Heathkit of the Month:
by Bob Eckweiler, AF6C

Heath IT-1
AC Isolation Transformer.

Introduction:

The IT-1 is a simple kit that is worthwhile for anyone who plays with electronics or does service work. It is a necessity if you work on any AC-DC devices such as an old five-tube AC-DC AM radios that was in just about every American household in the fifties and sixties, It will also provide additional safety if you are working directly with the AC line voltage.

Heathkit IT-1 Isolation Transformer

To understand the purpose of an isolation transformer, a fundamental understanding of typical house wiring is needed. Most of today's modern homes have split-phase 234 volt* connections to the power grid. The power is delivered from the utility pole through a step-down transformer mounted on a nearby power-pole by three wires; two are insulated and usually wrapped around the third which may or may not be insulated. The third wire is heavy and also provides structural support for the other two wires. The voltage between the two insulated wires is nominally 234 volts AC RMS; these two leads are called the **hot** leads. The third wire is the center-tap off the transformer and is called the **neutral** lead. The voltage between the neutral wire and each of the other wires is nominally 117 VAC. The two hot leads are 180° out of phase, thus the term *split-phase* power. (When one of the two insulated wires is positive the other is negative.) Figure one shows typical power-pole to home circuitry.

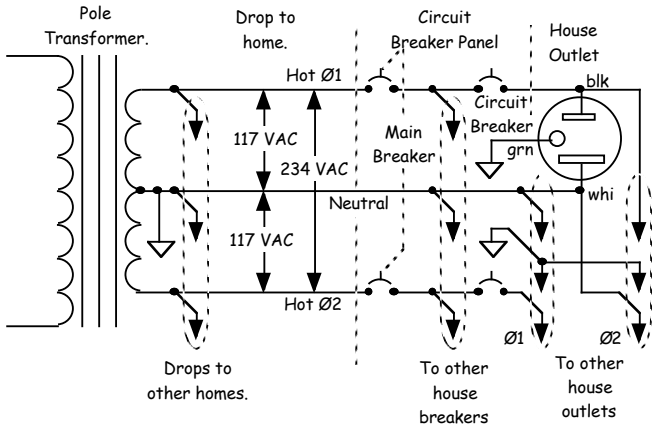


Figure 1: Typical Home Power Drop Wiring

The typical Orange County outlet has three connections. The Hot terminal is the shorter of the two slots and is identified with a brass colored screw; the Neutral terminal is the longer of the two slots and is identified with a silver colored screw; and the Ground terminal is the round-like contact and is identified with a green colored screw (often with a hex head). Measuring between the hot and neutral terminals of a properly wired outlet yields 117 VAC nominal. Measuring between the neutral and ground terminals should yield just a few volts, or ideally 0 VAC. This is because the neutral and ground are connected nearby, and any voltage measured is from IR drops between the outlet and the ground point.

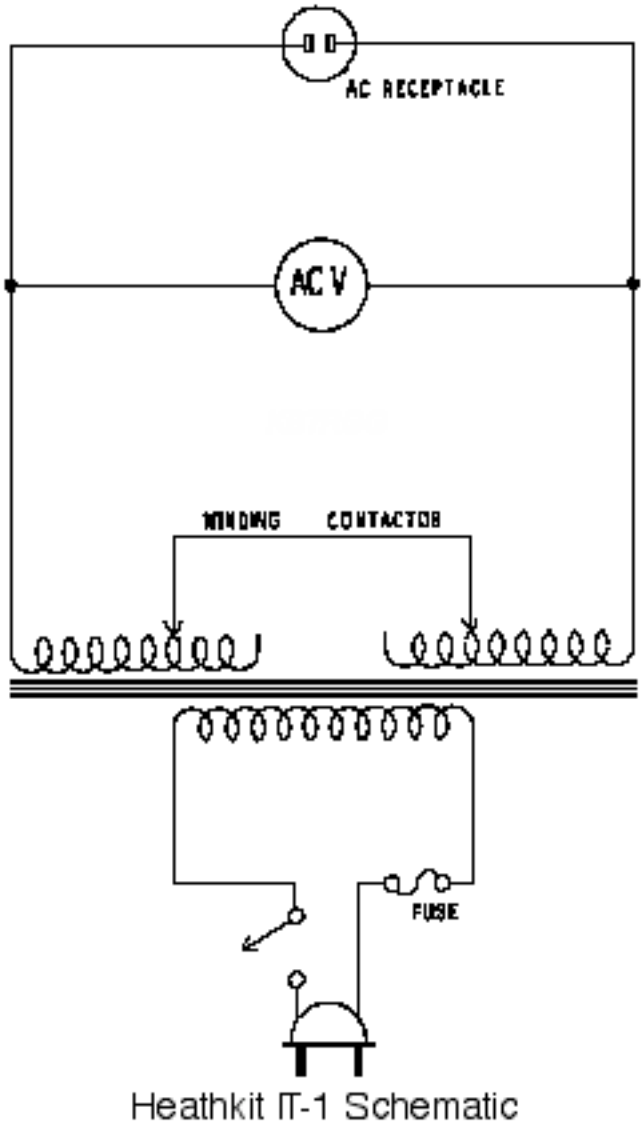
Now here is the problem. Should you be somewhat grounded while working on a piece of electronic equipment and touch a part of the circuit connected to the hot AC lead you will receive a shock. This might seem easy to avoid, but many AC-DC devices can have a hot chassis, especially the older ones that have plugs that may be inserted either way. Servicing one of these with the plug in one of the two possible directions, if you accidently touch the chassis - Zap. If you should accidently grasp the chassis to pick it up and move it, you may not be able to let go, resulting in serious injury or electrocution. That kind of takes the fun out of the hobby.

