ACTIVE EXPERIMENT DEVELOPMENT
Design Phase

In order to design a space experiment the following experimenter and NASA supplied items will be involved:

NASA Supplied:
- Documentation
- Internet Data Base

Experimenter Supplied:
- IBM PC compatible computer with Microsoft Windows 3.1x or Windows 95 strongly recommended.
- Internet Access strongly recommended.

An experiment emblem or decal may be designed which symbolizes the experiment concept. Experiments must be designed in accordance with the design constraints outlined in the NASA Documentation.

Experiments may be designed to fit within the SEM Experiment Module by one of two methods.

Method 1 uses NASA provided **"Space Capsules"** to enclose test articles. The Space Capsules are clear, sealable polycarbonate vials 1.0 inch in diameter and 3.0 inches in depth. A total of twenty-two Space Capsules may be packed in an individual Experiment Module using silicone foam cushions fabricated at NASA specifically for the SEM program. Figure XX shows the NASA Space Capsule and how it can be packaged within an Experiment Module.

Method 2 utilizes the Module Cover as an **Experiment Mounting Plate.** The free space available for experiment apparatus in the Module experiment compartment, termed the **"Experiment Envelope"**, is a precisely defined volume delineated on the inboard surface of the Experiment Mounting Plate and extending 3.25 inches below the inboard surface of the Mounting Plate. Figure XX shows an overview of the Experiment Envelope as it fits within the Experiment Module. Figure XX illustrates the perimetric dimensions of the Experiment Envelope as outlined on the Experiment Mounting Plate. Experiments are designed to be mounted to the inboard surface of the Experiment Mounting Plate using integration hardware (screws, nuts, and washers) supplied to the experimenter by NASA.

Mechanical Specifications:

METHOD 1

1. Test Articles small enough to fit through the neck of the Space Capsule and inside of the Capsule:

Capsule neck size: 0.5 inch diameter
Capsule inside depth: 3.0 inches

2. Experiment Emblem: 8.0 inches by 2.9 inches

METHOD 2

1. Experiment Envelope:

Mounting plate surface: Approximately 85 square inches (550 square cm)(see drawing)

Depth of Experiment compartment below mounting plate: 3.25 inches (8.2 cm)

2. Maximum weight of experimenter hardware: 6 lb. (2.7 Kg.)

3. Experiment Integration: Experiment to be attached to supplied Integration Hardware as specified in the Integration Hardware is defined as follows:

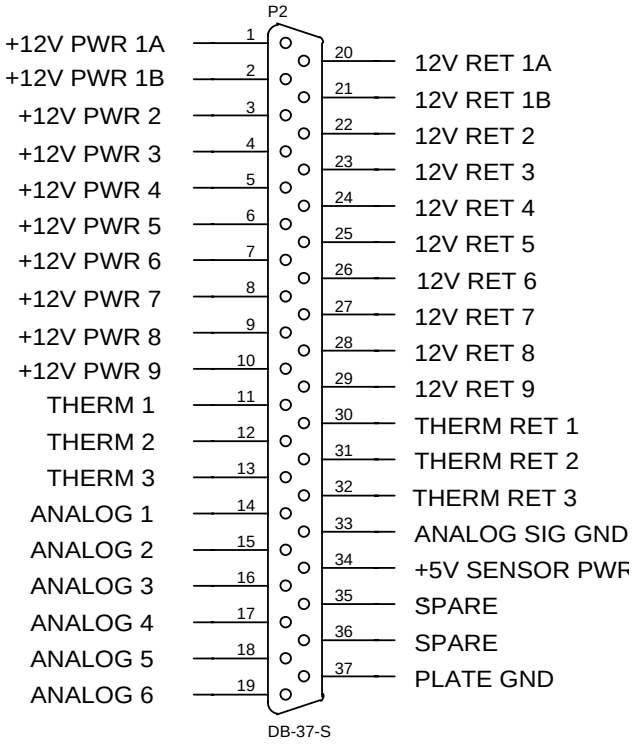
Nuts, Self-locking, #6-32 per MS21043-06
Washers, sealing, #6 per NAS1523C-06B
Screws, panhead, #6-32, .375 long per MS51957-28
Screws, panhead, #6-32, .438 long per MS51957-29
Screws, panhead, #6-32, .500 long per MS51957-30
Screws, panhead, #6-32, .625 long per MS51957-31
Screws, panhead, #6-32, .750 long per MS51957-32

Experiment Mounting Plate using NASA Experiment Integration Instructions. The

4. Experiment Emblem: 8.0 inches by 2.9 inches

Electrical Specifications:

Connector:



The module will have a D type 37 pin connector socket (D37S) on the side of the experiment compartment. The experimenter will provide a 37 pin plug connector (D37P) and the necessary wires to connect any desired components to the provided electrical services. The wire length must be sufficient to allow the connector to be attached prior to attachment of the mounting plate to the module. The connector pin assignments are as follows:

