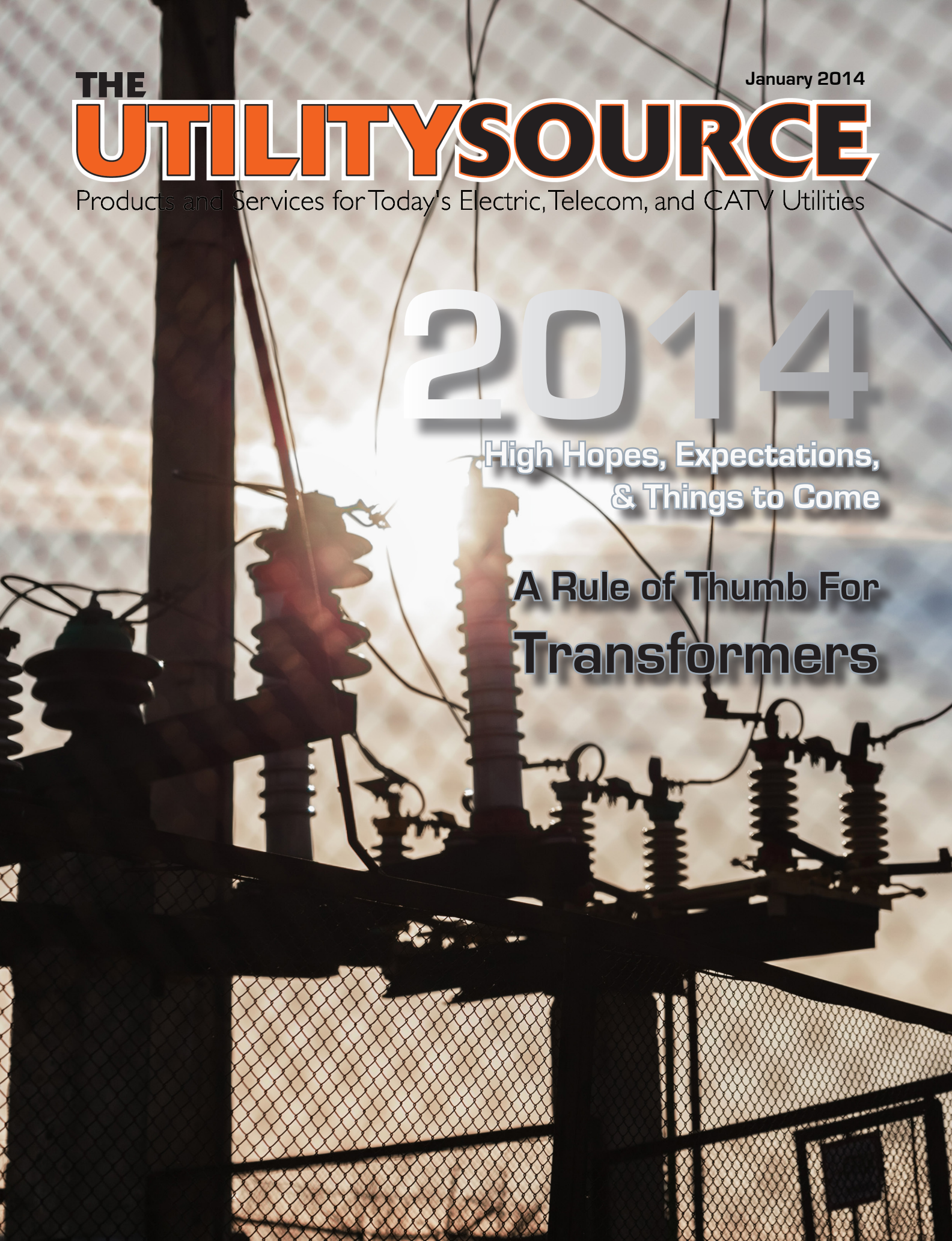
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2014

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A Rule of Thumb For Transformers

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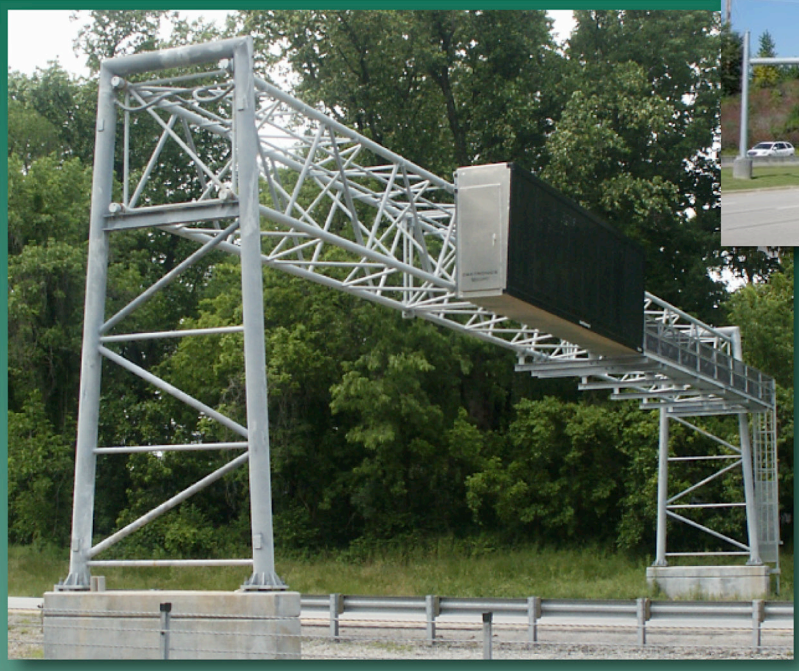
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It's a new year, and with it come high hopes and expectations for things to come.

