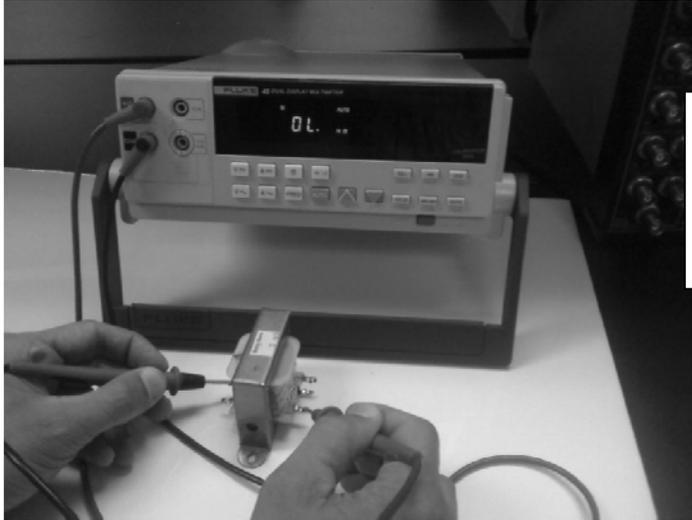
measurement of resistance of primary coil of transformer using multimeter.

Secondary Coil Resistance: Locate connection points for the secondary coil of the transformer. Measure the resistance of the secondary coil using multimeter. The resistance should be less than 100 Ω but not zero. Zero ohms may indicate a shorted secondary coil. A low resistance indicates that the secondary coil of transformer is not broken or discontinuous anywhere inside the transformer frame.



measurement of resistance of secondary coil of transformer using multimeter.

Resistance Between the Coils: Measure the resistance between the primary coil and the secondary coil of the transformer using a multimeter. The resistance between the two coils should be very high. The multimeter will display a value in $M\Omega$ or OL (overload indication on multimeter). A very high resistance between the coils indicates that the primary coil and secondary coil of the transformer are not connected (electrically insulated) to each other.



measurement of resistance between primary coil and secondary coil of transformer using multimeter.

Resistance Between Coils and Frame: Measure the resistance between primary coil and the frame of transformer using a multimeter. The resistance between the coils and the frame should be very high. The multimeter will display a value in MΩ or OL (overload indication on multimeter). A very high resistance between the coil and the frame indicates that the primary coil and the frame of the transformer are not connected to each other.

Repeat the measurement between the secondary coil and the frame. A very high resistance between the coil and the frame indicates that the secondary coil and the frame of the transformer not connected to each other



measurement of resistance between primary coil and the core [frame] of transformer using multimeter.

If the measured resistances match the expected values, there is no need to rewind the transformer. If the readings do not match, you need to replace or rewind the transformer.

Do not attempt to rewind a transformer yourself. Rewinding a transformer is not easy. Take the transformer to a professional. Most urban areas will have someone who is able to rewind transformers. The professional will ask you for your measurements in order to know how to rewind the transformer.

Exercise

Your instructor will give you a transformer. Use correct safety procedures before beginning.

Use the procedure to check the transformer. Look for visible damage. Check the output voltage. Measure the 5 resistances described in the procedure above.

Compare the measured values with the expected values. You may want to use a table as shown below:

Measurement	Measured Value	Expected Value
(Example: Output voltage)	(Example: 80V)	(Example: 220V)
(Example: Primary Coil Resistance)	(Example: 25 ohms)	(Example: <100 Ohms)

Does the transformer need to be rewound?
Your instructor must verify your work before you continue.

Preventative Maintenance and Calibration

Equipment which is frequently blowing fuses may have a faulty transformer.

Always calibrate every medical device before returning it to use.