X-723-65-406

NASA TM X-55338

HANDLING, CLEANING, DECONTAMINATION AND ENCAPSULATION OF MOSFETS CIRCUITRY

BY

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OCTOBER 1965

NASA

GODDARD SPACE FLIGHT CENTER

GREENBELT, MARYLAND

HANDLING, CLEANING, DECONTAMINATION AND ENCAPSULATION OF MOSFETS CIRCUITRY

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EFFECTIVE DATE: 10/19/65

FOREWORD

The problems and definition of electrostatic charges have been aptly stated by Mr. Harry W. L. Street, System Review Office and are hereby reproduced.

In the Metal-Oxide Field Effect Transistor, the gate electrode is insulated from the silicon wafer by an extremely thin layer of silicon oxide. This insulating film can be damaged by the application of potential differences of less than 100v. Since the insulation resistance is very high and the gate capacitance very small (< 10 pf), only a very small amount of charge is necessary to damage the insulation. Such a charge can very easily be transferred from a surface or object which has been electrostatically charged by friction due to people moving around in normal activity. It is essential, therefore, to avoid conditions which give rise to static charges when handling MOSFETS and equipment containing them.

When the surfaces of two dissimilar materials are brought together, a transfer of charge (electrons) takes place at "points" of intimate contact. If the surfaces are rubbed together, this increases the number of "points" (actually small areas) of intimate contact, and thus increases the total charge transfer. When the surfaces are separated, a potential difference appears between them, which increases as the surfaces are separated. If one (or both) of the materials is a good insulator, the charges remain frozen on that surface for a considerable length of time. If another object which is at a different potential (such as one of the leads of a transistor) approaches that surface, a spark may occur, transferring some charge to the second object. If a conducting object is insulated from ground and other neighboring objects, and rubbed on an insulating material, the charge transferred to the metal object will be distributed over the entire object after separation, since the charge on a conductor is free to move about. If this conducting object is brought up to an object at ground potential (or at a different potential) the entire stored charge will discharge in the resultant spark, resulting in the release of considerable energy. An example of this is a person walking across a carpeted floor, and drawing a spark from the door knob. When two conductors are rubbed together, charges cannot remain "frozen" in position on either surface, and it is not possible to separate the surfaces rapidly enough to prevent neutralization of all charges by a current flowing through the last point of contact.

1. Scope

1.1 Purpose of Document. — The prime purpose of this document is to outline the procedure that is to be used by Mechanical Systems Branch personnel in the cleaning, decontamination and encapsulation of electronic circuits containing MOSFETS.

1.2 Purpose of Procedure. — The purpose of this procedure is to obtain decontaminated and encapsulated electronic circuits containing MOSFETS that are reliable and undamaged by effects of electrostatically charged surfaces they may have come in contact with.

1.3 Definitions. Definitions as apply to this procedure are as follows:

1.3.1 MOSFETS. Refers to the Metal-Oxide Silicon Field Effects Transistors. Also, refers to Insulated Gate Field Effects Transistors.

1.3.2 Anti-static. Treatment applied to surfaces of insulating materials to obtain conductive qualities.

1.3.3 Alcohol. Isopropal (C_3H_7OH).

1.3.4 Electrostatic Volt Meter. An instrument capable of detecting and measuring electrostatic charges generated on surfaces of materials.

1.3.5 Silastic gasket. Dow Corning Silastic No. 50 or equivalent.

1.3.6 "Clean Test". Treatment for Synthetic garments.

2. Documentation. The following Section records are to be kept current by the lead technician on any project pertinent.

2.1 Assembly and Quality Control Record, Structural and Mechanical Applications Section, Mechanical Systems Branch.

2.1.1 Photographic log accompanying Assembly and Quality Control Record book.

2.1.2 Conformal coating and Encapsulation Record.

3. Pre-Encapsulation Inspection and Certification.

3.1 All electronic printed circuits and/or welded modules are to be inspected according to the dictates of Head Spacecraft Integration Branch and Cognizant Project Manager.

3.1.1 Any electronic circuit and/or electrical connector that is to be cleaned, decontaminated, conformal coated and/or encapsulated by Mechanical Systems Branch personnel must be accompanied by an electronic inspection certificate signed off by an individual authorized by the Head, Systems Integration Branch. It is to be understood that any waiver to the preceeding must come from the cognizant project management office.

3.2 Spacecraft Integration and Sounding Rocket Division Procedures Q-II and Q-III apply.

4. Handling Requirements for Delivery.

4.1 Prior to delivery to the Structural and Mechanical Application Sections, clean room for encapsulation modules containing MOSFETS are to —

4.1.1 Be in the metal containers that were furnished by the Mechanical Systems Branch for this purpose.

4.1.2 Affixed in a manner that does not allow any movement of the module within the metal container.

4.1.3 Have teflon sleeves removed from leads.

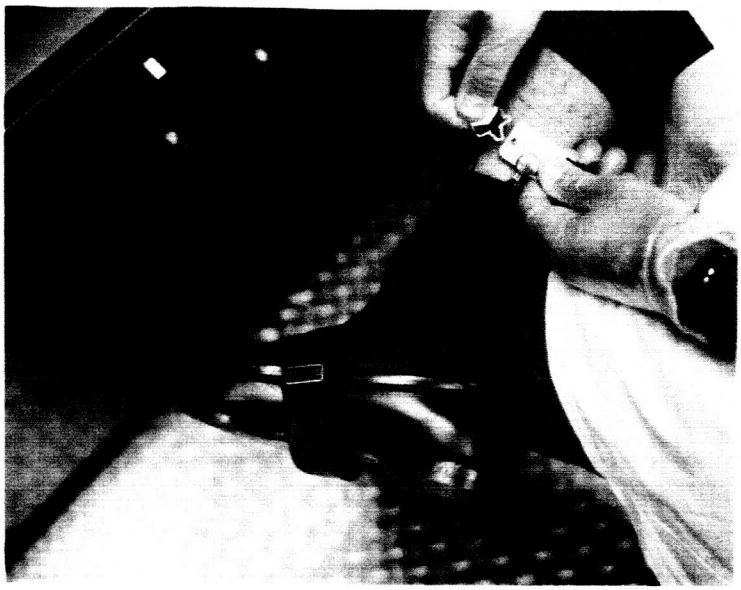
4.1.4 Have leads separated by drilled fiberglass board.

