

General Licensing Class

“G0”



Presented by the
Renton Emergency Communications Services

June 13, 2011



General Class Element 3 Course Presentation

➤ **ELEMENT 3 SUB-ELEMENTS**

G1 – Commission's Rules

G2 – Operating Procedures

G3 – Radio Wave Propagation

G4 – Amateur Radio Practices

G5 – Electrical Principles

G6 – Circuit Components

G7 – Practical Circuits

G8 – Signals and Emissions

G9 – Antennas

G0 – Electrical and RF Safety

➤ RF safety principles, rules and guidelines

- RF energy can heat human body tissue.
 - *Body parts may absorb those frequencies.*

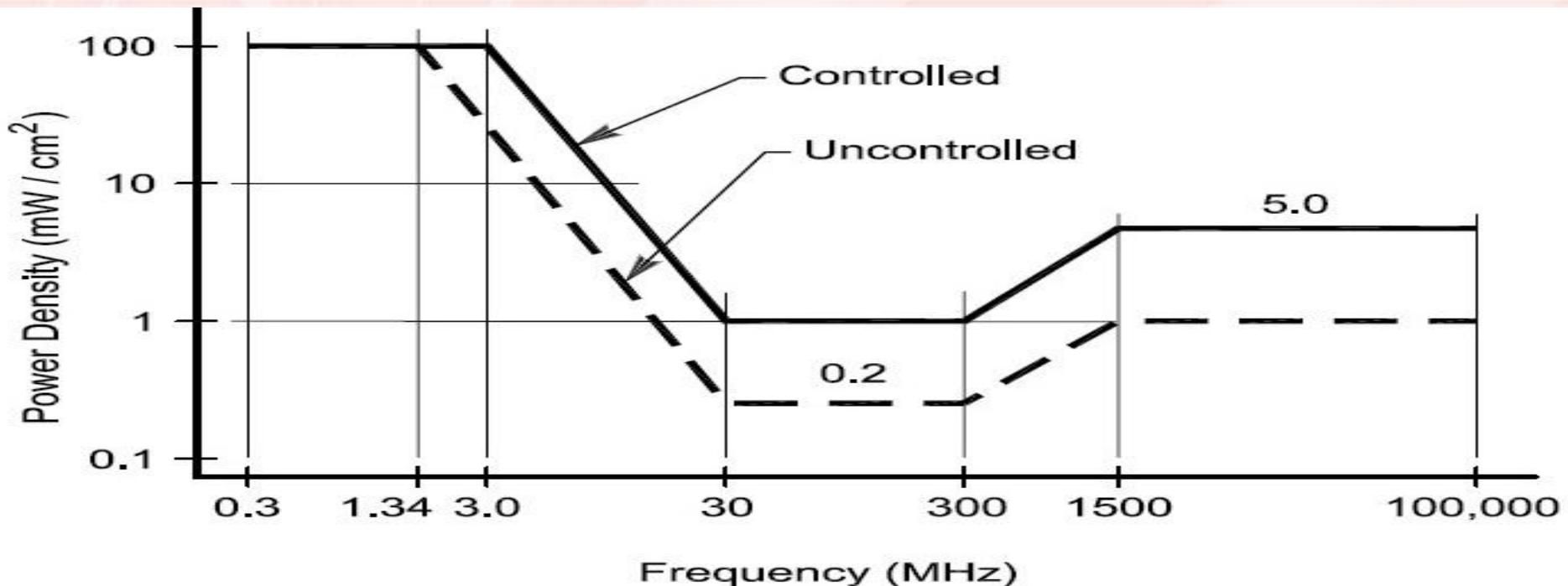


HOWEVER:
Genetic damage has never been observed at amateur frequencies and power levels, but apply safety principles nonetheless.

