



**DYNAMIC POSITIONING CONFERENCE**  
October 9-10, 2012

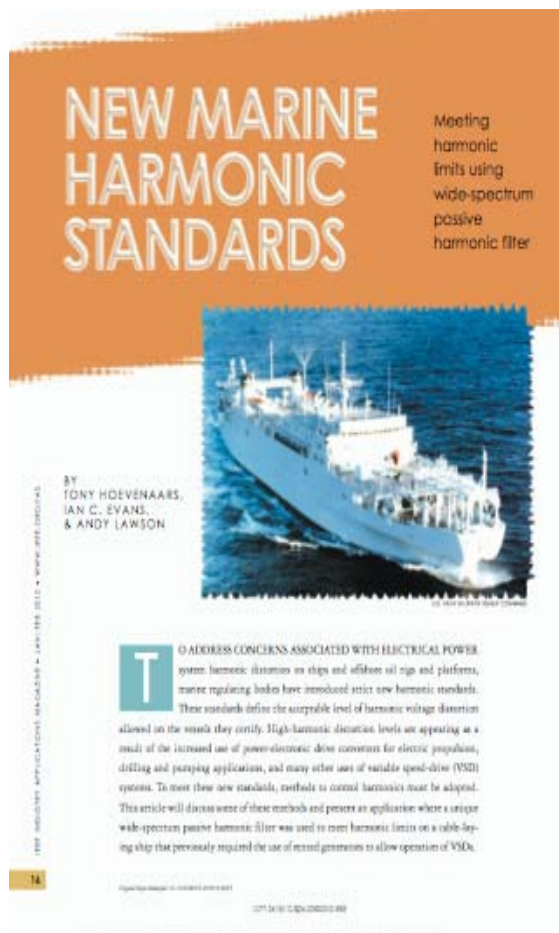
**RISK SESSION**

**More Reliable Functionality of Electronics is Now Possible in the  
Marine Industry**

**BY: Leonard Webster  
Leveler LLC  
Downers Grove, IL, USA**

### This Referenced Paper:

<http://www.mirusinternational.com/downloads/IAS-Magazine-Meeting-New-Marine-Harmonic-Standards-JanFeb%2010.pdf>



Presents the current state of affairs concerning “Harmonics” in the Marine Industry.

This paper describes an: **“Expanded Tool”**

**That will improve the Marine Industry’s ability to: meet & develop new electrical standards**

**Power Reliability Issues on DP Rigs and Ships Are Created By:****The Uncoordinated Design of Electronic Devices****Power Generation Problems**

- Phase Differences
- Harmonics

**Heavy Equipment Operation**

- In Rush Current Due to On – Off Cycles
- Equipment Failure
- Transients
- Harmonics
- High Frequency Noise

Current Analysis Processes focus on 440-volt power level problems mentioned above. They represent only a small portion of the power disruption and harmonic problems that exist.

**The entire Electrical Grid on a rig or ship is its own worst enemy:**

- Mixture of electronic and non-electronic devices on grid
- Every electronic device creates disruption on the vessel because of the way they use electricity

Measuring distortion at 440-volt distribution has limited value because it doesn't provide the information required to limit or eliminate the majority of disturbances because majority of impacts are at power levels less than the 440 volts.

**IMPACTS FROM ALL ELECTRICAL DISRUPTION CAN ONLY BE FOUND AT THE POINT OF USE OR LOAD THAT IS DISRUPTED.**

**THE MOST IMPACTIVE DISRUPTIONS ARE TO ELECTRONICS AND THEY USE POWER AT LEVELS BELOW 440 VOLTS.**

**System created noise affects all Electronics**

- Harmonics
- Spikes
- Distortion
- Ground noise

**Electronic Noise affects other Electronics**

- Damage components
- Shorten life
- Cause mal-operation

**All Noise affects Software**

- Soft-ware crashes

## The Expanded Analysis Tool:

### Load Centric Power Analysis (LCPA)

**Over 90% of electrical disruptions are caused by the way electronic loads use electricity, NOT by the electricity provided to the equipment.**

All disruptions have voltage, current and ground signatures

Measuring at the load and then working toward distribution the LCPA captures & interprets the signatures that identify disruptions

Measuring at the load allows Identification of disruptions

By understanding the cause of disruptions, the LCPA provides information for a cost effective solution