The economy seems to have begun a slow march toward recovery. There is a push from the White House for research, growth and development in the energy sector. Technological innovations and breakthroughs are driving progress forward and speeds that are fascinating to watch.

Back in October, ICUEE showcased a lot of large, old names in the industry bringing renewed ingenuity to equipment that, for a long time, seemed to change little beyond the cosmetic. And it introduced a few newer, smaller companies doing revolutionary things that, if successful, could usher in big changes in the industry.

My hope for the new year is that we all continue to build strategically and carefully on the successes of last year, while remaining open to people and ideas that could catapult us to a whole new level. 2014 promises to be a year of optimism and steady growth… but I suspect it may also usher in some pretty audacious milestones and achievements as well. Hopefully you, our readers, will be on the receiving end of the latter.

For our part, we will continue to expand our chorus of new voices in an effort to continuously improve this book. We will also branch out not only on the type of content we provide, but in the way we deliver it. This issue marks the completion of our transition to a 99.9% digital publication.

While we understand that some people prefer a physical copy in their hands—and we will still provide that for those who request it—the move to digital will allow us to bring richer, more varied and more interactive content, while at the same time making this more of a two-way conversation with you, our readers.

Like I said, it's a new year, and with it comes high hopes and expectations for things to come. For me that means a challenge to make each issue of The Utility Source is better than the one before. And I'm grateful to have you along for the ride.

Danny Thompson, EDITOR

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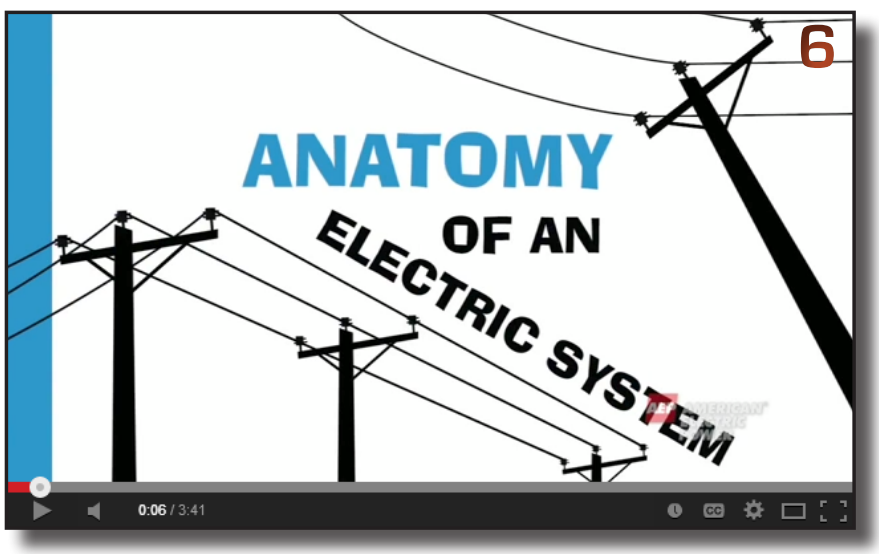
Best of the WEB



Just some of the things we came across while surfing the web.

1. Open IE Looks at a White House report on the major problems facing the power grid
   http://bit.ly/1kCIT57
2. SmartGridNews Jesse Berst offers advice on future-proofing your utility
   http://bit.ly/1kCIYWv
3. SmartGrid also rounds up media coverage and commentary on the positive side of smart meters
   http://bit.ly/1kCmBPR
4. The Center for Rural Affairs offers this white paper on addressing key community concerns in clean energy transmission
   http://bit.ly/1kCmgN2
5. Off-topic, but really cool: IEEE Spectrum gives an overview or DARPA's Rescue Robot Showdown.
   http://bit.ly/1kCmjIO
6. For comparison: an 1944 newsreel piece on how transmission and distribution work, versus a modern video uploaded in 2012. YouTube has made video ubiquitous... but is it better?
   1944: http://bit.ly/1kCnulk
   2012: http://bit.ly/1kCnsQN
7. Terex's Tru-Level pedaling system. We saw this in action at ICUEE. It's pretty awesome.
   http://bit.ly/1kCnrMC
8. Showcasing the wild side of what electricity is capable of (amateur videos... some language)
   http://bit.ly/1kCnI7O









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Hioki Releases iPad App for Memory HiCorders

Wireless Application Streamlines and Enhances Analysis of Waveform Data

Test and measurement equipment leader Hioki E.E. Corporation announces the development and release of the HMR Terminal to the App Store, a free iPad-only app that empowers users of the company's Memory HiCorders to analyze waveform data on their tablets. Hioki is the first company in the industry to release a software tool capable of analyzing waveforms on a tablet PC. The app supports the MR8740 (54-channel model), MR8741 (16-channel model), and MR8847 series (with models capable of measuring up to 16 channels).

Development Background of HMR Terminal

Because Memory HiCorders are used to record multiple channels of high-resolution data over extended periods of time, they have always posed challenges in terms of how to best facilitate easy viewing of large volumes of recorded data. The volume of data generated by these devices continues to increase, with recent models capable of capturing 54 channels. At the same time, the method used to view waveforms, which typically involves moving to the location the user wishes to view on the instrument's display, is essentially unchanged. Consequently, ever-larger amounts of time and effort must be expended in order to find and analyze areas of interest in recorded waveforms.

