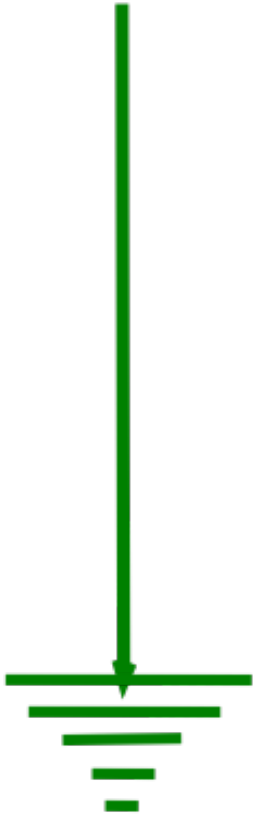


GROUNDING
&
BONDING

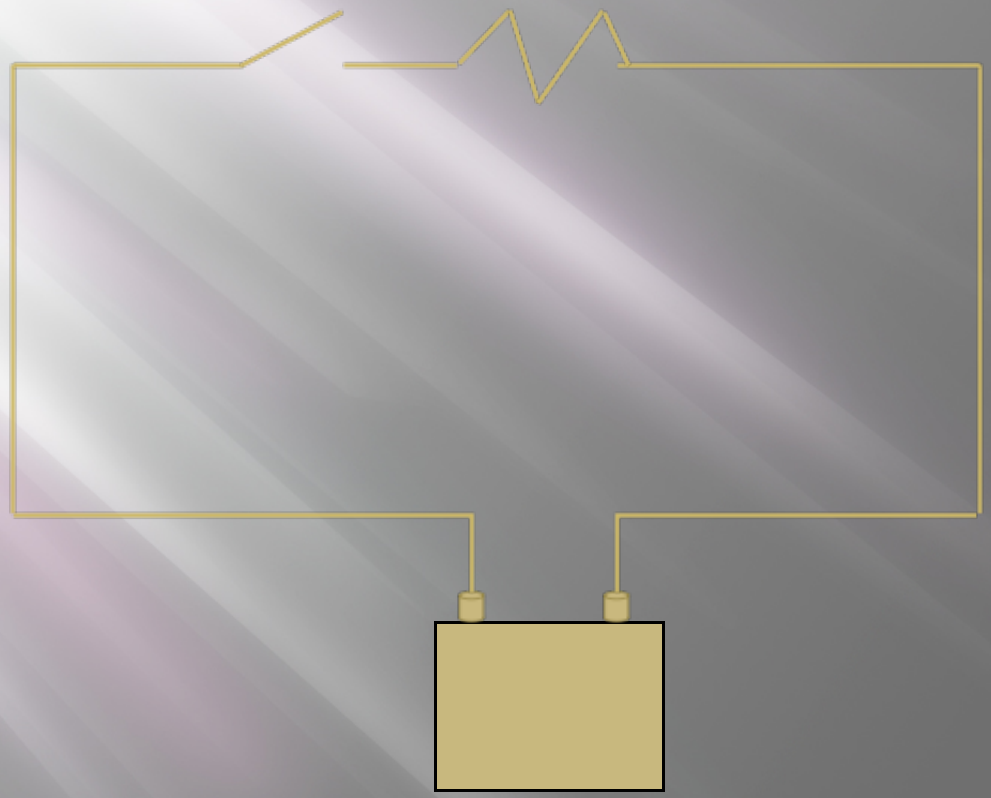
WHY IS IT SO COMPLICATED?