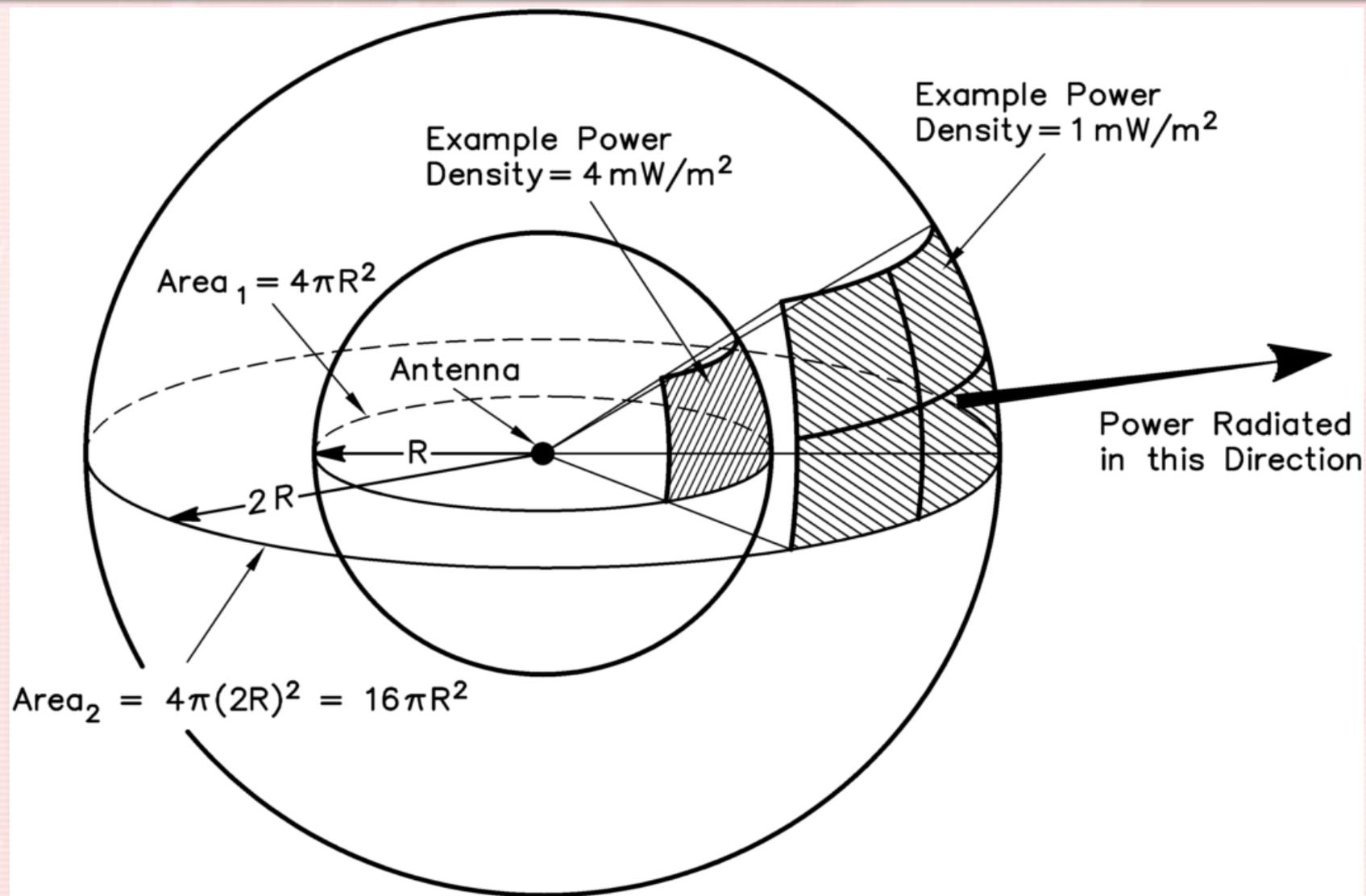
- **RF safety principles, rules and guidelines** (cont)
 - **The RF safety rules require no further action when the maximum power output capability of an otherwise compliant station is reduced.**
 - **Whenever you make adjustments or repairs to an antenna turn off the transmitter and disconnect the feedline.**
 - **If an evaluation of your station shows RF energy radiated from your station exceeds permissible limits you must take action to prevent human exposure to the excessive RF fields.**

➤ RF safety principles, rules and guidelines (cont)

- You should make sure that MPE (*Maximum Permissible Exposure*) limits are not exceeded in occupied areas if you install an indoor transmitting antenna.