HIOKI developed HMR Terminal based on the concept of dramatically improving the efficiency of waveform analysis by taking advantage of the manner in which tablets such as the iPad, whose popularity has exploded in recent years, are used to radically reassess how users view waveform data.

Drag-based waveform scrolling and pinch-based zooming in and out allow users to view enormous waveform spaces in an intuitive, stress-free manner just as if they were interacting with a map. Once memorized, a diverse selection of gestures such as swiping in from the right side of the screen to display the cursor and flicking between screens offer such profound advantages in terms of ease of use and convenience that users typically find themselves unable to return to their previous practice of using the Memory HiCorder or a computer to analyze data.

Principal HMR Terminal Features

1. Intuitive Waveform Manipulation Like a Map App

Just enlarging one portion of a waveform for viewing on a Memory HiCorder used to require an extremely large amount of time and effort. By empowering users to scroll freely and zoom in and out by manipulating waveforms on the iPad's touch screen, HMR Terminal eliminates the stress of operations such as enlarging a waveform to view part of it at a high level of detail and zooming out to view the waveform in its entirety.

2. Simple Display of Measured Values by Freely Placing Measured Value Cursors

Users can easily display as many measured value cursors as they wish by swiping in from the right side of the touch screen. Cursors can be dragged around and placed freely and intuitively anywhere on the screen the user desires.

3. Simple Display of Waveform Data Calculation Values in List Form

Users can easily switch to a screen displaying a list of calculated values for the displayed waveform including maximum, minimum, and average values simply by flicking the screen. The ability to instantly switch to the screen of calculation values while viewing dozens of channels of waveform data streamlines analysis.

4. Quick, Batch Adjustment of Channel Positions

Tasks such as grouping channels and aligning their zero-positions or tweaking the display so that channels do not overlap used to involve manipulating one channel at a time, making them extremely time-consuming. HMR Terminal lets users group channels intuitively simply by connecting their zero-positions with their fingers and then change the position or zoom factor of each, all at once. Users can also quickly and easily space channels evenly and position them as desired in the waveform space.



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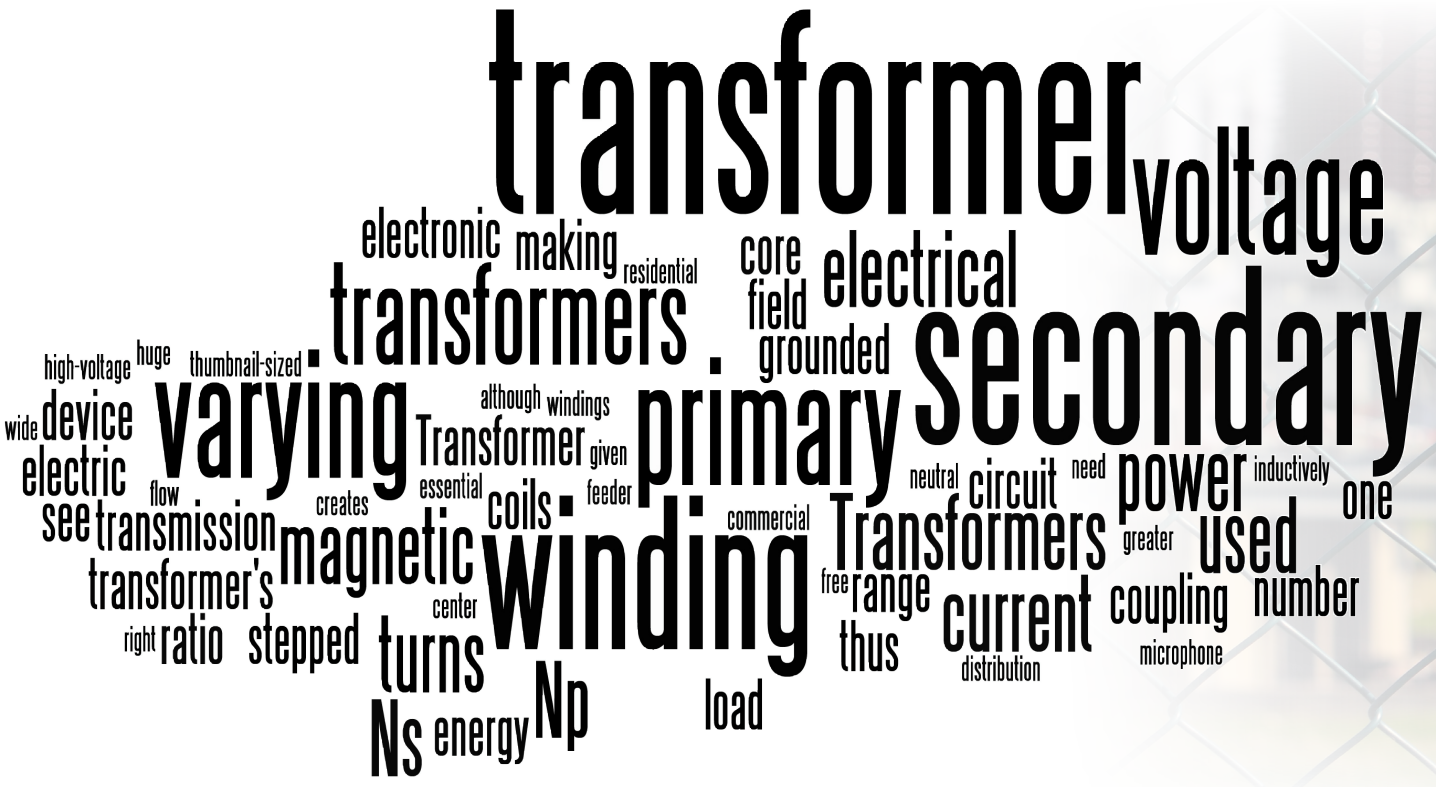
A Rule of Thumb





