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Protecting Yourself from EMP by Duncan Long

EMP. The letters spell burnt out computers and other electrical systems and perhaps even a return to the dark ages if it were to mark the beginning of a nuclear war. But it doesn't need to be that way. Once you understand EMP, you can take a few simple precautions to protect yourself and equipment from it. In fact, you can enjoy much of the "high tech" life style you've come accustomed to even after the use of a nuclear device has been used by terrorists--or there is an all-out WWIII.

EMP (Electro-Magnetic Pulse), also sometimes known as "NEMP" (Nuclear Electromagnetic Pulse), was kept secret from the public for a long time and was first discovered more or less by accident when US Military tests of nuclear weapons started knocking out phone banks and other equipment miles from ground zero.

EMP is no longer "top secret" but information about it is still a little sketchy and hard to come by. Adding to the problems is the fact that its effects are hard to predict; even electronics designers have to test their equipment in powerful EMP simulators before they can be sure it is really capable of with standing the effect.

EMP occurs with all nuclear explosions. With smaller explosions the effects are less pronounced. Nuclear bursts close to the ground are dampened by the earth so that EMP effects are more or less confined to the region of the blast and heat wave. But EMP becomes more pronounced and wide spread as the size and altitude of a nuclear blast is increased since the ground; of these two, altitude is the quickest way to produce greater EMP effects. As a nuclear device is exploded higher up, the earth soaks up fewer of the free electrons produced before they can travel some distance.

The most "enhanced" EMP effects would occur if a nuclear weapon were exploded in space, outside the Earth's atmosphere. In such a case, the gamma radiation released during the flash cycle of the weapon would react with the upper layer of the earth's atmosphere and strip electrons free from the air molecules, producing electromagnetic radiation similar to broad-band radio waves (10 kHz-100 MHz) in the process. These electrons would follow the earth's magnetic field and quickly circle toward the ground where they would be finally dampened. (To add to the confusion, we now have two more EMP terms:

"Surface EMP" or "SEMP" which refers to ground bursts with limited-range effects and "High-altitude EMP" or "HEMP" which is the term used for a nuclear detonation creating large amounts of EMP.)

Tactically, a space-based nuclear attack has a lot going for it; the magnetic field of the earth tends to spread out EMP so much that just one 20-MT bomb exploded at an altitude of 200 miles could--in theory--blanket the continental US with the effects of EMP. It's believed that the electrical surge of the EMP from such an explosion would be strong enough to knock out much of the civilian electrical equipment over the whole country. Certainly this is a lot of "bang for the buck" and it would be foolish to think that a nuclear attack would be launched without taking advantage of the confusion a high-altitude explosion could create. Ditto with its use by terrorists should the technology to get such payloads into space become readily available to smaller countries and groups.

But there's no need for you to go back to the stone age if a nuclear war occurs. It is possible to avoid much of the EMP damage that could be done to electrical equipment--including the computer that brought this article to you--with just a few simple precautions.

First of all, it's necessary to get rid of a few erroneous facts, however.

One mistaken idea is that EMP is like a powerful bolt of lightning. While the two are alike in their end results--burning out electrical equipment with intense electronic surges--EMP is actually more akin to a super-powerful radio wave. Thus, strategies based on using lightning arrestors or lightning-rod grounding techniques are destined to failure in protecting equipment from EMP.

Another false concept is that EMP "out of the blue" will fry your brain and/or body the way lightning strikes do. In the levels created by a nuclear weapon, it would not pose a health hazard to plants, animals, or man PROVIDED it isn't concentrated.

EMP can be concentrated. That could happen if it were "pulled in" by a stretch of metal. If this
happened, EMP would be dangerous to living things. It could become concentrated by metal girders, large stretches of wiring (including telephone lines), long antennas, or similar set ups. So--if a nuclear war were in the offing--you'd do well to avoid being very close to such concentrations. (A safe distance for nuclear-generated EMP would be at least 8 feet from such stretches of metal.)

This concentration of EMP by metal wiring is one reason that most electrical equipment and telephones would be destroyed by the electrical surge. It isn't that the equipment itself is really all that sensitive, but that the surge would be so concentrated that nothing working on low levels of electricity would survive.

Protecting electrical equipment is simple if it can be unplugged from AC outlets, phone systems, or long antennas. But that assumes that you won't be using it when the EMP strikes. That isn't all that practical and--if a nuclear war were drawn out or an attack occurred in waves spread over hours or days-- you'd have to either risk damage to equipment or do without it until things had settled down for sure.

One simple solution is to use battery-operated equipment which has cords or antennas of only 30 inches or less in length. This short stretch of metal puts the device within the troughs of the nuclear-generated EMP wave and will keep the equipment from getting a damaging concentration of electrons. Provided the equipment isn't operated close to some other metal object (i.e., within 8 feet of a metal girder, telephone line, etc.), it should survive without any other precautions being taken with it.

If you don't want to buy a wealth of batteries for every appliance you own or use a radio set up with longer than 30-inch antenna, then you'll need to use equipment that is "hardened" against EMP.