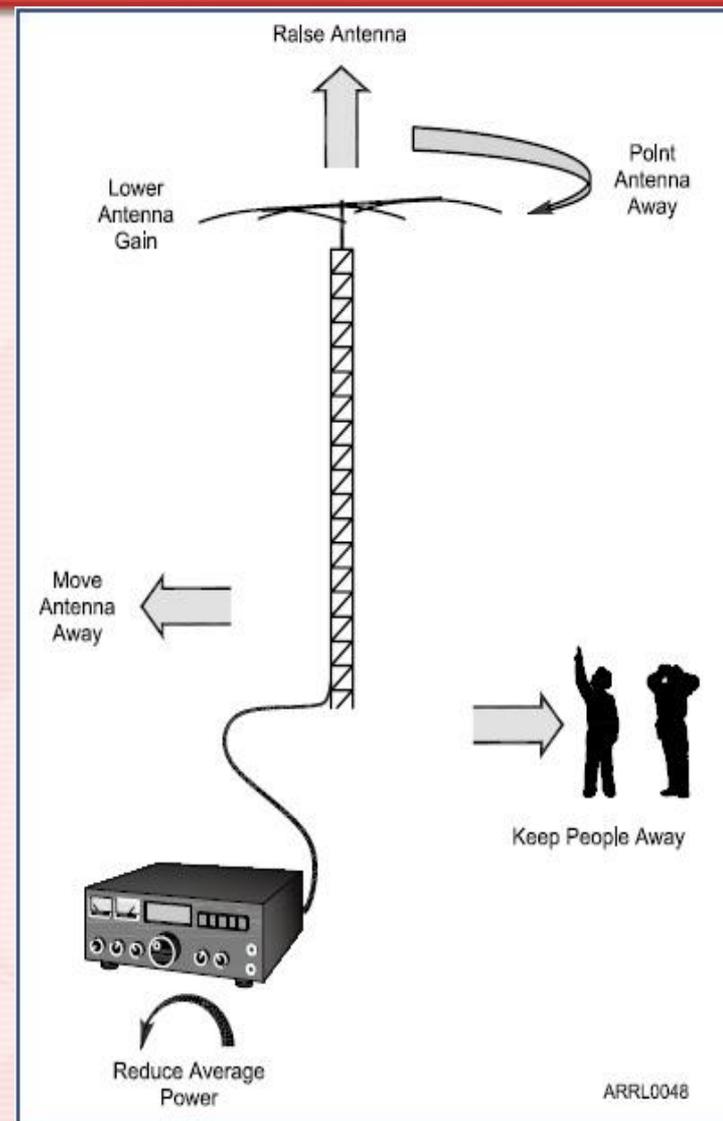


MPE measured



RF safety principles, rules and guidelines (cont)

- **When installing a ground-mounted antenna it should be installed so no one can be exposed to RF radiation in excess of maximum permissible limits.**
- **If evaluation shows that a neighbor might receive more than the allowable limit of RF exposure from the main lobe of a directional antenna take precautions to ensure that the antenna cannot be pointed at their house.**



➤ Routine station evaluation

- **A calibrated field-strength meter with a calibrated antenna can be used to accurately measure an RF field.**
- **An amateur operator must perform a routine RF exposure evaluation to ensure compliance with RF safety regulations.**
- **Any transmitter that contributes 5% or more of the MPE at a multiple user site is responsible for RF safety compliance.**



➤ **Routine station evaluation** (cont)

- **The critical angle is NOT important in estimating if an RF signal exceeds the maximum permissible exposure (MPE).**

What is the critical angle?

- **You can determine that your station complies with FCC RF exposure regulations:**
 - **By calculation based on FCC OET Bulletin 65**
 - **By calculation based on computer modeling**
 - **By measurement of field strength using calibrated equipment**
 - *[All of these choices are correct]*

➤ **Routine station evaluation** (cont)

- **The term, "time averaging", means the total RF exposure averaged over a certain time in reference to RF radiation exposure.**
- **The power level and frequency of the energy have the most direct effect on the permitted exposure level of RF radiation.**
- **A lower transmitter duty cycle permits greater short-term exposure levels when evaluating RF exposure.**
 - **Your "time averaged" exposure is reduced when you spend more time listening and less time transmitting, ie, a "lower duty cycle".**

➤ Routine station evaluation (cont)

- **A lower transmitter duty cycle permits greater short-term exposure levels when evaluating RF exposure.**
 - **Your “time averaged” exposure is reduced when you spend more time listening and less time transmitting, ie, a “lower duty cycle”.**

Mode	Duty Cycle	Mode	Duty Cycle
SSB	20-40%	FM	100%
AM	25-100%	ATV	60-80%
AFSK	100%	SSTV	100%
CW	40%	Carrier	100%

➤ **Safety in the ham shack: Electrical shock and treatment**

- **The most hazardous type of electrical energy is 60 cycle Alternating Current.**
- **The maximum amount of electrical current flow through the human body that can be tolerated safely is 50 microamperes.**
 - **Previously 10 milliAmps.**
- **Current through the heart can cause the heart to stop pumping. Electrical shock can be lethal.**