For Transformers

By Mike Dickenson



Transformers and Losses

Transformers aren't perfect devices; they don't convert 100% of the energy input to usable energy output. The difference between the energy input and that which is available on their output is quantified as energy loss. There are two types of transformer losses: no-load losses and load losses.

- **No-load losses**

No-load losses are also referred to as core losses. This loss is calculated based on the amount of power required to magnetize the core of the transformer. Since most distribution transformers are energized 24/7, no-load losses are present at all times, whether a load is connected to the transformer or not. When lightly loaded, no-load losses represent the greatest portion of the total losses.

- **Load losses**

Load losses on the other hand, are those losses incident to carrying a load. These include winding losses, stray losses due to stray flux in the windings and core clamps, and circulating currents in parallel windings. Because load losses are a function of the square of the load current, they increase quickly as the transformer is loaded. Load losses represent the greatest portion of the total losses when a transformer is heavily loaded. Transformer loss data is readily available from most manufacturers.

Deciding which Transformer to Purchase

Many electrical distribution utilities claim that they purchase distribution transformers using some type of loss evaluation procedure. However, transformer cost continues to be a major factor in determining which transformer to buy. The components in a transformer, design, construction and installation all affect its cost. For example amorphous metal core transformers have 75% less no-load loss than a silicon steel core transformer but cost 25% more than a silicon steel transformer.

Transformer losses affect the cost of design, construction and installation. The transformer manufacturer typically incorporates the cost of losses in the cost of the transformer in optimizing transformer design.

Most companies buying transformers look at the quotation rather than the total cost of ownership (TCO). The TCO over the life of the transformer tends to be high in less energy-efficient transformers, while the initial cost is higher and the TCO low for energy-efficient transformers.

The payback period for investing in high-efficiency transformers however is relatively short - often less than 2 years. The Internal Rate of Return in energy efficient transformers is consistently above 10% and sometimes as high as 70%.

Making buying decisions for a large power transformer is more complex than simply comparing manufacturer prices. It requires a company to know its requirement and compare not just the cost of transformers but also the TCO over a two- to three-decade period. If this is accurately done, the cost-efficient solution invariably turns out to be the energy-efficient transformer, even



though it has a slightly higher initial cost.

How To Choose A Transformer

When choosing a transformer, there are two primary concerns: the load and the application. Several factors must be evaluated carefully while making the choice, to ensure that the needs of both primary concerns are met.

To use a cliche, it is typically a 'no-brainer' to choose smaller transformers. A unit with a kVA rating that is larger from the anticipated load can quickly be picked up. But if you are selecting a large unit for an electrical utility system, to be part of a large distribution network, you are typically making a much larger investment; thus the evaluation process is much more detailed and elaborate. With over 90 years of experience in this industry, Pacific Crest Transformers has put together a quick checklist to help you make your choice judiciously.

Top Questions

There are three major questions that influence your choice:

- Does the chosen unit have enough capacity to handle the expected load, as well as a certain amount of over load?
- Can the capacity of the unit be augmented to keep up with possible increase in load?
- What is the life expectancy of the unit? What are the initial, installation, operational, and maintenance costs?

Evaluation Factors

The cost and capacity of the transformer typically relate to a set of evaluation factors:

1. Application of the Unit

Transformer requirements clearly change based on the application. For example: in the steel industry, a large amount of uninterrupted power is required for the functioning of metallurgical and other processes.Thus, load losses should be minimized - which means a particular type of transformer construction that minimizes copper losses is better suited. In wind energy applications, output power varies a great extent at different instances; transformers used here should be able to withstand surges without failure. In smelting, power transformers that can supply constant, correct energy are vital; in the automotive industry, good short-term overload capacity is a necessary attribute.

To Select the Right Transformer, First Determine:

- Primary voltage, which is the available voltage
- Secondary voltage required by load equipment
- Frequency (in Hz) and phase (single or three-phase ? for the secondary voltage as well)

- kVA load; with possible future increases factored in
- Is the transformer to be used indoors or outdoors?
- Is the transformer to be floor or wall-mounted?
- Is an auto transformer or a double-wound transformer required?

Textile industries, using motors of various voltage specifications, will need intermittent or tap-changing transformers; the horticulture industry requires high-performance units that suit variable loading applications with accurate voltage.

These examples serve to underline that type of load (amplitude, duration, and the extent of non-linear and linear loads) and placement are key considerations. If standard parameters do not serve your specific application, then working with a manufacturer that can customize the operating characteristics, size and other attributes to your needs will be necessary. Pacific Crest regularly builds custom transformers for unique applications.

