

# Power Quality Forensic Analyses of Failed Electronic End-Use Equipment

## Determining the Cause of Failure of End-Use Electronic Equipment

Conducting a PQ-based forensic analysis of failed electronic equipment provides information critical in determining the cause of failure. Failures suspected to be caused by PQ disturbances, facility wiring, and ground errors are frequently caused by deficiencies in equipment design, and manufacturing defects.

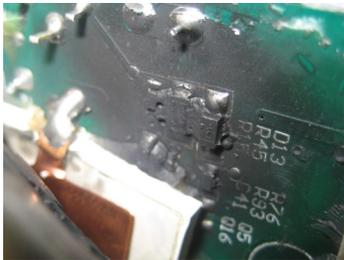
Electrical environments change in customer facilities. While manufacturers

have improved their designs for PQ immunity, many are still susceptible to PQ disturbances. Changes to facility electrical systems often cause PQ problems to develop. Grounding in facilities is also critical to achieving acceptable PQ performance. Electrotek's forensic analysis approach can be used to identify issues with circuit protection, sensitivity to ground currents, and "hidden pathways" in surge

protection networks which allow transient to get to sensitive electronic components. The move from analog electronics to digital electronics also increases equipment susceptibility. A circuit protection network suitable for an analog product, may not provide adequate protection for its digital counterpart.

Manufacturers cannot afford to risk their reputation and profits to underlying PQ

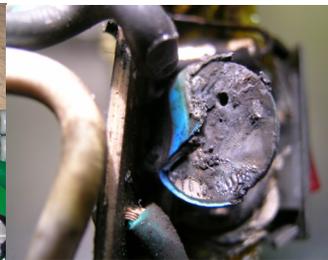
problems with their new product designs. The costs to subject a new product to real-world PQ disturbances in Electrotek's Advanced PQ Testing Laboratory vs. the costs to "clean up" a group of catastrophic failures of a new product is 1:1000. Advanced PQ immunity testing typically uncovers about three design issues critical to the success of PQ performance.



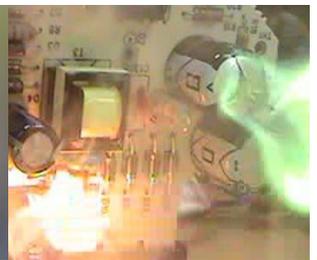
Insufficient ground plane allows disturbance current to flow through the board.



Gate driver network is susceptible to low-level voltage transients.

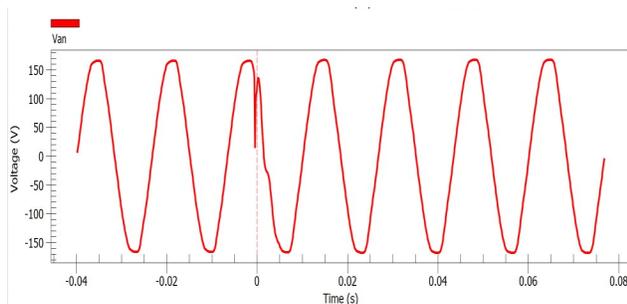


Metal oxide varistor (MOV) is susceptible to temporary over-voltages.



Voltage swells cause capacitor degradation and over-current conditions to develop.

## Impulsive Voltage Transient Analyzed by PQView® is Key to Board Failure



Impulsive voltage transient captured by Dranetz Encore 61000 analyzed by PQView® is key to power supply failures.

When trying to link the failure to its cause, PQView is key when reviewing disturbance characteristics that likely caused the failures.

Here, PQView presents the details of an impulsive voltage transient likely leading to the failure of a digital power supply controller.

PQView's superior ability to display disturbance details and provide analytical data allows our engineers to link the failure to its cause. We then regenerate problem disturbance in our PQ Lab and inject it into a working product sample to reproduce the failures.

