

Re: Repairing Lightning Damaged Tv's

Source: <http://sci.tech-archive.net/Archive/sci.electronics.repair/2004-06/1349.html>

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Date: 06/17/04

Date: Thu, 17 Jun 2004 10:55:05 -0400

Protection starts with the underlying geology. Best is a monolithic soil of clay or loam that is damp. Worst is sand or gravel. Also bad would be two different types of soil where the more electrically conductive vein is far from the single point ground. Example: they had a bathroom wall struck twice by lightning. They installed lightning rods. The bathroom wall was struck a third time. Lightning rods were earthed in sand. Bathroom plumbing made a better connection to deeper limestone. One poster in the Perennes once said he had to sink a 150 foot ground rod to get through glacier tailings and into more conductive soil. A rather extreme example that demonstrates the point.

Establish the single point earth ground. For most, two ground rods driven well below the frost line and separated by a distance equivalent to their length is sufficient (Rods closer tend to act as if they were the same rod). Idea is to make this the best electrical ground on the property.

All incoming utilities first connect to this single point ground either by direct wire connection or via a surge protector. Unfortunately, your antenna violates the principle. But there are alternative solutions. Three examples – the bad, ugly, and good (left to right) – are provided in figure 2. Concept demonstrated in figure 1. Halo ground that connects your earth grounds together. This could be a buried bare 4 AWG ground wire that interconnects AC electric ground to TV antenna ground. That buried bare wire makes all grounds equipotential as well as enhances the connection of earth ground to earth:

<http://www.cinergy.com/surge/ttip08.htm>

A US government publication further discusses the single point principle:

http://www.pueblo.gsa.gov/cic_text/housing/surge/contractors.htm

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Equipotential means earth beneath cottage appears to be the same voltage no matter how massive the direct strike. We can install a great earth ground. But that may not be sufficient. So we surround the house with a halo ground or Ufer ground to also make earth beneath building equipotential. Homes built to contain transistors have a halo or Ufer ground installed when footing are pours – plans for good earthing must be started that early. This principle avoids complications created by varying earths. A complication that most homes new not worry about. But a halo or Ufer ground should be installed in all new construction because it is so cheap and so effective.

Now that we have established a good earth ground, we are now ready to make connection to that ground. Every wire entering the building must connect that that single point ground. Ground wire connection (ie from neutral bus bar) must be short, direct, and independent. IOW (short) it must be less than ten feet. It (direct) must have no sharp bends; no splices. (Even 90 turns and lead solder joints on copper water pipes violate good connection requirements). It (independent) must be separated from all other non–earthing wires and must not connect to any other earthing wire until they all meet at the single point ground.

Idea is to make that earthing wire low impedance; not just low resistance. For example, 90 degree bends could add a microhenries to wire inductance. For earthing, that would result in a substantial increase in wire impedance.

Using numbers: that earthing wire might have less than .1 ohms resistance. But it might also have as much as 4 ohms impedance. Any increase in earthing wire impedance means a surge may seek other and destructive paths to earth ground inside the building. An earthing wire from bus bar straight through foundation to a point just above soil would be superior to an earth ground that routes up over top of foundation (through 2x10 or rim board) and back down to earth.

Two other AC electric wires have also entered the building and cannot be earthed – also called hot wires. These are the most common source of surge damage especially to phone appliances that use AC electric – answering machine, computer modem, portable phone base station. The 'whole house' protector must connect from each wire to that bus bar. One minimally sized example sold in Home Depot is Intermatic IG1240RC. Others have been listed in newsgroup misc.rural as "telephone wire/lightning strikes" on 30 Sept 2003:

<http://tinyurl.com/q6g6>

A 'whole house' protector for residential service should be at minimum 1000 joules and 50,000 amps. Some, such as GE's THQLSurge (if I have remembered the name correctly) that is also sold in Lowes, is undersized and overpriced. Square D makes one protector that is undersized AND does not even provide joules in its specs. But in that list is another Square D product that is well designed – more than meets minimum requirements.

Telco installs a 'whole house' protector that meets US National Electrical Code requirements:

>From Article 800.30A:

- > A listed primary protector shall be provided on each circuit
- > run partly or entirely in aerial wire or aerial cable not
- > confined within the block containing the building served so
- > as to be exposed to accidental contact with electric light or
- > power conductor operating at over 300 volts to ground. In
- > addition, where there exists a lightning exposure, each
- > interbuilding circuit on a premise shall be protected by a
- > listed primary protector at each end of the interbuilding
- > circuit.

Article 800.30B Location.

- > The primary protector shall be located in, on, or immediately
- > adjacent to the structure or building served and as close as
- > practical to the point of entrance.

Article 800.31

- > The primary protector shall consist of an arrester connected
- > between each line conductor and ground in an appropriate
- > mounting. Primary protector terminals shall be marked to
- > indicate line and ground as applicable.