Pin Design Function

Pin #	***Signal Name***	***Signal Discription***	***Limits***
1	+12V PWR 1A (Port 1)	12V Power Output	2.5A maximum
2	+12V PWR 1B (Port1)	12V Power Output	2.5A maximum
3	+12V PWR 2 (Port 2)	12V Power Output	1A maximum
4	+12V PWR 3 (Port 2)	12V Power Output	1A maximum
5	+12V PWR 4 (Port 2)	12V Power Output	1A maximum
6	+12V PWR 5 (Port 2)	12V Power Output	1A maximum
7	+12V PWR 6 (Port 2)	12V Power Output	1A maximum
8	+12V PWR 7 (Port 2)	12V Power Output	1A maximum
9	+12V PWR 8 (Port 2)	12V Power Output	1A maximum
10	+12V PWR 9 (Port 2)	12V Power Output	1A maximum
11	THERM 1	External Thermistor 1	0 to +5 VDC
12	THERM 2	External Thermistor 2	0 to +5 VDC
13	THERM 3	External Thermistor 3	0 to +5 VDC
14	ANALOG 1	External Analog 1	0 to +5 VDC
15	ANALOG 2	External Analog 2	0 to +5 VDC
16	ANALOG 3	External Analog 3	0 to +5 VDC

17	ANALOG 4	External Analog 4	0 to +5 VDC
18	ANALOG 5	External Analog 5	0 to +5 VDC
19	ANALOG 6	External Analog 6	0 to +5 VDC
20	12 RET 1A (Port 1)	Port 1 Power Return	Must be used with +12V PWR 1A
21	12 RET 1A (Port 1)	Port 1 Power Return	Must be used with +12V PWR 1B
22	12 RET 2 (Port 2)	Port 2 Power Return	Must be used with +12V PWR 2
23	12 RET 3 (Port 3)	Port 3 Power Return	Must be used with +12V PWR 3
24	12 RET 4 (Port 4)	Port 4 Power Return	Must be used with +12V PWR 4
25	12 RET 5 (Port 5)	Port 5 Power Return	Must be used with +12V PWR 5
26	12 RET 6 (Port 6)	Port 6 Power Return	Must be used with +12V PWR 6
27	12 RET 7 (Port 7)	Port 7 Power Return	Must be used with +12V PWR 7
28	12 RET 8 (Port 8)	Port 8 Power Return	Must be used with +12V PWR 8
29	12 RET 9 (Port 9)	Port 9 Power Return	Must be used with +12V PWR 9
30	THERM RET 1	Thermistor 1 Return	Must be used with THERM 1
31	THERM RET 2	Thermistor 2 Return	Must be used with THERM 2
32	THERM RET 3	Thermistor 3 Return	Must be used with THERM 3
33	ANALOG SIG GND	Analog Singal Ground	Must be used with ANALOG 1 to 6
34	+5V SENSOR PWR	+5V Sensor Power	10 mA maximum
35	SPARE	SPARE	-
36	SPARE	SPARE	-
37	PLATE GND	Plate or Chassis Ground	Single Point Ground

(1) If more than 2.5 Amps (peak) will be needed, use two power wires and two return wires on Power Port 1. Power return must not be connected to module case in the experiment.

Signal ground (SIGGND) should not be connected to case or power return.

SEM signal connections and connector pin numbers:

SEM power and grounding connections and pin numbers.

Outputs to Experiment:

- One, timeline controlled 12 Volt (10V to 12.6 V depending on battery charge and temperature) output, 5 amps peak maximum, (P1)

- Eight, individually timeline controlled 12 Volt outputs, 1 Amp peak maximum (P2 - P9)

Total simultaneous current from all the outputs P1 through P9 together must not exceed 5 Amps.

Experimenter components to be connected to the programmed power outputs typically include heaters, electric valves for fluid control, fans, pumps for fluid circulation, motors, or camera actuators. All connections to the P1 - P9 or PWRRET pins to be made by means of size #20 stranded copper wire, Teflon insulated.

Sensor power, regulated 5.0 volts, 10 milliampere maximum. The sensor power is turned on only when the processor is making a measurement and can be used to power an experiment sensor which works on a voltage divider (potentiometer) principle such as a pressure gauge or linear position sensor.

The energy drawn from the all of the five experimenter power lines together cannot exceed 60 Watt Hours during the flight. This corresponds to a current-time product of 5 ampere hours at the nominal 12 V battery voltage.

Inputs from experiment:

As instructed by the timeline, the module processor will sample the voltage on any or all of the six input data lines, convert the voltage into a digital number, and store the number in a memory. The memory can hold at least 16,000 measurements. The digital number will be ten bits in length which means that there are only 1024 possible numbers and that the corresponding voltage between 0 and 5.12 volts can only be determined to a precision of approximately one part in 1024 or about 0.1 percent. Actual accuracy will be somewhat lower. Experiment information to be stored must be converted into a voltage between zero and +5.12 volts by components in the experiment and connected to one of the six data input lines designated I7 - I12. These inputs each have an input resistance of not less than 1 megohm.