2. Insulation Type (Liquid-Filled or Dry Type)

While there is still debate on the relative advantages of the available types of transformers, there are some performance characteristics that have been accepted:

- Liquid-filled transformers are more efficient, have greater overload capability and longer life expectancy.
- Liquid-filled units are better at reducing hot-spot coil temperatures, but have higher risk of flammabili ty than dry types.
- Unlike dry type units, liquid-filled transformers sometimes require containment troughs to guard against fluid leaks.

Dry type units are usually used for lower ratings (the change-over point being 500kVA to 2.5MVA). Placement is also a crucial consideration here; will the unit be indoors serving an office building/apartment, or outdoors serving an industrial load? Higher-capacity transformers, used outdoors, are almost always liquid-filled; lower capacity, indoor units are typically dry types. Dry types typically come in enclosures with louvers, or sealed; varnish, vacuum pressure impregnated (VPI) varnish, epoxy resin or cast resin are the different types of insulation used.

Liquid-filled types: choice of filler material

The choice of filler material is usually based on factors that include temperature rating of the transformer, mechanical strength of the coils, dielectric strength of the insulation, expansion rate of the conductors under various loads, and resistance to thermal shock of the insulation system.

Liquid-filled types: temperature considerations

Using fluid both as an insulating and a cooling medium, liquid-filled transformers have rectangular or cylindrical forms when constructing the windings. Spacers are utilized between the layers of windings to allow the fluid to flow and cool the windings and core.

Within the sealed tank that holds both core and coils, the fluid flows through ducts and around coil ends, with the main heat exchange taking place in external elliptical tubes. For transformers rated over 5 MVA, radiators (headers on the top and bottom) are used for additional heat transfer. Modern paper insulation in liquid-filled units allows a 650C average winding temperature rise.

Dry type: temperature considerations

Dry type insulation provides dielectric strength and ability to withstand thermal limits. Temperature rise ratings are typically 1500C, 1150C, and 800C, based on the class of insulation used (see box).

3. Choice of Winding Material

Transformers use copper or aluminum for windings, with aluminum-wound units typically being more cost-effective. Copper-wound transformers, however, are smaller - copper is a better conductor - and copper contributes to greater mechanical strength of the coil. It is important to work with a manufacturer that has the capability and experience to work with either material to suit your specific requirement.

Dry Type Units: Insulation Classes

- Class H - 2200C (with 300C winding hot spot allowance)
- Class F - 1850C (with 300C winding hot spot allowance)
- Class B - 1500C (with 300C winding hot spot allowance)

4. Use of Low-Loss Core Material

Core choice is a crucial consideration, and core losses should be determined properly. Losses that occur in the core are due to hysteresis and eddy currents. High quality magnetic steel should be used so that hysteresis losses are reduced; laminated cores are chosen to minimize eddy current losses.

5. Protection from Harsh Conditions

It is very important that transformer core, coils, leads and accessories are properly protected, especially when used in harsh environments. Liquid-filled transformers should be of sealed-

type construction, automatically providing protection for the internal components. For highly corrosive conditions, stainless steel tanks can be employed. Some approaches to building dry-type transformers for harsh environments include cast coil units, cast resin units, and vacuum pressure encapsulated (VPE) units, sometimes using a silicone varnish. Unless the dry-type units are completely sealed, the core/coil and lead assemblies should be periodically cleaned, even in non-harsh environments, to prevent dust and other contaminant buildup over time.

6. Insulators

Dry-type transformers normally use insulators made from fiberglass-reinforced polyester molding compounds. These insulators are available up to a rating of 15kV and are intended to be used indoors or within a moisture-proof enclosure. Liquid-filled transformers employ insulators made of porcelain. These are available in voltage ratings exceeding 500kV. Porcelain insulators are track resistant, suitable for outdoor use, and easy to clean.

High-voltage porcelain insulators contain oil impregnated paper insulation, which acts as capacitive voltage dividers to provide uniform voltage gradients. Power factor tests must be performed at specific intervals to verify the condition of these insulators.

7. Regulation

The difference between the secondary's no-load voltage and full-load voltage is a measure of the transformer's regulation. This can be determined by using the following equation:

$$\%\text{Regulation} = \frac{V_{no-load} - V_{full-load}}{V_{full-load}} \times 100$$

Where $V_{no-load}$ is the no-load voltage

and $V_{full-load}$ is the full-load voltage.

Poor regulation means that as the load increases, the voltage at the secondary terminals drops substantially.

8. Voltage Taps

Even with good regulation, the secondary voltage of a transformer can change if the incoming voltage changes. Transformers, when connected to a utility system, are dependent upon utility voltage; when utility operations change or new loads are connected to their lines, the incoming voltage to your facility may decrease, or even perhaps increase.

To compensate for such voltage changes, transformers are often built with load tap changers (LTCs), or sometimes, no-load tap changers (NLTCs). (LTCs operate with the load connected, whereas NLTCs must have the load disconnected.) These devices consist of taps or leads connected to either the primary or sec-



ondary coils at different locations to supply a constant voltage from the secondary coils to the load under varying conditions.

9. Life Expectancy

It is commonly held that the useful life of a transformer is the useful life of the insulation system. Insulation life is directly proportional to the temperatures being experienced by the insulation across operation. Winding temperatures vary, and hot spots at a maximum of 30˚C above average coil winding temperature are usually acceptable for dry-type transformers. Hot spot temperatures are estimated by calculating the sum of the maximum ambient temperature, the average winding temperature rise, and the winding gradient.

