

You should measure between 5 volts and 9 volts ac. If you get any other reading, the filament voltage circuit in the ballast is bad and you should replace the ballast.

Measure the starting voltage by probing between one end of the lamp holder to the other. (see *Figure 4*) You should measure between 150 and 390 volts ac, depending on the type of ballast and lamps used. If the voltage you measure is not in the correct range, replace the ballast.

#### **Electronic Ballasts**

It is easy to check an electronic ballast to see if it is oscillating, which means it is generating the frequency that the lamp needs to operate. Set your DMM to the frequency measurement function. With the light turned ON, probe with your DMM between pins on opposite ends of the lamp holder. You should measure a frequency of 20 to 50 kHz. Normally, if the electronic ballast has failed there will be no output signal at all. If you do not obtain a proper frequency measurement (and about 117 volts ac is present at the ballast line power supply wires), replace the ballast.

#### **6. Where to Go From Here:**

By now you should have isolated and fixed the problem. If not, it may be time to replace the fixture completely. If you suspect a more serious problem, call a qualified licensed electrician for help.

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### **How-to Test it Yourself**

# **Fluorescent lighting**

**Lighting #5**

#### **Problem:**

Fluorescent lighting is a great way to save energy and expense, but more can go wrong with them than with a standard light bulb. Getting rid of that annoying buzz or constant flicker can be a challenge. The problem might be a bad lamp, a bad ballast, a loose connection, or incorrect wiring.

#### **Task Summary:**

This booklet will help you identify, test and troubleshoot common electrical problems in “shop light” style fluorescent lighting. Small, compact fluorescent “bulbs” that replace standard light bulbs in lamps and light fixtures are completely self-contained and cannot be repaired. If you have problems with a compact fluorescent bulb, simply replace it.

#### **Recommended Tools:**

You will need a DMM with all the basic measurement functions such as ac volts, dc volts, resistance, and continuity, plus some more advanced features like True RMS and frequency measurement (up to 50KHz). It is assumed you have basic knowledge of how to make electrical measurements and how to operate a DMM. If not, you should start by reading “Basic DMM Measurements” and your DMM owner’s manual.

## **Step by step troubleshooting:**

### **1. Which Type of Lighting - The Basics of Ballasts**

Fluorescent lights operate when a high voltage electrical current passes between the electrodes on one end of the tube to the other through a conductive gas inside the lamp. The ballast is a device in the light fixture that creates the high voltage and limits the current flow through the lamp to the correct level once it lights.

There are two types of ballasts in residential lighting: electromagnetic

and electronic. You can easily tell which one you have in your fixture because of the size. Electromagnetic ballasts are large and heavy because they have an iron core inside, and electronic ballasts are about 50% smaller and lighter because they operate by electronic switching circuitry.

The most important point about ballasts is they are matched to a certain type of fluorescent lamp. When you replace a lamp in a fluorescent light fixture, you need to choose one that is intended for the type of ballast you are using.



Similarly, if you change the ballast, it should be matched to the lamps already in the fixture or to the type you intend to use in the fixture. Check the label on the ballast in your fixture to see what type it is, and what type of lamps it is intended for.

## 2. That Annoying Buzz

All electromagnetic ballasts generate hum. Look for the “sound rating” of A through F on the ballast’s label. Sound rating A is the quietest. If your ballasts are “B” or higher, you can improve things by upgrading to an “A,” or better yet, an electronic ballast, which is the quietest of all.

An excessively noisy fixture is usually an indication of a poor ground connection or loose mechanical parts in the fixture, which is good news because this is easy to fix.

Before you proceed, unplug the lamp cord or turn OFF the circuit breaker for the fixture you are troubleshooting. Remove the lamps and open the fixture.

Use your DMM to make sure the power is OFF. Carefully unscrew the wire nuts on the connections to the main power supply wires and make sure they are clear of all objects and not touching each other. Set the DMM to the ac voltage function and the 200 volt range. Probe between the black wire and the white wire. (*see figure 1*) The DMM should display zero. Now probe between the black wire and ground (the green or bare copper wire), and between the white wire and ground. Both readings should also be zero.