- The LCPA process is different from traditional surveys
- Most data is collected is at the electronic loads and is done under full load.
- It's not possible to accurately measure power quality if it's turned off
- Data acquisition does not disrupt operations
- Analogy: A multi-lane expressway at the height of rush hour has the most chaotic conditions with the greatest potential for problems to occur
- **The LCPA is designed to be done at rush hour**
- **The LCPA turns Chaos into Knowledge**
- **The LCPA converts Knowledge into Recommendations & Solutions**

The LCPA identifies and solves power quality problems effecting the functionality of electronics in the following order:

- **Acquisition** – employs trained electrical personnel using safe operating procedures and appropriate power quality recording tools to record **TIME SYNCHED** data in a live electrical infrastructure
- **Analysis** – compares operating expectations of the site's loads with the recorded data. The data is examined for patterns and anomalies then correlated by time, date and synchronization relationship.
  - Multiple load data is then compared and contrasted to identify the source of problems and their possible negative impact throughout the grid.
- **Report** – is written in plain language, interprets the data, identifies problems and provides recommendations for cost effective solution(s).

**LCPA Process: (Acquisition pre-board)****Client Information Requirements:**

A set of the most current line drawings of the electrical infrastructure and a questionnaire describing the electrical conditions/problems that are known/observed to disrupt the functionality of electronics are required for review at least two weeks before boarding a ship or rig so a work plan for the LCPA can be completed.

**Planning Process:**

Upon receipt of the line drawings and questionnaire the plan for the LCPA acquisition sequence and procedures is completed and the number of days to complete the analysis is determined. All aspects of the LCPA process will be provided and discussed with the client so that when the technicians come on board the process can be started without delay.

**Plan:**

The plan will identify the locations and the sequence to be followed to obtain data in the most efficient manner.

**LCPA Process: (Acquisition onboard)****On Board Sequence:**

Upon arrival a meeting with on-board personnel (OBP) will be held to review the plan and coordinate the activities necessary to carry out the analysis in the most efficient manner. The sequence that will be followed is to have the OBP take the technicians to the first two data acquisition sites so that they start with simultaneous readings. Then the OBP will take the technicians one at a time to their next acquisition site in sequence. This procedure means there is a continuous stream of data being recorded from a predetermined sequence of sites during normal operations.

**On Board Procedures:**

Data acquisition must be done during normal operations and does not require any changes in normal procedures unless a specific problem requiring special testing becomes necessary. If any interruption to operations to acquire needed data becomes necessary it will be discussed and agreed to with the client before the modified plan for the analysis is begun. The LCPA is a “fact finding” exercise for electrical problems that occur during normal operations so the “best” analysis is one that is carried out during those operations. If a new infrastructure is being analyzed it is necessary that all anticipated operations are carried out during testing to determine if any electrical problems surface.

**LCPA Process: (Report & Recommendations)**

**Report:** compiles, organizes and presents the data acquired for the analyses. The report is written in non-technical English, presents all data, provides conclusions, recommendations and solutions for action to correct the identified electrical problems disrupting electronic functionality.

**Recommendations:** a specific solution for each electrical problem identified will be presented including cost of solution and options for deployment. Each solutions impact will be detailed with waveform examples of the electrical environment. Information based on field experience will be included to provide expected improvement in performance so that a realistic cost payback can be made by the client. All LCPA's include the installation of one solution recommendation and provides comparative data with and without the solution in place. The solution will be left in place to provide long-term performance comparison.

If necessary collaboration with other industry experts regarding issues resulting from unique disruptive power quality concerns may be recommended.

**Analysis:**

Contrasts the recorded data sets to expected data to identify the disruptive electrical patterns and anomalies. Multiple data sets are then compared by date, time and synchronization disruption patterns to locate the sources of electrical problems that recommendations and cost effective solutions are based upon.

**Example: DP RIG LCPA DATA**

The following four slides represent a fraction of a second of a four day process. They are graphic representation of a Harmonic issue on a DP Rig that leads to significant interruption of operations when ship power exceeds 30%.

This data identifies a time sequence discovery process, which is done by simultaneous comparison, location comparison and/or combinations of all three.

