EduCALC TECHNICAL NOTES

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STATIC ELECTRICITY AND MY CALCULATOR

Every Machine is Affected

Invisible energy exchanges are continuously taking place around us. The heating and cooling of objects, for example, causes them to expand, contract, and change shape. On a very hot day, we 'see' these heating effcts by shimmering hot air movements. There are other, more subtle, exchanges that are more difficult to observe. Every time two objects touch, rub against each other, or are separated from each other (intimate contact), the movement will disrupt the distribution of electric charges that all objects have. Under normal conditions the charges are quickly recombined and their presence is not noticed. Under cool and dry conditions, however, the charges remain in 'pools' of high charge concentration and we know that they are present by the strange things the charges do.

An astounding example of massive charge concentration is lightning. Air movements and clouds cause charges to built up until the attractive force is so great that a bolt of lightning results. Less spectacular examples are sparks to door knobs, Scotch tape being attracted to your hand, the TV star 'static cling,' and calculator disruption.

This Technical Note is concerned with calculator disruptions. EVERY calculator in a plastic case is prone to being disrupted by a static discharge. When the machine is adversely affected by Electro Static Discharge, ESD, the result is a static crash. There are two kinds of crashes, hard and soft. A hard crash is a hardware failure. A soft crash confuses the calculator's logic, often resulting in a locked-up keyboard or blank display. Most calculator designs are protected from ESD hard crashes. It is the soft crash that disrupts normal operation and erases data that causes the most difficulties for calculator users.

High static conditions are an environment problem. When temperatures drop, and the air is dry, the normal rapid recombining of charges is slowed down. Moisture in the air normally keeps charges from building up to troublesome levels. Air conditioned rooms and man-made materials used in carpets contribute to 'generating' charges.

Today's calculators use very low power circuits. The energy generated by walking across a carpet will easily power a liquid crystal display. Static electricity provides more than enough energy to cause extraneous 'signals' to be injected into the calculator's logic system. The only way to keep the charges out of the machine is to seal it in a conductive shell. Manufacturers do not consider this practical for cost and style reasons so users must adjust to the problem. It is important to realize that the problem is environmental and that not all machines will be exposed to the same environmental and handling conditions. The static season is usually during the winter months.

Precautions can be taken during the static season to reduce static crashes. Here are a few suggestions.

- Operate your machine in an anti-static bag such as the Comp-U-Bag #41-543A (HP-41) or 71-5435 (HP-71).
- Use your machine on a conductive surface if possible.
- Avoid plugging and unplugging modules and peripherals.
- Avoid using your system connected to the AC power line. The AC power cord provides a grounding path that increases charge flow.

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- Touch a large metal or grounded object such as a filing cabinet or a finger stop of a telephone dial before touching the calculator.

- Breathe with your mouth into both items to be plugged together. Your moist breath will discharge collected static charges.

- Coat machine, peripherals, modules, carrying case, etc. using a solution made with one teaspoon of liquid soap dissolved in a cup of water.

CAUTION—DO NOT GET ANY LIQUID INTO YOUR MACHINE!

- Review your handling procedures to avoid machine movement and moving contact with other materials. A surveyor who experienced many static crashes while working in the field discovered that the hard case on his belt was too large and the machine rocked with each step. Two felt strips glued inside the case corrected the problem.

When you experience strange calculator behaviour a static crash should be suspected. Almost any behavior is possible and it is useless to describe and analyze what is happening. The corrective step is to reset the machine. Consult your owner's manual, usually in the service or warranty section. Removing the batteries is a sure way of resetting the machine. HP-41 batteries need to be out 36 to 48 hours. A master clear should be performed in any way possible, such as using the backarrow-on sequence, of assigning STO c to a key using the PPC ROM, ZENROM, or key assignment card. Some machines—mostly Japanese models— have a reset button on the back. Press with a paper clip to reset the machine.

Conclusion: every calculator or computer can experience a static crash and these days it is unusual for the crash to be a hard crash that damages the equipment. Soft crashes cause strange behaviour and the machine must be reset to a known starting condition to insure proper operation. Precautions for getting through the static season are listed above. Some machines are more sensitive to static disruption than others of the same model. Applying a conductive coating on work surfaces, carrying cases, and the machine will greatly reduce static problems. Most users will not have problems, but the real world environment is constantly changing and you may experience a static crash. Unfortunately, most manufacturers won't even discuss the problem, and this Technical Note can only scratch the surface.