Power Quality Survey And Analysis Report

A Major Fast Food Chain
Located in Wentzville, MO

"Power Over Electricity"

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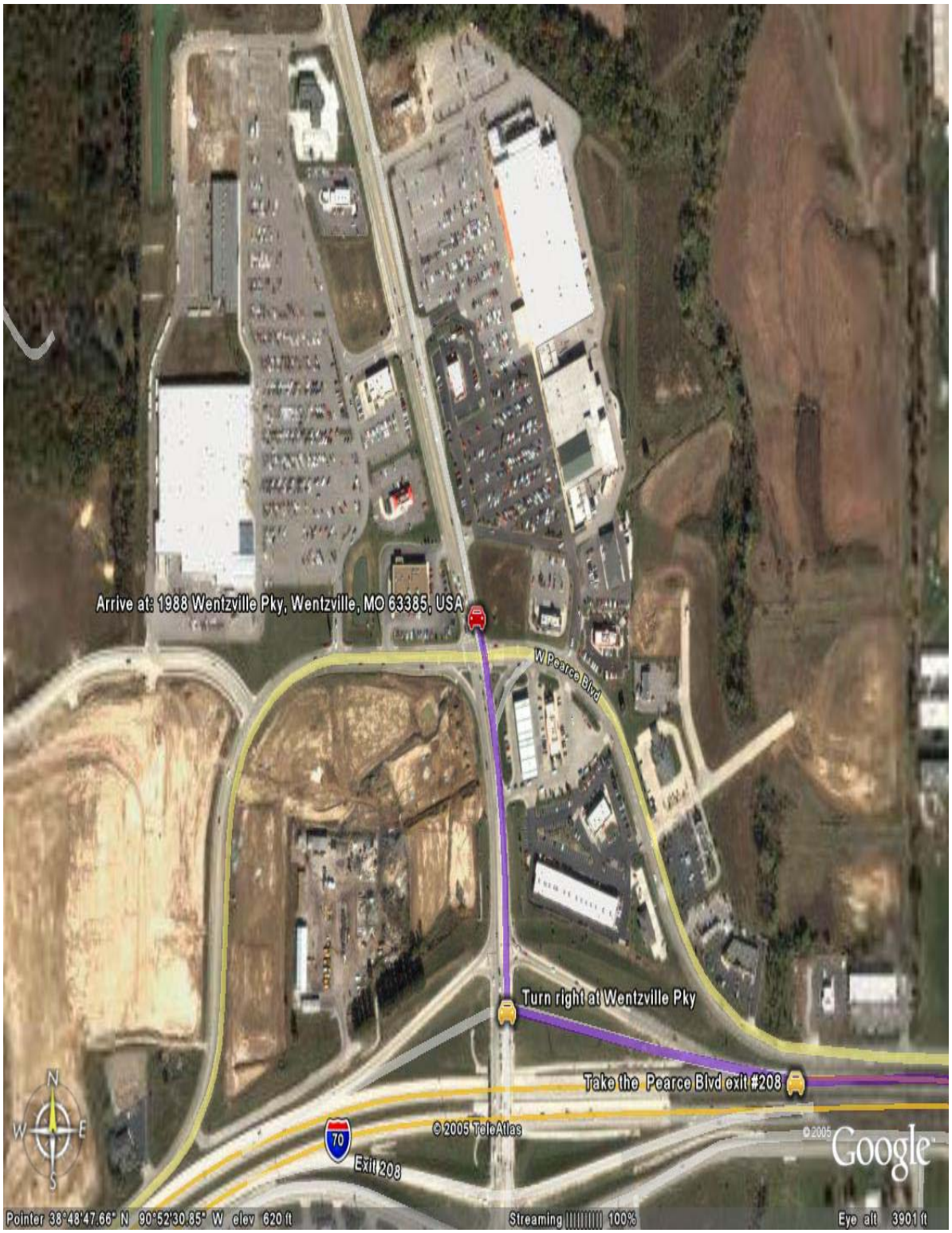
James M. O'Brien



Summary of Contents

Organization of Document

This document is organized by "Site" and further by each "Location" within a "Site." Typically, a Site is a physical structure, such as a restaurant. Locations are points within a Site between the utility power source and the final load. Leveler chooses Locations that are closest to an electronic load to measure the power quality, as opposed to stopping at the closest panel or sub-panel. This allows us to collect data regarding the power experienced by an individual load, not the power experienced at a panel.