➤ **Safety in the ham shack: Grounding**

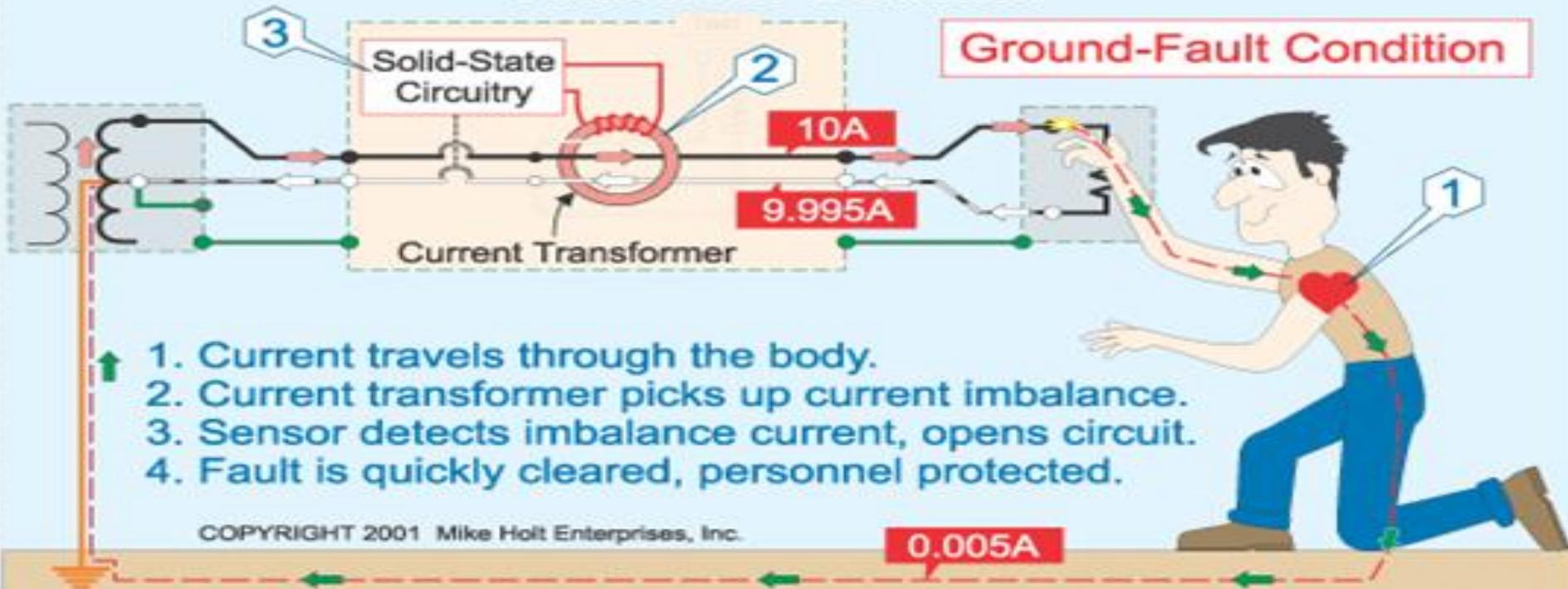
- **Current flowing from the hot wire to ground will cause a Ground Fault Circuit Interrupter (GFCI) to disconnect the 120 or 240 Volt AC line power to a device.**