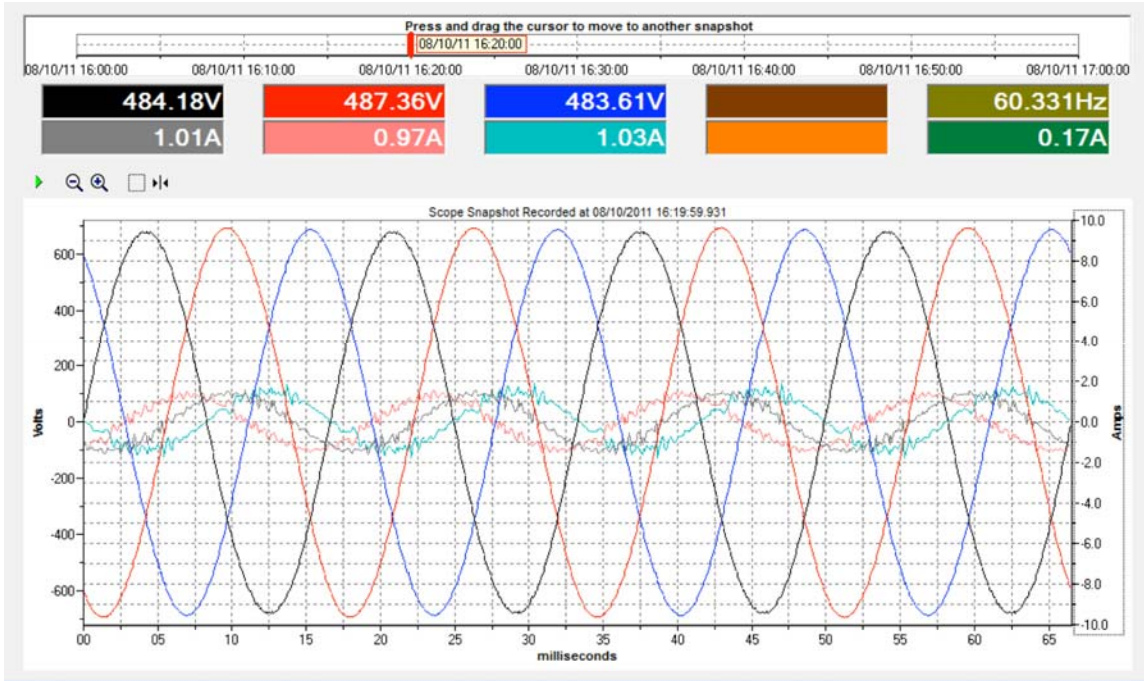
The first three graphs are of the three phases being measured. The fourth slide is one of the 3 phases, which allows greater detail of data. The level of analysis provides a clear picture of all loads effect on the electrical distribution system as well as provide the ability to track impacts of any changes to the distribution system

The examples of data and summary page included in this presentation are from an actual DP Rig Report.

### SHALE SHAKER #2

As ships power increases more electronics come on line and the harmonic load increases

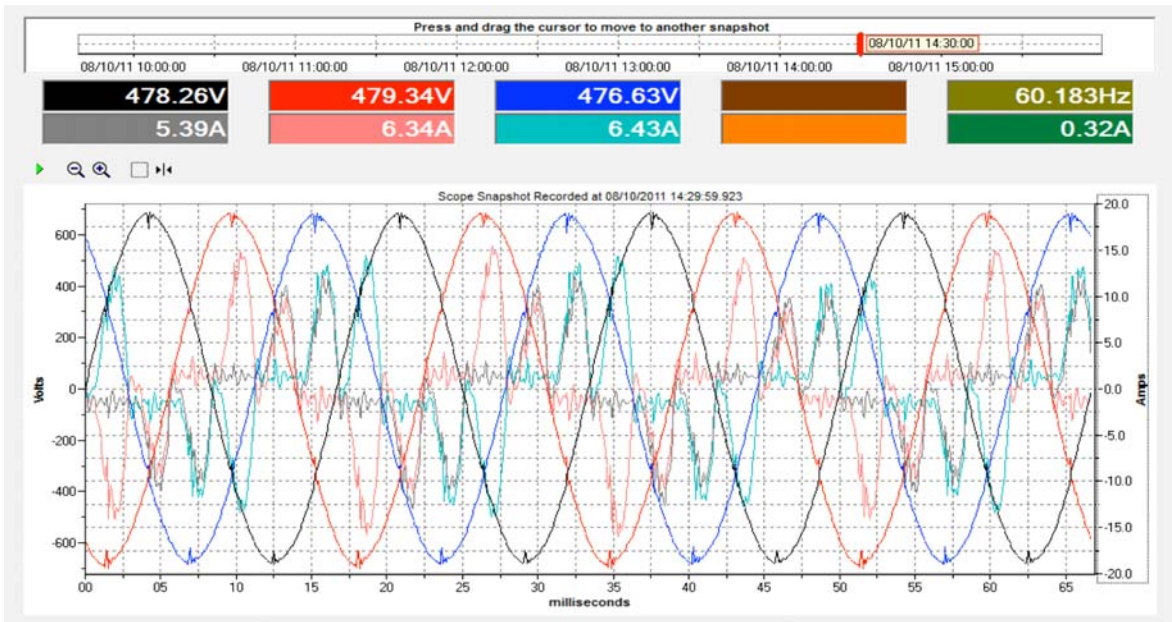
#### Ship Power At Minimum: No significant Harmonic Disruption



