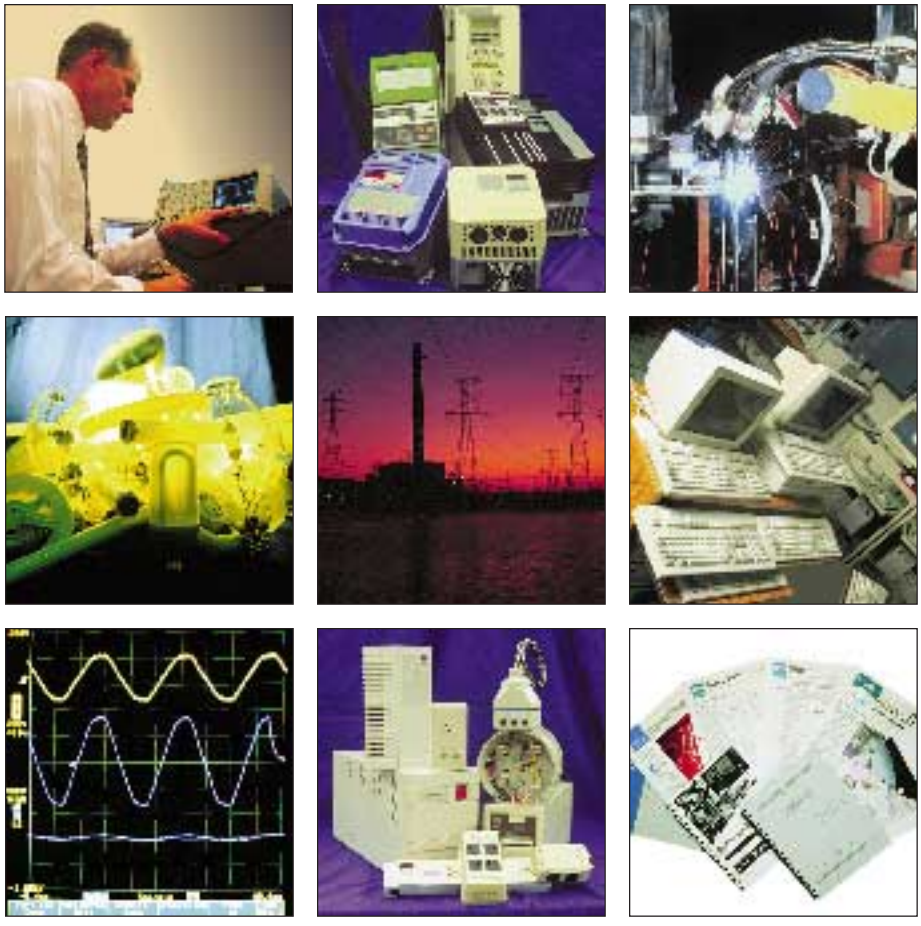
EPRI Power Electronics Applications Center

System Compatibility Research Project

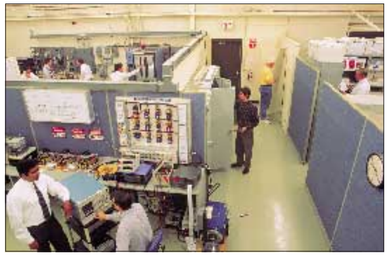


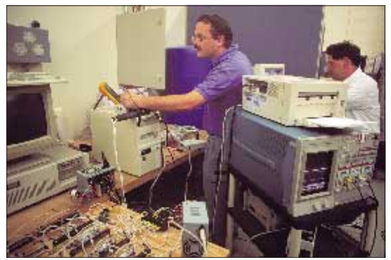
System Compatibility Research Project

From adjustable-speed drives to personal computers, electronic appliances make electricity more valuable by using electricity more efficiently and in innovative ways that greatly reduce manual labor and increase productivity. But, as electric utilities know all too well, these beneficial technologies can and often do interfere with each other, and can even contribute to problems with facility transformers, wiring, and grounding. Furthermore, common electrical disturbances in the power system—such as voltage sags and brief interruptions—can disrupt the processes of many electronic appliances and equipment. Now, electric utilities, manufacturers, and end users have a unique opportunity to join together to resolve these common system compatibility problems. Sponsored by EPRI and its member utilities and conducted by the Power Electronics Applications Center (PEAC), the System Compatibility Research Project identifies ways to enhance the design of appliances and equipment to be more compatible with their intended electrical environments. This applied research takes straight aim at *results* that directly benefit utilities. So far, more than a dozen manufacturers have altered the designs of their products—from computer power supplies to electronic ballasts—based upon the results of testing conducted at PEAC.