Standard GFCI wall socket. ➔



Ground-Fault Circuit Interrupter

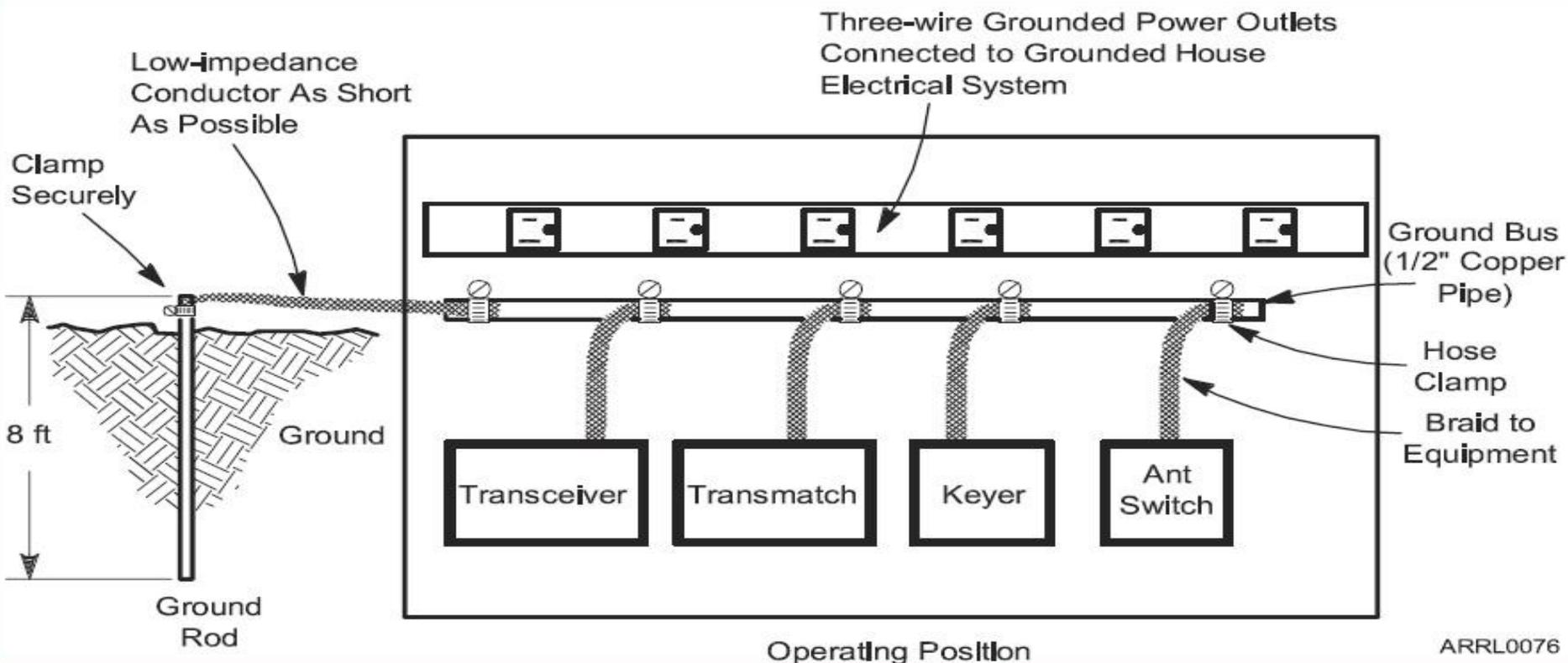
Ground-Fault Circuit Interrupter *Article 100 Definition*



Ground-Fault Circuit Interrupter (GFCI): A device intended for the protection of personnel that will de-energize a circuit or portion of circuits when the current to ground exceeds the value of a Class A device (4 mA to 6 mA, see FPN).

➤ Safety in the ham shack: Grounding (cont)

- **The metal chassis of every item of station equipment must be grounded (assuming the item has such a chassis) because it ensures that hazardous voltages cannot appear on the chassis.**



➤ **Safety in the ham shack: Grounding** (cont)

- **It is not safe to use soldered joints with the wires that connect the base of a tower to a system of ground rods because a soldered joint will likely be destroyed by the heat of a lightning strike.**
 - **Use mechanical clamping to connect ground wires.**
- **A danger from lead-tin solder is Lead can contaminate food if hands are not washed carefully after handling.**

- **Safety in the ham shack:
Grounding** (cont)
 - **A good engineering practice for lightning protection grounds is ensuring they are bonded together with all other grounds.**