Unscrew all the wire nut connections and retighten them for a tight, positive connection. For solid wires, do not twist the wires together. Instead, lay them in parallel and screw on the wire

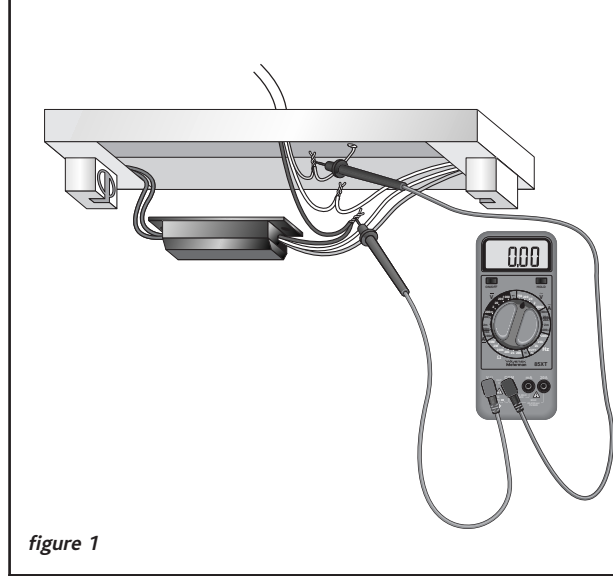


figure 1

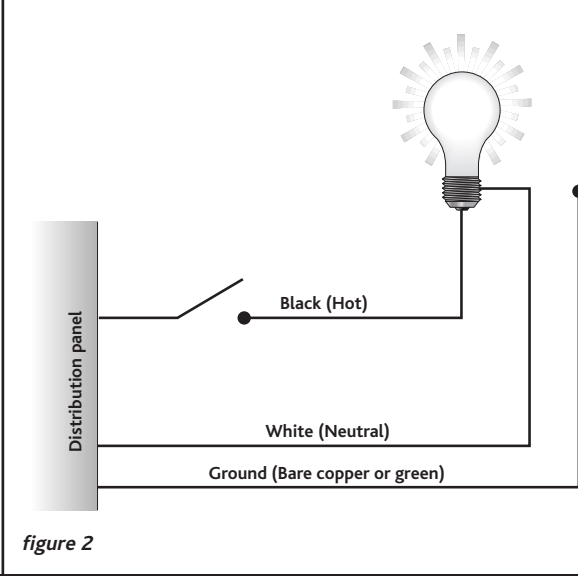


figure 2

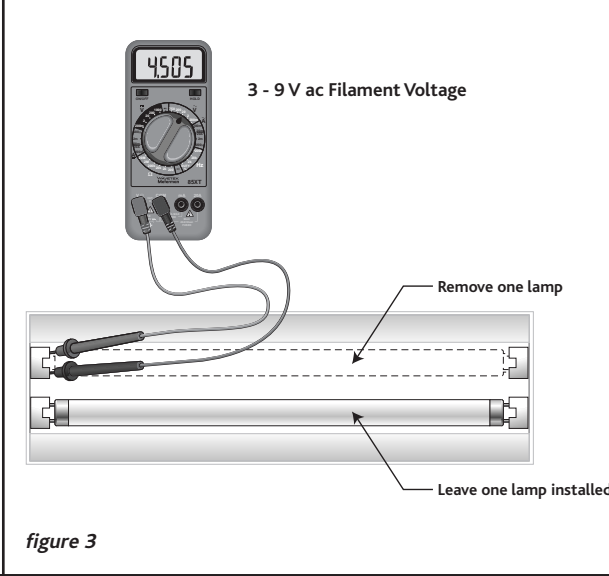


figure 3

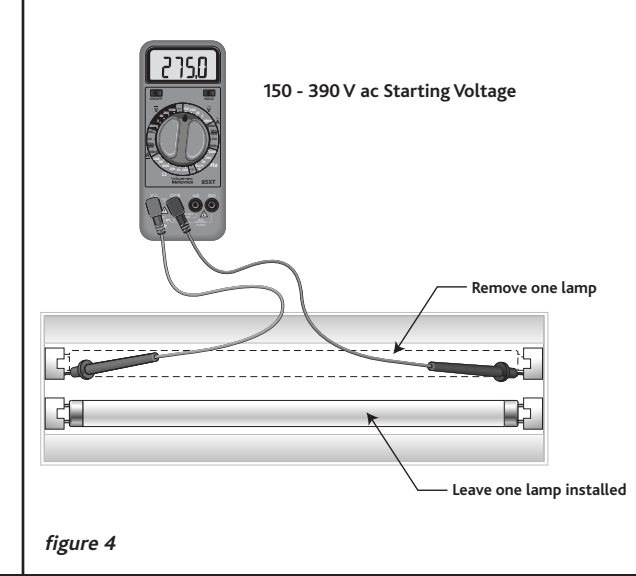


figure 4

# Troubleshooting fluorescent lighting

nut. It is OK to twist a stranded wire around a solid wire before you install the wire nut. Inspect and tighten every ground connection: the green wire in the fixture should be securely connected to the green or bare copper wire coming in, and should be securely fastened (typically with a screw) to the metal frame of the fixture. Inspect and tighten the hardware, especially the hardware that connects the ballast to the fixture.