Revising the Status Quo

Like a sophisticated circuit, the System Compatibility Research Project is made up of many discrete components called *tasks*. Guided by sponsors, we design each task to characterize the compatibility between a type of electronic appliance and its intended electrical environment. Enabled by our power quality experts, laboratory equipment, and database of power quality problems and solutions, we precisely test appliances to determine how they respond to common electrical disturbances, how they affect other equipment and processes, and how they contribute to the ever-widening compatibility gap between our electrical system and its diverse loads.

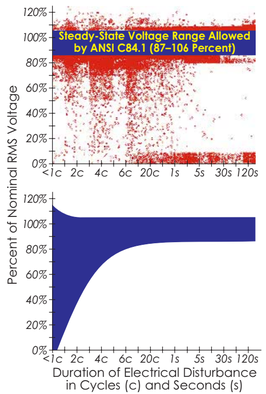




This project goes far beyond assessing the performance of electronic appliances. Each type of appliance earmarked for system compatibility assessment will also be analyzed from the standpoints of designers, manufacturers, electric utilities, end users, and standards organizations. By establishing a durable relationship between these key players, we encourage comprehensive participation in the analytic process: characterize the intended electrical environment, characterize the appliance and how it is used, determine areas of incompatibility, and influence the design of similar electronic appliances to achieve better compatibility with the electric power system.

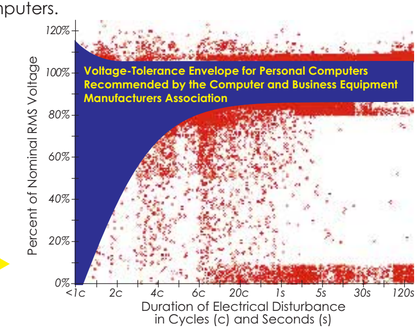
Inevitably, the wake of glittering technological advancements conceals a relentless assault upon the electrical system. For instance, behind the high efficiency of some modern lighting lurks an unprecedented amount of harmonic distortion, and emissions that interfere with other appliances. Moreover, energy-efficient computer power supplies can crash during voltage interruptions lasting as little as 50 milliseconds. Our test results indicate that the addition of energy-storage capacitors enables a power supply to ride through otherwise disruptive interruptions lasting as long as two seconds.

How To Build a Standard



To characterize various industrial, commercial, and residential electrical environments, we collect and process data from three North American power quality surveys. Processing these data yields baseline electrical environments for various locations such as the commercial environment, shown top left, applicable to personal computers.

After assessing the power quality performance of appliances, we create voltage-tolerance envelopes, much like the one for personal computers shown bottom left (the CBEMA curve established by the Computer and Business Equipment Manufacturers Association). By placing the voltage-tolerance envelope of an appliance over the baseline electrical environment, we create a system compatibility profile, shown right, which depicts areas of appliance intolerance to electrical disturbances (shown in red).



Project Benefits

In 1978, Tom Key, now technical director of PEAC, and the Computer and Business Equipment Manufacturers Association created the widely referenced CBEMA curve. Since then, the curve has been used by manufacturers of information-technology equipment as a system-compatibility design goal. And since then, a lot has changed. The Association now calls itself the Information Technology Industry Council, and in 1996, it significantly revised the CBEMA curve based upon the results of research conducted at PEAC. What does this mean for electric utilities? Simply this: Information technology equipment, such as personal computers, will now be more likely to tolerate typical and expected voltage variations in the standard electrical environment. And that is just one example benefit of a project that brings together the end users of many different types of equipment and appliances, the manufacturers who design and build them, electric utilities who power their efforts, and the standards organizations who eventually codify the results of the project by creating performance criteria and industry standards. The far-ranging benefits are specific to the type of participant.

Electric Utilities

The System Compatibility Research Project will apply the results of laboratory research to actual business environments of utility customers experiencing compatibility problems, thereby helping providers of electric power resolve the power quality concerns of their customers and whetting their competitive edge for the next decade of deregulation and fierce competition.

Appliance Manufacturers

Manufacturers will receive exclusive information about the electrical environment where their products are used and thereby benefit from the opportunity to enhance their products and increase customer loyalty.

