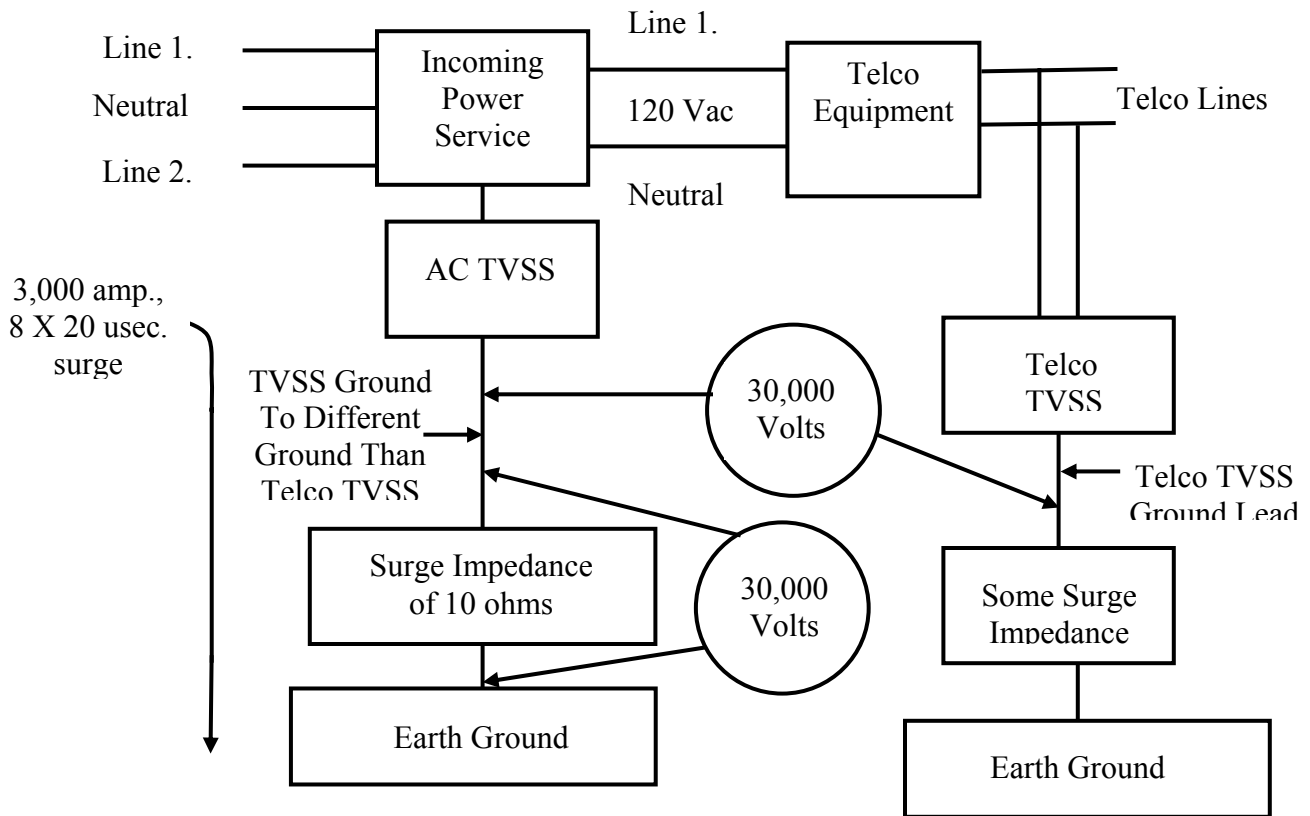


Subject: Telephone Switch Surge Protection.