4.1.5 Have passed electrical inspection.

5. Clean Room and Personnel Preparations.

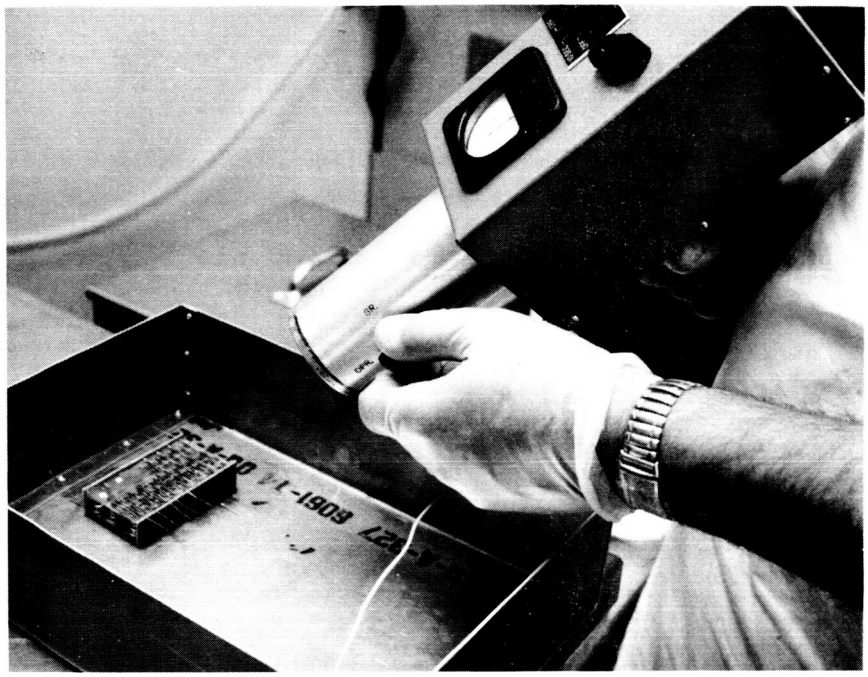
5.1 Prior to removing module from metal container one must—

5.2 Affix leg stats.



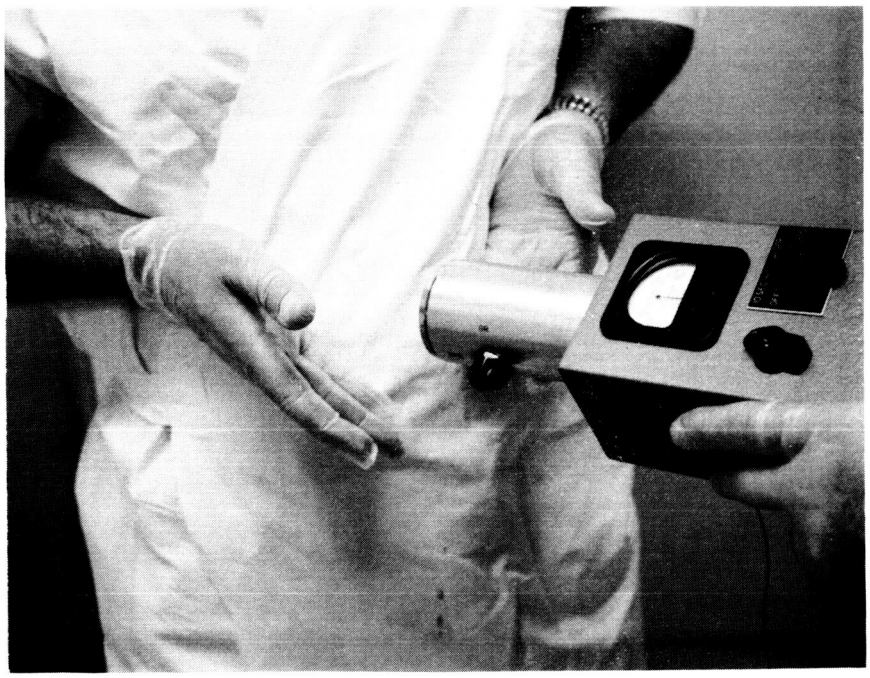
5.3 Attach grounding wire from electrostatic volt meter to the ground plate, floor of clean room.