Electrotek's Power Quality Engineering Services Center is a world-renowned center for power systems and power quality engineering. Our Center includes an Advanced Power Quality Testing & Research Laboratory.

Learn about our Center by visiting: [www.pqengineering.com](http://www.pqengineering.com)

Email: [pqengineering@electrotek.com](mailto:pqengineering@electrotek.com) for more information.

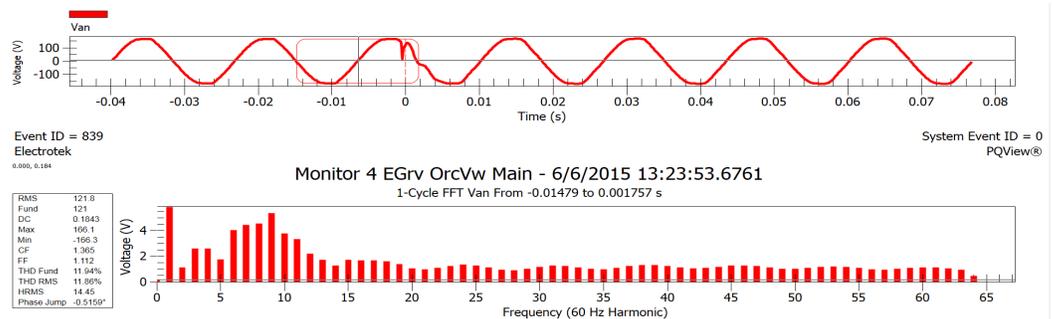
General Manager: Brian Todd, [btodd@electrotek.com](mailto:btodd@electrotek.com); Telephone: +1-732-248-4281

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Electrotek Concepts, Inc.  
 Software Development Center  
 100 Cummings Center  
 Suite 130G  
 Beverly, MA 01915-6177  
 United States of America  
 Telephone: +1-978-927-8755  
 Fax: +1-617-848-0088  
 E-mail: [pqview@electrotek.com](mailto:pqview@electrotek.com)  
 Website: [www.electrotek.com](http://www.electrotek.com)

Electrotek Concepts, Inc.  
 Engineering Services Center  
 9041 Executive Park Blvd.  
 Suites 136 & 142  
 Knoxville, TN 37923-4664  
 United States of America  
 Telephone: +1-865-470-9222  
 Fax: +1-865-247-5984  
 E-mail: [pqengineering@electrotek.com](mailto:pqengineering@electrotek.com)  
 Website: [pqengineering.electrotek.com](http://pqengineering.electrotek.com)

## PQView® Provides Harmonic Data Critical to Linking Failure and Cause



PQView can display harmonic component out to the 256th and display areas of concern regarding harmonic energy content allowing us to determine how the disturbance caused electronic component failures.

PQView allows our engineers to determine all of the disturbance characteristics necessary to determine how the disturbance impacts different parts of an electronic circuit. These characteristics are based on amplitude, wave shape, and frequency.

Our real-world PQ immunity testing methodology allows us to study the effects of the problem-causing disturbance on the product's electronics. Our engineers are able to increase or decrease the severity of specific

parts of the disturbance to determine what type of internal mitigation is required to protect the electronics. This allows us to definitively link the cause of the failure, while aiming to improve the product's PQ performance.

## About Electrotek

Founded in 1984, Electrotek Concepts, Inc. is world renowned for its research, developmental, applications and problem-solving work in understanding, identifying, analyzing and preventing power quality (PQ) problems. Our expertise extends from the utility generators, to inside the electrical/electronic load inside a customer's facility. The experience of Electrotek's team of PQ engineers extends from experts in utility power systems, participants on IEEE and IEC standards boards regarding PQ standards, and to designers of end-use electronic equipment. Our engineers are armed to address any PQ problem at any level. The future of reliable and available power and customer equipment in today's modern technological society depends on compatibility between utility power, the customer's facility electrical system and the end-use equipment customers depend on to carry out their day-to-day business activities.

