Orbital uses a proprietary electronics unit for control of various functions. Stacks have been qualified with module counts ranging from 3 to 10. The basic building block is a module with dimensions of 6.0 inches x 3.0 inches x 1.25 inches. I/O connectors (Right angle 'D' subminiature) come out the top face. Interconnects between modules are accomplished by flex cables on the bottom edge of the boards (Samtec connectors)

This box configuration has fit in most locations on our vehicles. There is a desire to mount units in areas with significantly less head height on future programs. The goal is to fit these units into a space that is 5.0 inches high. Note that the units themselves are just over 3 inches high. However, the mating connector, EMI backshell and cable strain relief will put the required height well over 5 inches.

We would like the NAU team to come up with an alternate packaging approach that fits into areas with a 5" minimum head height. A list of requirements is shown below.

1. Board outline and connector locations should be as shown in figure 1. Perimeter changes to PWBs to augment mounting are allowed. Modules have two PWBs – one to provide the module function and another to provide the standard interface protocols. Some freedom will be allowed in re-thinking this approach.
2. The new design must accommodate 6 modules.
3. Maximum height of the finished unit (including mating connectors, backshells and cable strain relief) shall be less than 5 inches.

In addition to meeting the above hard requirements the following parameters should be optimized.

1. Unit footprint should be optimized. If the unit's volume stays the same (it won't), a decrease in height must be accompanied by an increase in footprint. We can judge the efficiency of the new design by comparing the new footprint to the reduction in height.
2. I/O connector locations. Placement of I/O connectors is a critical parameter. It is desirable to have all I/O connectors on one face of the unit. At most, connectors could be on two faces of the unit.
3. Board and unit resonant frequencies. Low resonant frequencies that have accompanying high deflections will usually fail vibration testing. Board frequencies should be over 500 Hz. Resonant frequencies and deflections in vibration and shock should be calculated. Orbital will work with the team to specify minimum deflections. Overlap of unit and board natural frequencies can cause coupling and inflate transmissibility leading to failures in vibration or shock testing. Board and unit natural frequencies should be separated by an octave at least
4. Safety factors should be calculated for critical parts assuming Mil-STD-1540 minimum qual vibration and a 2000 G shock. Minimum safety factor shall be 1.4
5. Thermal conduction paths should be understood. Temperature rise from a unit power dissipation in the center of the board shall be optimized.

6. Units mass shall be optimized. The goal is to keep the mass similar to the current unit while still meeting all performance parameters.
7. Design for manufacturability. There are many texts and references on designing for manufacturability. Some thought should be put into this topic. Issues to address are as follows:
    a. Reduce hardware (screw, nuts and washers) count and hardware types. Different length screw of the same size counts as a different type.
    b. Top down design – ask me
    c. Reduce number of piece parts.
8. Minimize Cost. Simplify parts to reduce machining costs.

The above criteria should be used as a starting point for the NAU team's design effort. The team should explore different approaches to packaging the PWBs. The key to having a volume efficient, easily manufacturable, robust design is the configuration of the PWBs and the interconnection scheme. Design variations and tradeoffs should be discussed with the Orbital team.