Voltage waveform

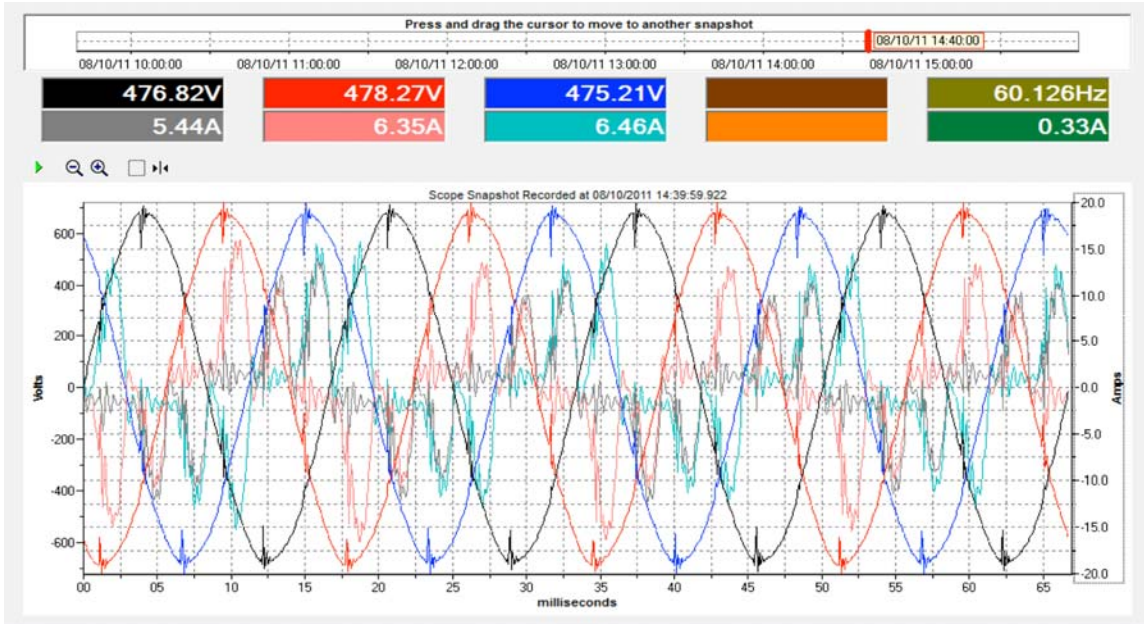
Current waveform

#### Ships Power at 30%: Significant Harmonic Load but electronics function

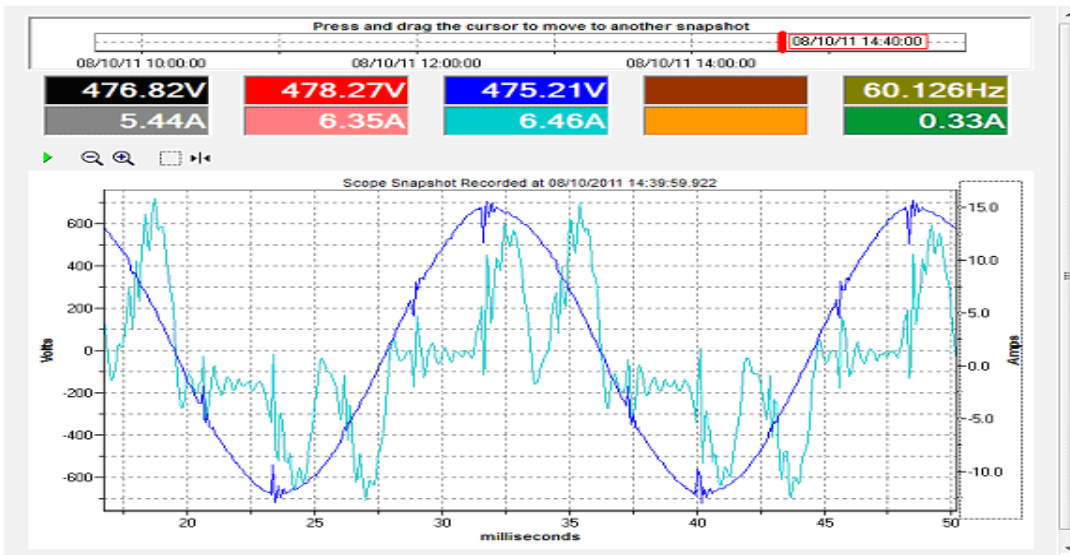


Notches at voltage waveform peaks caused by disrupted current waveform

**Ships Power at 60%: All Electronics are Disrupted**



**One of three Legs shown on all previous Graphs allows further detail of analysis to identify the origin of harmonics on that leg**



**Current Waveform Disruption Signature is of a Variable Drive**

**If power is used at 120 volts all electronic loads data will be recorded and that provides a further level of analysis (see Page 11)**

**PORTION OF A NARATIVE DATA SUMMARY PAGE (DP Shale Shaker 2 Graphs)**



- DP Rig is experiencing high harmonic distortion within its infrastructure. The cause is due to the introduction of growing number of electronic loads during operation. The growth of the electronic use creates an exponential growth of harmonics. Harmonics creates heat, lowers power factor, which wastes energy and shorten the useful life of any electronic Equipment.
- Electronic loads distort the current waveform, which, result in voltage waveform distortion.
- Simple devices like Laundry room Washers and Dryers are also victims of the same phenomenon.
- **The inherent nature of grounding on a ship prevents fault and noise current from being completely “removed” from the vessel, so that those undesired currents tend to circulate throughout, raising the impedance of the ground path so it no longer is the “path of least resistance.” Those currents may then follow the supply paths or data signal paths resulting in unreliable functionality of electronics and electrical systems.**

