

FLUKE®

FLUKE Electrical News

Products and tips for electrical professionals

Volume 1, Number 1



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Fluke Corporation
PO Box 9090, Everett, WA USA 98206

Fluke Europe B.V.
PO Box 1186, 5602 BD
Eindhoven, The Netherlands

For more information call:
In the U.S.A. (800) 443-5853 or
Fax (425) 446-5116
In Europe/M-East/Africa +1 (31 40) 2 675 200
or Fax +1 (31 40) 2 675 222
In Canada (800) 36-FLUKE or
Fax (905) 890-6866
From other countries +1 (425) 446-5500 or
Fax +1 (425) 446-5116
Web access: <http://www.fluke.com/>

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Electrical tools for electricians

Proper use of clamp meters in commercial settings

There's nothing so annoying as a breaker that keeps tripping, usually at the most inopportune times. More annoying yet is not being able to figure out why as the production line stands silent waiting for you to work your magic. The pressure's on!

Beyond the basic measurements clamps were specifically designed for – circuit loading and balance of three-phase feeders – modern digital clamp meters have voltage and resistance measurement capability as well. That means it's possible to make most, if not all, of the common every-day measurements using a clamp meter. For optimum performance that clamp meter should be a true-rms model, like the Fluke 335, 336 or 337.

Clamp meters in commercial environments

Clamp meters are used at the panel board to measure circuit loading on feeders as well as on branch circuits. Measurements on branch circuits should always be made at the load side of the breaker or fuse.

- Feeder cables should be checked for balance as well as loading: current on all three phases should be more or less the same, to minimize the return current on the neutral.

- The neutral should also be checked for overloading. With harmonic loads, it's possible for the neutral to be carrying more current than a feeder – even if the feeders are balanced.

- Each branch circuit should also be checked for possible overloading.

- Finally, the grounding circuit should be checked. There should be minimal current on the ground.

Testing for leakage currents

To check if there is leakage current on a branch circuit, put both the hot and neutral wires in the jaws of the clamp. Any current that is measured is leakage current, i.e., current returning on the ground circuit. The supply (black wire) and return (white wire) currents generate opposing magnetic fields. The currents should be equal (and opposite) and the opposing fields should cancel each other out. If they don't, that means that some current, called leakage current, is returning on another path. The only other available path is the ground.

If you do find ground current, you should check to see if any receptacles are mis-wired (visit the Fluke Digital Library at www.fluke.com/electric for information on receptacle diagnostics). It is also possible that individual loads have internal leakage currents.

Measuring individual loads

To measure individual loads, you can use a break-out cord at the receptacle.

This is simply an extension-type cable where the outer insulation is stripped so that the black, white and green wires are exposed. It's a lot easier than taking the receptacle out to get at a wire. Plug the load into the cable and the cable into the outlet. To measure load current, clamp the black wire. Make the ground current check directly on the green cable or on the black and white wire together. ■

For the entire article, visit our web site at www.fluke.com/electric



Fluke 330 and 320 Series Clamp Meters



Choose from 7 new clamp meters to get the right combination of features and functions that fit your job.

- Measures amps, volts, ohms and continuity
- Backlight available on most models
- New inrush current feature measures motor-starting current the way a circuit breaker or overload unit sees it (selected models)
- All models feature display hold button and auto shut-off
- 3-year warranty on 330 Series, 2-year warranty on 320 Series
- Includes: batteries, test leads, instruction card, safety sheet and carrying case

CAT III 600 V

Test drive this product before you buy at www.fluke.com/electric

Fluke VoltAlert™ Voltage Detectors

Pocket-sized, non-contact ac voltage detectors that glow red when near an outlet or conductor if voltage is present.

- Fluke 1AC for 90 V ac to 600 V ac
- Fluke 1LAC for 24 V ac to 90 V ac

CAT III 600 V



Find more articles on the *Fluke Electrical News* web site.

"Receptical measurements are simple – understanding what they mean is not"
www.fluke.com/electric

Fluke 61 IR Thermometer

Easy to use

- Quick non-contact temperature measurements from -18 to 275 °C (0 to 525 °F)
- 0.2 °C or 0.5 °F resolution
- Backlight illuminates the display in the dark
- Laser-sighted; 8:1 optical resolution



"Non-contact temperature measurements using IR thermometers"
www.fluke.com/electric

T5-600 and T5-1000 Electrical Testers

- OpenJaw™ technology for easy current measurements
- AC amps to 100.0 A
- Continuity/ohms to 1000 Ω
- 600 volts ac/dc (model T5-600)/1000 volts ac/dc (model T5-1000)

