

Product & Technology Review

CR-Max

An electronic power conditioning device intended to increase power factor, protect equipment from surges, improve power quality, and save energy.

Product

Circuit Rider CR-Max, a family of over 46 “surge and lightning protection devices” that can be specified for a customer’s unique system capacity and power quality situation. Single-phase and three-phase CR-Max models are made for commercial, residential, and industrial applications.

Manufacturer

Circuit Rider Marketing, LLC
P.O. Box 6611
Lubbock, TX 79493
Phone: (877) 613-1682
Fax: (806) 748-8119
E-mail: support@cr-max.com
Website: <http://www.cr-max.com/>

Distributor

Brian Acuff, Dealer
Pyramid Energy Resources
12347 Lake City Way NE #417
Seattle, WA 98125
Phone: (206) 683-5490
E-mail: brian@pyramidenergyresources.com
Website: <http://www.pyramidenergyresources.com/>

Product History

The CR-Max was developed in Lubbock, TX, by Rodney Folsom. It has been marketed in the United States since July 2001.



Photograph courtesy of Circuit Rider Marketing, LLC, Lubbock, TX

Product Function and Application

The product and technology is proprietary. There is no information available from the manufacturer on how it works.

In a demonstration of a small unit on an unloaded single-phase motor, a three percent reduction in real power was observed along with

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a substantial improvement in power factor. Some low-amplitude high-frequency noise appeared in the current wave with the CR-Max engaged and a slight increase of about 3% in total harmonic distortion. This performance is consistent with surge suppression circuitry and power-factor-correction capacitors, though other components may also be present.

Energy Savings Claims

The following information was provided primarily by the manufacturer and is not evaluated in this section. The manufacturer's website claims a "Guaranteed 10% kWh reduction on your electric bill." However, the manufacturer's actual warranty document (see <http://ecologicx.com/PDFs/CircuitRider-LtdWarranty.pdf>) guarantees "...a minimum 10% savings as measured in kilowatt-hours, or kVA..." It states that a full refund will be given if a customer demonstrates between three and six months following installation that the savings have not been accomplished. In addition, the manufacturer claims that in the appropriate application a CR-Max will reduce demand charges by more than 10% and reduce power factor penalties. See the section "*Additional Reviewer Comments*" for evaluation of these claims.

Non-Energy Benefits

The following information was provided primarily by the manufacturer and is not evaluated in this section. The CR-Max unit has been rated by UL (Underwriters Laboratory) as a TVSS 1449 Second Edition Surge Protector. The manufacturer claims that in the appropriate application, in addition to saving energy, a CR-Max will improve phase voltage balance, and reduce electric faults and equipment damage by mitigating spikes and surges. The manufacturer asserts that they have incorporated the surge and lightning protection along with other electrical and electronic components to interact with the consumer's electrical system to deliver cleaner power, correct the power factor, and reduce harmonics.

Reducing harmonics may be important if you have had harmonic interference with electronic devices. Improving phase voltage balance can be important if you are running three-

phase motors on the same circuit. If voltage supplied to a motor is significantly out of balance, it can decrease the operating efficiency and service life of the motor.

Independent Testing Results

We have not been able to find any independent lab testing of the CR-Max product line.

Cost

There are many different models of the CR-Max. The model is chosen based upon the size and type of loads served. A major installation in an industrial plant may consist of a combination of different models connected in different locations. The cost will vary depending upon how many of which models are installed. Below are examples from the manufacturer of the cost of the smallest and largest units.

Unit	Application	List Price	Installation	Total
CR-Max 240 1Ph	Residential	\$750	\$100- 200	\$850- 950
CR-Max 480 3Ph	Industrial and large commercial	\$2,800	\$200- 400	\$3,000- 3,200

Alternative Products and Strategies

The CR-Max is advertised as providing a variety of power conditioning functions. All power conditioning issues can be addressed with various separate, well established technologies. There are surge suppressors that protect circuits from over-voltage spikes, and there are voltage regulators that reduce or increase voltage or even adjust it in real time to a specified level. There are motor voltage regulators that adjust voltage based on motor load. There are capacitors and capacitor switching systems to control power factor. There are harmonic filters to block or absorb harmonics, and filters to block electromagnetic interference. Some of the well-established technologies use passive components like capacitors and inductors. Others

add automatic switching of passive components to adjust to changing power situations. At the high end are “active” controls that use electronic control to mitigate or correct power issues in “real time,” often at sub-cycle speed.

Typically each of these remedies is employed when the particular issue is identified as a problem. Rarely are all these issues present at once in the same circuit.

Case Studies

The manufacturer or their representatives have taken a number of power readings before and after installations and reported savings in the tens of percent. We place the greatest stock in testing done by an independent third party, but we have not found any well-designed independent studies of the CR-MAX that show convincingly that the CR-MAX can achieve the energy savings claimed.

A “before and after” installation study supplied to us by the manufacturer was conducted on an installation at Jones Plastics Company in Louisville, KY, between June 28 and July 26, 2004. Testing was done by Delta Electric Co. Inc. under contract to Circuit Rider Corp. Performance was monitored for two weeks before the installation, then the CR-Max was activated and another two weeks’ data were recorded. The report does not discuss how much the results might be expected to vary between these two time spans due to production levels, weather, or other variables; this information would be critical for a valid case study. The average electric power usage was 17.3% lower after the installation. The average kVAR was 26.4% lower.