5.4 Make reading of static charge, if any, on the module.



5.4.1 Take reading no more than 12 inches from module.

5.5 Make a static charge reading on clothes including gloves.

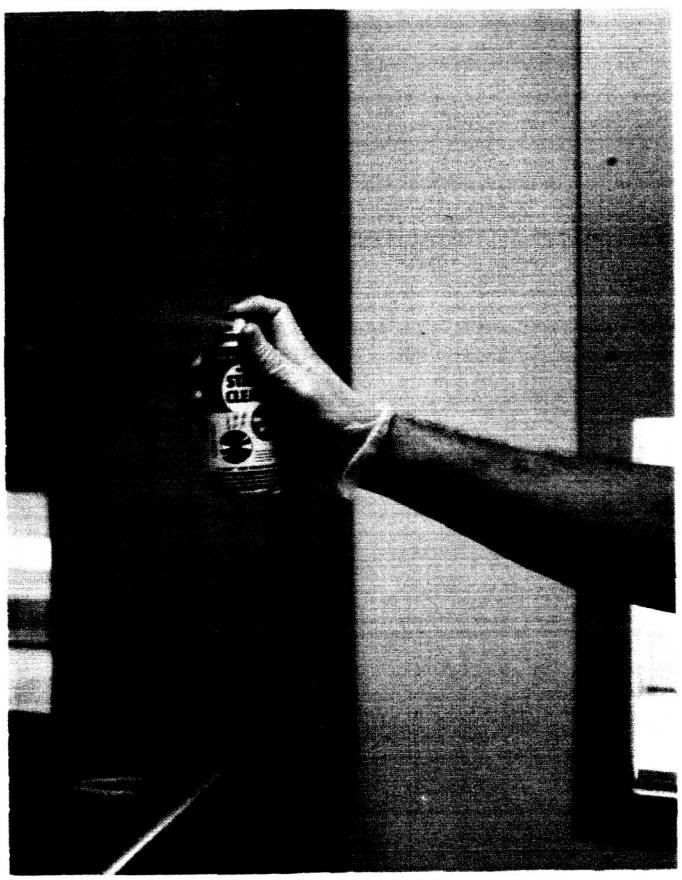


5.6 Make a static charge reading on all glass and/or plastic surfaces in the encapsulation area of the clean room.

NOTE: a. Do not remove module from its container until all static charges have been eliminated from surfaces.

b. If clean room clothing show static charge either spray with "clean test" or replace with clean room garments not having a static charge.

c. If static charges are on glass or plastic surfaces spray same with an anti-static spray.



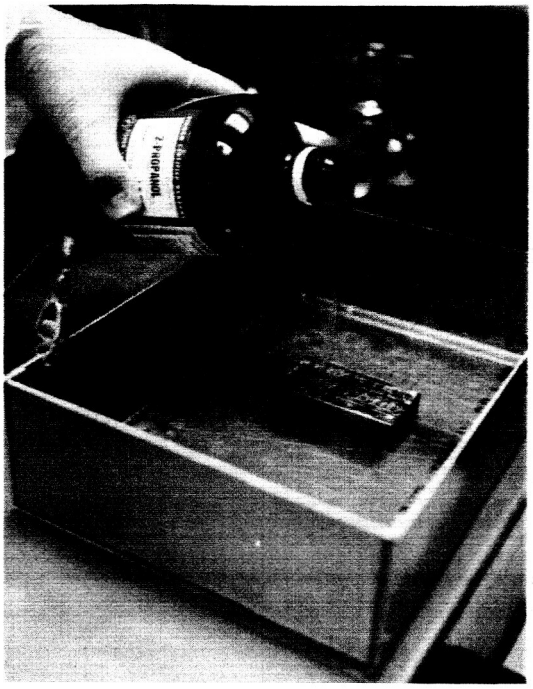
6. Preencapsulation Procedure

6.1 Attach grounded wire to metal container containing module with MOSFETS circuit.

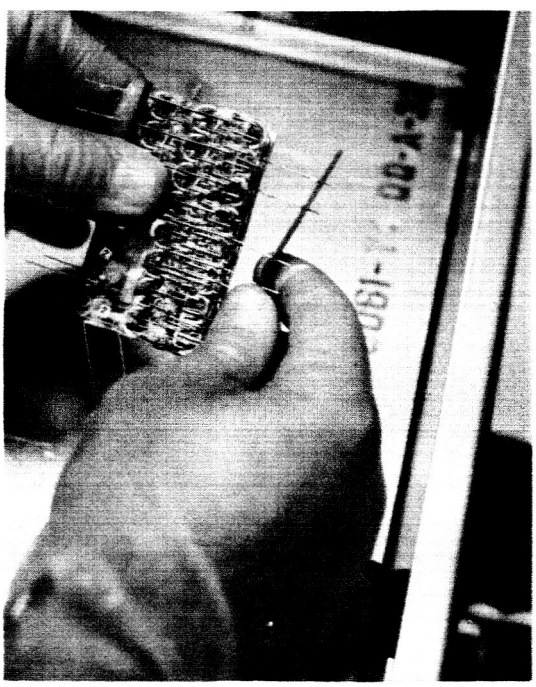
6.2 Place sheet of aluminum foil on balance.

6.2.1 Ground balance to ground plate, (floor of clean room).

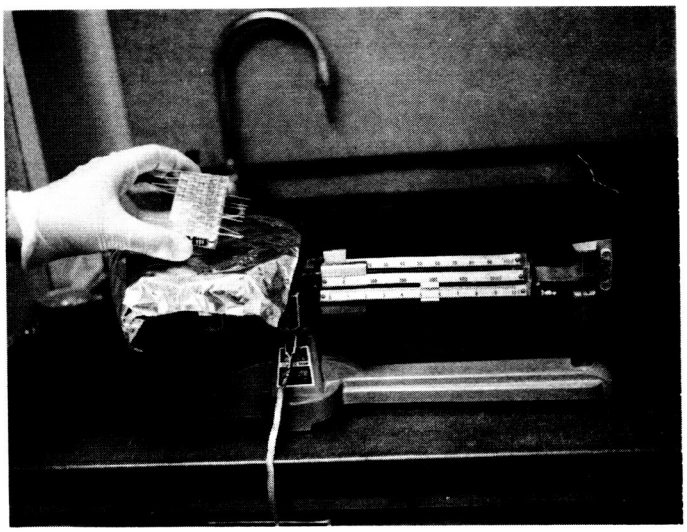
6.3 Thoroughly wet module, the fiberboard lead separator, wire leads and bottom surface of metal container with propanol.