BY

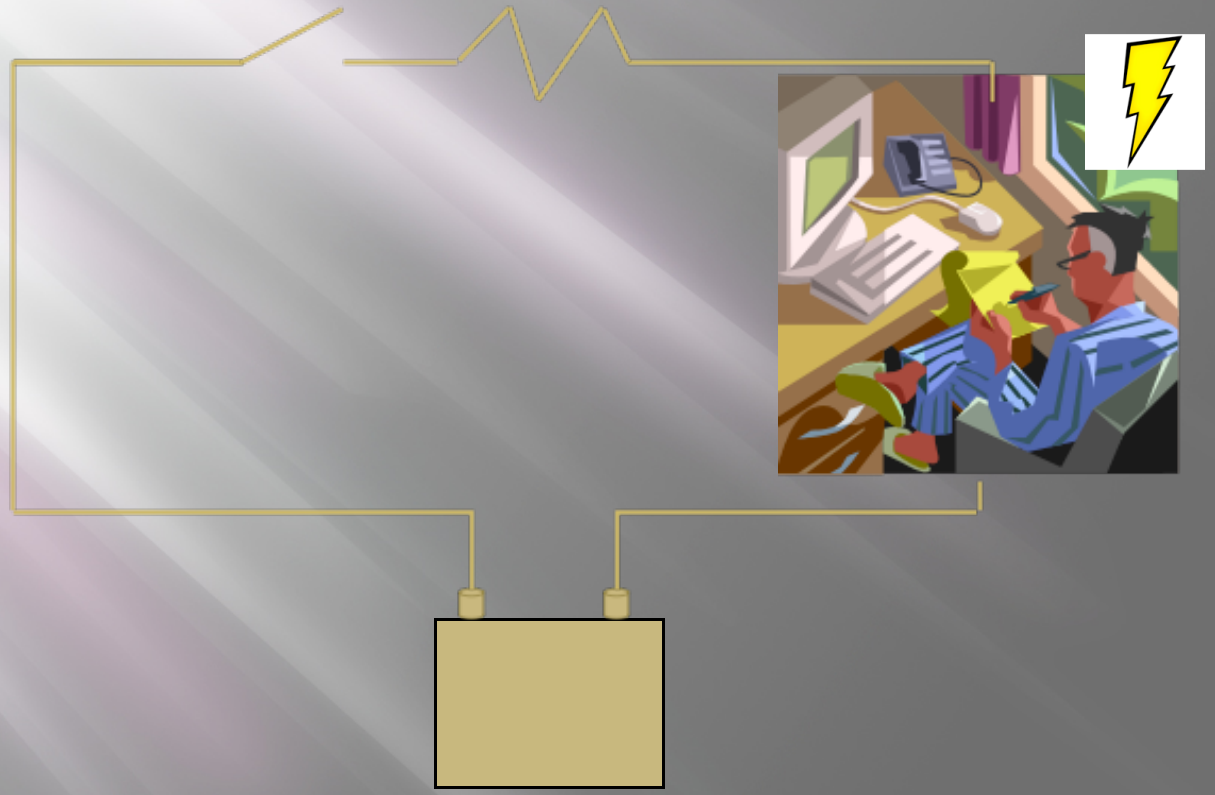
PAUL MELVIN

K4PGM

ELECTRICAL CIRCUIT



ELECTRICAL CIRCUIT

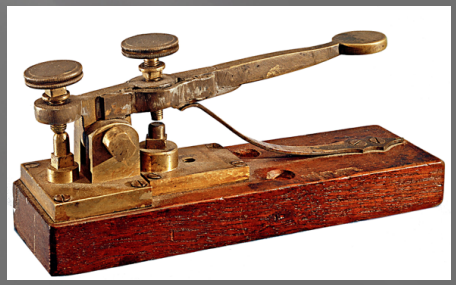


HOW MUCH CURRENT ?

- FEEL THE SENSATION.

Where it all began!

Telegraph was the first nationwide electrical system.