Equipment Used for Power Analysis

Dranetz PX-5 Power Recorder

Ideal Circuit Tester

Leveler Protective Technology® Testing Methodology

Leveler employs distinctive testing methodologies that differ from the standard power quality analysis practices in an effort to better serve our customers. We examine the quality of power at a point closest to your loads (voltage and current), as opposed to analyzing the state of power quality from a top-down (voltage only) viewpoint. Also, we examine the components of power that your electronic loads are most subject to. We look for noise, harmonics, and energy on ground; all the disturbances that cause digital equipment to fail. We use high-speed, multi-sample oscilloscopes and industrial-strength power meters to obtain this deep level of data.

Monitoring Equipment Installation

Power recorders and meters were used at the output of the LP-2 panel, to measure the quality of power at key load points.

Results and Analysis

The next three sections present a summary of the power quality issues and their solutions identified at all locations. The Power Quality Issues section identifies the issues, the Definition section identifies the findings, and the Conclusions section analyses the business impacts to the customer.

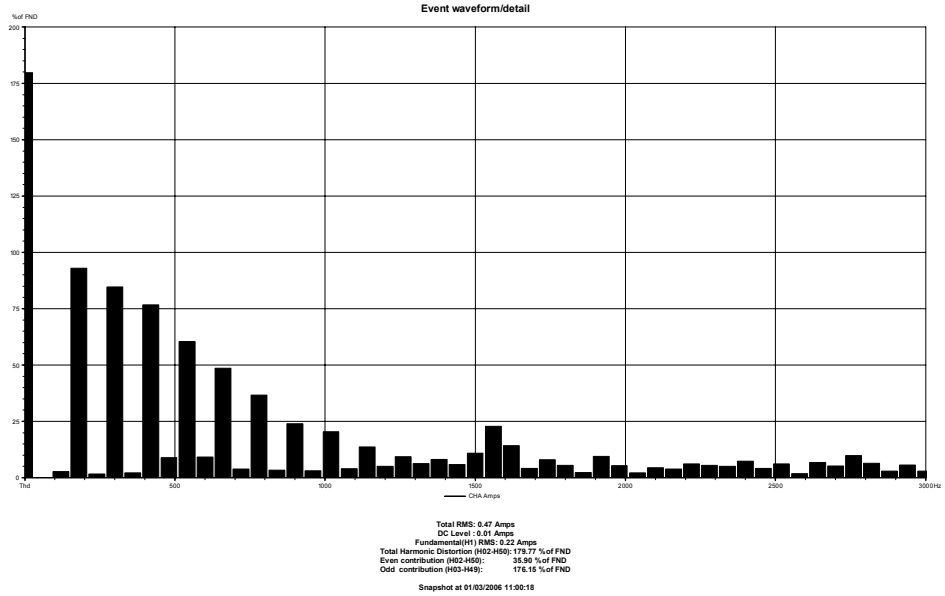
Power Quality Issues

Excessively High Current Harmonics on Drive-Thru

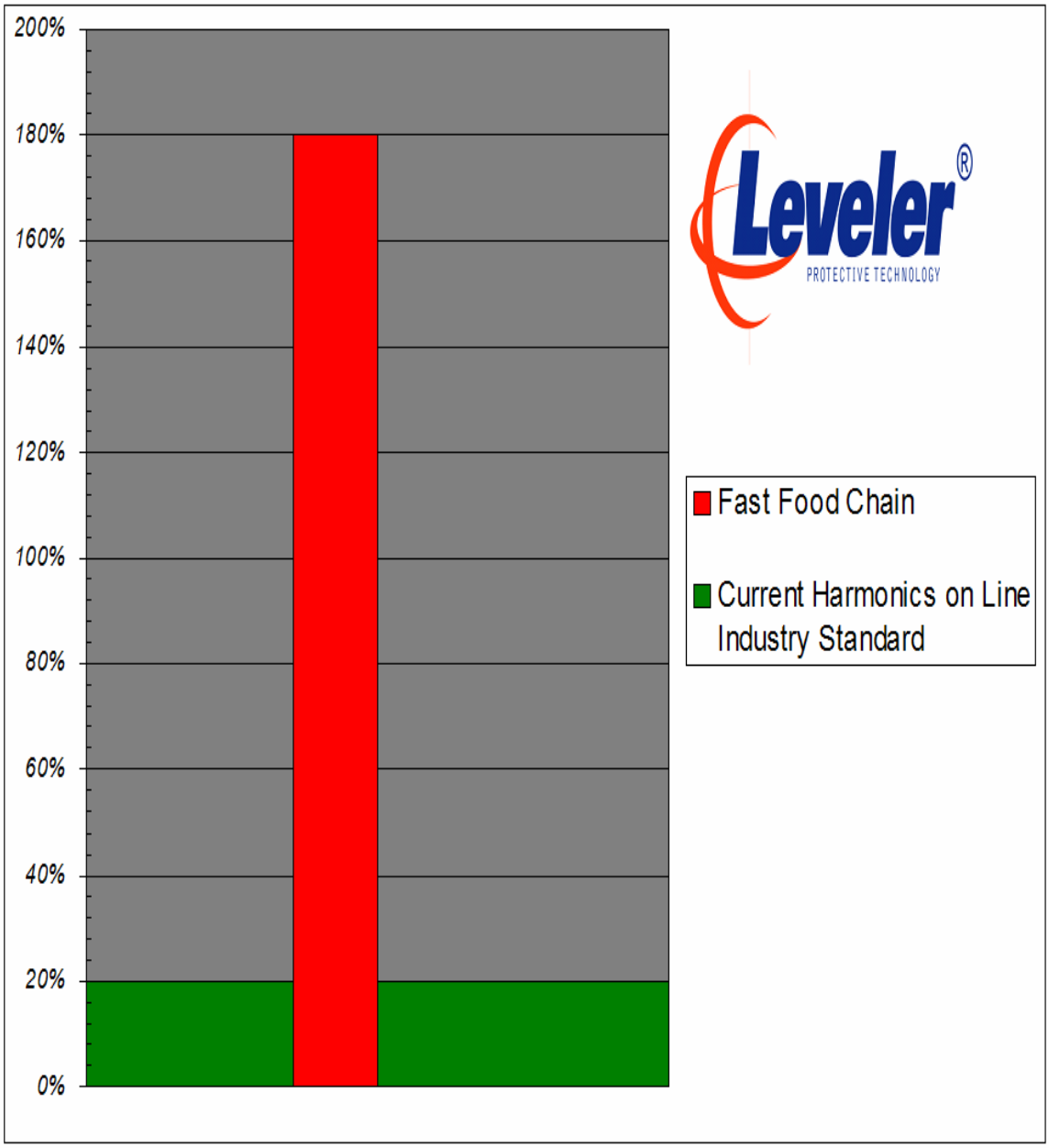
Causes are switch-mode power supply and HF Antenna behind building

These high harmonic levels can cause the computer to work much harder creating excess heat causing future computer lockups, hard drive failure, data corruption and/or end of computer life. See charts below