**The information presented to this point is a single example of the detail provided by the Load Centric Power Analysis and ability to use the data to identify a source of electrical disruption in the Marine Industry. Knowing the disruption allows a recommendation for solution as well as a procedure to show the solution works.**

**The remainder of this paper will focus on recommendations for solutions as well as solutions.**

### **Non-Electronic Recommendations & Solutions:**

**When the LCPA process identifies disruptions caused by the signature of a non-electronic equipment cause it will be identified. Examples in the Marine industry have been delaminating transformers, faulty auto-switches and generator malfunctions. All recommendations will be generic in nature and the solution will normally be sourced through the client’s current provider. If requested Leveler will consult with the equipment provider to review the relevant data so they can select their “best” product solution.**

### **Electronic Recommendations & Solutions:**

**When the LCPA process identifies disruptions to electronics they will be identified and recommendations will include specific solutions, which in most cases will be Leveler products. Leveler products are based on patented technology that provides the following primary impacts:**

## Basic Functionality of Leveler Technology/Products

- **99% of Surge energy is dissipated providing complete protection not possible with conventional systems** (See Graphs following page)

The primary failure mechanism that Leveler is designed to mitigate is the presence of non-fundamental current energies emanating from a Source and directed towards a Load on any and all power delivery paths such as Line, Neutral or Ground.