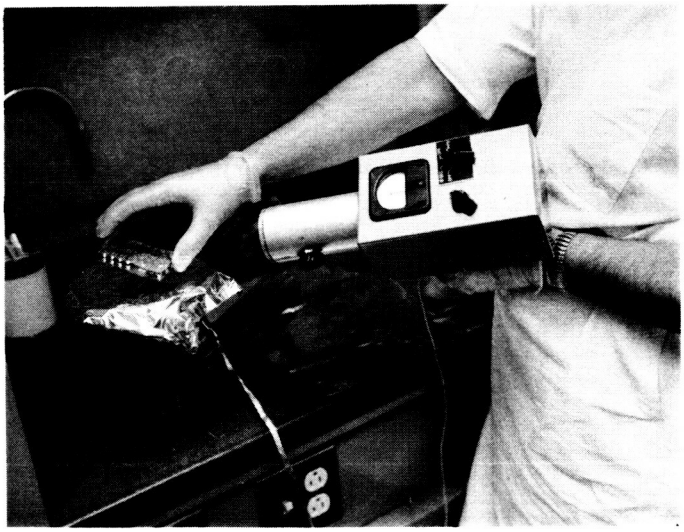
6.3.1 Gently remove module from container and remove fiberglass separator board.



6.3.1.1 Place module on foil sheet previously placed upon balance.



6.3.1.2 Monitor module transfer with the electrostatic volt meter.

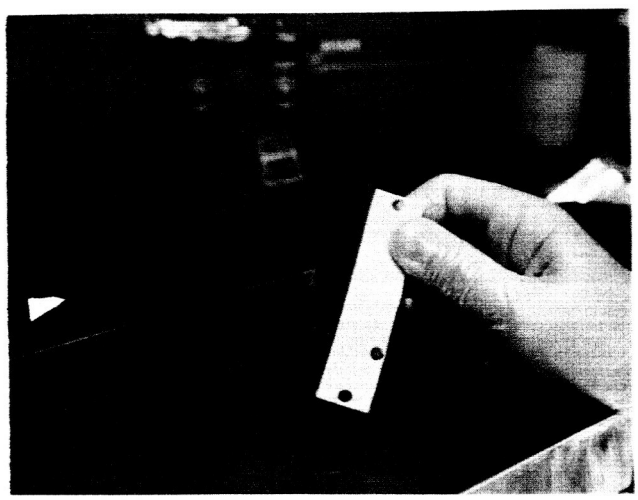


6.3.2 Weigh module deducting weight of foil, and log weight on Encapsulation Record sheet.

6.3.3 Gently remove module from balance and place under hood on grounded metal foil.

7. Prefit and Assemble Mold

7.1 Wet Silastic gasket with propanol.



7.1.1 Fit Silastic gasket onto wire leads, both ends of mold.

7.1.1.2 Monitor any static charge that may have built up during any of the operations.

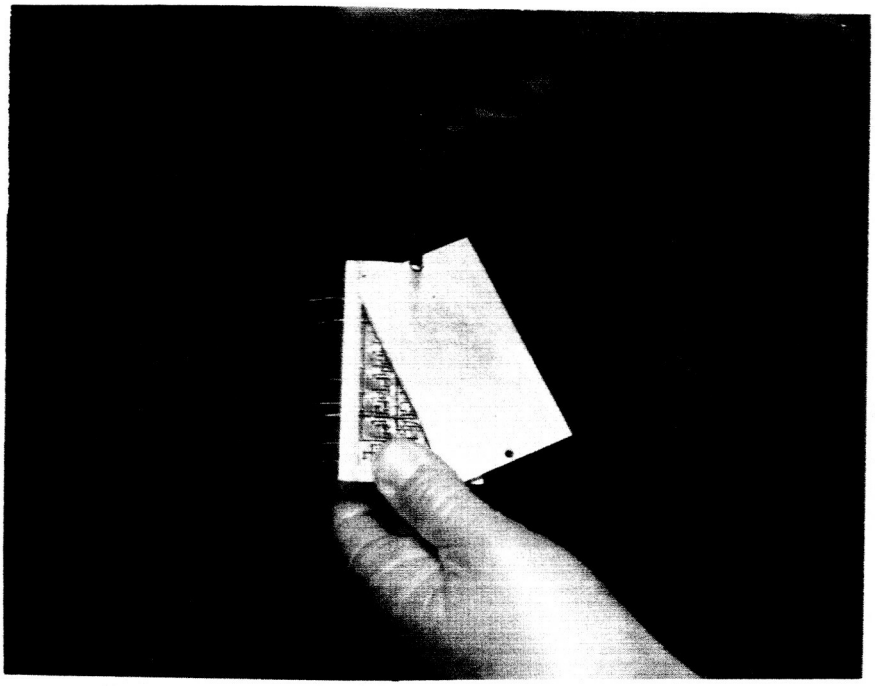
NOTES:

a. Module and gasket fitting must be done only when the entire assembly is wet with propanol.

b. If/or when any static charge has built-up on the surfaces of the module or any surface notify your immediate supervisor before continuing the encapsulation operations.