Current Harmonics Drive Thru



Current Harmonics Chart Drive Thru

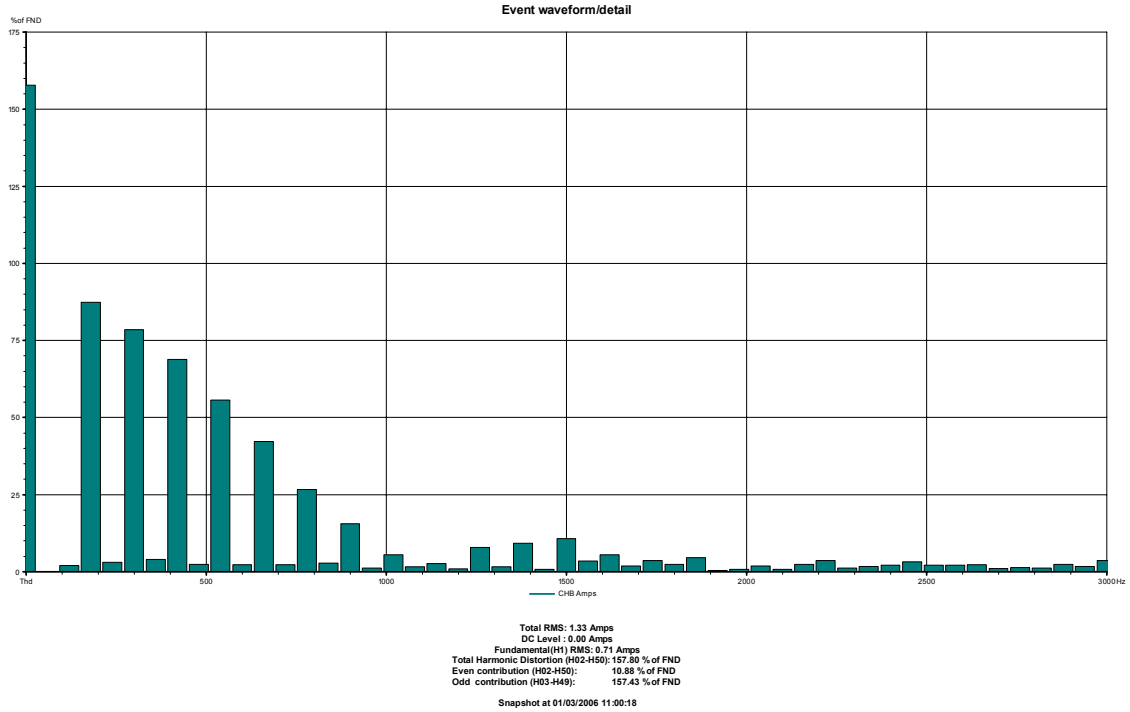


Excessively High Current Harmonics on Front Registers

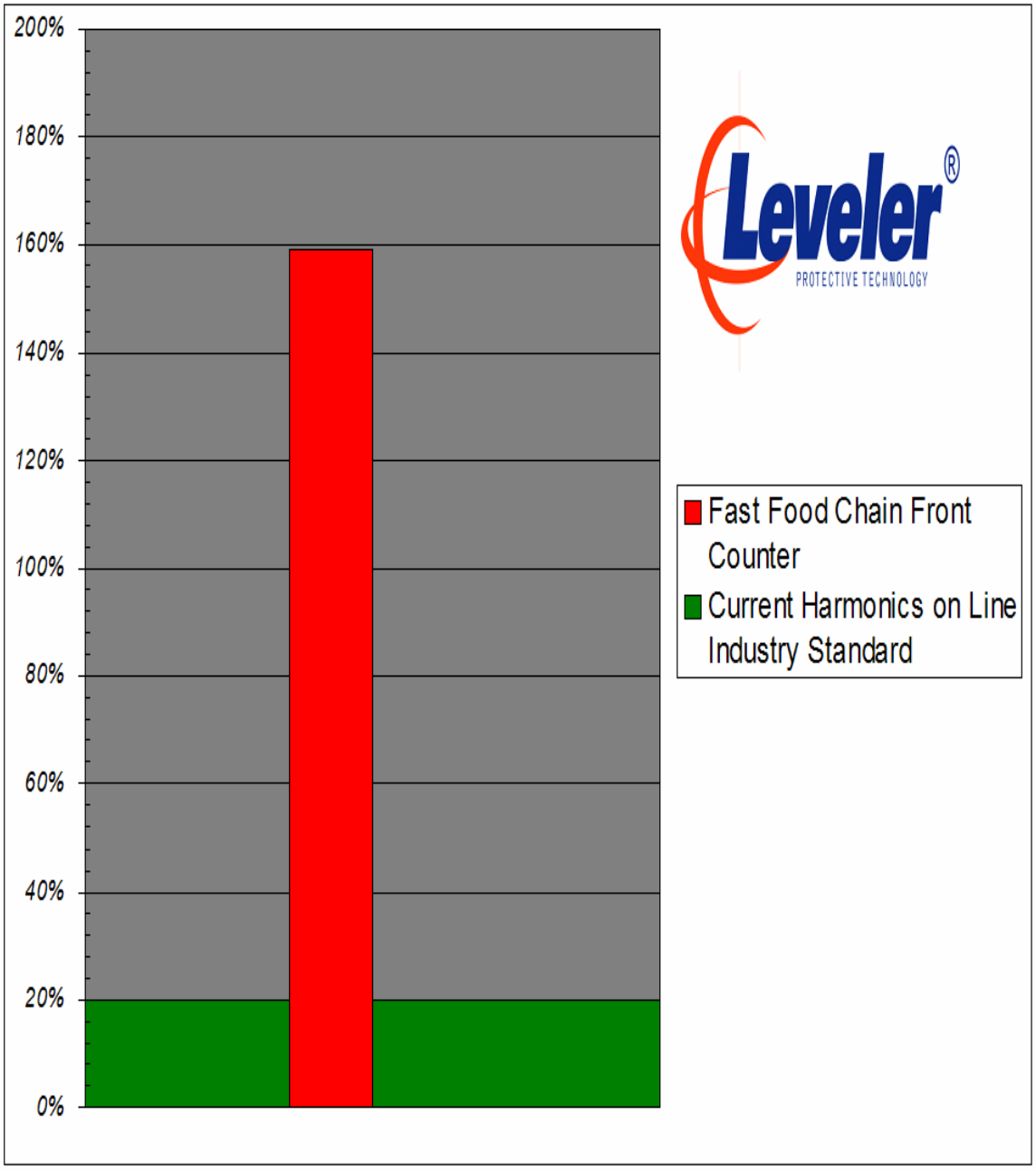
Causes are switch-mode power supply and HF Antenna behind building