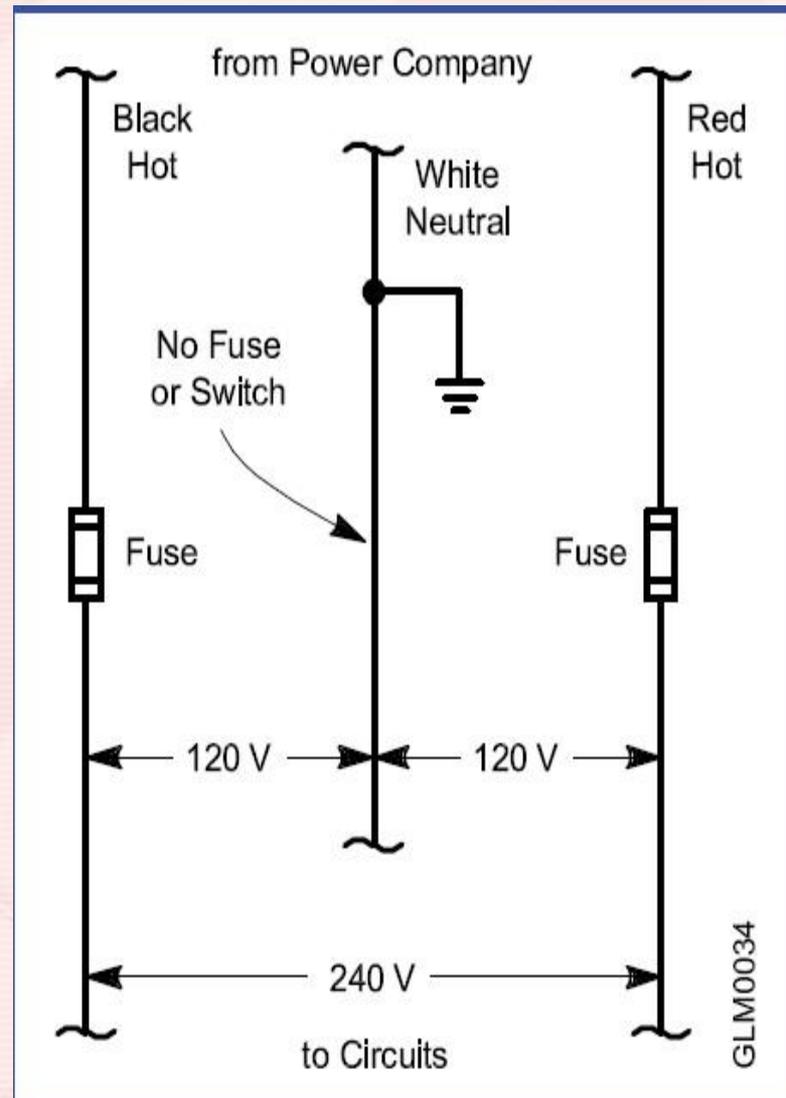
➤ **Safety in the ham shack: Fusing**

- **A 15 ampere fuse or circuit breaker would be appropriate to use with a circuit that uses AWG number 14 wiring.**



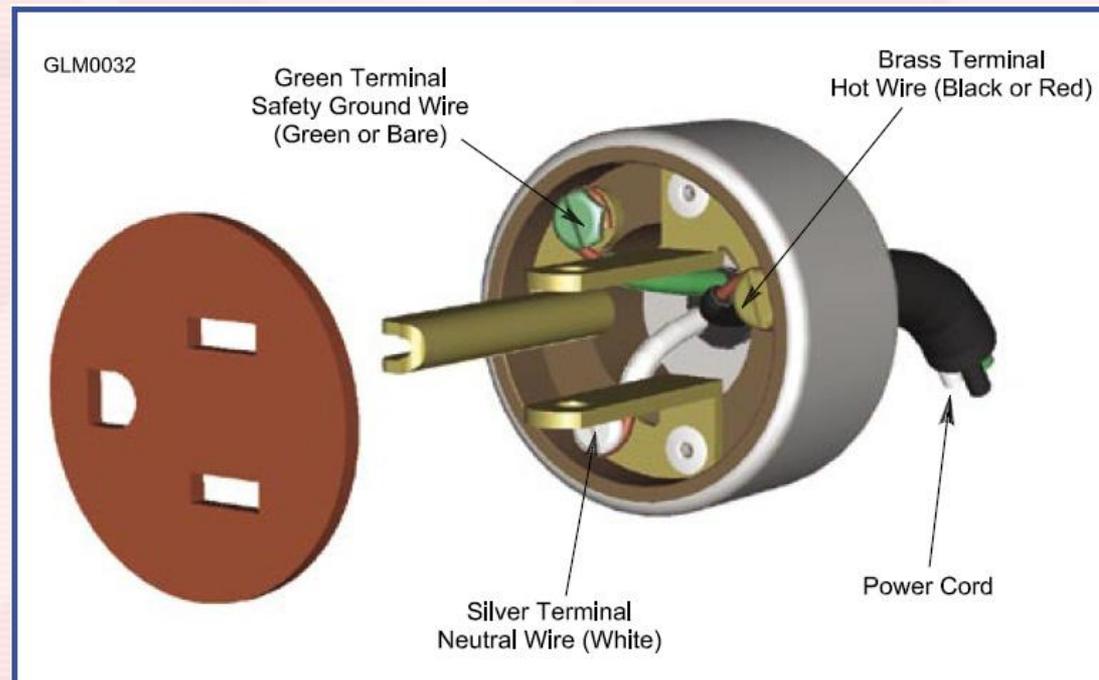
➤ Safety in the ham shack: Wiring

- **Only the "hot" (black and red) wires in a four-conductor line cord should be attached to fuses or circuit breakers in a device operated from a 240-VAC single-phase source.**



➤ Safety in the ham shack: wiring (cont)

- **AWG number 12 is the minimum wire size that may be safely used for a circuit that draws up to 20 amperes of continuous current.**



➤ Safety in the ham shack: interlocks

- **The purpose of a transmitter power supply interlock is to ensure that dangerous voltages are removed if the cabinet is opened.**

Never defeat the interlock system if your transmitter or power amplifier has one.

This amateur operator disabled the interlocks and he's very sorry.