The trick is that it must REALLY be hardened from the real thing, not just EMP-proof on paper. This isn't all that easy; the National Academy of Sciences recently stated that tailored hardening is "not only deceptively difficult, but also very poorly understood by the defence-electronics community." Even the US Military has equipment which might not survive a nuclear attack, even though it is designed to do just that.

That said, there are some methods which will help to protect circuits from EMP and give you an edge if you must operate ham radios or the like when a nuclear attack occurs. Design considerations include the use of tree formation circuits (rather than standard loop formations); the use of induction shielding around components; the use of self-contained battery packs; the use of loop antennas; and (with solid-state components) the use of Zener diodes. These design elements can eliminate the chance an EMP surge from power lines or long antennas damaging your equipment. Another useful strategy is to use grounding wires for each separate instrument which is coupled into a system so that EMP has more paths to take in grounding itself.

A new device which may soon be on the market holds promise in allowing electronic equipment to be EMP hardened. Called the "Ovonic threshold device", it has been created by Energy Conversion Devices of Troy, MI. The Ovonic threshold device is a solid-state switch capable of quickly opening a path to ground when a circuit receives a massive surge of EMP. Use of this or a similar device would assure survival of equipment during a massive surge of electricity.

Some electrical equipment is innately EMP-resistant. This includes large electric motors, vacuum tube equipment, electrical generators, transformers, relays, and the like. These might even survive a massive surge of EMP and would likely to survive if a few of the above precautions were taking in their design and deployment.

At the other end of the scale of EMP resistance are some really sensitive electrical parts. These include IC circuits, microwave transistors, and Field Effect Transistors (FET's). If you have electrical equipment with such components, it must be very well protected if it is to survive EMP.

One "survival system" for such sensitive equipment is the Faraday box.

A Faraday box is simply a metal box designed to divert and soak up the EMP. If the object placed in the box is insulated from the inside surface of the box, it will not be effected by the EMP travelling around the outside metal surface of the box. The Faraday box simple and cheap and often provides more protection to electrical components than "hardening" through circuit designs
which can't be (or haven't been) adequately tested.

Many containers are suitable for make-shift Faraday boxes: cake boxes, ammunition containers, metal filing cabinets, etc., etc., can all be used. Despite what you may have read or heard, these boxes do NOT have to be airtight due to the long wave length of EMP; boxes can be made of wire screen or other porous metal.

The only two requirements for protection with a Faraday box are: (1) the equipment inside the box does NOT touch the metal container (plastic, wadded paper, or cardboard can all be used to insulate it from the metal) and (2) the metal shield is continuous without any gaps between pieces or extra-large holes in it.

Grounding a Faraday box is NOT necessary and in some cases actually may be less than ideal. While EMP and lightning aren't the "same animal", a good example of how lack of grounding is a plus can be seen with some types of lightning strikes. Take, for example, a lightning strike on a flying airplane. The strike doesn't fry the plane's occupants because the metal shell of the plane is a Faraday box of sorts. Even though the plane, high over the earth, isn't grounded it will sustain little damage.

In this case, much the same is true of small Faraday cages and EMP. Consequently, storage of equipment in Faraday boxes on wooden shelves or the like does NOT require that everything be grounded. (One note: theoretically non-grounded boxes might hold a slight charge of electricity; take some time and care before handling ungrounded boxes following a nuclear attack.)

The thickness of the metal shield around the Faraday box isn't of much concern, either. This makes it possible to build protection "on the cheap" by simply using the cardboard packing box that equipment comes in along with aluminium foil. Just wrap the box with the

aluminium foil (other metal foil or metal screen will also work); tape the foil in place and you're done. Provided
it is kept dry, the cardboard will insulate the gear inside it from the foil; placing the foil-wrapped box inside a larger cardboard box is also wise to be sure the foil isn't accidentally ripped anywhere. The result is an "instant" Faraday box with your equipment safely stored inside, ready for use following a nuclear war.

Copper or aluminium foil can help you insulate a whole room from EMP as well. Just paper the wall, ceiling and floor with metal foil. Ideally the floor is then covered with a false floor of wood or with heavy carpeting to insulate everything and everyone inside from the shield (and EMP). The only catch to this is that care must be taken NOT to allow electrical wiring connections to pierce the foil shield (i.e., no AC powered equipment or radio antennas can come into the room from outside). Care must also be taken that the door is covered with foil AND electrically connected to the shield with a wire and screws or some similar set up.

Many government civil defence shelters are now said to have gotten the Faraday box, "foil" treatment. These shelters are covered inside with metal foil and have metal screens which cover all air vents and are connected to the metal foil. Some of these shelters probably make use of new optical fibre systems--protected by plastic pipe--to "connect" communications gear inside the room to the "outside world" without creating a conduit for EMP energy to enter the shelter.

