# CMOS DEVICES
# PRECAUTIONS & SPECIAL HANDLING REQUIREMENTS

Assemblies containing CMOS Devices can be damaged by improper operation or mis-handling. The following precautions are required.

## I. PRECAUTIONS

1. Do not insert or remove boards with power on.
   Do not apply signals to the board with the power supply off.

   Circuit boards should not be inserted into or removed from cages with power ON because transient voltages and current surges may cause permanent damage. The same damage can appear when connectors joining parts of a power up assembly are connected or disconnected. Signals should not be applied to the circuit boards while the power supplies are in the OFF condition or disconnected.

2. Use only the proper test equipment

   Circuit boards operating in a system are very sensitive to capacitive coupling. Touching (hand capacitance) any part of an operational circuit (even test points) can cause a malfunction. Oscilloscope probes should be 10:1 (do not use 1:1). High capacitance leads to meters should not be used. Use twisted pair leads or short coaxial leads. Only high impedance ( $>1$ Magohm), low capacitance ( $<30$ pico-farad) meters or scopes should be used to test an operational system. All test equipment should be grounded. Output logic states should not be forced: do not short CMOS outputs to ground (CMOS inputs can be shorted to ground only if they are not driven by a CMOS output), do not short CMOS outputs to other CMOS outputs, do not short CMOS outputs to any power supply.

3. Repair boards properly

   Circuit boards being repaired must be handled with special care. The precautions outlined in handling specifications in section II or this I.L. should be followed. These precautions outline the special handling required to guarantee the proper operation of the device being replaced as well as the proper operation of the unterminated devices on the board during the repair. Repair facilities should be grounded.

4. Use protective bags to store boards

   Special design techniques have been applied to these circuit boards which provide the CMOS devices with a relatively high immunity to damage due to static electric charge. However, to insure that there will be no damage even in the most extreme circumstances, it is recommended that during all times a circuit board is not inserted in a logic cage it should be placed in an electrically conductive bag such as 1835A76H02 or 1835A76H03. In no cases should boards be assembled, fixtured, stored, transported, package or shipped in polystyrene material or any other high dielectric materials. Storage in high humidity areas should be avoided.

II. SPECIAL HANDLING

Proper handling of MOS-type integrated circuits including CMOS is important during the entire lifetime of these devices and therefore these specifications apply during all phases of handling including packaging, receiving inspection and test, screening, conditioning, storage, assembly and manufacture of p-c boards, p-c test, in-plant board handling, sub-assembly test, system test, shipping, field handling, field test, customer handling and maintenance. In addition the designer of MOS-type circuitry should be aware of these specifications in order to provide circuit protection whenever practical using such techniques as pull-up or pull-down resistors and grounding of isolated inputs.

1. The leads of MOS devices should be in contact with conductive material to avoid build-up of static charge. Containers used for transporting or storing MOS devices should be made of conductive material or coated with anti-static material. In no case should MOS devices be inserted into polystyrene foam or other high dielectric materials.

2. MOS devices and/or circuit boards containing MOS devices should not be inserted into or removed from Test Circuits and/or Burn-In Circuits with power on because transient voltages may cause permanent damage.

3. Signals should not be applied to the inputs of MOS devices while power supplies are in the off condition or disconnected.

4. All unused inputs must be connected to either the power supply ($V_{DD}$) or ground ($V_{SS}$).

5. All electrical equipment should be hard-wired to ground. Soldering iron tips, metal parts of fixtures and tools, and handling systems should be grounded.

6. In the case of any mechanical operation or equipment which is capable of generating static electrical charges and cannot be hard wired to the electrical ground system, an ionized air blower should be used to neutralize any static charge generated.

7. Manufacturing operating personnel should wear anti-static smocks and gloves. When handling individual MOS devices personnel should be grounded using conductive wrist straps. In no case should an operator be attached to a hard ground. There should always be at least a 1 megohms series resistor between the operator and ground.

8. All work stations should have conductive material work surfaces and conductive material floor mats connected to a common ground system. Chairs and stools should be made of metal or covered with anti-static material to prevent static charge generation.

9. Subassembled modules and printed circuit boards should be manufactured and handled using the same procedures as described above for individual MOS devices.

10. Circuit boards containing MOS devices which are being transported between work stations and assembly and test areas should be contained within anti-static material or have all board terminals shorted together using a conductive shorting bar. These precautions should be taken until the subassembly is inserted into the complete system in which the proper voltages are applied.

11. In no cases should subassemblies be constructed, fixtured, stored, or transported in polystyrene material or any other high dielectric materials.

12. Subassembled modules and printed circuit boards can be excluded from the above restrictions if the design of the subassembly has provided for the adequate termination of all isolated MOS inputs. A resistive pull-up or pull-down will prevent the buildup of a static charge.