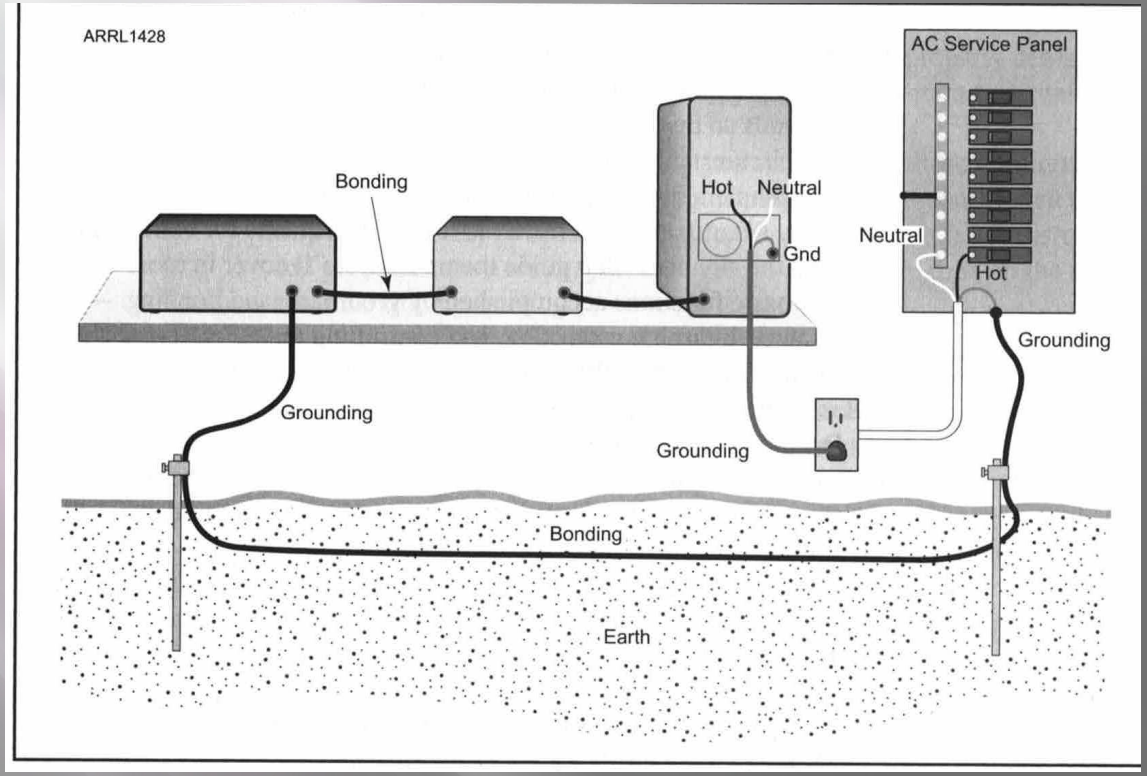


GROUNDING & BONDING EXPLAINED

- Grounding is the connection of the electrical circuit to the earth.
  - This allows a safe means for unused current to be returned to the source and removed from conductive surfaces.
- Bonding is the connection of equipment so there is no potential voltage between equipment.
  - Both bonding and grounding must be used to assure a safe environment.

GROUNDING and BONDING

TYPICAL GROUNDING/BONDING CONNECTION



CALL IT WHAT YOU WANT!

- Grounding
- Earthing
- Protective earth conductor
- That green wire?

REASONS FOR GROUNDING

1. SAFETY
   - REDUCES ELECTRICAL SHOCK HAZARDS
     - CURRENT AMOUNTS AND EFFECTS
2. LIGHTNING
   - REDUCES STATIC BUILD UP
   - HELPS TO RETURN SURGES SAFELY TO GROUND.
3. RF BURNS AND SHOCK HAZARDS
   - RADIO FREQUENCY INJURY

It’s The Law!

General requirements

- Grounding of electrical equipment
- Bonding of electrical equipment
- Bonding of electrically conductive materials and other equipment
- Effective ground fault current path

2017 NEC

- National Electrical Code
  - Enacted as law by NC legislators
  - Insurance concerns.
- Article 250
  - Covers grounding and bonding.
  - Ensures safety and fire protection.

EQUIPMENT GROUNDING

Normally non-current-carrying conductive materials enclosing electrical equipment, or forming part of such equipment, ***SHALL*** be connected to earth so as to limit the voltage to ground on these materials.

Metal cases

- Radio
- Tuner
- Meters
- amplifiers

EQUIPMENT BONDING

Normally non-current-carrying conductive materials enclosing electrical conductors or equipment, or forming part of such equipment, ***SHALL*** be connected together and to the electrical supply source in a manner that establishes an effective ground-fault current path.

- Connect it all together
  - Everything listed in previous grounding slide!

CONDUCTIVE MATERIALS AND OTHER EQUIPMENT

Normally non-current-carrying electrically conductive materials that are likely to become energized ***SHALL*** be connected together and to the electrical supply source in a manner that establishes an effective ground-fault current path.

- If it is conductive and ***<u>can become energized</u>*** then bond it and ground it!

EFFECTIVE GROUND-FAULT CURRENT PATH

Electrical equipment, wiring and other electrically conductive material likely to become energized ***SHALL*** **be installed in a manner that creates a low impedance circuit facilitating the operation of the over current device.**

- Grounding must allow for the correct operation of:
  - Circuit Breakers
  - Fuses
  - Circuit interrupters

ELECTRICAL SAFETY GROUNDING

- #1 REASON FOR GROUNDING
  - PERSONAL SAFETY
  - SAFETY OF PERSONS VISITING
  - FIRE SAFETY
  - PROTECTION OF EQUIPMENT

YOUR STATION

- DESIGN YOUR STATION
  - Use best practices to install electrical
  - Power equipment with low DC voltage
    - Less likely to cause serious injury
  - Mitigate areas of high current
    - High current causes more serious injuries
  - ***GROUNDING IS YOUR BEST PROTECTION!***

AREAS OF CONCERN

- OUTLETS
  - Are outlets grounded per NEC?
  - Are all ground prongs intact?