Another "myth" that seems to have grown up with information on EMP is that nearly all cars and trucks would be "knocked out" by EMP. This seems logical, but is one of those cases where "real world" experiments contradict theoretical answers and I'm afraid this is the case with cars and EMP. According to sources working at Oak Ridge National Laboratory, cars have proven to be resistant to EMP in actual tests using nuclear weapons as well as during more recent tests (with newer cars) with the US Military's EMP simulators.

One reason for the ability of a car to resist EMP lies in the fact that its metal body is "insulated" by its rubber tires from the ground. This creates a Faraday cage of sorts. (Drawing on the analogy of EMP being similar to lightning, it is interesting to note that cases of lightning striking and damaging cars is almost non-existent; this apparently carries over to EMP effects on vehicles as well.)

Although Faraday boxes are generally made so that what is inside doesn't touch the box's outer metal shield (and this is especially important for the do-it-yourself since it is easy to inadvertently ground the Faraday box--say by putting the box on metal shelving sitting on a concrete floor), in the case of the car the "grounded" wiring is grounded only to the battery. In practice, the entire system is not grounded in the traditional electrical wiring sense of actually making contact to the earth at some point in its circuitry. Rather the car is sitting on insulators made of rubber.

It is important to note that cars are NOT 100 percent EMP proof; some cars will most certainly be effected, especially those with fibreglass bodies or located near large stretches of metal. (I suspect, too, that recent cars with a high percentage of IC circuitry might also be more susceptible to EMP effects.)

The bottom line is that all vehicles probably won't be knocked out by EMP. But the prudent survivalist should make a few contingency plans "just in case" his car (and other electrical equipment) does not survive the effects of EMP. Discovering that you have one of the few cars knocked out would not be a good way to start the onset of terrorist attack or nuclear war.

Most susceptible to EMP damage would be cars with a lot of IC circuits or other "computers" to control essential changes in the engine. The very prudent may wish to buy spare electronic ignition parts and keep them a car truck (perhaps inside a Faraday box). But it seems probable that many vehicles WILL be working following the start of a nuclear war even if no precautions have been taken with them.

One area of concern are explosives connected to electrical discharge wiring or designed to be set off by other electric devices. These might be set off by an EMP surge. While most citizens don't have access to such equipment, claymore mines and other explosives would be very dangerous to be around at the start of a nuclear box if they weren't carefully stored away in a Faraday box. Ammunition, mines, grenades and the like in large quantities might be prone to damage or explosion by EMP, but in general aren't all that sensitive to EMP.

A major area of concern when it comes to EMP is nuclear reactors located in the US. Unfortunately, a little-known Federal dictum prohibits the NRC from requiring power plants to withstand the effects of a nuclear war. This means that, in the event of a nuclear war, many nuclear reactors' control systems might will be damaged by an EMP surge. In such a case, the core-cooling controls might become inoperable and a core melt down and breaching of the containment vessel by radioactive materials into the surrounding area might well result. (If you were needing a reason not to live down wind from a nuclear reactor, this is it.)

Provided you're not next door to a nuclear power plant, most of the ill effects of EMP can be over come. EMP, like nuclear blasts and fallout, can be survived if you have the know how and take a few precautions before hand.

And that would be worth a lot, wouldn't it?

Some initial thoughts on EMP protection from the US military packaging division.

A continuously sealed metal barrier has proven to be very effective in preventing EM/HPM energy from reaching susceptible electronic or explosive components. Exterior packaging fabricated from plastic, wood or other fibre materials provides almost no protection form EM/HPM threats. The metal enclosure can be very thin provided there are no openings (tears, pin holes, doors, incomplete seams) that would allow microwaves to enter. Sealed barrier bags that incorporate a thin layer of aluminium foil and are primarily used to provide water vapour proof protection to an item, can add a great deal of resistance to EM/HPM penetration.

A number of cylindrical and rectangular steel containers have been developed by the Packaging Division for a wide range of munitions, weapon systems and associated components. The cylindrical containers are end opening and the rectangular containers are top opening. All the containers have synthetic rubber gaskets that allow them to maintain a +3 psi environmental seal to the outside environment. The containers are constructed using seam welding to provide for continuous metal contact on all surfaces of the body assembly. The cover openings have been held to a minimum and the sealing gaskets positioned in a manner to allow overlapping metal parts to add additional protection to these areas. Microwaves are very adept at bouncing around and working their way into even the smallest opening. Tests of the cylindrical and rectangular steel containers used by this organization have demonstrated a high level of protection in preventing EM/HPM energy from entering the container.

The key is to use a metal enclosure and eliminate or minimize any openings. Where openings are needed they should be surrounded to the greatest extent possible by continuous metal and in the case of a gasket, metal sheathing or mesh can be placed around the elastometer material or conductive metal moulded into the gasket. The closer the surrounding container comes to a continuous metal skin the more protection that will be provided.

High quality gaskets, utilizing either a mesh or embedded conductive metal design, are very expensive. They add a magnitude of cost to a normal gasket and can easily double the price of a container similar to the ones mentioned above.

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