EE 496 Project Form

By completing this form, the student and faculty advisor agrees to the EE 496 requirements described in the following two documents:

- "Instructions to EE 496 Students":

  http://www.ee.hawaii.edu/student/index.php?stc=1&stp=79

- EE 496 course syllabus:

  http://ee.hawaii.edu/gfx/content/ee496.doc

(A link to the syllabus can also be found at the "Instructions to EE 496 Students" web page.)

A completed form must be submitted to the EE Office in Holmes 483 for permission to register for EE 496.

PROJECT TITLE: ______________________________

SEMESTER eg (Fall 2008): ______________________________

STUDENT NAME: ______________________________

STUDENT SIGNATURE AND DATE:______________________________

STUDENT EMAIL ADDRESS: ______________________________

FACULTY NAME: ______________________________

FACULTY SIGNATURE AND DATE: ______________________________

PLEASE SIGN IN INK

ASSUMPTION OF RISK AND RELEASE

Department of Electrical Engineering

SEMESTER: __________

Course (Lab):__________ Section: ______________ Name of TA: ________________

I have read and fully understand the written safety and other rules and precautions that are a part of the requirements for my participation in the above reference course, as well as those explained to me by my instructor(s), and I agree strictly to observe them; and

I do for myself, my heirs, executors, and administrators hereby accept full responsibility for and indemnify, release, and discharge the University of Hawaii, its officers, agents and employees from property damage, and/or personal injury which may result from my failure to abide by these safety rules and precautions, or from any inherent risks inside the course.

____
Name of Student (PRINT Last, First)

_______________________________________ Date________________________
Signature

_______________________________________ Date________________________
Co-Signature of parent or guardian if student is under 18 years of age

Electrical safety

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Safety is important whenever you use electrical equipment — whether in the classroom, in the laboratory, or in the home. In this article we look at some basic safety considerations, particularly as they relate to the safe use of measurement equipment. The accompanying sidebar on Third-party safety certification explains why safety certification should be an important consideration when choosing electrical equipment.

Safety is everyone's responsibility. Nowhere is this truer than when using electricity.

Using electricity is like swimming, in that novices and experts can both enjoy its benefits provided they follow the rules at all times. None of us can fully depend on others to provide a safe working or playing environment. You have more control than anyone else over your activities and the caution you use when participating in those activities.

Practice safety

Tektronix encourages you to learn and follow these general precautions, and to read and follow instructions specific to circuits or equipment you work with.

- Never work alone.
- Learn first aid, especially cardiopulmonary resuscitation (CPR), for electrical accident victims.
- Except when absolutely necessary, turn off power or disconnect power source before working on electrical or electronic circuits. Consider all wires and terminals to be live until proven otherwise by a safe test method.
- Be sure your test equipment is operating properly before using it.
- Do not work on electronic circuits or equipment while standing on a wet floor, or when touching plumbing or metal objects that may provide a hazardous earth-ground path.
- Remove metal jewelry, watches, rings, chains, etc., before working on electrical circuits or equipment.
- Whenever possible, make current and voltage measurements with one hand in your pocket or behind you.
- Resist the temptation to throw a switch "to see what happens."
- Turn off power and unplug equipment before checking or replacing fuses. Locate and correct the cause of a blown fuse or tripped circuit breaker before replacing the fuse or resetting the breaker.
- Replace defective cords and plugs. Form a habit of inspecting for defects such as frayed wires, loose connections, and cracked insulation.
- Always check the electrical ratings of equipment you use, and be sure you use that equipment within its ratings.
- In general, treat all circuits as if high voltage or high current is present.

Safety measures

A primary safety measure is grounding the equipment chassis through a wire in the power cord. This practice is variously referred to as "green-wire ground" (because of the color of the insulation on the chassis ground wire) or "third-wire ground" (because a ground wire is a third wire).

If an internal electrical fault should somehow apply a dangerous voltage to the chassis of an instrument with a grounded chassis, the chassis ground wire would safely conduct the fault current to ground. In the process, the current might trip a circuit breaker or blow a fuse, which would alert the user that the instrument has a problem. But the main reason for the ground wire is to provide a path for any fault current. No fault current will then flow through the user if he/she touches the chassis.

For the reasons just explained, do not cut off the ground terminals of power cords in order to make "floating measurements" — doing so defeats ground protection. (Floating measurements are referenced to a voltage other than ground potential.) Use safety-approved equipment or procedures for such measurements.

The market offers various products, such as the Tektronix A6901 Ground Isolation Monitor and the A6902B Voltage Isolator, that permit floating measurements.

One technique of making floating measurements is to use a buffer to isolate the device being tested from the measurement portion of the test instrument. The Tektronix A6902B Voltage Isolator uses this buffer technique, which extends the range of the test instrument to 3000 volts (DC + peak AC) or 500 volts (DC + peak AC), depending upon the type of probe used.

Another way of making floating measurements is to isolate the power supply of the test instrument from the AC power-line ground reference. The Tektronix A6901 Ground Isolation Monitor uses this method, which allows an instrument's chassis to float up to ±40 volts (28 volts rms) from ground.

Safety symbols as marked on equipment

- ⚡ DANGER — high voltage.
- ⏚ Protective ground (earth) terminal.
- ⚠ ATTENTION — see operator's manual.

Safety symbols in manuals

- ⚠ ATTENTION — This symbol indicates the location of applicable cautionary or other information in Tektronix operator's and service manuals.

What is electric shock?

According to Stedman's Medical Dictionary, electric shock is "a sudden violent impression caused by the passage of a current of electricity through any part of the body." This says nothing about the magnitude of that current.