We were given data recorded by the distributor at an installation in a motor control center at a concrete manufacturing company. These data were gathered when the CR-Max was turned on and off for ten-minute periods over the course of an hour. That data contained real power data and reactive power data. There was a clear reduction in *apparent* power of about 31 kVAR each time the CR-Max was powered on, and an increase of 31 kVAR each time it was powered off. There was no discernable change

in *real* power associated with the unit being powered on or off. In other words, it improved power factor in the same way that adding capacitors would, but it saved very little real power. However, the installation would meet the performance provision of the manufacturer guarantee because the kVA was reduced well over 10% when it was powered on.

Suggestions for Further Research and Testing

A CR-Max product should be tested in an independent laboratory to assess its energy saving potential. Loading should be typical for the application, e.g. loaded electric motors, various types of lighting, and process heating. The useful work output, e.g. motor shaft power, illuminance from lighting, and heat output from heating devices should be compared to input kW with the CR-Max in the circuit and out of it. If there are versions of the CR-Max for which different claims are made for savings, these versions should be separately tested. The CR-Max is intended to save energy by correcting power quality problems, so the research plan should define and provide for the simulation of a level of bad power quality that is typical in a real situation. This could include manipulating voltage by the introduction of spikes of known magnitude and frequency of occurrence, $\pm 5\%$ over/under voltage, and 3% voltage unbalance. Other power quality problems like low power factor come not from the line but the loads themselves. These too should be defined in advance of the tests. Although reduction of power quality problems may be desirable, the primary focus of controlled tests should be to evaluate energy savings on the input or meter side of the product.

Additional Reviewer Comments and Analysis

The CR-Max designates a product line of power conditioners that are intended to improve multiple power quality issues while saving energy. The manufacturer says the CR-Max has accomplished energy savings of typically 10-20% or more, according to testing performed by themselves, their distributors, and testing contractors. Our ability to assess its performance based on engineering principles has

been precluded due to the fact that there are many models of the unit and we have not been given access to the internal circuit descriptions or scientific principles of operation. Also, there has not been any independent lab testing of performance. The demonstration and field test data that we have been shown clearly indicates power factor correction. It should be noted that a reduction in either real power or reactive power will lower kVA. A 10% reduction in kVA can be accomplished by a power factor correction from 0.85 to 0.95 *with little or no energy savings*.

Neither physical inspection of the product nor independent testing is conducted as part of our product and technology reviews. Appraisal of energy saving potential relies upon a description of the technology and information from the experience of others, e.g. the manufacturer, independent laboratories, field tests, etc. Of these sources, we generally place the highest credibility on independent lab test results. We place the least credibility on customer testimonials since these may be hand picked from many customers and/or based on field data, with little control over extraneous variables like weather and facility operation.

When information about internal circuitry and scientific principles is unavailable in the presence of remarkable energy savings claims, we are cautious in our conclusions unless independent lab tests confirm energy savings results. The data we have seen from field installations suggest that the primary components in this device are capacitors to correct power factor. Improving power factor in a commercial or industrial setting can sometimes be useful. It can reduce energy costs by reducing the power factor penalty, if you have one. Few, if any, utilities charge power factor penalties in residential service, and not all commercial and industrial customers are charged a power factor penalty. Each utility has its own way of charging for power factor. It is sometimes subtle. For instance, a power factor penalty may be built into the demand charge and not otherwise mentioned, as in when it is indexed on kVA, or sometimes called "adjusted kWh." In other cases, there is a "kVARh" charge. If unsure, call

your utility or the *EnergyIdeas* Clearinghouse to find out exactly what you are being charged for low power factor.

Improving power factor also reduces current flow, sometimes allowing installation of smaller circuit breakers, wires, and transformers, or adding capacity to a circuit. However, other than a small reduction in line losses (usually less than 1% of total usage), correcting power factor does not save energy. For further information on power factor, what it means to facility energy use, and other ways to correct it, see the resources in the references.

Conclusion

We have not seen any lab or field test data that unequivocally demonstrate energy savings where extraneous variables such as changes in production and weather are described and controlled. We recommend that if utilities are considering supporting this product they should await lab testing or well-controlled field testing of the CR-Max to confirm energy savings before concluding that it will occur.

The manufacturer's guarantee does not necessarily guarantee an energy savings because it states that the product is guaranteed to save at least 10% measured in kWh or kVA. kVA can be dramatically reduced by improving the power factor (with capacitors, for example), without significant energy reduction. If the goal is to improve power factor, compare the cost of this device to installing power capacitors and a surge suppressor.

Additional Information

Northwest businesses and electric utilities can contact the *EnergyIdeas* Clearinghouse for additional information on this or other energy technologies or products. Contact:

Phone: 1-800-872-3568

E-mail: info@EnergyIdeas.org

Website: www.EnergyIdeas.org

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Reviewer

Johnny Douglass, P.E.
Senior Industrial Engineer
WSU Extension Energy Program

Note: Product & Technology Reviews are peer reviewed by objective industry professionals prior to publishing.

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