T5-600: CAT III 600 V

T5-1000: CAT III 1000 V, CAT IV 600 V



Fluke 65 IR Thermometer

Best IR accuracy

- Quick non-contact temperature measurements from -40 to 500 °C (-40 to 932 °F)
- Resolution of 0.1° up to 200°, 1° over 200°
- Repeatability of ±1° or ±1 %, whichever is greater
- Backlight illuminates the display in the dark
- Laser-sighted; 8:1 optical resolution



T3 Tester

- Easy-to-use, rugged two-pole tester with 7-level LED indicator
- AC and DC voltage and continuity
- Auto-on light that automatically turns off after eight minutes
- Test leads and probes included

1000 V CAT III, 600 V CAT IV



Test tools for electricians

Fluke 1520 MegOhmMeter

- Three output voltages for insulation resistance testing: 250 V, 500 V, 1000 V
- Insulation resistance testing up to 4000 MΩ
- AC/DC voltage measurement up to 600 V

CAT III 600 V

Test drive this product before you buy at www.fluke.com/electric



Fluke 1550 MegOhmMeter

- Digital MegOhmMeter that tests switchgear, motors, generators and cables up to 5000 V dc.
- Wide range of tests - simple spot checks to timed tests and breakdown tests
- Measurement storage and included PC interface software make it ideal for preventative maintenance.

CAT III 600 V

Test drive this product before you buy at www.fluke.com/electric



Fluke 43B Power Quality Analyzer

Performs the measurements you need to maintain power systems, troubleshoot power problems and diagnose equipment failures.

- Display voltage and current waveforms
- Measure real power, apparent power and power factor
- Record sags and swells, capture transients and displays harmonics up to the 51st harmonic

CAT III 600 V

Test drive this product before you buy at www.fluke.com/electric



Fluke 41B Power Harmonics Analyzer

- Displays the harmonic spectrum, waveform and complete power data for non-linear waveforms.
- Saves up to eight sets of measurement data.
- Use the included FlukeView® software to download data to your PC for analysis and presentation.

CAT III 600 V



VR101S Voltage Event Recorder System

- Records up to 4000 sags, swells transients, outages and frequency variations on line voltage at receptacles
- Includes a compact VR101 event recorder, an optical interface cable, and EventView™ software that turns your PC into a power quality reporting tool.

CAT III 300 V



Find more articles on the *Fluke Electrical News* web site.

"Power quality at the service panel"
www.fluke.com/electric

"Troubleshooting power harmonics"
www.fluke.com/electric

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Measuring ac signals accurately is a fundamental, but increasingly difficult, job in today's offices and industrial plants. Personal computers, electronic lighting, and adjustable speed drives controlling the air handling equipment in large office buildings are just a few examples of types of non-linear loads; loads that draw current in abrupt pulses rather than in a smooth, sinusoidal manner. These pulses cause distorted current wave shapes that in turn cause harmonic currents to flow back into other parts of the power system.

Symptoms of harmonics usually show up in the power distribution equipment that supports the non-linear loads, whether single-phase or three-phase. Single-phase non-linear loads are prevalent in offices, while three-phase loads are widespread in industrial plants. The details of the effect of harmonics on different types of electrical systems vary, but common problems include transformers that overheat, even when supplying normal loads; circuit breakers that trip for no apparent reason; or neutral conductors in balanced circuits that overheat from excessive loads. Yet when measured, standard troubleshooting procedures show everything to be normal.

What's happening?

The reality is, harmonics and other types of distorted waveforms cause the readings of conventional electrical measurement tools - the majority of those on the market today - to be significantly inaccurate. When confronted with these more complicated conditions, average-responding meters can give incorrect readings that may be off by as much as 50 percent. That's because average-responding meters are designed to provide correct readings for pure sine waves only. They typically will read low when confronted with a distorted current waveform.

Enter true-rms.

Today's more complicated signal measurements require the right tools. That's why Fluke Corporation designed its 170 Series Digital Multimeters (DMMs) with true-rms (root mean square) capabilities. True-rms meters give correct readings for any wave shape within the instrument's crest factor and bandwidth specifications.

True-rms meters eliminate the risk of these incorrect measurements. A true-rms meter uses an electronic measurement technique to provide the user with the correct effective value of an ac current, whether the signal's waveform is a perfect sine wave or the short-pulse distorted waveforms frequently encountered on the job today.

Electrical and electronic equipment will only get more complicated. To track down the hidden problems that plague such systems, technicians must first make an accurate measurement by reaching for the correct tool for each measurement task. In more and more cases today, that task requires true-rms capabilities.

True-rms is available on Fluke Corporation's 110 and 170 Series Digital Multimeters and on selected 330 Series Clamp Meters.