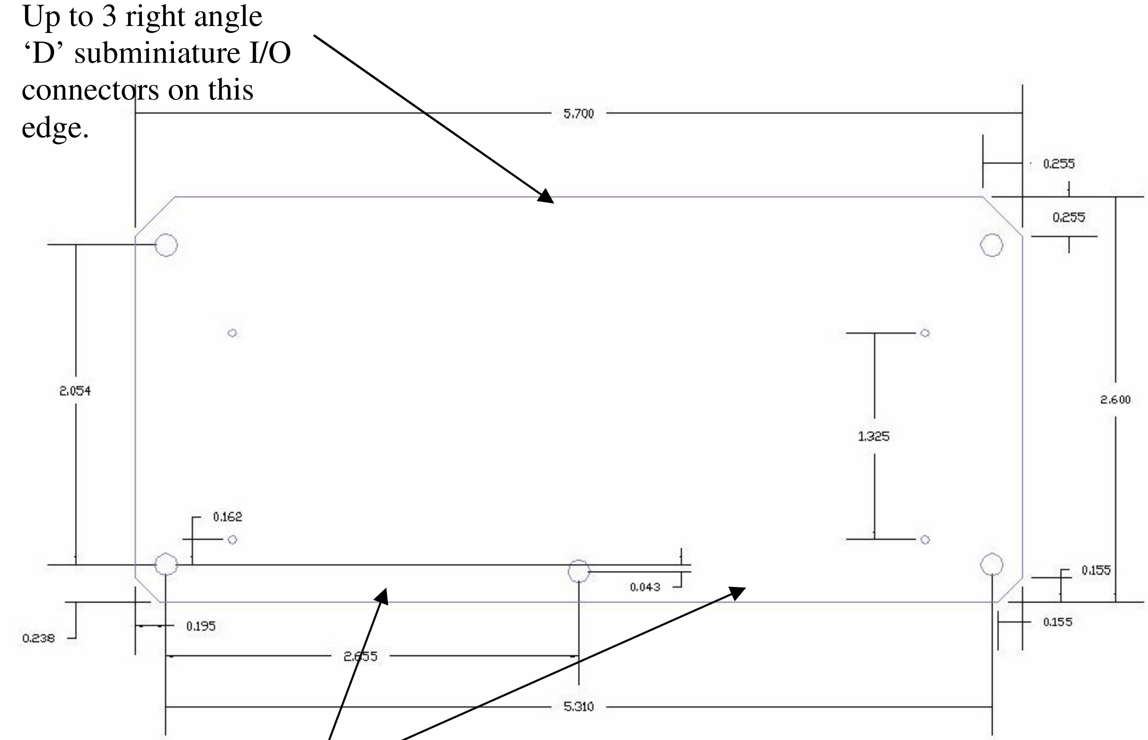

Figure 1

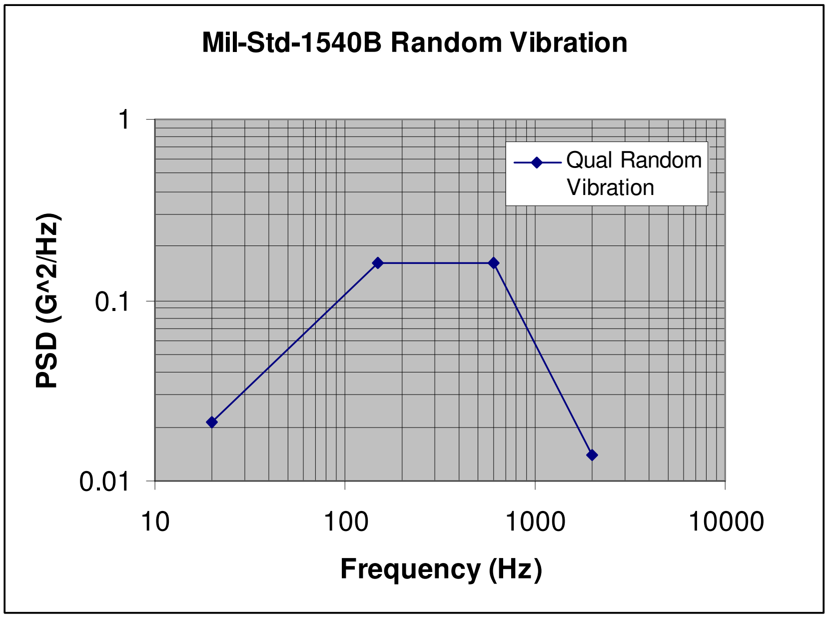

Figure 2

Req'd Qual Levels	
Hz	PSD
20	0.021
150	0.16
600	0.16
2000	0.014
12.2 Grms	
3 min/axis	

Table 1

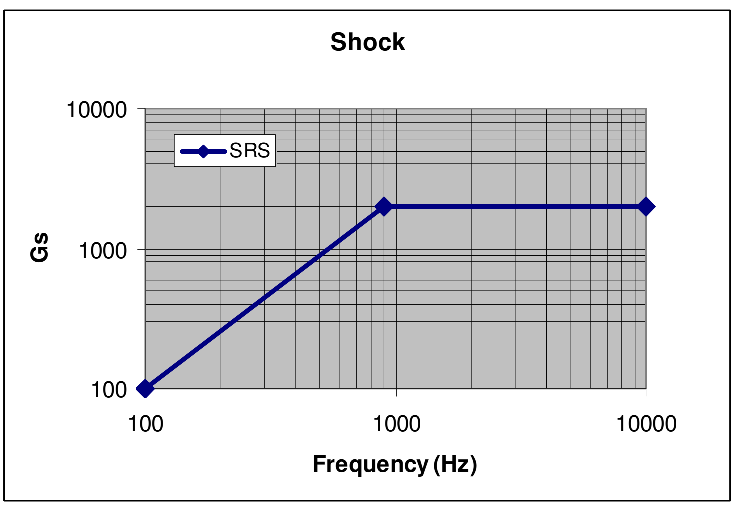

Figure 3

Shock Response Spectrum	
Hz	Gs
100	100
900	2000
10000	2000
3 hits/axis	

Table 2