Replace all wire nuts and make sure they are tightly fastened. Reassemble the fixture and replace the lamps. Turn on the circuit breaker or plug in the power cord and turn on the light.

If this does not stop the buzzing, check for a bad ballast as described later in this booklet.

## 3. Blinking Lamp

A lamp that blinks or does not seem to light fully is a sign of either low ac line voltage or normal lamp failure. Check for normal line voltage first as follows.

Before you proceed, unplug the lamp cord or turn off the circuit breaker for the fixture you are troubleshooting. Remove the lamps and open the fixture. Use your DMM to make sure the power is OFF using the procedure described above.

Verify the main power supply wires are clear of all objects and not touching each other. Turn the circuit breaker ON or plug in the power cord. Use your DMM in the ac voltage function to check for approximately 117 volts ac between the black and white wires of the main power supply wires. If you measure low ac line voltage (less than about 108 volts ac) there is a more serious problem with your electrical wiring. Contact a qualified, licensed electrician. If proper ac line voltage is present, you most likely have a failed lamp. Replace the lamp.

If the light fixture is controlled by a switch, it is important that the “hot” (black) wire is the wire controlled by the switch. (*see figure 2*) This is a good time to check for proper light switch wiring while you have the fix-

ture open and the wires exposed. With the circuit breaker ON and the switch ON, use your DMM in the ac voltage function and probe between the black wire and ground (green or bare copper). You should get a reading of about 117 volts ac. Now probe between the white wire and ground. The reading should be about zero. Turn OFF the light switch. If you still get a reading of about 117 V ac between the black wire and ground with the light switch off, stop and re-wire the light switch so that the hot (black) wire is controlled by the switch. NEVER have the neutral wire controlled by a switch. Switching the neutral wire leaves live voltage ON even when the switch is OFF.

## 4. One or More Lamps Won't Light

When one or more lamps won't light it's usually because of a bad ballast, a bad lamp, or faulty wiring. Check the easy things first before you replace a ballast:

Make sure the light fixture is getting power. Check the circuit breaker to make sure it's ON, plug in the power

cord, turn ON the wall switch, and turn ON the light. If nothing happens, check the outlet for power (see the brochure “How to Safely Test Electrical Outlets”) or check for 117 volts ac power inside the fixture as described earlier in this booklet.

If only one lamp won't light, try the lamp in another fixture to see if it works there. If it does not light in another fixture, replace the lamp and see if that fixes the problem.

Next, you'll need to check for loose connections inside the pin sockets. Before you proceed, turn OFF the power to the fixture using the procedure described earlier in this booklet. Use your DMM to verify power is OFF.

Remove the lamps. Inspect the pin sockets to see if they are damaged, bent, or loose and failing to properly connect with the pins on the lamp. Replace the entire fixture if the pin sockets are damaged.

Open the fixture, unscrew all the wire nut connections and examine the

wires for a tight, positive connection. Reconnect the wire nuts. For solid wires, do not twist the wires together. Instead, lay them in parallel and screw on the wire nut. It is OK to twist a stranded wire around a solid wire before you install the wire nut.

Turn on the breaker and see if the problem is fixed. If not, it is time to troubleshoot the ballast.

## 5. Checking for a Bad Ballast

### Electromagnetic Rapid-Start Ballasts

You have the rapid-start type if there are two wires going into each end of the lamp holder. This is the most common type. The lights normally come on in less than one second, but not instantly.

Take one lamp out of its holder, turn the power ON, and measure the filament voltage by probing between the two pin sockets at one end of the lamp holder. (*see figure 3*)

Work safely!



Electricity can be dangerous. Protect yourself and your home by remembering to follow a few simple rules when working with electrical circuits:

- Always turn the power off at the electrical panel before handling wires or terminals. Don't assume that you know which wire is hot! Use your meter to verify the power is off before handling any wires or terminals.
- Make sure your meter is working with a 3-point check: Measure a known live circuit, next measure the circuit you're working on and finally re-check the known live circuit.
- Use caution when measuring live circuits. Don't stand in water, use one hand to probe whenever possible, and don't wear metal jewelry.
- Only use a meter that has the proper voltage ranges for the job at hand and make sure the meter has the proper safety ratings and protection.

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