STATION GROUNDING

- DON'T LEAVE ANYTHING UNGROUNDED

LIGHTNING PROTECTION

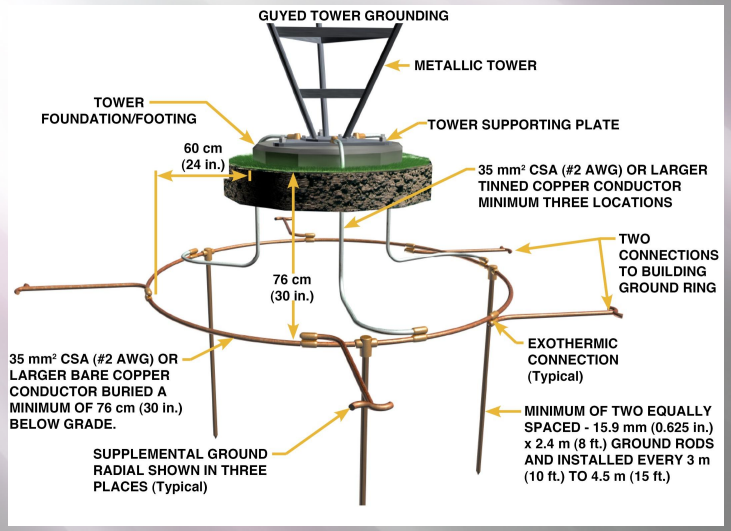
- LIGHTING SURGES AND STRIKES
  - CANNOT BE PREVENTED
  - CAN BE DIVERTED TO GROUND
  - CAN REDUCE THE AMOUNT OF CURRENT FLOWING THROUGH EQUIPMENT.
- MOST RADIO EQUIPMEN IS SOLID STATE
  - THE COMPONENTS OPERATE AT LOW VOLTAGE
  - HIGHER VOLTAGE FROM SURGES DAMAGE THEM BEYOND REPAIR.
  - YES IT IS A GAMBLE. INCREASE YOUR ODDS.

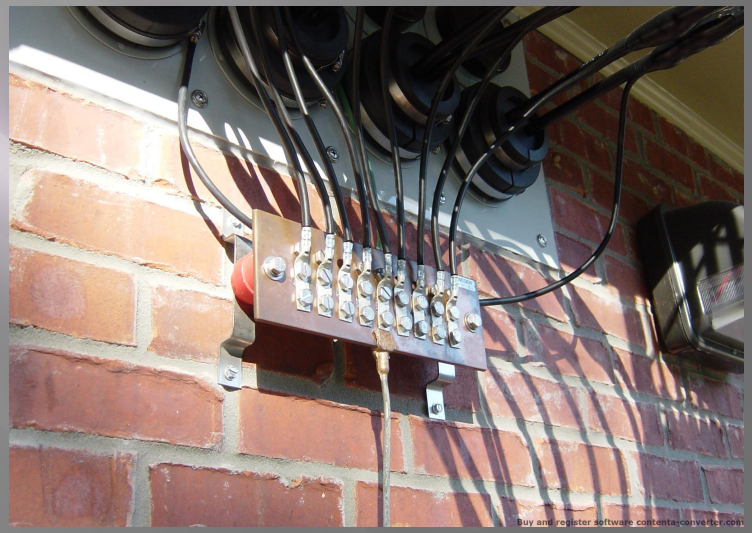
BOND THAT EQUIPMENT!