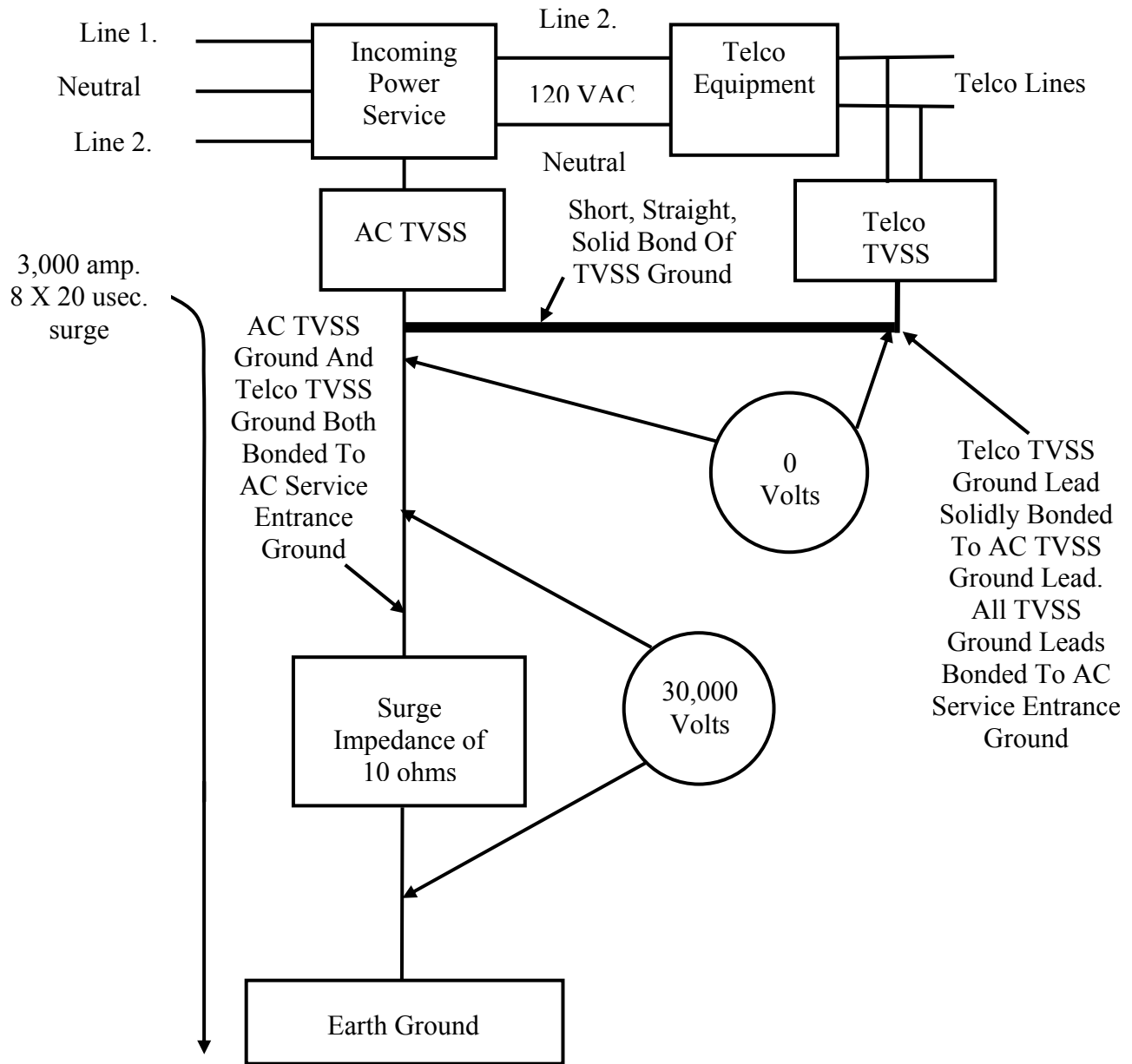
Based upon the information provided to me concerning electrical transient damage to a telephone switch, the recommendations provided below are forwarded to you.

1. Insure that a single point ground exists at the telephone switch. See drawings 1., 2., and 3., which apply at the service entrance and at each piece of protected equipment.
2. A green non-current carrying safety ground from the electrical service entrance ground-to-neutral bond is preferred. If conduit is the safety grounding means, inspect the electrical system to ensure that the conduit is properly connected, electrically continuous, and bonded.
3. The presence and continuity of the green non-current carrying safety ground (or conduit grounding means) must be verified at the serving transformers. The presence of a ground-to-neutral bond must be physically verified at each applicable transformer. All connections should be clean, dry, and tight.
4. Eliminate extraneous ground paths, which cause ground loops. The ground loops are noise and transient loops and allow transient voltage equalization through equipment connected to them. These extraneous ground paths may be “auxiliary” ground rod(s) driven at the telephone switch or bonds to building steel. Refer again to drawings 1., 2., and 3. to observe the effects of different grounds.
5. A single ground reference point at the equipment to be protected is essential. This ground reference point is the AC power grounding green non-current carrying safety ground.
6. A “surge reference ground”, or “local ground window” must be may be established (typically, a ground plane constructed of copper sheet or buss). The electrical system green is bonded to it, and all suppressor ground leads are bonded to it. This includes the telco primary suppressor covering the incoming telco lines and the appropriate Innovative Technology high-speed, high-power solid state protection system (e.g., an MDF series) which is connected between the telco primary protector and the telephone switch. The appropriate Innovative Technology telco protector is selected based upon the number of wires, the data transmission rates, and the peak voltages.
7. The ground lead from the local AC power surge suppressor is bonded to the surge reference ground. This may be an HS-P-SP, sized by voltage and current. All leads are to be kept as short and straight as possible.
8. An AC panel mounted suppressor should be mounted at the panel serving the switch (or, transformer secondary). The proper voltage configuration and proper circuit interrupts must be provided.
9. If evidence exists that transients are being fed into the switch from the station lines, they too will require the proper protection.
10. Refer to the drawings that follow for an explanation of the transient problem and cure.