7.2 Assemble ends of mold over the silastic gasket.

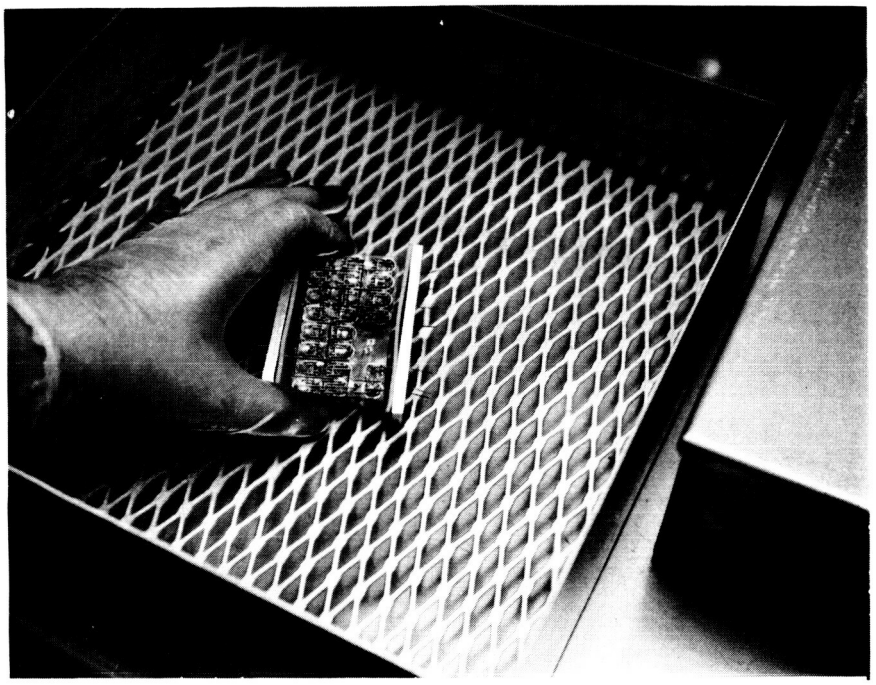
7.2.1 Assemble the sides to remaining portion of mold so as to determine fit.



7.3 Make adjustments to mold if necessary.

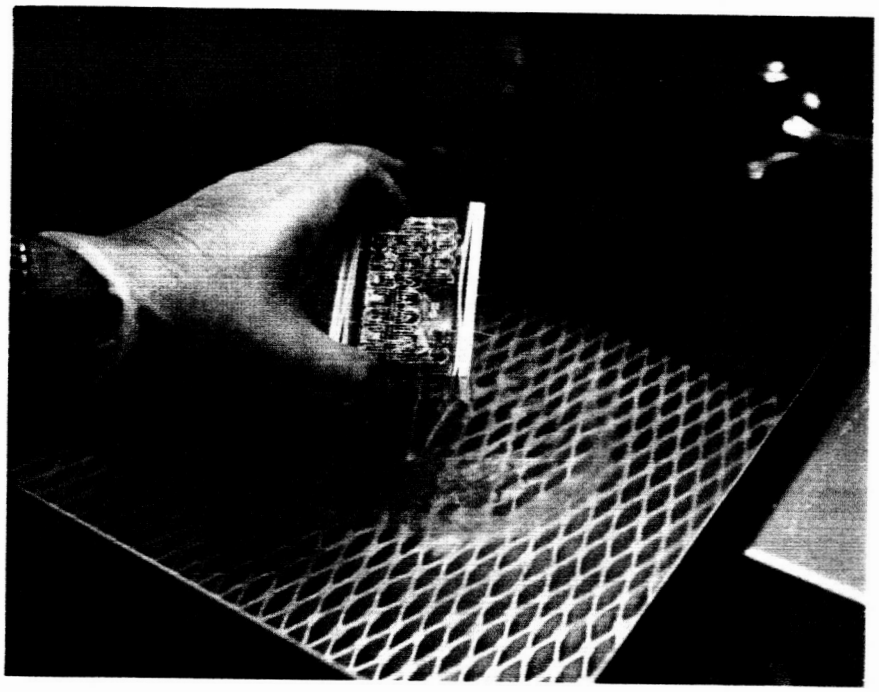
7.4 Remove sides from mold with the ends preassembled, leads protruding.

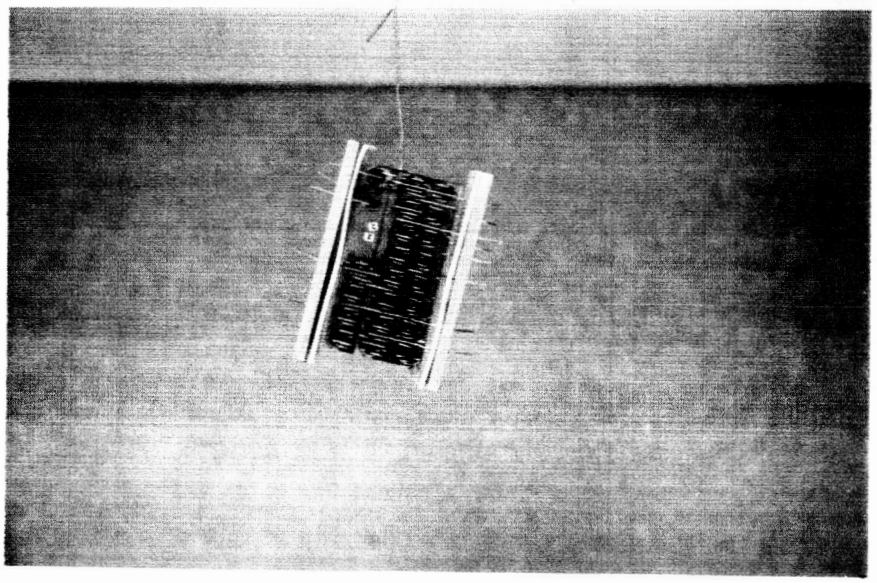
7.5 Immerse entire module with the two gasketed and fitted sides into a bath containing fresh propanol.