These high harmonic levels can cause the computer to work much harder creating excess heat causing future hard drive failures, computer lockups, data corruption and/or end of computer life. See charts below

Current Harmonics Front Counter Registers



Current Harmonics Chart Front Counter Registers



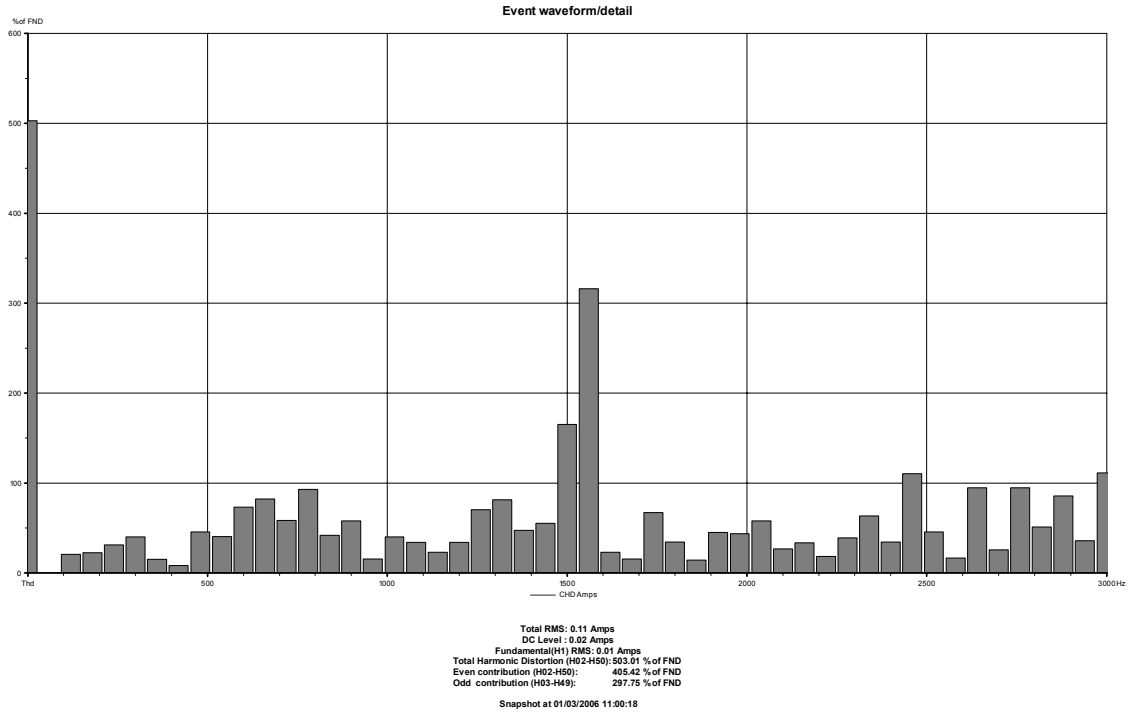
Excessively High Ground Current Harmonics on LP-2 Panel

Ground current harmonics measured is over 170% distortion.