- **The circuits operate bi-directionally, significantly reducing harmonics and the associated heat and energy loss**

The Leveler circuit operation captures the energy flow in two directions; first as the current flows from the source to the intended equipment, and then afterwards as the current flows from the same load back to the source (Harmonics)

- **Ground paths are clean with no ground current to create frequency interference to chip logic and elimination of dangerous ground current now commonly present in electrical infrastructures of data centers**

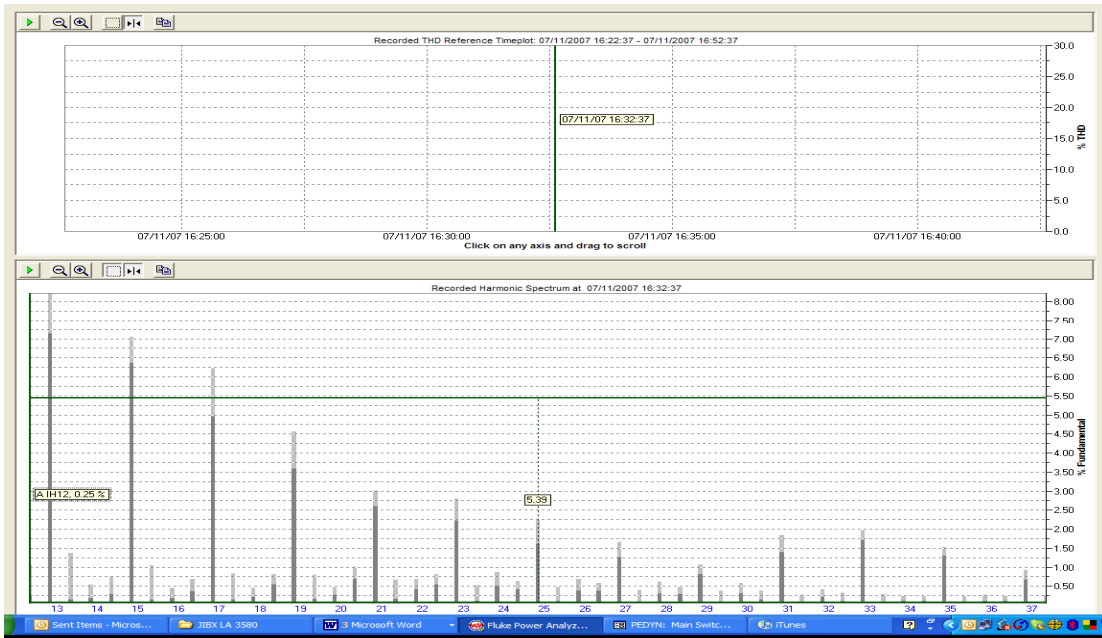
## Primary Benefit of Leveler Technology/Products

### INCREASED UP-TIME OF ELECTRONICS AND ALL RELATED SYSTEMS

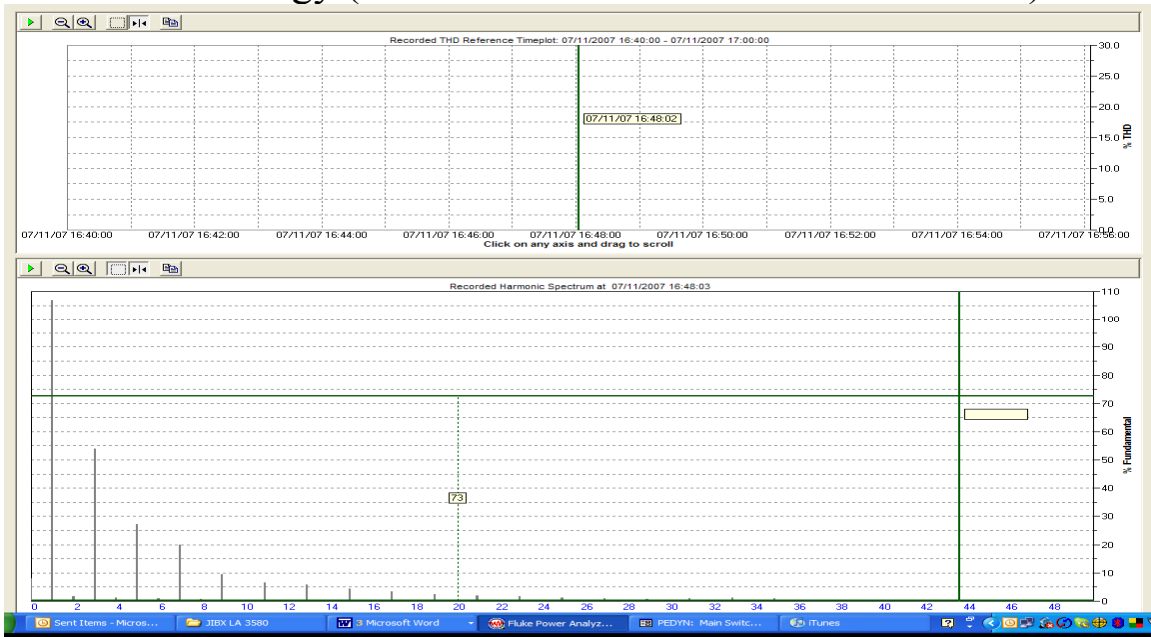
Use of Leveler products ensures the maximum utilization of electronics and their related systems which leads to the most efficient and profitable operation for any Marine environment where deployed.