For the entire article, visit our web site at www.fluke.com/electric

Find hidden ac problems with **true-rms**





Monitoring load current with a DMM

down ratio is commonly 1,000 to 1. So, measuring 100 amps in a load circuit through a current clamp will apply 100 mA to the DMM's current input. That's well within the DMM's capability and, conveniently, a direct reading from the DMM display. Just switch the DMM to mA ac mode and think "amps" when reading the display.

The current clamp is designed to clamp around a single conductor and uses the fluctuating magnetic field around the conductor to induce a current. Because it uses transformer action, the current transformer is only usable on ac circuits. However, there are other clamps, like the Fluke i410, designed to use the "Hall Effect" sensor which allows them to be used on both ac and dc circuits.

As long as the DMM is safety rated for the environment in which you will be making the measurement, say CAT III for electrical panels and switch gear, you can safely attach an appropriately rated current clamp to your DMM and make the measurement. Just remember that when you are using a DMM/current clamp combination you need to combine the measurement specifications of the current transformer and the DMM to get overall measurement accuracy.

Combining a DMM with a current clamp accessory enables accurate measurement and analysis of load currents.

Fluke has a wide range of current measurement accessories to fit just about any application. Current clamps with a maximum current rating ranging from 200

to 2,000 amps are available at your nearest Fluke distributor. These same distributors stock a collection of Fluke DMMs with varying feature sets so you can purchase the exact features you need in your work. ■

For the entire article, visit our web site at www.fluke.com/electric

A digital multimeter (DMM) has become a necessity for electrical system measurements, and most electricians and electronic technicians would feel lost without one. The features available in today's meters make them versatile enough to find most problems in electrical and electronic circuits.

There are, however, some measurement tasks that make a technician think twice about his DMM.

Take for instance, load currents. Many DMMs are designed to safely measure current up to 2, 10 or 20 amps depending on the DMM. Yet load currents found in most industrial environments are much higher and backed by high energy. On the surface it's not an attractive match.

That's where a DMM accessory called a current clamp comes in handy. A current clamp, like the Fluke 80i-400, can be employed to overcome the DMM's limitations for measuring ac current. Like a power transformer, the current clamp uses windings around a laminated core to step-down the circuit current within the measurement range of the DMM. The step

Fluke digital multimeters – Rugged. Reliable. Accurate.

Fluke 179 Digital Multimeter

Tough meters for industrial professionals

Designed tough to withstand the harshest work environments, and accurate enough to rival most bench meters.

- 6000-count display provides better resolution
- 0.09 % basic dc accuracy zeros in on tight readings
- True-rms ac voltage and current measurement for accurate readings on all waveforms
- Frequency, capacitance and resistance
- Auto and manual hold
- Min/max/average records irregular activity

CAT IV 600 V, CAT III 1000 V

Test drive this product before you buy at www.fluke.com/electric



Fluke 189 Logging Multimeter

Smart meters for the most demanding users

The Fluke 180 Series DMMs deliver breakthrough features and functions with the accuracy to meet the demands of any application.

- 50,000-count resolution with instant readings for detailed analyses (0.001 mV, 0.01 mA, 0.01 Ω)
- Multiple reading display with bargraph and two-level backlight
- 0.025 % basic dc accuracy
- True-rms ac, ac and dc
- 100 kHz ac bandwidth for troubleshooting modern electronics
- Two separate internal memories. One for logging up to 995 readings automatically at user selectable intervals and one for 100 manually saved measurements.

CAT IV 600 V, CAT III 1000 V

Test drive this product before you buy at www.fluke.com/electric



Find more articles on the *Fluke Electrical News* web site.

"Is that a tingle she feels? A lesson in data logging from down on the farm"

www.fluke.com/electric

"ABCs of DMM safety, Cat IV can really mess up your DMM. Worse yet, it can kill you."

www.fluke.com/electric

"So you need a DMM? Which one do you pick?"

www.fluke.com/electric

Fluke 112 Digital Multimeter

Compact meters for installers and contractors

Compact digital multimeter with a wide range of functions for general purpose measurements

- 6000-count display provides improved resolution
- 0.7 % basic dc accuracy
- True-rms ac voltage and current measurement for accurate readings on all waveforms
- Frequency, capacitance and resistance capabilities
- Min/max/average captures irregular activity
- Backlight illuminates the display in dark workspaces

CAT III 600 V

Test drive this product before you buy at www.fluke.com/electric



Fluke 80 Series III Analog/Digital Multimeters

High-performance meters for demanding industrial and electronic applications

Fluke's 80 Series III DMMs provide 11 functions for electronic and industrial applications including high-performance dc/ac voltage and current measurement, frequency, duty cycle, resistance, conductance, continuity, diode test and capacitance measurement.

