ORBIT POWER GROUP
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Military Modernization and Power Conditioning

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With the current effort of the military to use up to date modern electronics, there is increasing emphasis on conditioning the input power so that it meets the published requirements of the commercial equipment. Many previously “Full Mil” systems are now being configured with “off the shelf” displays, computers, routers, disk drives and other such commercial products. Virtually all the major defense prime contractors are designing new systems using standard electronics. The system designer then conditions the environment so that it doesn’t exceed the commercial specifications. This conditioning may include things such as shock mounts to reduce shock and vibration, heaters to minimize temperature extremes and conditioning of the input power so that voltage and frequency variations and transients do not go beyond the commercial specifications.

Each branch of the service uses a different specification to define their AC and DC input power requirements. MIL-STD-1399 is used for shipboard power, MIL-STD-704 for aircraft, and the army uses specifications such as MIL-STD-1332, MIL-STD-633, MIL-STD-705 and MIL-STD-1275. Each of these specifications has its own unique requirements, and there are very few commercial items that are tested to and guaranteed to meet these specifications.

So what can a system designer do to use off the shelf electronics with these types of inputs. The answer is to condition the raw power with some type of power supply that can accept the “Mil Spec” inputs and provide a good old fashioned AC output, usually 115VAC 60HZ. The exact type of power supply depends on which input is being provided as well as the actual system operating requirements. For example, on most navy ships, both new and old, the AC power is defined by MIL-STD-1399. The preferred frequency is 60HZ and the voltages available are 115VAC or 440 VAC ungrounded three phase delta. There are 20% voltage variations for up to 20 seconds and power can be lost in emergency conditions for up to 2 minutes. If a system must operate during these emergency conditions, obviously some type of UPS must be used. The other significant requirement of MIL-STD-1399 is that for systems requiring over 1KVA of power, the input harmonic current must contain no single harmonic greater than 3% and a total harmonic distortion of no more than 5%. Most standard PFC input supplies won’t meet this without special tweaking. An ideal unit to meet all navy requirements would be an Uninterruptible Power Source (UPS) with a high quality power factor corrector and good input transient suppression. The supply would also have EMI filtering to meet MIL-STD-461 conducted and radiated emission and susceptibility requirements. Batteries would be required so the system could ride through power interruptions. These are of relatively short duration, (2 minutes), so the size and weight of the batteries usually do not have to be very large. The system designer may add more hold-up time just as a precaution in critical systems. The output would be a clean regulated AC and or DC voltage as required by the commercial electronic load.

For aircraft applications, input power conditioning is required to meet MIL-STD-704 and MIL-STD-461, EMI and transient requirements; however a UPS function with batteries is usually not required because power interruptions are limited to 50 milliseconds in most cases. This can generally be handled using only hold-up capacitors. There are problems with some types of capacitors related to altitude and temperature requirements however these problems can usually be resolved. The other areas of input conditioning that are being required, on new systems, is input harmonic current limiting similar to the navy requirement above but at power levels of 35W or less rather than 1KW. Also the ability to handle a wild frequency input, usually around 300HZ to 800HZ is being required. The aircraft manufacturers are now starting to realize that this is important for airborne systems and greatly improves overall aircraft performance.

Most airborne requirements can be met with a custom frequency converter or inverter that accept whatever AC or DC input is available and produces the required voltage for the commercial equipment.

Requirements for ground based systems can be even more complicated than for the other systems above. The problems arise from the fact that the input power sources are usually much more varied. Also the environments encountered are usually less easily controlled. The army is currently attempting come up with ideas to standardize their future power system requirements. Fuel savings is becoming very important and studies have even shown a relationship between fuel savings and human casualties. Less fuel demand translates to less convoys and less exposure to attack.

The current initiatives are to maximize the use of alternate power such as wind turbines, solar power and fuel cells. The efforts are to have systems able to accept any input, switch between them in an efficient intelligent manner and produce reliable output power necessary for completion of various army missions. In addition to the special efficient sources listed above, the power input might also come from any foreign power grid, when available. These of course may vary anywhere from DC to a variety of frequencies and voltages. Inputs may also be from any number of different standard motor generator sets that the army has in inventory. In this future view, all these varied inputs need to be converted to some yet undefined “Standard Buss” format, (probably DC). This standard power source could then be switched under computer control to the output system load to make the most efficient use of available resources. The actual output would be supplied by a standard inverter which would take the appropriate DC input and provide clean, reliable power to support a particular mission. Typical mission loads may vary from 10KW for a small system to several hundred KW for loads such as a mobile hospital unit. The great variety of input and output combinations amplify the complexity of these ground based systems. Current programs are underway, just to define an appropriate system architecture. Modern power supplies and inverters are available to perform specific submissions but no currently available overall solution to meet this need.