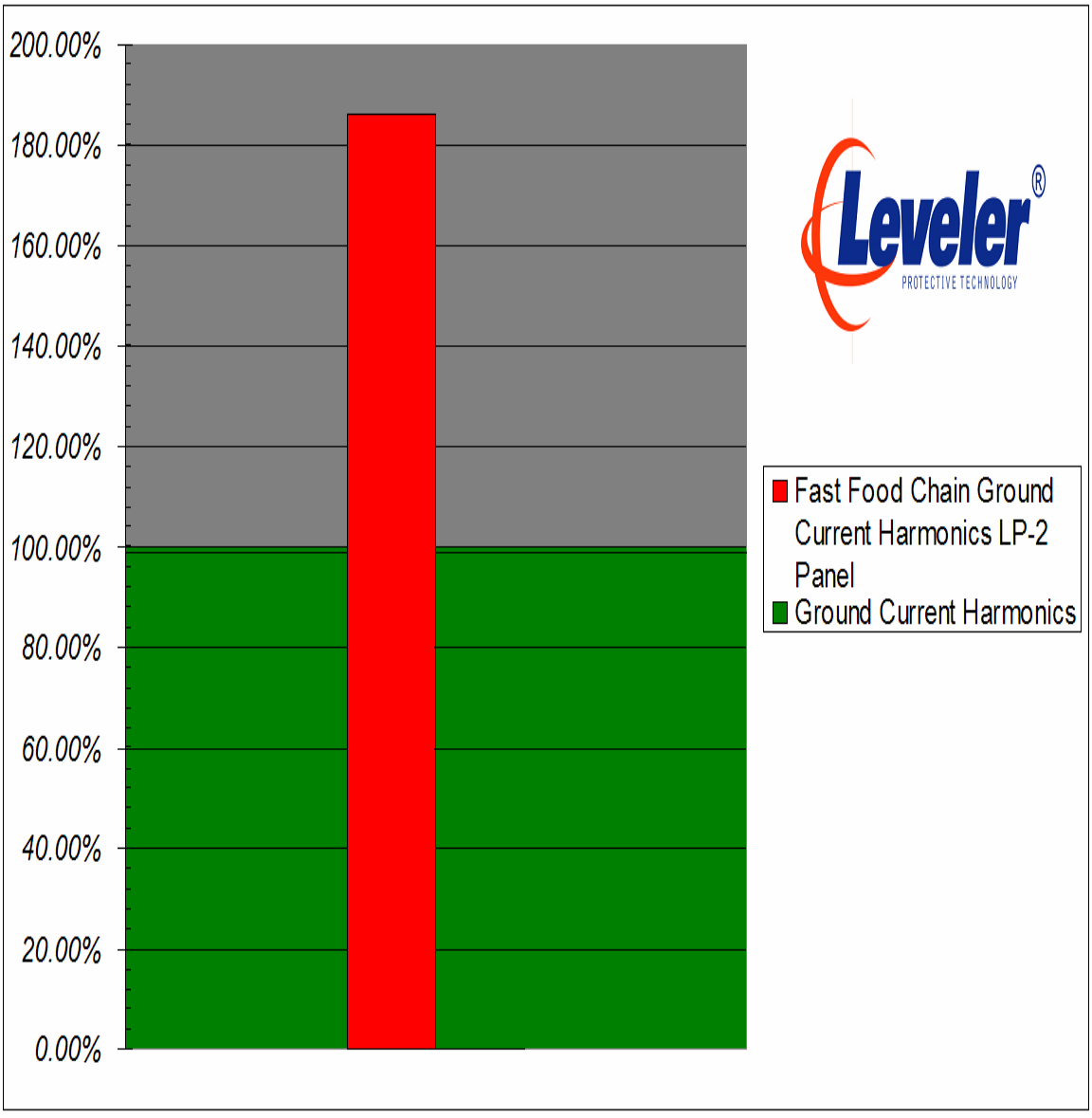
Causes are switch-mode power supply and HF Antenna behind building

These high harmonic levels can cause the computer to work much harder creating excess heat causing future hard drive failures, computer lockups, data corruption and/or end of computer life.