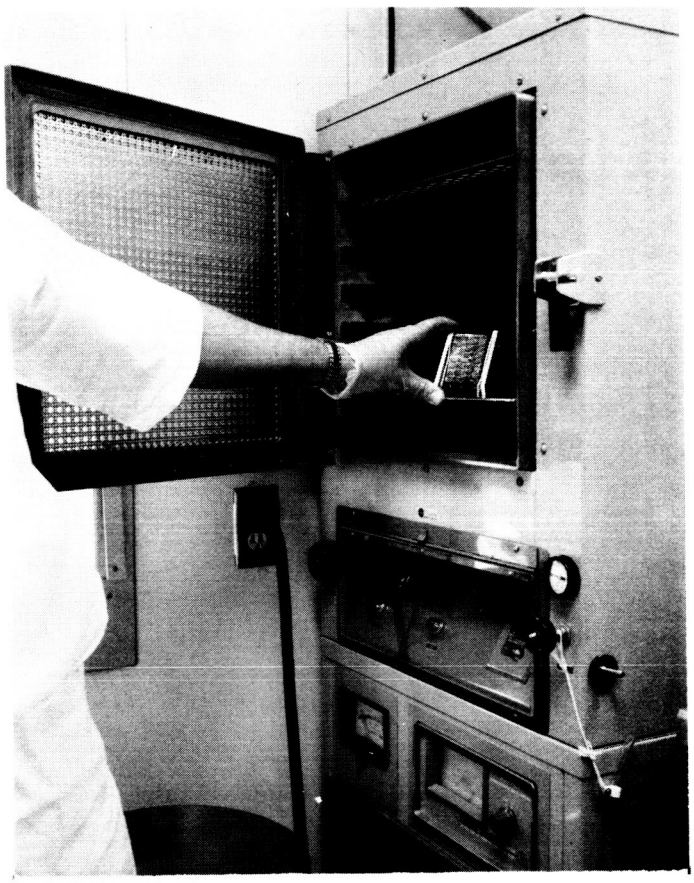
7.5.1 Allow module to remain in bath for a minimum of 10 minutes. Agitate several times before removing from bath.

7.5.2 Remove from bath and hang on hanger under hood and allow to drain for five minutes.





7.5.3 Place module upon foil sheet in the thermo vacuum chamber and raise temperature to 55 + 0° - 5° C.



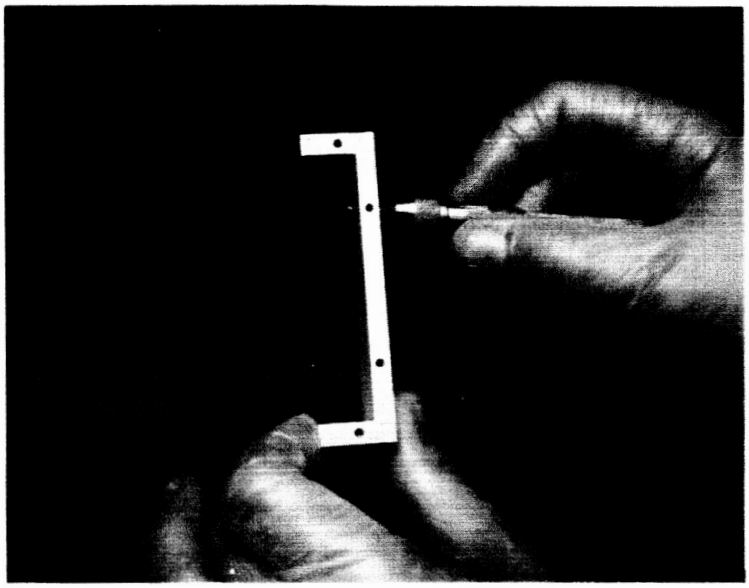
7.5.3.1 Reduce pressure to 2×10^{-2} mm hg.

7.5.3.2 Maintain temperature and pressure for a minimum of one hour.

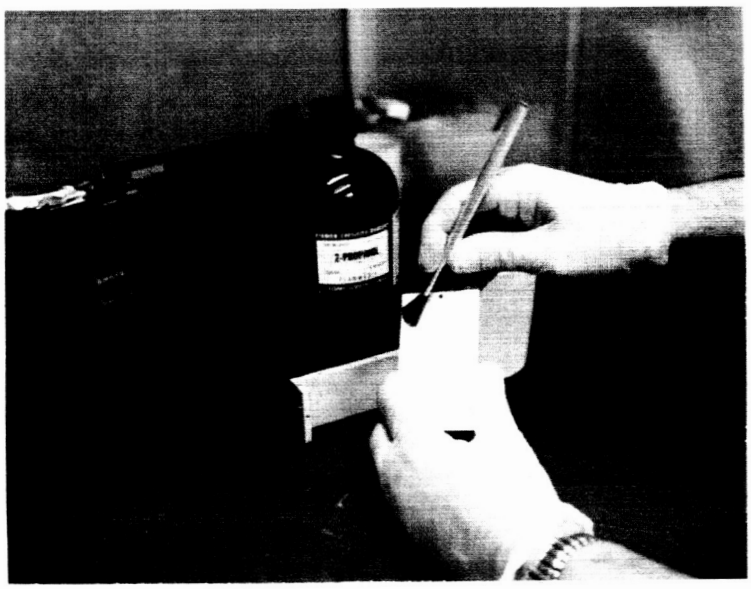
7.5.3.3 Monitor any static charge build up during any and all transfer operations.

8. Prepare mold for encapsulation.

8.1 Remove any potting material from bleed holes in mold left from previous encapsulation.



8.1.1 Brush-clean mold in propanol and allow to dry under hood.



8.1.2 Spray inner portion of mold, mold cover, and base with mold release.

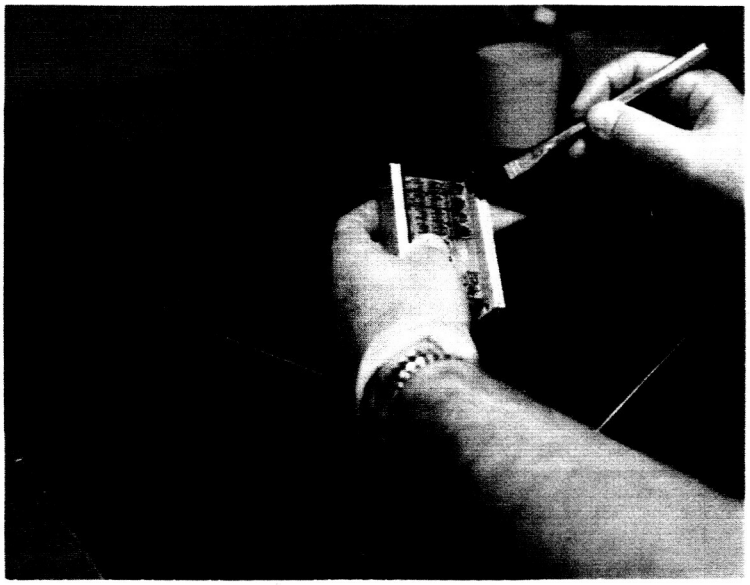
8.1.2.1 Allow to dry under hood.