### **Leveler Harmonic Performance: (120 Volt)**

Example of disruptive current harmonics at a load without Leveler technology (Left vertical line is total current to load)



Example of non-disruptive current harmonics at the same load with Leveler technology (Left vertical line is total current to load)



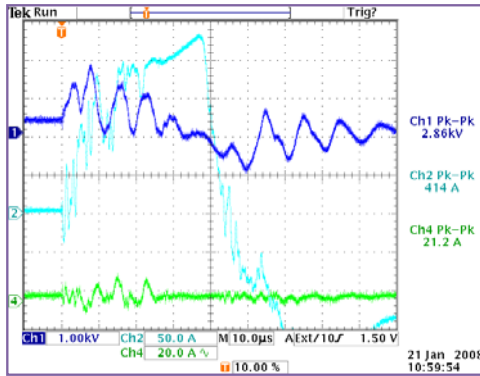
Leveler

Surge and

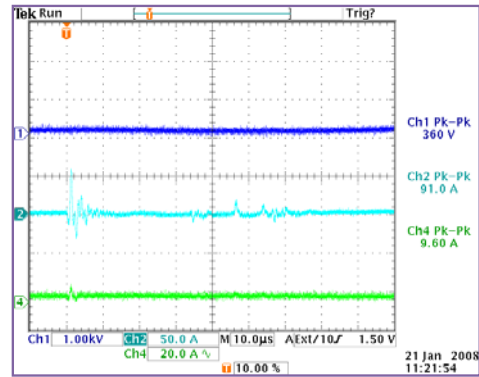
### Ground Protection

## LEVELER SURGE RESPONSE CHARACTERISTICS

### 6000V 3000A UL Lightning Surge Standard



Surge Event



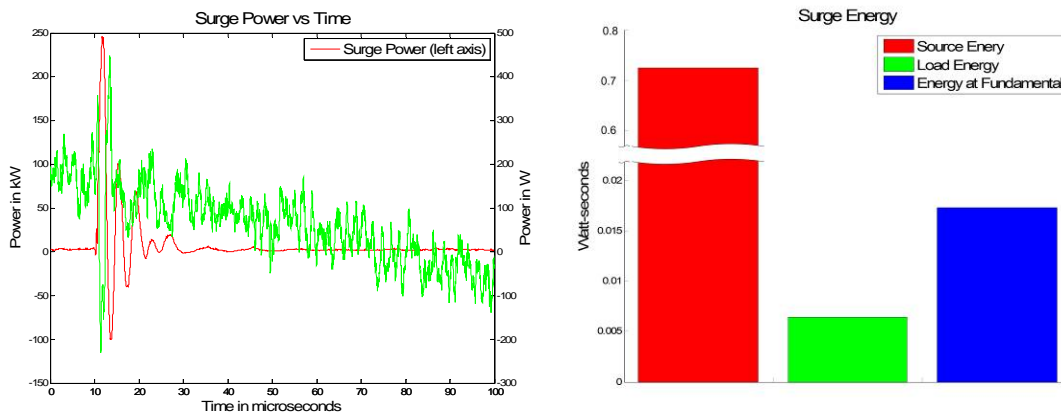
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Line/Neutral surge energy is blocked/Ground Path Isolated

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The above graph shows the performance of Leveler products for both surge and ground protection. At the point of the highest energy in a UL standard surge there is no significant energy on ground and non-disruptive levels on line and neutral.