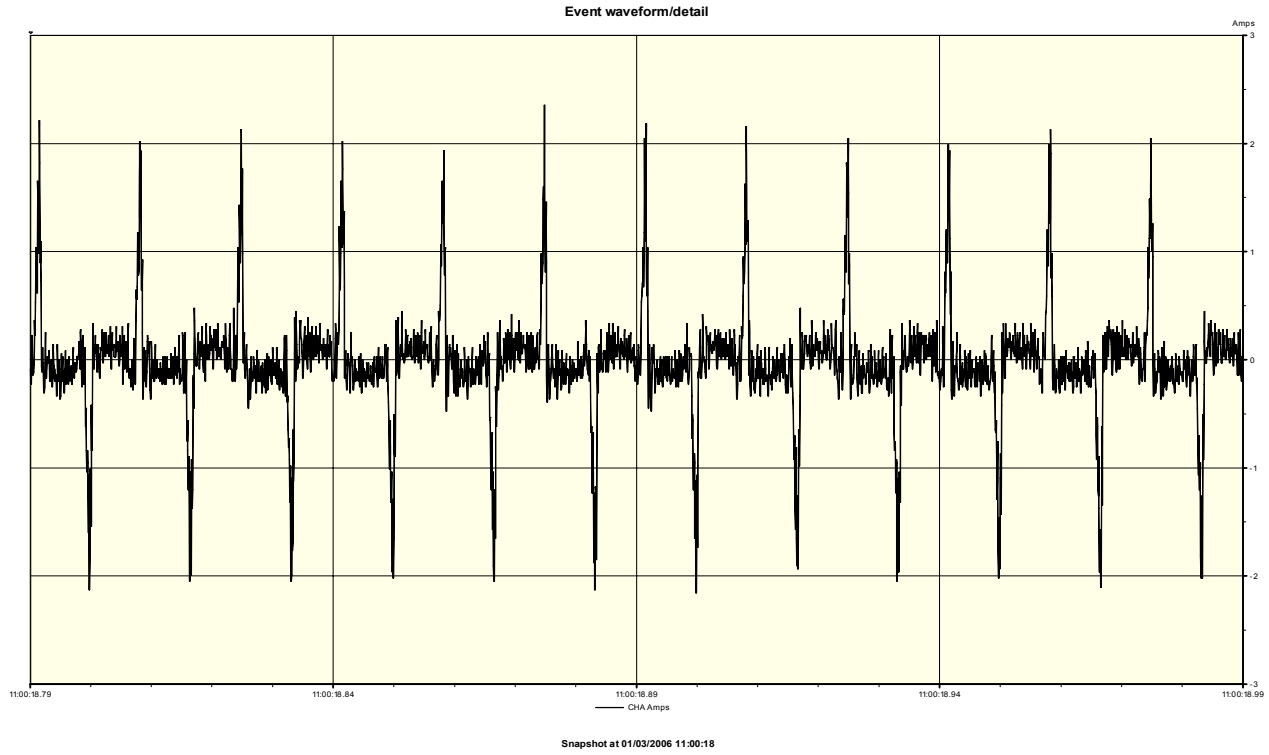
Ground Current Harmonics LP-2 Panel



Ground Current Harmonics Chart LP-2 Panel



Current Waveform at Fast Food Chain



Typical Current Waveform

Definition of Captured Power Quality Issues

- **Harmonics** – excess voltage or current present in a cycle other than 60 Hz. Harmonics are frequencies of power unavailable for use, but disruptive as "noise" in power supplies. They can increase component wear and heat buildup. Harmonics are measured on Line, Neutral, and Ground. Harmonics can be considered "wasted" power that was not used during the generation of AC to DC by the electronic system. This power cannot be recaptured and must be evacuated by the infrastructure as heat or noise, or both.

- **Noisy Ground** – excessive Harmonics of significant strength make for an unstable zero reference for electronic devices.