Transformers typically have a 'nameplate' kVA rating, and this represents the amount of kVA loading that will result in the rated temperature rise under standard operating conditions. When used in these 'standard operating conditions', including the accepted hot-spot temperature with the correct insulation class, a 'normal' transformer life expectancy can be estimated.

10. Overloading

Operating conditions can sometimes necessitate overloading of a transformer; and what this overloading means to the unit, in terms of what it can withstand without developing problems or faults is an important consideration. A primary issue is heat and its dissipation.

For example, if a transformer is overloaded to a factor of 20% above its rated kVA for a certain period of time, any heat developed in the coils may be easily transferred to the outside of the transformer tank depending on the period of overload. If this heat transfer occurs, then the chances of a fault occurring are small; but there is clearly a time period beyond which the transformer cannot continue to be in the overloaded condition; heat can start to build up internally within the unit and cause serious problems, leading eventually to a fault and a possible power outage. Heat dissipation issues are often addressed with built-in fans, thus augmenting the load capability of the transformer as well.

11. Insulation Level

The insulation level of a transformer is based on its basic impulse level (BIL). The BIL can vary for a given system voltage, depending upon the amount of exposure to system over voltages a transformer might be expected to encounter over its lifecycle. If the electrical system in question includes solid-state controls, the selection of BIL should be done very carefully. These controls when operating chop the current, and may cause voltage transients.

12. Shielding

A transformer's ability to attenuate electrical noise and transients is an important consideration, especially when dealing with particular types of load. The application of a shield between the primary and secondary coils of a distribution transformer is often accomplished when solid state equipment such as computers and peripherals are being served.

13. Placing Transformers Near the Load

Minimizing the distance between the unit and the principal load is clearly beneficial in several ways - apart from reducing energy loss and voltage drops, it also brings down the cost of secondary cabling. The downside here is that any placement of high-voltage equipment requires very close scrutiny of electrical and fire safety issues. A suitable balance can be achieved by using units that are pre-approved or permitted by insurance companies.

14. Accessories

An added cost, accessories are installed when required. Examples include stainless steel tanks and cabinets for extra corrosion protection, special paint/finishes for corrosive atmospheres and ultraviolet light, weather shields for outdoor units, protective provisions for humid environments; rodent guards, temperature monitors, space heaters to prevent condensation during prolonged shutdown, optional location of openings for primary and secondary leads, tap changing control apparatus, and more.

Mike Dickinson is the Director of New Business Development for Pacific Crest Transformers. He has 37 years experience in transformers, including design, manufacturing, training, testing, marketing, and sales of distribution, small power, and high voltage CTs, PTs, and CVTs up to 230 kV.



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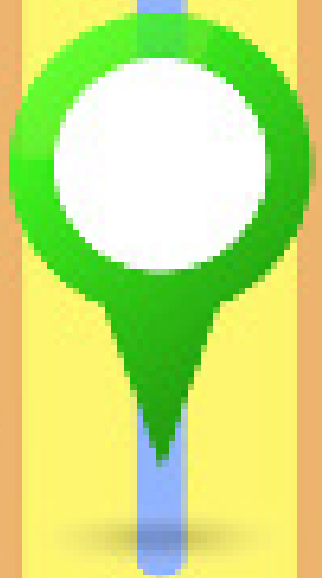
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Improving Fleet Efficiency



Vehicle tracking systems have been available to fleet managers for some time and despite an initially slow uptake in the technology, they have now become very popular amongst those who run commercial fleets. Not only do they give fleet managers peace of mind knowing that they have the exact location of every vehicle in their fleet at any one time - they can also improve fleet efficiency too, an important factor during a time of economic hardship.

A GPS tracker works by using a triangulating algorithm to give the precise location of the vehicle it is fitted to. This information is fed through to a remote-operating centre, which can then chart the location of every vehicle in the fleet. Through this mapping system, fleet managers can prioritise routes or re-allocate a vehicle to a pick-up, minimising the time that the customer waits for their collection and maximising efficiency. The utility services and network companies running fleets of mobile engineers are also finding this system extremely useful, as it allows them to allocate call-outs to the nearest available vehicle. Courier and delivery services have been using vehicle tracking systems for several years and were the first organisations to really appreciate the benefits of such a system.

Vehicle tracking systems don't just relay information on a vehicle's location, though. Good quality systems can also provide fleet management professionals with additional information such as the speed of a vehicle. Speeding is an extremely inefficient operation as increased speed invariably means increased fuel consumption. Major fleets that have used these systems have been able to reduce their annual fuel bills by up to 40% just through the information provided by vehicle tracking systems.

By spending a little company capital at the outset, a GPS vehicle tracking system can help facilitate effective scheduling, which results in a reduction in the amount of time vehicles are standing idle or not being used at optimum efficiency. They can also

with GPS Tracking

By Kent Stabler

reduce delivery time delays and improve supply chain management by enabling fleet managers to prioritise routes. This leads to better customer relations as fleet managers are able to give their customers more accurate estimated arrival times.

Another saving comes in a more unexpected area. Fleet insurance policies can be cripplingly expensive, particularly for small and medium sized companies. However, insurers now regard vehicle tracking devices as a major force in the fight against vehicle theft and offer substantial policy discounts for fleets with GPS trackers fitted. Faster recovery times of stolen vehicles, a reduction in the potential damage to stolen vans and cars by thieves and eliminating the need to hire replacement vehicles to cover the shortfall left as a result of a vehicle theft all add up to a considerable annual saving.