Three additional inputs, designated I1 - I3 are special and are designed to be connected to a NASA supplied temperature sensor. The sensor is a small bead (0.1 inches (2.5 mm) in diameter) which can be glued to the component whose temperature is to be measured and wired to one of the temperature inputs. This sensor is designed to measure temperatures in the range of -40 degrees C to + 80 degrees C. The sensor will continue to work between -50 degrees C and +110 degrees C but with reduced accuracy. The sensor has two wires. One must be connected to a temperature input and the other connected to SIGGND. The temperature sensor, known as a thermistor, has an electrical resistance which varies with temperature. The special inputs I1 - I3 are the same as the I7 - I12 inputs except for a resistor (10K ohms) connected to 5.00 volts.

Three of the processor inputs, I4, I5, and I6 are pre-wired in the MEU to measure module processor temperature, battery voltage, 5.00 V supply voltage.

Electrical grounds and returns

Current flowing from the +12 V power lines must be returned to the battery on the wires designated power return (PWRRET).

The wire designated signal ground (SIGGND) is the reference point for measurement of voltage for the input signals. One side of all temperature sensors and other sensors should be connected to SIGGND. SIGGND should have no connection to any power line or power return line.

The experimenter should provide a wire connecting the plate ground pin on the connector (PLTGND) to the mounting plate.

Environmental Limitations: See Experiment Environment Section

Safety Limitations: See Safety Considerations section

Access to Internet Data Base strongly recommended

Hardware Phase:

Participants selected for the **hardware phase** will receive a package of hardware from NASA to support the construction and development of the experiment created in the SEM Design Phase. The contents of the package depends on the proposed experiment design.

Experimenters with designs using the NASA Experiment Mounting Plate to mount experiment components receive a package including the Experiment Mounting Plate, Integration Hardware (screws, nuts and washers) as specified in the selected design, an Emblem Mount, and Integration Instructions**.**

> It is the experimenters responsibility to drill into the Experiment Mounting Plate and attach the experiment using the NASA provided integration hardware and Integration Instructions.

Experimenters with designs using the NASA Space Capsules receive a package including the number of Space Capsules specified in the selected design, an Emblem Mount, and Instructions. Experimenters proposing to use the Space Capsules packaged in the NASA foam cushions will receive 22 Capsules in their package.

> It is the experimenters responsibility to insert their test articles into the Space Capsules and tighten the Capsule lids.

All experimenters have the option to fabricate an experiment decal and attach it to the NASA provided Emblem Mount.

> If an emblem is desired, it is the experimenters responsibility to design and manufacture their experiment emblem, attach the emblem to the NASA provided Emblem Mount, and send the Emblem Mount back to NASA for integration into the SEM Experiment Module.

Experimenters with designs requiring power, command, or data recording receive a package including the SEM Ground Module Electronics Unit (GMEU). The GMEU is an electronic replica of the SEM Module Electronics Unit (MEU). The GMEU requires the use of an experimenter supplied IBM type computer and 12 volt power supply. The GMEU is a small box which connects to a serial port (e.g. COM1) on the experimenters computer with a NASA supplied cable. The GMEU also connects to the experiment hardware and power supply using experimenter supplied cables.

> It is the experimenters responsibility to include (as part of the experiment) the electrical wiring which connects experiment components to the Module MEU.

The experiment hardware is then connected to the GMEU which will simulate the functions of the flight MEU. Trial runs of the experiment can then be conducted according to the chosen timeline. Experiment data from the trial runs is recorded in a Measurement Data File (MDF) on the experimenter's computer and can be printed or plotted using the supplied software. The electronic or paper version of the experimenter's report from the hardware phase is used as part of an application for the flight phase.

Experimenters with designs using the NASA provided thermistors receive a package including the number of thermistors specified in the selected design.

> It is the experimenters responsibility to mount the thermisters to the experiment components and incorporate the thermistor wires into the experiment wiring to the MEU interface.

In order to develop and test a space experiment the following experimenter and NASA supplied items will be involved:

NASA Supplied:

- Space Capsules, if required
- Experiment Mounting Plate, if required
- Integration Hardware, if required
- GMEU and GMEU cable
- GMEU software

- Thermistors, if required
- Documentation
- Internet Data Base
- Emblem mounting plate, if requested

Experimenter Supplied:

- Test Articles for Space Capsules, if used
- Experiment Apparatus, if used with Experiment Mounting Plate
- Power Supply, 12 Volt, up to 5A, Radio Shack No.22-120 for 12 Volt, 2.5 A or less
- Serial port for GMEU
- IBM PC compatible computer with:
    1. Microsoft Windows 3.1 or Windows 95 strongly recommended.
    2. Internet Access srongly recommended.
    3. Printer (recommended)
    4. Serial port for GMEU
    5. Experiment Emblem, if used

Flight Phase:

Experimenters selected for participation in the **flight phase** will submit their experiments and emblem mounts to NASA/SSPP to be installed in modules.

> If an emblem is desired, it is the experimenters responsibility to design and manufacture their experiment emblem, attach the emblem to the NASA provided Emblem Mount, and send the Emblem Mount back to NASA for integration into the SEM Experiment Module.

Experimenters will send their experiments to NASA mounted on the Mounting Plate. Following Shuttle spaceflight of the SEM payload, the experiment hardware and emblem mount will be returned to the experimenter.