The energy bar graph below shows that the load energy is attenuated beyond the energy that would be present during normal operation (shown in blue). In other words, the energy falls below the load's energy need during normal operation. The dip in energy is not disruptive to electronic loads because of the dip's very short duration. Electronic loads such as SMPS can skip a 60 Hz cycle without losing normal operation and a 60Hz cycle is over 1500 times greater in duration than the surge time interval.



## LEVELER MARINE 0 to 300 Volt PRODUCT SPECIFICATIONS



Visit Leveler Protective Technology on the Web to learn more or speak with a representative today!

<http://www.levelerllc.com>

### Electrical Ratings

Input connection	IEC or NEMA plug
Input Voltage	0-300 VAC single phase
Amperage	20
Nominal Cycle	50 to 60 Hz

### Performance Metrics

Electrical Mode Protection	Patented in-series Normal (L-N) and Common Mode (L-G, N-G, L,N,G)
Harmonic Attenuation	40% typical reduction of odd-numbered current harmonics
Power Factor Correction	Up to 30% average improvement
EMI/RFI Filtration	Each path bi-directionally filtered (patented)
Noise Attenuation	Up to 100dB reduction Normal Mode, up to 60dB on Ground; Range of 100 Hz - > 1GHz
Electromagnetic Pulse Reduction	Blocks all unwanted current from pulses entering all paths
Surge Joule Rating	Series Mode Protection = Unlimited Joules of Energy Suppression
Duty Cycle	Tested independently to retain performance after 24 hours of constant 6000V, 3000A surges without any degradation to unit or load.
Surge Withstand Rating	Severe Performance Test— 6000 Volts, 500 Amps Cat. A C62.41-1991 Ring-wave surge (at 90 degree point of input sine wave, positive charge, L1, L2/PE) injected every 45 seconds with powered loads in place for a total of over 1260 injections in a 24 hour period— no degradation of device or attached load.

### Intellectual Property

U.S. Patents  
6,166,458, 6,288,917 and  
patents pending



### Approximate size:

**Height**  
2.0inches

**Width**  
7.0inches


**Depth**  
3.0inches


### Questions Regarding:


Technology ● Performance ● Patents ● Agency Testing  
LEVELER, LLC,  
5120 Belthont R. Site E, Downers Grove, IL 60515



## LEVELER MARINE SOLUTION RESULT







**Description:** Derrick barge  
**Location:** Mexico  
**Length (ft/m):** 456/139  
**Water Depth (ft/m):** 650/200  
**Pipe Diameter (in/cm):** -  
**Lift (tons) st/mt:** 880/800  
**Berths:** 346

### The Problem

Global Industries Derrick Barge, the Titan II, had recently been overhauled and outfitted with advanced electronics, communications and navigational control equipment. In preparation for deployment and operations off the coast of Mexico, sea trials were being conducted to ensure readiness.

In short order, an old problem crept into the vessel causing disruptive conditions with the computerized navigation and positioning systems. Power engineers were once again baffled and the operational start date was fast approaching.

That's when Leveler got the call.

### Our Solution

Leveler responded by rapidly collecting technical data and conducting an assessment over the phone. We knew what their problem was. A combination of harmonic distortion, transient events and the inherent missing ground in marine vessels was causing the performance problems.

Within 10 days, our staff engineered a specially sized configuration of our technology, manufactured our devices on the opposite side of the country and delivered the solution for transport by helicopter to the installation site.

Our rapid response not only corrected a problem that has plagued the industry for more than 25 years, but in this case saved Global Industries more than \$250,000 in lost revenue per day.

With today's technologies serving as the lifeblood of your vessel, make certain that Leveler is a part of your crew.

To learn more about how Leveler can help you provide the ultimate level of protection for your technology investment, visit us online at [www.leveler3c.com](http://www.leveler3c.com).

## **Primary Benefit of Leveler Technology/Products**

### **UPTIME OF ELECTRONICS AND ALL RELATED SYSTEMS**

Use of Leveler products ensures the maximum utilization of electronics and their related systems which leads to the most efficient and profitable operation for any Marine environment where deployed.

All data and graphs used in this presentation is from on site tests or third party confirmation reports. All details and data are available on request. Information from some third party reports will require a non-disclosure agreement to be executed.