Vehicle tracking systems can also tell a fleet manager if vehicles are being used out of hours by drivers for their own, personal use. Technically, this could be regarded as misappropriation of a company vehicle and can cost firms a great deal of money over the course of a year. If a driver knows that their movements are being plotted by a remote GPS tracking device, then he or she will be less inclined to use a company vehicle inappropriately. Again, this all adds up to savings for the company.

In a time of recession, every business is looking for ways to improve productivity, efficiency and cut costs. Although it may seem strange to advocate spending money on a complex vehicle tracking system during these lean times, the long-term savings these systems represent are financially prudent and an essential part of effective fleet management.

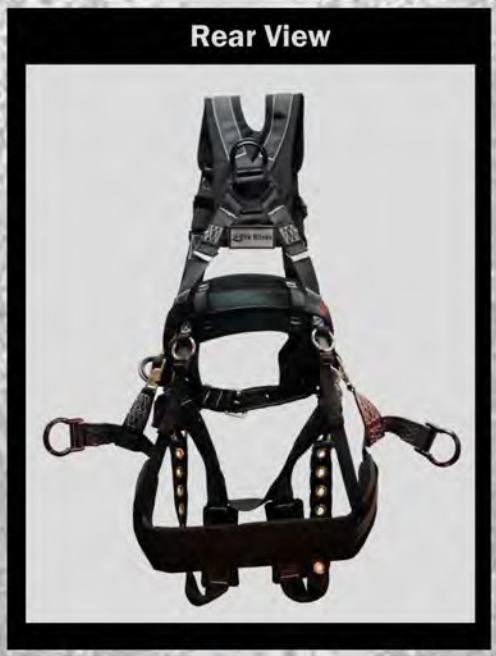


Kent Stabler - Marketing Manager - Chameleon Direct are suppliers of gps vehicle tracking systems, gps tracking devices, hands free car kits and speed camera detector equipment. Our vehicle tracking aims at helping improve your fleet management. With over 1 Million UK customers Chameleon Direct also provide hands free installation services.

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Power Pole Setter

Machines That Do the Work for You

By Jerry Seaman

As cities expand and rural areas begin to open up to development, more and more rough terrain utility pole installations are being seen across the U.S. When work is contracted out to companies who specialize in this type of job, the companies should be able to provide a power pole setter than can get the work done with smaller crews and more controlled precision. The machinery used should also be able to work through any kind of weather, including strong winds and ice. Poleset is a company who qualifies across the board, offering to get rough terrain jobs done in no time by utilizing our Xtreme Polesetter II hard-tracked trucks.

The Polesetter II has been engineered to work even in the harshest of inclement weathers and rough land terrain. The truck was tested by independent parties using computer generated analysis to ensure that it would live up to the claims made of its abilities. This impressive power pole setter is able to dig a hole to the appropriate depth with ease, effortlessly lift and place the nearly half-ton pole, and attach requisite wires seamlessly. Other pole setters may vary in size, making different machines right for different jobs, but before every job begins, engineering and design plans are thoroughly researched and implemented.

Before excavation of land begins for the power pole setter to drop in the towers, crews will be thinking about everything involved in the job, including the new installations, retrofitting or upgrading existing systems, consolidation, or realignments. Designers will do their best to ensure that work done in a neighborhood will block street and sidewalk access as little as possible and also do their best to ensure that the end result doesn't add up to a cluttered street view. Pre-planning allows for maximizing space for drops, reducing clutter, cutting, and trenching, and creating a job environment that is safer for the amount of planning to ensure that it will be so.

With the amazing modern machinery used today, it's no wonder that power pole setters have cut down both crew size and job time from years gone by. These trucks are able to be transported easily to and from job sites without ruining lawns and landscapes in the process, can hoist one to two workers 60 feet into the air to reach important work spaces with little fear of injury, and can be remotely operated to ensure safety in cases where extra precaution is required. Durable, weather touch, and quick, it make sense to have these trucks, especially trucks like the Xtreme Polesetter II, with you on any pole set job.

Cat Powered Pole

A cat powered pole setter is one of the most popular types of pole setting equipment, with a wide range of different settings, shapes, and sizes. However, there are other special features that you will want to look at. For example, many technicians will choose to find a setter that has hydraulic capabilities in boom movement.

The boom of the cat powered pole setter might be constructed of many different types of materials, but fiberglass tends to be one of the most popular because it is so lightweight yet sturdy at the same time. The control panel should have multiple levered controls, as well as an





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emergency stop switch on the main panel so that you can stall the engine should there be any obstructions in the road. When you are navigating heavy machinery through rough terrain, these safety features are important, because you might run into wildlife or other factors of this nature out in the wilderness.

Other recommended features for your cat powered pole setter include a platform liner, leveler pads, and wheel chocks. The best vehicles will also have a fall protection system, to help protect against any tumbles or spills that you might take. Be sure that your vehicle has been examined by an independent contractor or team before making any purchase, because you want a separate assessment than what the manufacturer might be giving you. This is particularly true for any used models. Although they can be a great bargain, they may come with their share of hazards if you are not careful.

Some extra options that you can add on to your cat powered pole setter include radio remote upper controls, an engine foot throttle, high speed winch, and a boom tip winch. You can also choose whether or not you would prefer a behind cab and corner mount, or hydraulic upper controls. It's possible to virtually construct your own vehicle before making any final decisions. This can ensure that you will get the most unique and individualized piece of machinery for your outdoor work.