- **RMS Events** – changes in initial measured voltage compared over time. This event can be an indicator of the addition or subtraction of new substantial loads to a circuit. RMS (root-mean square) changes that exceed 10% can cause a power supply to miss a cycle of AC/DC conversion, among other symptoms.

- **Impulses (Transients)** – fast movements of voltage and current that occur so rapidly that the exact results are unpredictable when detected, but range from "not experienced" to destructive. Knowing the amplitude, or size of a transient, along with its frequency, it may be possible to locate the offending equipment generating it. Often, transients cause reboots or data errors in electronic devices

- **Waveshape Events** – a very long (half a cycle to 1 day) Impulse or Transient that can stress power supply components, result in heat buildup, or equipment shutdown. Transients that have a negative polarity (-) typically appear as Waveshape faults; they act to pull down the Voltage sine wave and then spike back.

Power Assessment

Product: PowerVar

Description: PowerVar 1.0 and 2.0

Purpose: Power Conditioning and Surge Suppression

Rating/Thresholds: 1.0 and 2.0

Three PowerVar 1.0 located at the front counter for all three registers. Far left PowerVar not plugged in. Register plugged directly into wall.

One PowerVar 1.0 located at the DT window register and one PowerVar 2.0 located at DT window.

Grill printer not protected

Server not protected

Office computer not protected

Conclusion of Findings

Fast Food Chain is experiencing extremely high harmonic distortion on their infrastructure due to the switch mode power supplies located inside your POS system. Electronic equipment (switching power supplies) draws current differently than non-electronic equipment. Current impulses introduce unanticipated reflective current (harmonics) back to the power distribution system. The results of harmonics can cause hard drive failures, data corruption, erratic behavior, and or end operating life.

Energy is also being radiated by a HF antenna behind the Fast Food Chain. This transmitter is on the same power distribution grid as the Fast Food Chain. This is likely the cause for some of the distortion. This energy is present on all electrical wires within the Fast Food Chain. The distortion numbers found on Ground are high because Ground is not expected to carry any current. Where as line and neutral are expected fundamental power frequency of 60 Hz. This condition is detrimental to computer systems. Effects caused by these conditions can be hard drive failures, data loss, data corruption and / or end of computer life. You can also see the closer you are to the HF antenna (drive thru window) the higher the frequency is in relation to the front counters (lower HF noise).

As stated previously, the perspective of this survey is to measure and assess the quality of power experienced by the sensitive electronic systems. All of the findings in this report show that the electrical environment is not ideal or suitable for long-term electronic equipment use according to IEEE Std. 519 (Harmonics) et al. and our experience. Leveler's research and experience shows that effective conditioning and protection can only be achieved closest to the electronic load. These high harmonics levels can cause hard drive failures, brownouts, computer lock ups, data corruption and/or ending of computer life. Power conditioning technology now exists that simultaneously and bi-directionally cleans noise, removes fault current and harmonics from all paths and protects electronic loads. Once the electronic systems are protected, several overall conditions are improved: PC's which are known polluters of the electrical infrastructure are now contributing far less "waste" and the reduction of this waste allows for a better power experience of the linear loads, improving their performance.

Recommendation

- If you have any questions or comments regarding this report please contact Jim O'Brien 630.963.8101 email at jobrien@levelerllc.com. I will be happy to discuss any and all issues with you.

- Leveler provides complete solutions for next-generation power conditioning and ups systems. Our solutions will correct all the problems identified and provide the Fast Food Chain with a superior level of protection. Please contact Andy Kaluski at 630-963-8101or email at akaluski@levelerllc.com with questions regarding system solutions.

Detailed Power Analysis Location Reports

The remaining sections of this document are reports from the databases of the Dranetz PX-5 Power Recorder as collected during the surveys. The data from these reports provided the information for the preceding Results and Analysis sections. Although there is great detail in the reports that may be cumbersome to the casual reader, the data contained within can be helpful to baseline the current electrical infrastructure and assist in arriving at a power quality solution to mitigate the adverse findings.

We thank you for the opportunity to provide this survey and look forward to serving you in the future.

Sincerely,

Leveler® Power Quality Analysis Team