The human body is electrically controlled; that is, it operates in response to its own minute electrical signals. Different persons have different resistances and sensitivities to electricity.

We recognize that electric shock is voltage dependent. One does not expect to get a shock from a battery or other low-voltage source. Sources below 30 volts are usually no problem. When voltages above 30 volts are present, precautions to prevent electric shock are appropriate. We must guard against any shock that could be fatal itself, or cause a severe reaction. We even want to prevent perception of the current.

The threshold of current perception is about 0.5 milliamps for 99.9% of the population, according to Charles F. Dalziel.[1] In other words, 999 persons out of a thousand will perceive a current of 0.5 milliamps; one will not.

Cord-connected appliances and equipment usually comply with this 0.5 milliamps leakage current limit. Some industrial equipment may exceed this value. Equipment with greater leakage current is usually marked "Warning — the protective grounding conductor provides protection from electric shock; this equipment must be earth grounded for adequate protection."

The "let-go current" is the maximum current a person can tolerate and still release the conductor by using the muscles directly stimulated by the current[1] — the average is 9 milliamps for men and 6 milliamps for women. The "conductor" is the source of current that the person has grasped.

"Further increase in current up to values that are not well-defined but thought to be on the order of 100 milliamps may cause a fibrillation of the heart," according to K. S. Geiges.[2] He specifies five important parameters, as follows:

Lowest resistance of the body	
Wet skin, outdoors	500 ohms
Dry skin, indoors	1500 ohms
Let-go current for adults	6 to 20 milliamps, AC, depending upon the person
Safe current, adults	
AC (rms)	5 milliamps at 30 volts
DC	5 milliamps at 20 volts

"Current caused by ordinary household voltage (120 V, North America; and 240 V, Europe) will be 240 milliamps (120 V/500 ohms) and 480 milliamps (240 V/500 ohms), showing that lethal shock can occur in the home."[2] Or, we add, in any place where standard electricity is available.

Fuses and circuit breakers will open the circuit under fault conditions. The time it takes these protective devices to open is rather long compared to body reaction times and, as a result, electric shock can result. Ground Fault Interrupters (GFI) are devices that sense current in the hot and neutral AC power lines. If currents are unequal, the difference must be a ground current, which causes the GFI to open the circuit. A GFI can be used to prevent severe electric shock when line current is diverted into a fault. With a GFI installed in the power circuit, a reaction will occur but fibrillation should not result.

"Currents above those possible from ordinary household voltage across a body impedance of 500 ohms (usually in the ampere range) can affect the nerve centers, causing paralysis. The most common effect of paralysis is respiratory failure. (Power linemen are subject to this.) Such current passing through the body causes hemorrhages and burns."[2]

Summary of electric shock effects[1]

Following is a summary of the effects of electrical shock. Also refer to Figure 1.

- Currents above the reaction-current level may cause involuntary movement and trigger a serious accident.
- If long continued, currents in excess of the "let-go current" passing through the chest may produce collapse, unconsciousness, asphyxia, and death.
- An alternating current as small as 20 microamps may produce ventricular fibrillation if injected directly into the human heart.
- Currents in the order of milliamperes flowing through nerve centers controlling breathing may produce respiratory inhibition that may last for a considerable period, even after interruption of the current.
- Cardiac arrest may be caused by relatively low currents flowing in the region of the heart.
- Current in the order of amperes may produce fatal damage to the central nervous system.
- Electric currents may produce deep burns, and currents sufficient to substantially raise body temperature produce immediate death.
- Delayed death may result from serious burns or other complications resulting from severe electrical shock.
- Capacitor discharges in excess of 20 joules (watt-seconds) are likely to be hazardous.[3]

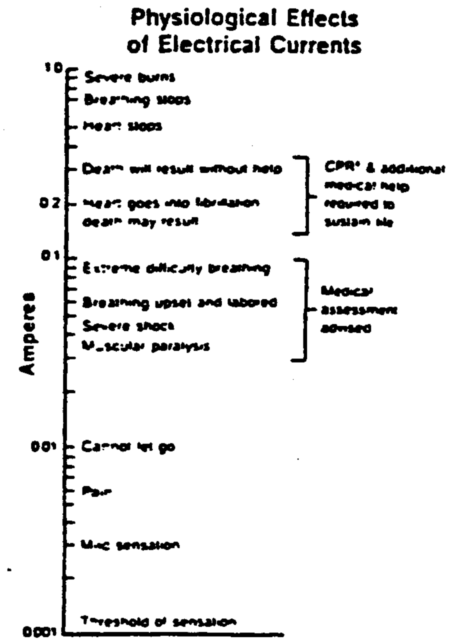

Figure 1. *Physiological effects of electrical currents.*

References

1. Charles F. Dalziel, "Electric Shock Hazard," IEEE Spectrum, February 1972.

2. K. S. Geiges, "Electric Shock Hazard Analysis," AIEE Transactions, Part III-Power Apparatus and Systems, Volume 75, 1956.

3. Canadian Standards Association C22.2 No. 154-M1983.

4. Cardiopulmonary Resuscitation: ANSI C101.1.1986 American National Standard for Leakage Current for Appliances.

J. E. Bridges, G. L. Ford, I. A. Sherman, M. Vainberg, "Electrical Shock Safety Criteria," Pergamon, New York, 1985.

International Electrotechnical Commission (IEC), IEC Publication 479, "Effects of Current Passing through the Human Body," 2nd edition.

Adapted from Tektronix Safety Note 40W-6687 and Third-Party Certification Note 40W-6837. Tektronix encourages you to reproduce this document for student use. Contact your local Tektronix Field Office or sales representative for copies of the above safety notes.