Jerry Seaman is Vice President / Sales-Poleset Equipment. Our off road, radio remote controlled, hard track equipment design allows our company to tackle steeper and more sidling terrain than our competition. Our machines allow the operator to remain at a safe distance while positioning the equipment and operating the boom. www.poleset.com



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Tuf Lugger Lite Cable Puller

A powerful gas powered cable puller this comes out of the box ready for pulling jobs up to 2200 lbs. Adding snatch blocks can double, triple or quadruple your pulling strength (depending on the arrangement). Lightweight at only 35 lbs, this cable puller can be carried in and out of less easily accessible locations.

Clear Loc Couplers

Underground conduit couplers that simplify the installation process by sliding completely over one conduit end then sliding back over the second conduit end once aligned. A clear body provides visual assurance of proper conduit and coupler placement.

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Falcon MINI Asphalt Recycler & Hot Box

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ECCO's New 5590 Reflex™ LED Minibar

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Product Features:

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• High visibility yellow rubber tipped temples improve visibility, reduces slipping.

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AutoExec, Inc. HideAway

Working in a utility vehicle doesn't mean you have to mount your technology out in the open. The AutoExec HideAway is designed to securely mount a laptop inside of the metal storage box that has been a standard in utility vehicles for years. The HideAway has a unique gas lift that can support up to 25 lbs. The HideAway is easy to use and keeps your laptop out of view, and out of the way of the driver; making this the ultimate laptop support system in the mobile office industry.



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The i-Guard Theft-Deterrent System by STRATTEC

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Certifications for Operators of Digger Derricks, Articulating Boom Cranes

Crane Institute Certification (CIC) announces certification programs for operators of articulating boom cranes and digger derricks. Written and practical tests were developed by subject matter experts representing manufacturers, public utilities, unions, contractors, and training professionals. Certified Mobile Crane Operators can add designations for Articulating Boom or Digger Derrick by completing a supplement written exam. CIC practical exams are an effective measure of the operator's skill.





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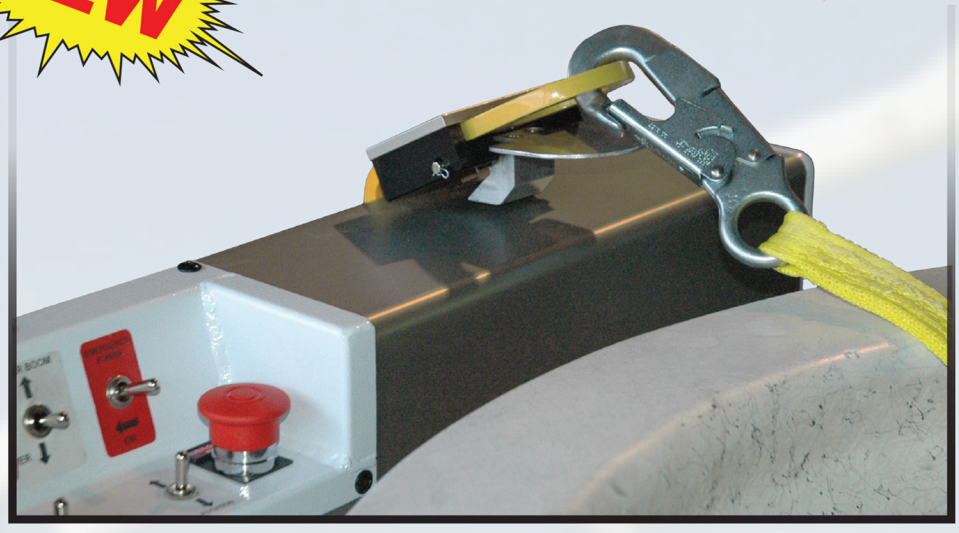
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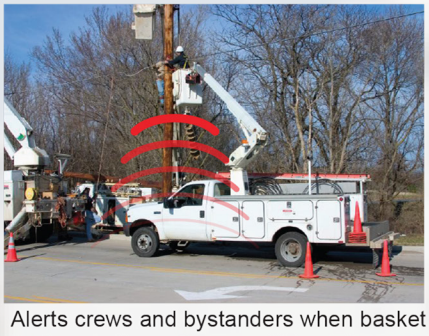
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Vert-Alert™ is an integrated warning system that alerts operators of aerial lifts to attach their safety harness lanyard prior to elevating the lift.



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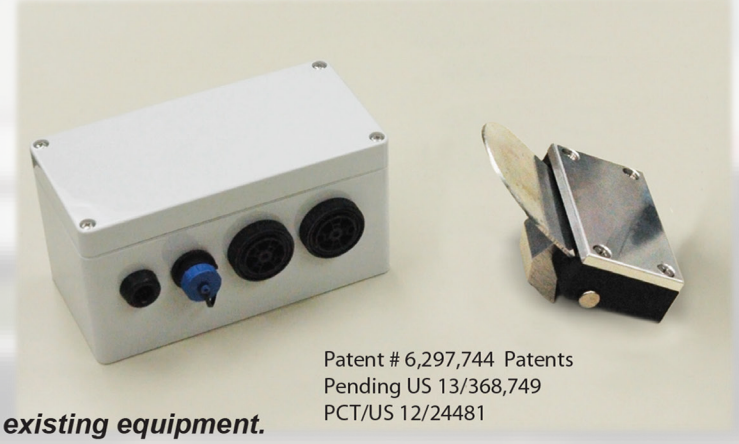




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