

Re: Repairing Lightning Damaged Tv's

Source: <http://sci.tech-archive.net/Archive/sci.electronics.repair/2004-06/1648.html>

From: Sunny (sunny_at_nospam.net)

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Date: Mon, 21 Jun 2004 00:04:10 -0400

Your incredibly comprehensive and useful reply is very much appreciated!

Thanks,

Sunny

w_tom wrote:

- > 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:

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- > <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
- >
- > 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
- > mircohenries 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'

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- > 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

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- > 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.
- >
- > 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.

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- > *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.erico.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:*
- > 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*

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>>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.

>>
>>Thanks,
>>
>>Sunny