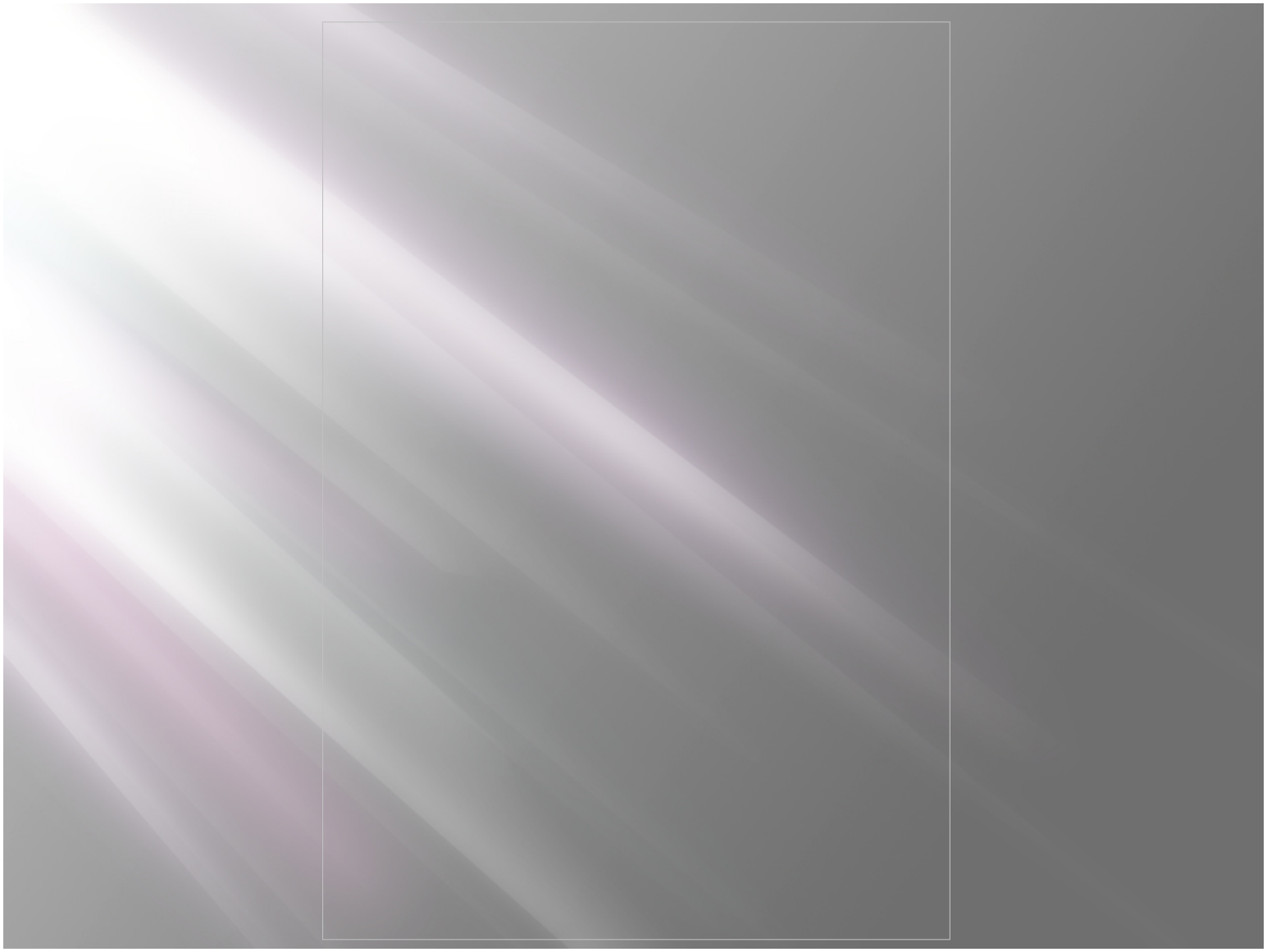
ANTENNA/TOWER

- GROUNDING AT THE CONNECTION POINT
  - GROUND THE SHIELD AND ALL METALLIC PARTS THAT DO NOT CONNECT TO THE CENTER CONDUCTOR.
- GROUND THE TOWER OR POLE AT THE BASE ON EACH LEG OR MULTIPLE TIMES.
  - DRIVE 8’ GROUND RODS
  - BOND THEM TOGETHER WITH COPPER CONDUCTOR.

TOWER AND ENTRY GROUNDING







LIGHTNING SURGE PROTECTORS

RF MANAGEMENT

- RADIO FREQUENCY VOLTAGE AND CURRENT CAN DISRUPT NORMAL OPERATION (RFI).
- "THERE IS NO RF GROUND"
  - EQUALIZE AUDIO AND RF THROUGHOUT YOUR STATION
    - ***BOND ALL CONDUCTIVE MATERIALS***
    - ***BONDING DOES NOT ASSURE "0" AUDIO AND RF VOLTAGE BUT KEEPS IT THE SAME SO CURRENT WILL BE REDUCED.***

REMEMBER!

- YOU CANNOT OVER GROUND!
- KEEP ALL EQUIPMENT BONDED TO REDUCE POTENTIAL VOLTAGE AND CURRENT.
- KEEP ALL GROUND CONDUCTORS AS SHORT AS POSSIBLE.
- ALL GROUNDING ELECTRODES MUST BE BONDED TOGETHER.