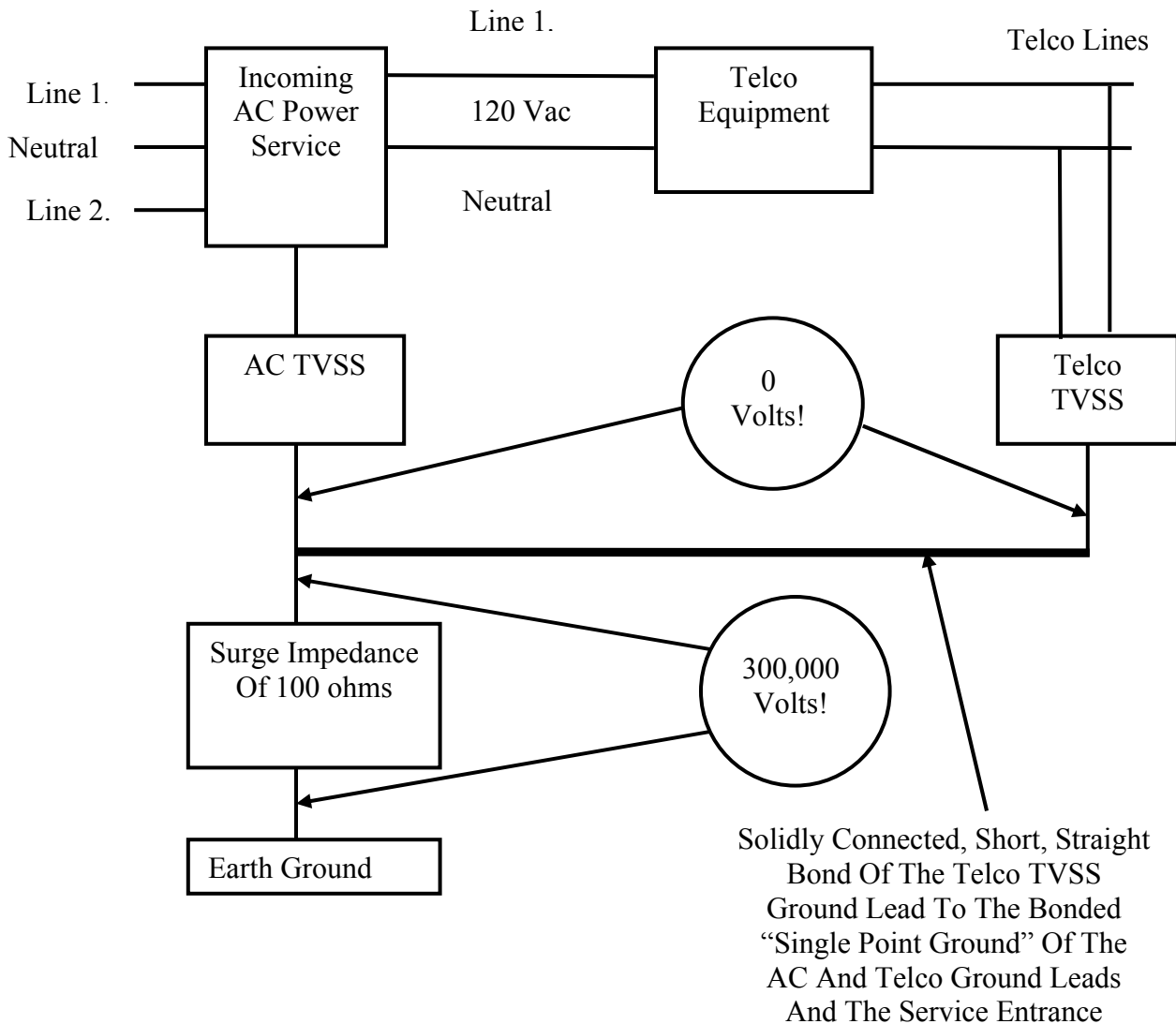
**Drawing 1.** Ground Potential Difference. Bond your grounds at the service entrance. Use the same ground reference for your TVSS grounds (at the service entrance and at the protected equipment). This will minimize ground potential differences. By bonding your grounds at the service entrance to create a “single point ground” or “local ground window” or “surge reference ground” and by using the same ground reference for all TVSS at each protection level, potential equalization through the protected equipment will be minimized. Because the Telco and AC TVSS ground leads are not solidly bonded to exactly the same physical and electrical point, a 30,000 volt potential difference exists between the two different ground points. This potential difference will be equalized through the Telco equipment and destroy it.



**Drawing 2.** Elimination of ground potential differences. By bonding your grounds at the service entrance to create a “single point” ground and by using the same ground reference for all TVSS at each protection level, potential equalization through the protected equipment is minimized. Note that the Telco TVSS ground lead is solidly bonded to the AC TVSS ground lead with a short, straight connection. The 30,000 volt shift in ground potential now causes a 0 volt shift in the potential between the AC and Telco TVSS ground lead connections.



**Drawing 3.** Why bonding your grounds at the service entrance and using the same ground reference for all TVSS at each protection level is far more important than a “low resistance ground” for transient protection. In this case the ground surge impedance is increased from 10 ohms to 100 ohms. The voltage across the ground surge impedance is now 300,000 volts instead of 30,000 volts. The TVSS protection will still work. Note that the voltage between the AC and Telco TVSS grounds is still 0 volts, while the voltage from the service entrance ground bonding point to true earth ground is 300,000 volts. I can protect an airplane or a 911 emergency vehicle, neither of which drag ground rods behind them.



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