An isolation transformer provides a power source that is isolated from ground, helping to protect you from this type of shock. It often has other features such as an electrostatic shield between the transformer windings to reduce the transfer of noise on the power line and sometimes a way to change or adjust the voltage ± a significant percentage.

Isolation transformers can also provide voltage transformation. Some have identical voltages on the primary and secondary; other can step up or step down the voltage. Common isolation transformers have inputs and outputs of 117V/117V, 234V/234V (often with a center-tap for two 117V outputs, 234V/117V and 117V/234V again often with a center-tap. The transformers are rated for their volt-amp capability.

The Heathkit IT-1:

In 1953 Heathkit introduced the IT-1 Isolation Transformer Kit. It sold for $16.50 in their 1956 catalog. The Heath IT-1 is small: 8"H x 4-1/4"W x 4-3/4"D excluding knobs, so it takes up very little space on the workbench. The transformer has an adjustable slider that allows the output voltage to be adjusted between about 90 VAC and 130 VAC. The front panel includes a 0 - 150 **AC VOLTS** meter that measures the output voltage, a FUSE holder for a **2 AMP** 3AG slow-blow fuse, an **OFF / ON** toggle switch and a two prong non-polarized **VARIABLE AC VOLTAGE** outlet. A control marked **VOLTAGE** varies the transformer output. The IT-1 is rated for 100 watts continuous and 200 watts intermittent.



Heathkit IT-1 Schematic

For the low price of $16.50, Heath had to cut some costs to bring it to the market. Most noticeable is the meter which is of the inexpensive type with no movement damping, similar in style to the meters on the AT-1, DX-20 and DX-35 ham transmitters. Still the accuracy of the meter on the unit reviewed is amazingly precise and has an expanded scale so 90 VAC is center scale and voltages between 90 and 130 VAC are easy to read. Also noticeable is transformer noise. The transformer "sings" at higher voltages, which can be distracting.

Heathkit manufactured the IT-1 through 1960, after which a succession of "improved" isolation transformers were produced among which are:

- Heathkit IP-10 Isolation Transformer - Circa 1961 - 1962
- Heathkit IP-22 Isolation Transformer - Circa 1963 - 1964
- Heathkit IP-5220 Variable Isolated AC Power Supply - Circa 1975 - 1983

Each has some improvements and higher power capability as well as styling changes.

Later Heathkit IP-22 Isolation transformer

Uses:
Uses for the Heath IT-1 Isolation Transformer include:

1. Isolating the AC mains power from the equipment under test to prevent shock from the AC power to ground - especially important when servicing AC-DC electronic equipment.
2. Troubleshooting equipment that is intermittent due to under or over-voltage conditions.
3. Plugging-in for the first time that piece of unknown equipment you just bought or built.
4. As a safe variable calibration source for AC voltmeters.
5. For isolating equipment that may be radiating RF into the power lines.

Finally:
This column features a different Heathkit each month. Sometimes it features ham gear, other times, test equipment, or one of the household products, and occasionally it features one of the more unusual Heathkit products. If you'd like to see a specific kit discussed contact me at rf_feedback@w6ze.org and it will be seriously considered.

Next month we'll look at the V-7A VTVM and the numerous earlier Heathkit VTVMs that led up to this classic kit.

*** Note:** 234V and 117V values are used as the AC house voltages; they are the nominal voltage the power company delivers. Often they are referred to as 240V/120V or 220V/110V. These all refer to the same USA household electric service.

73, from AF6C

I'd like to thank Cliff - K6CEO for pointing out an error in the original column where I called split phase power two-phase power. Cliff's email, with my comments follow:

Correction to the IT-1 Heathkit of the Month article:

In [this] Heathkit of the Month - **The IT-1 Isolation Transformer** - [article] I referred to the typical home power drop as ***two-phase power***. **Cliff - K6CEO**, a fellow Boeing retiree, sent me an interesting email saying:

There is only SINGLE (ONE) PHASE power distributed to any American home I ever heard about. The 240 VAC drop to homes is

single phase, as are the two, 120 VAC - 2 wire circuits. This is so because you either use the 240 VAC pair of wires, which are surely single phase or you use one of the 120 VAC, 2-wire circuits, which is also single phase.

Cliff is right. The term I should have used is ***split-phase power***. *Two-phase power* is sometimes incorrectly used to describe home power because the two 117 volt circuits are 180° out of phase with each other relative to neutral. I fell into this trap!

Cliff goes on to say: *I know of no two phase power used anywhere on earth.*

I did some research after receiving Cliff's letter and found that two-phase power did exist, though it is now well antiquated. Two-phase power was delivered using four leads. A three lead variation also existed with the neutral lead heavier, since it had to handle the vector sum of current from both phases. The power in each of the two lead pairs (or between each lead and the neutral lead in the case of three wires) were 90° out of phase with each other. In industrial use the two-phase power made for simple self-starting motors. The original generators at Niagara Falls (circa 1895) were two phase generators. In later years three-phase power quickly became the standard as it required less copper to deliver the same power and had additional benefits.

You may wonder what benefits multiphase power has. If you look at single-phase power, there are two points in each cycle when the voltage is zero. At this point no power is being delivered. With multiphase delivery, when one phase is at the zero voltage point the other phase(s) are delivering power. This results in higher mean power being delivered.

I thank Cliff K6CEO taking the time to point out my error.

de AF6C

Remember if you come across any old Heathkit Manuals or Catalogs that you do not need, please pass them along to me.
Thanks - AF6C

This article originally appeared in the November 2009 issue of RF, the newsletter of the Orange County Amateur Radio Club - W6ZE.

The correction to the article originally appeared in the December 2009 issue of RF.