9. Preparation for Encapsulation

9.1 After module has been an hour in the thermo-vacuum chamber, back fill with dry nitrogen.

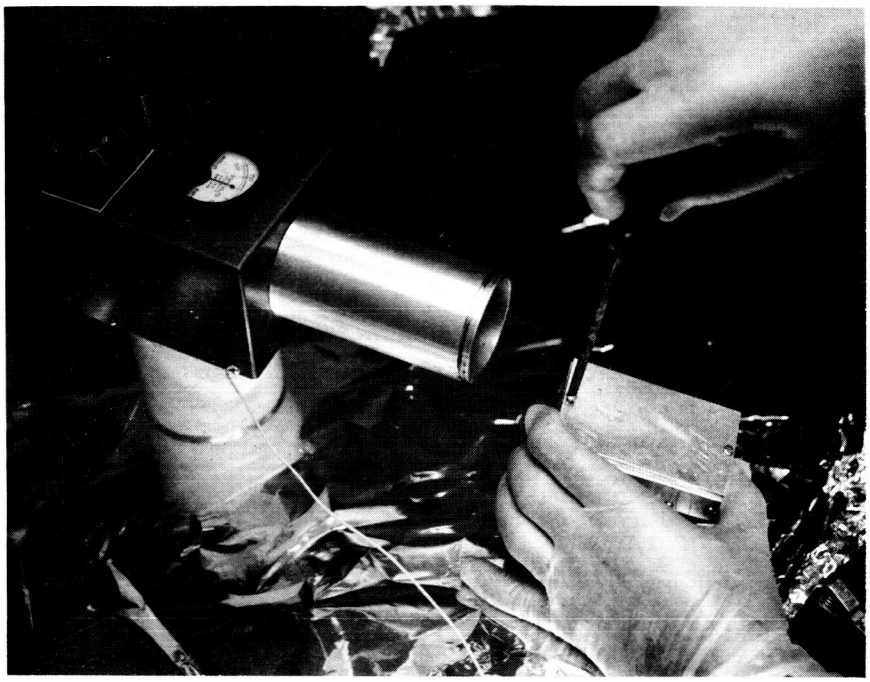
9.1.1 Wet gloved hands with propanol and then remove module from chamber.

9.1.2 Brush exposed portion of Silastic gasket with alcohol.



9.1.3 Fit gasketed module and fitted sides to the remaining portion of mold that was previously sprayed with mold release.

9.1.3.1 Screw all mold parts in place and monitor the operations for possible static charge build-up.



10. Mix the required amount of Eccofoam FPH that will obtain a density of from 6 to 10 pounds per cubic foot for finished module.

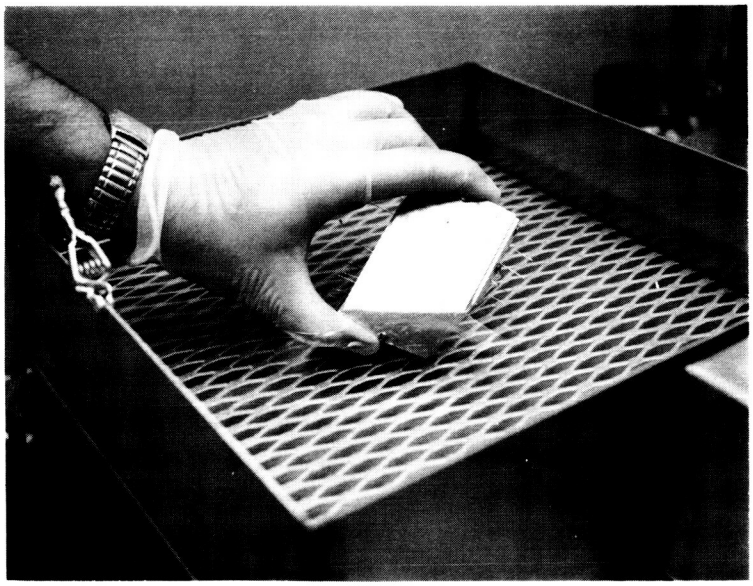
10.1 Inject the Eccofoam mix into the mold through the hole provided for this purpose.

10.2 Place mold in an oven that has been preheated to 50° + 5 - 0° C and allow to remain for a period of one (1) hour cure.

