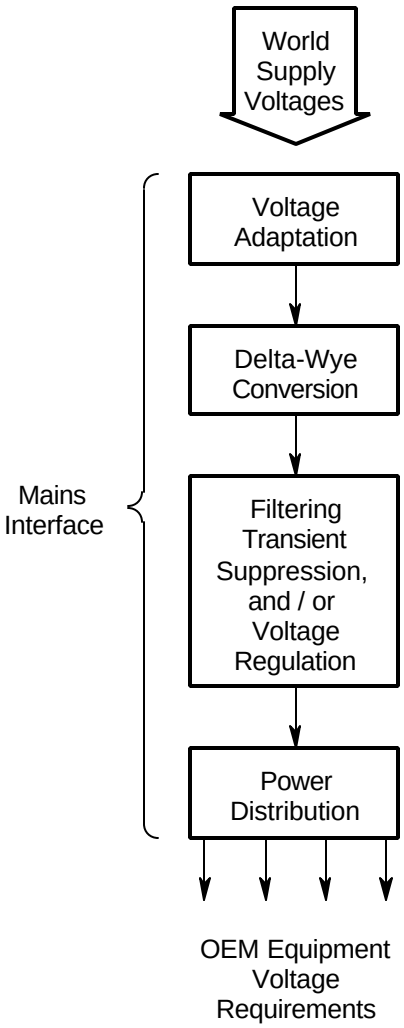
Mains Interfaces for World Voltages Application Note - AN-6

Original Equipment Manufacturers (OEMs) face a difficult task with regard to Mains Interfaces. In most cases, a complex system is designed to operate from the electrical system of the country of origin. Exporting this device to other countries may result in problems if the equipment has not been designed to operate from a variety of electrical supplies.

Product benefits in price, features, or performance may be outweighed by the cost of adapting the mains supply found at the customer's location to the equipment requirements.



Frequency Adaptation

There are two AC power frequencies used for commercial and industrial mains supplies across the world: 50 Hz and 60 Hz. The term Hertz (Hz) is a unit of measure for the number of alternating current (AC) cycles per second. A 60 Hz voltage alternates (changes polarity) 60 times each second.

In most cases, equipment can operate from either 50 Hz or 60 Hz, and frequency adaptation is not a requirement of a mains interface. However, all devices in a system must be checked to enure frequency compatability.

Naval and Aviation equipment, as well as some large mainframe computer equipment, also use 400/415 Hz power, however, this is a specialized application, not likely to be encountered within facilities.

Voltage Adaptation

The major difference in electrical systems across the world is the *nominal*, or ideal system voltage. There is a major difference between nominal mains voltages in Europe (where 400Y/230 VAC supplies both industrial and residential loads) and North America (where 480 VAC supplies industrial loads, and 208Y/120 VAC supplies low power and residential loads). Other parts of the world often adopted the mains voltage of the major colonial power that introduced electricity to the country, or major trading partners.

Power Quality Issues

Power quality varies considerably across the world. In Europe, where there are strict mains regulations and the infrastructure was completely rebuilt following World War II, power quality is quite good. North America, with an older electrical system, lower levels of regulation, and a large dependence on overhead electrical distribution, has a lower level of power quality. Developing countries may have major problems with the quality and availability of electrical power.

Regulatory Issues

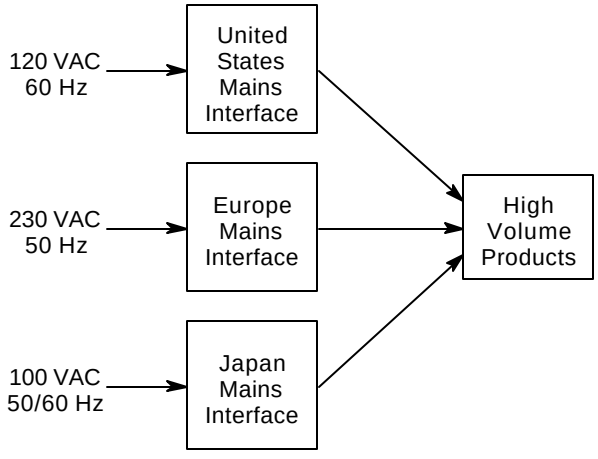
Most design engineers can develop a mains interface that will function in a world environment. However, obtaining the regulatory approvals and safety listings required for world-wide acceptance can be very expensive. Large companies may have a regulatory group adept at obtaining international approvals. However, both small and large companies may find that obtaining safety approvals and listing may be an expensive proposition.

The expense of obtaining regulatory approvals is comprised of several components. The approving agency itself has substantial fees and expenses to evaluate the project and perform the testing. The OEM must support this process with engineering time to process the paperwork and rework the design as required. Testing agencies often require a prototype or test unit that will be subject to destructive testing. Finally, the entire approval process and subsequent redesign may add months to the product development time.

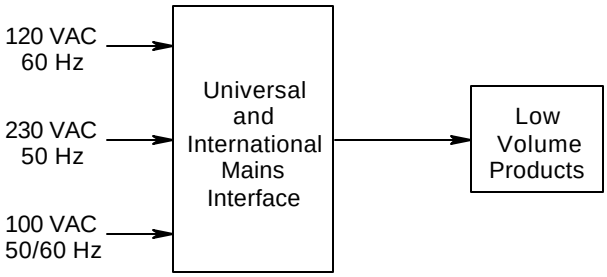
Guidelines for OEM's Developing Mains Interfaces

An OEM engineering group that is planning to design a system for world installation must consider each of the issues mentioned above. Developing a cost-effective mains interface has many factors and design decisions:

- High volume devices may benefit from separate mains interfaces for each nominal voltage level.



- Low volume devices will be more likely to need a single mains interface with provision for multiple voltages.



- Adding voltage taps can provide substantial flexibility to the mains interface. However, a large range of input voltages can increase transformer weight, size, and cost
- Mains interface costs include both OEM incurred costs (components) and customer incurred costs (installation). An optimized mains interface minimizes the *total cost* of electrical installation.
- Plan for system and equipment upgrades when developing a mains interface. A properly designed mains interface will not need to be replaced or modified over the life of the installed equipment.

In-house Design vs. Outsourcing

The decision to design and manufacture mains interfaces internally vs. outsourcing these functions is best made on a case-by-case basis.

An "In-house" group is feasible if the design volume is sufficient to keep engineers busy, up to date, and challenged. The many standards, power quality issues, and world voltages involved often force an organization to keep a dedicated "power expert" on staff with appropriate support personnel.

In many cases, design volumes and product life cycles may make in-house design cost prohibitive. In this case, out-sourcing the design and development of your mains interface may be the quickest, safest, and most cost-effective path.

TEAL Electronics *maintains a state-of-the-art design, development and manufacturing capability to provide mains interfaces for OEMs world-wide.*