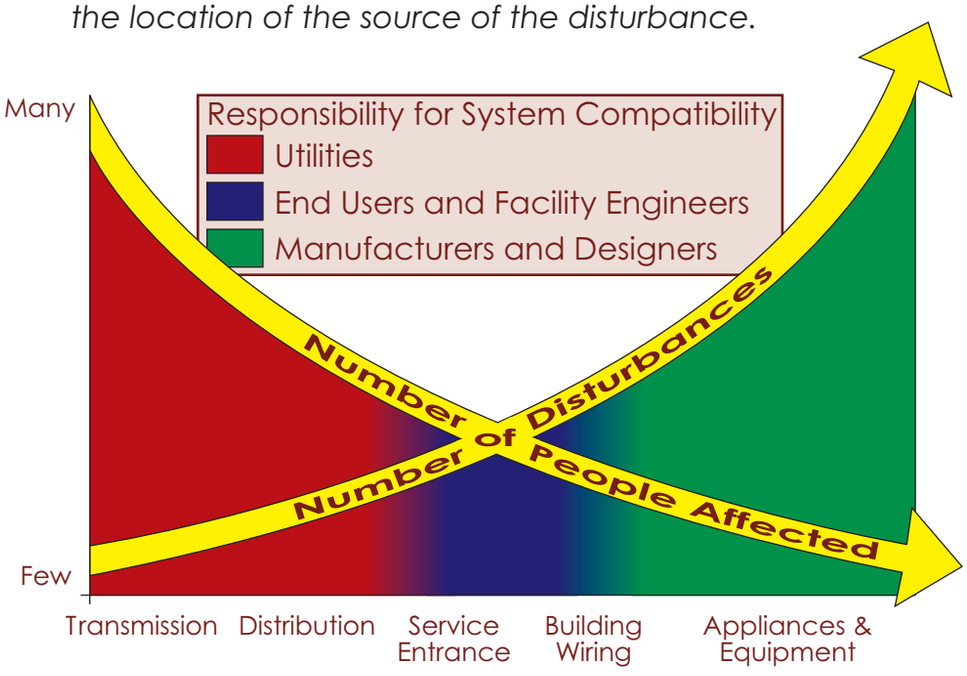
End Users

End users will benefit from computers that don't crash, adjustable-speed drives and programmable logic controllers that don't shut down critical processes, hospital equipment that doesn't interrupt medical procedures, lights that don't flicker or interfere with communication appliances, and many other better-behaved appliances.

Photo by CTI, Inc.

Who Is Responsible for System Compatibility?

Number of electrical disturbances and number of people affected per disturbance based upon the location of the source of the disturbance.

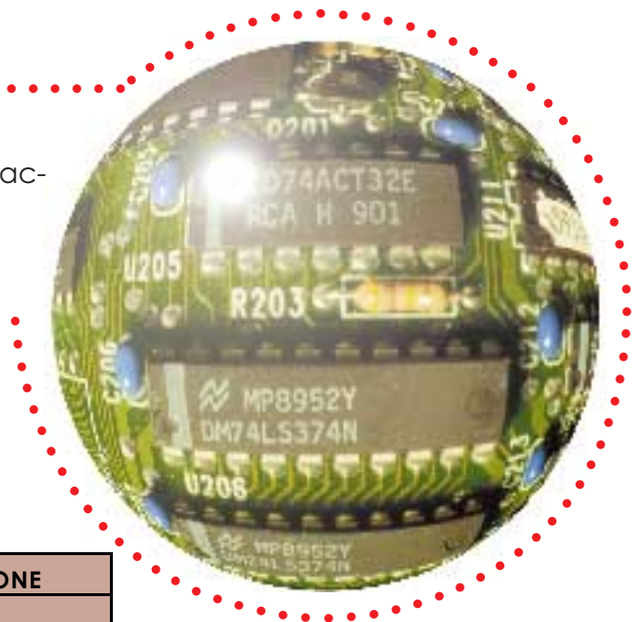


Complicated? You bet. But the bottom line is that responsibility for system compatibility does not rest solely with suppliers of electricity. Although there is room for improvement on the utility side of the meter, some disturbances—such as those caused by road accidents, weather, and animals—are still beyond utility control. These disturbances are few, but can affect many people. On the customer side of the meter, disturbances may be quite frequent, but the low level of each disturbance keeps it from affecting many people. Even so, the number of affected people really adds up when you consider the tremendous number of disturbances generated in millions of customer facilities. Appliance manufacturers have the opportunity to eliminate many compatibility problems by making minor design changes. End users and facility engineers need to specify better compatibility and ensure that appliances and power-conditioning equipment are properly installed, and that wiring and grounding are maintained.

How to Participate

The System Compatibility Research Project is an industry-wide, multi-year collaborative research effort. Electric utilities, manufacturers, end users, and standards organizations are all invited to participate. Electric utilities can use their EPRI tailored collaboration dollars to invest in any of the thirty-plus ongoing tasks, or can sponsor a task directly. For details about joining, call the appropriate contact listed in the box below, or write to:

SCRP Coordinator
Power Electronics Applications Center
10521 Research Drive, Suite 400
Knoxville, Tennessee 37932



Participants	Contact	Organization	Phone
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• Standards Organizations • Other Interested Parties	Francois Martzloff	**IEEE Standards Coordinating Committee on Power Quality (SCC-22)**	(301) 975-2409