➤ **Safety in the ham shack: Antenna and tower safety**

- **For safety when climbing on a tower using a safety belt or harness always attach the belt safety hook to the belt "D" ring with the hook opening away from the tower.**
- **Any person preparing to climb a tower that supports electrically powered devices should make sure all circuits that supply power to the tower are locked out and tagged.**



Element 3 General Class Question Pool

Valid July 1, 2007

Through

June 30, 2011



G0A01 What is one way that RF energy can affect human body tissue?

- A.** It heats body tissue
- B.** It causes radiation poisoning
- C.** It causes the blood count to reach a dangerously low level
- D.** It cools body tissue

G0A02 Which property is NOT important in estimating if an RF signal exceeds the maximum permissible exposure (MPE)?

- A. Its duty cycle
- B. Its critical angle
- C. Its power density
- D. Its frequency

G0A03 Which of the following has the most direct effect on the permitted exposure level of RF radiation?

- A.** The age of the person exposed
- B.** The power level and frequency of the energy
- C.** The environment near the transmitter
- D.** The type of transmission line used

G0A04 What does "time averaging" mean in reference to RF radiation exposure?

- A.** The average time of day when the exposure occurs
- B.** The average time it takes RF radiation to have any long-term effect on the body
- C.** The total time of the exposure
- D.** The total RF exposure averaged over a certain time

G0A05 What must you do if an evaluation of your station shows RF energy radiated from your station exceeds permissible limits?

- A.** Take action to prevent human exposure to the excessive RF fields
- B.** File an Environmental Impact Statement (EIS-97) with the FCC
- C.** Secure written permission from your neighbors to operate above the controlled MPE limits
- D.** All of these answers are correct

G0A06 Which transmitter(s) at a multiple user site is/are responsible for RF safety compliance?

- A.** Only the most powerful transmitter on site
- B.** All transmitters on site, regardless of their power level or duty cycle
- C.** Any transmitter that contributes 5% or more of the MPE
- D.** Only those that operate at more than 50% duty cycle

G0A07 What effect does transmitter duty cycle have when evaluating RF exposure?

- A.** A lower transmitter duty cycle permits greater short-term exposure levels
- B.** A higher transmitter duty cycle permits greater short-term exposure levels
- C.** Low duty cycle transmitters are exempt from RF exposure evaluation requirements
- D.** Only those transmitters that operate at a 100% duty cycle must be evaluated

G0A08 Which of the following steps must an amateur operator take to ensure compliance with RF safety regulations?

- A.** Post a copy of FCC Part 97 in the station
- B.** Post a copy of OET Bulletin 65 in the station
- C.** Perform a routine RF exposure evaluation
- D.** All of these choices are correct

G0A09 What type of instrument can be used to accurately measure an RF field?

- A.** A receiver with an S meter
- B.** A calibrated field-strength meter with a calibrated antenna
- C.** A beta scope with a dummy antenna calibrated at 50 ohms
- D.** An oscilloscope with a high-stability crystal marker generator

G0A10 What do the RF safety rules require when the maximum power output capability of an otherwise compliant station is reduced?

- A.** Filing of the changes with the FCC
- B.** Recording of the power level changes in the log or station records
- C.** Performance of a routine RF exposure evaluation
- D.** No further action is required

G0A11 What precaution should you take if you install an indoor transmitting antenna?

- A.** Locate the antenna close to your operating position to minimize feed line radiation
- B.** Position the antenna along the edge of a wall to reduce parasitic radiation
- C.** Make sure that MPE limits are not exceeded in occupied areas
- D.** No special precautions are necessary if SSB and CW are the only modes used

G0A12 What precaution should you take whenever you make adjustments or repairs to an antenna?

- A.** Ensure that you and the antenna structure are grounded
- B.** Turn off the transmitter and disconnect the feedline
- C.** Wear a radiation badge
- D.** All of these answers are correct

G0A13 What precaution should be taken when installing a ground-mounted antenna?

- A.** It should not be installed higher than you can reach
- B.** It should not be installed in a wet area
- C.** It should be painted so people or animals do not accidentally run into it
- D.** It should be installed so no one can be exposed to RF radiation in excess of maximum permissible limits

G0A14 What is one thing that can be done if evaluation shows that a neighbor might receive more than the allowable limit of RF exposure from the main lobe of a directional antenna?

- A.** Change from horizontal polarization to vertical polarization
- B.** Change from horizontal polarization to circular polarization
- C.** Use an antenna with a higher front-to-back ratio
- D.** Take precautions to ensure that the antenna cannot be pointed at their house

G0A15 How can you determine that your station complies with FCC RF exposure regulations?