10.3 After the hour cure period remove module from oven and allow to cool to room temperature.

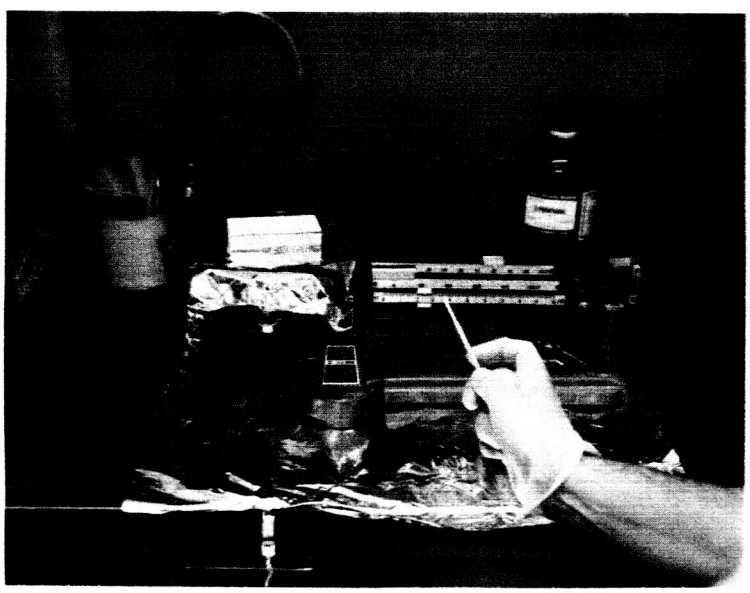
NOTE: a. Place module on grounded aluminum foil under hood during its cool down period.

10.4 Immerse mold with its encapsulated module into a propanol bath.

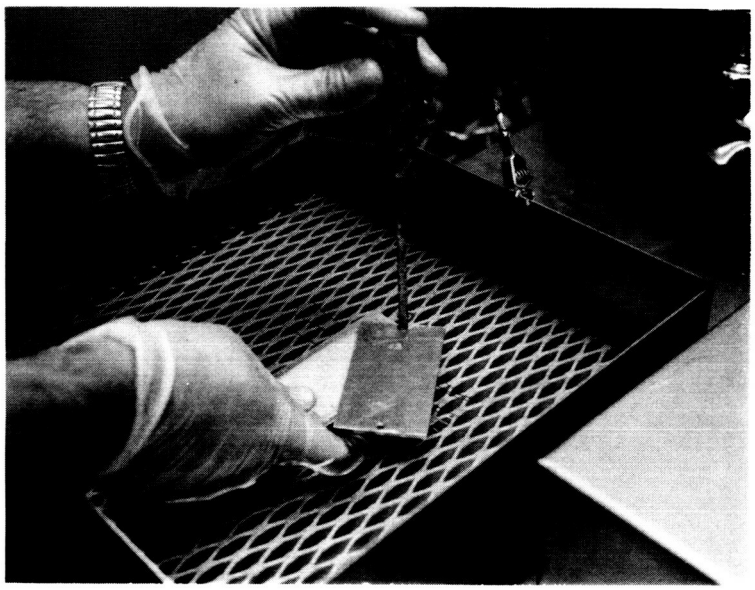


10.4.1.2 Remove excess encapsulant and trim when wetted with propanol.

10.5 Place encapsulated module on the grounded foil sheet upon the balance.



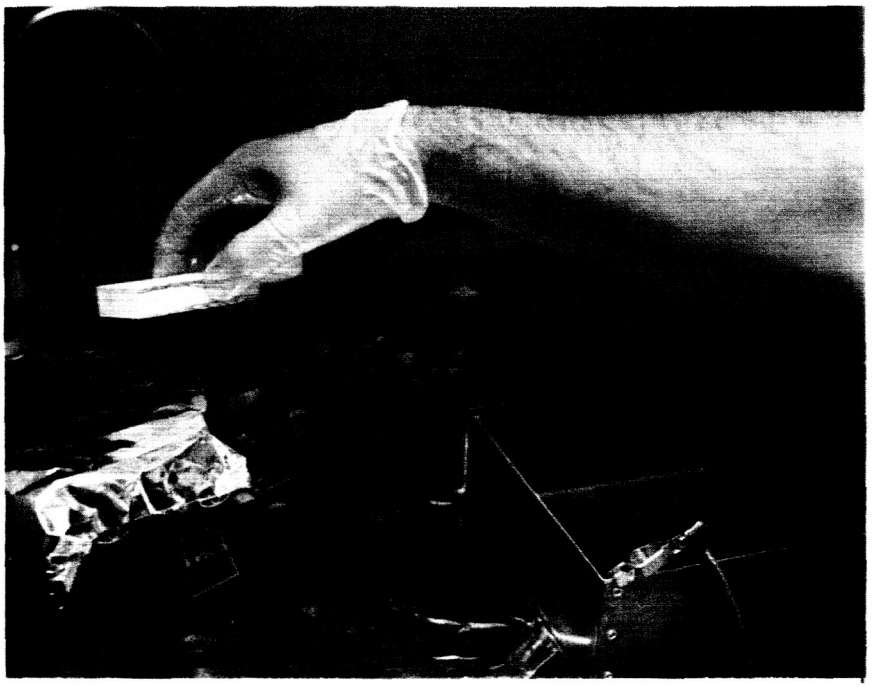
10.4.1 Remove module from mold while entire assemble is immersed in propanol.



10.4.1.1 Remove gaskets from lead wires while immersed in propanol.

10.6 Log weight of encapsulated module in the appropriate record book and also upon the tag that accompanied module.

10.7 Ground metal container that is to contain encapsulated module.



10.8 Remove module from balance with alcohol wet gloved hand.

10.8.1 Place module into its metal container and affix module restraining strap.

NOTES: Documentation as outlined, this procedure item 2 is to be kept current on a daily basis and reviewed weekly by Section Head or his appointee.

Clean room decorum shall prevail at all times personnel are in any of the clean room areas, and in particular:

a. No scuffing of feet. Pick them up and lay them down slowly.

b. All actions are to be slow and rhythmic.

c. Avoid wearing rubber or composition soled shoes.

d. Never slide a module or component on any surface.

e. Always pick up a module or component from a surface, and do it slowly.

f. Keep vinyl gloves wet with Alcohol during transfer and/or any handling of module containing MOSFETS.

g. Only the antistatic clean room clothing are to be worn when working with MOSFETS CIRCUITRY.

h. All operations of transfer and handling of the MOSFETS circuitry are to be monitored for electrostatic build up by one other individual using an electrostatic volt meter.