NID that contains telephone 'whole house' protector is:

<http://www.alarmsuperstore.com/bw/bw%20connectors.htm> or
<http://www.bass-home.com/gotoproduct.cfm?item=91598>

A 14 AWG wire connects from that box to the single point ground. Again, it should meet these criteria rather than look neat: be short, direct, and independent. Too many telco installers want to square off the wire or neatly ty-wrap a ground wire to other cables. Wrong. That 14 AWG (more often is 12 AWG) wire must run independently and directly to the same single point ground used by AC electric. Both grounds meet at the earthing rod – the single point ground.

Every incoming wire – all three AC electric, both telephone wires, and shield of any incoming coax cable from satellite dish – are earthed to same earth ground. As noted earlier, that antenna will require special attention. Now lets discuss induced transients.

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Lightning strikes the TV antenna seeking earth ground. Path will be destructive via household wires. And not necessary just through TV and AC electric to earth ground. That antenna wire may be bundled with other wires. Therefore that antenna wire induces transients on other wires or may even arc into those other wires.

Same problem is also created by plug-in protectors. Lets say a plug-in protector is earthing the transient. IOW it is shunting a transient into the AC electric safety ground wire. But that safety ground wire is bundled with other wires. Now a transient is induced onto those other wires. Just another example of why plug-in protectors are not effective and can even contribute to surge damage.

Idea is to earth a transient before it can enter the building. Not just earth anywhere, but earth less than 10 feet to a single point. Campers demonstrate the principle. They were sleeping nearby a tree that was struck. Lightning strikes tree to obtain earth borne charges some kilometers beyond those boys. Some were sleeping perpendicular to that tree and were not hurt. Any boy who was sleeping pointed towards that tree had electricity rise up into his feet, pass through his body, then exit via his head. Body is more conductive than earth. Lightning will find every conductive path to those earth borne charges some kilometers away. This is also why multiple earth grounds on a building can cause lightning to find the other earth ground, destructively, via the house.

When lightning is striking, stand with both feet together – the single point ground. Building uses same concept to not have appliances damaged.

Incoming transients also applies to buried wires. This industry professional (another source of protectors) demonstrates two structures – each with their own single point earth ground AND both single point grounds interconnected. Buried phone line is also carrying a destructive transient. Phone line is earthed at building's earth ground before entering because even buried wires carry destructive transients:

<http://www.ericom.com/public/library/fep/technotes/tncr002.pdf>

'Whole house' protectors are only secondary protection. Primary protection is provided by the utility at transformer. But that primary protector may need be inspected. Some pictures of what to look for:

<http://www.tvtower.com/fpl.html>

And rules for earthing:

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http://www.tvtower.com/grounding_and_bonding.html

Protectors are only a simple science of protection. The art is in the earthing. More about earthing was discussed previously in two threads in the newsgroup misc.rural:

Storm and Lightning damage in the country 28 Jul 2002

Lightning Nightmares!! 10 Aug 2002

<http://tinyurl.com/ghgv> and <http://tinyurl.com/ghgm>

Should you wish to learn more, Polyphaser (another manufacturer of 'real world' protectors) provides application notes such as this one about single point ground:

http://www.polyphaser.com/ppc_PEN1002.asp

and others:

http://www.polyphaser.com/ppc_technical.asp

http://www.polyphaser.com/ppc_pen_home.asp

Additional information in some MTL Surge Technology app notes at:

<http://www.mtlsurgetechnologies.com/downloads/tans/index.htm>

Bottom line is this: a surge protector is not protection. A surge protector is only as effective as its earth ground. Notice no technical references to companies that sell ineffective protection such as APC, Panamax, and Tripplite – and other plug-in manufacturers so often hyped by myth. What do they avidly avoid discussing to sell their ineffective products? Earth ground. No earth ground means no effective protection.

Sunny wrote:

- > *I personally installed the electric service at my cottage 20*
- > *years ago, in accordance with all Canadian electrical codes in*
- > *effect at the time. IIRC, earthing involved banging two 8'*
- > *rods into the ground several feet apart and connecting them to*
- > *the neutral bus-bar inside the fuse panel, and also running a*
- > *cable from the same bus-bar to the cold water plumbing. The*
- > *phone company installed the phone service, which enters the*
- > *building beside the electric meter, but I don't know if/how*
- > *they effected earthing. The only other incoming wire is from*
- > *the TV antenna, on the opposite side of the building, which*
- > *currently has no earthing.*
- >
- > *I would be grateful if you could explain, in laymans terms,*
- > *what further steps I could take to protect my cottage*
- > *electrical equipment from lightning strikes – since*
- > *unplugging doesn't work.*
- >
- > *I have no reason to doubt your assertion that protection is*
- > *always possible, but I am having some difficulty translating*
- > *your advice into practice.*

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> *Thanks,*

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> *Sunny*