- A.** By calculation based on FCC OET Bulletin 65
- B.** By calculation based on computer modeling
- C.** By measurement of field strength using calibrated equipment
- D.** All of these choices are correct

G0B01 Which wire(s) in a four-conductor line cord should be attached to fuses or circuit breakers in a device operated from a 240-VAC single-phase source?

- A.** Only the "hot" (black and red) wires
- B.** Only the "neutral" (white) wire
- C.** Only the ground (bare) wire
- D.** All wires

G0B02 What is the minimum wire size that may be safely used for a circuit that draws up to 20 amperes of continuous current?

A. AWG number 20

B. AWG number 16

C. AWG number 12

D. AWG number 8

G0B03 Which size of fuse or circuit breaker would be appropriate to use with a circuit that uses AWG number 14 wiring?

A. 100 amperes

B. 60 amperes

C. 30 amperes

D. 15 amperes

G0B04 What is the mechanism by which electrical shock can be lethal?

- A.** Current through the heart can cause the heart to stop pumping
- B.** A large voltage field can induce currents in the brain
- C.** Heating effects in major organs can cause organ failure
- D.** All of these choices are correct

G0B05 Which of the following conditions will cause a Ground Fault Circuit Interrupter (GFCI) to disconnect the 120 or 240 Volt AC line power to a device?

- A.** Current flowing from the hot wire to the neutral wire
- B.** Current flowing from the hot wire to ground
- C.** Over-voltage on the hot wire
- D.** All of these choices are correct

G0B06 Why must the metal chassis of every item of station equipment be grounded (assuming the item has such a chassis)?

- A.** It prevents blowing of fuses in case of an internal short circuit
- B.** It provides a ground reference for the internal circuitry
- C.** It ensures that the neutral wire is grounded
- D.** It ensures that hazardous voltages cannot appear on the chassis

G0B07 Which of the following should be observed for safety when climbing on a tower using a safety belt or harness?

- A.** Never lean back and rely on the belt alone to support your weight
- B.** Always attach the belt safety hook to the belt "D" ring with the hook opening away from the tower
- C.** Ensure that all heavy tools are securely fastened to the belt D ring
- D.** Make sure that your belt is grounded at all times

G0B08 What should be done by any person preparing to climb a tower that supports electrically powered devices?

- A.** Notify the electric company that a person will be working on the tower
- B.** Make sure all circuits that supply power to the tower are locked out and tagged
- C.** Ground the base of the tower
- D.** Disconnect the feed-line for every antenna at the station

G0B09 Why is it not safe to use soldered joints with the wires that connect the base of a tower to a system of ground rods?

- A.** The resistance of solder is too high
- B.** Solder flux will prevent a low conductivity connection
- C.** Solder has too high a dielectric constant to provide adequate lightning protection
- D.** A soldered joint will likely be destroyed by the heat of a lightning strike

G0B10 Which of the following is a danger from lead-tin solder?

- A.** Lead can contaminate food if hands are not washed carefully after handling
- B.** High voltages can cause lead-tin solder to disintegrate suddenly
- C.** Tin in the solder can “cold flow” causing shorts in the circuit
- D.** RF energy can convert the lead into a poisonous gas

G0B11 Which of the following is good engineering practice for lightning protection grounds?

- A.** They must be bonded to all buried water and gas lines
- B.** Bends in ground wires must be made as close as possible to a right angle
- C.** Lightning grounds must be connected to all ungrounded wiring
- D.** They must be bonded together with all other grounds

G0B12 What is the purpose of a transmitter power supply interlock?

- A.** To prevent unauthorized access to a transmitter
- B.** To guarantee that you cannot accidentally transmit out of band
- C.** To ensure that dangerous voltages are removed if the cabinet is opened
- D.** To shut off the transmitter if too much current is drawn

G0B13 Which of the following is the most hazardous type of electrical energy?

- A.** Direct Current
- B.** 60 cycle Alternating current
- C.** Radio Frequency
- D.** All of these choices are correct

G0B14 What is the maximum amount of electrical current flow through the human body that can be tolerated safely?

- A.** 5 microamperes
- B.** 50 microamperes
- C.** 500 milliamperes
- D.** 5 amperes

I cannot let you test if you do not bring these documents! No Exceptions

Bonus Question:

Which of the following are you required to bring to next week's class so you can take the Element 3 (General) exam?

- A. A photo ID (e.g., Driver's license, Passport, etc)
- B. The original version of your current license.
- C. A copy of your current license (If you have one)
- D. All of the above