- 4-1/2 digit mode, 20,000-count display (Fluke 87, 87/E only)
- 0.05 % basic dc accuracy
- True-rms measurements (Fluke 85, 87 and 87/E only)

CAT III 1000 V



Fluke 7-300 and 7-600 Testers

For fast, accurate tests of electrical power. Nothing makes the job easier; automatic readings of ac and dc voltage, and ohms. Ideal for first-level electrical troubleshooting. Auto-selection simplifies voltage measurement in power environments. 4.5 volt minimum Two-year warranty

CAT III 600 V



Cable test solutions

Fluke has teamed up with Fluke Networks

Fluke Networks is the world's leading supplier of network test solutions, offering electrical contractors the award-winning MicroTools line. This family of powerful Voice-Data-Video verification and troubleshooting tools allows you to grow your business into the VDV market.

FLUKE
networks™

MicroScanner™ Pro

The Essential All-In-One Network Tester

The MicroScanner Pro from Fluke Networks is a powerful tool that will add Voice-Data-Video (VDV) testing to the services you're already providing. It's a pocket-sized low-voltage tester that:

- Measures length and distance to fault with patented TDR technology.
- Checks wire continuity and configuration.
- Pinpoints opens, shorts, crossed and split pairs.
- Works with tone probes to locate hidden cables in walls, ceilings and wire closets.

Test drive this product before you buy at www.fluke.com/electric



MicroNetBlink Kit

- Verify cables, continuity, pair condition, line polarity, and voltage in network cabling systems and modular telephone lines.
- Flashes hub and switch port lights.
- Kit includes the MicroProbe tone probe and MicroNetBlink tone generator.
- With these tools you can trace cables hidden in floors, ceilings, walls, and in bundles.



MicroMapper™ LAN Wiremap Checker

Fluke Networks MicroMapper is a small, handheld cable tester that enables electricians to verify the integrity of twisted-pair cabling in one quick step.

The MicroMapper quickly and easily indicates opens, shorts, crossed, reversed and split pairs. Simply push the TEST button, and the MicroMapper will automatically scan all wire pairs.



MicroProbe™ – the inductive probe companion for MicroTools

Use this inductive probe with any tone generator to locate cables hidden in floors, ceilings, walls and in bundles.

- Compatible with MicroScanner Pro, MicroMapper, MicroNetBlink or any other tone generator.
- Adjustable volume control and LED for noisy environments.



Testing residential cabling systems

Networking, verifying and certifying today's "smart homes" is a growing business

It wasn't that long ago that wiring a home meant electricity and a single phone line. Today, consumers expect homes to be wired with multiple phone outlets, cable TV, and a computer network available in every room. Installers and contractors are now "home networking professionals" that are expected to not only install this new generation of residential networks, but verify and, in some case, certify them as well.

Data cabling installation is similar to, but markedly different than, the practices used to install telephone

ScopeMeter® 199C See more, fix more – with color!

The new ScopeMeter 190C Series with large, high-resolution, color screen and new Digital Persistence mode gives you an even better view of complex waveforms in the most demanding troubleshooting applications in the field.

- Up to 200 MHz bandwidth
- Up to 2.5 GS/s real-time sampling rate
- Connect-and-View™ triggering for an instant stable waveform
- Automatic capture and replay of last 100 screens
- Isolated Inputs (1,000 V CAT II/ 600 V CAT III)
- 4-hour battery operation

Test drive this product before you buy
at www.fluke.com/electric



ScopeMeter 123

- Dual input 20 MHz digital oscilloscope
- Two 5,000-count true-rms digital multimeters
- Dual input TrendPlot™ recorder
- Connect-and-View trigger simplicity for hands-off operation



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the *Fluke
Electrical
News*
web site.

**“Drive, motor or load?
Where do you start
to identify a problem?”**
www.fluke.com/electric

wiring, requiring installers to learn new skills. Even telephony wiring is changing with many newer systems employing the same four-pair UTP cabling used in data networks. Much work is already being done to standardize requirements for home cabling, often called SOHO (Small Office Home Office) cabling. In the U.S., this is covered in TIA 570A, the Residential and Light Commercial Telecommunications Wiring Standard.

These changes also require installers and contractors to have the latest generation of test tools, like the MicroScanner™ Pro from Fluke Networks, which tests both coaxial (RG6, RG59, etc. for CATV/CCTV), all twisted pair cable (UTP/STP/SSTP), and even troubleshoots other wiring for speakers, security networks or telephone cabling.

Data communications

Residential data communications cabling is typically four-pair 100-ohm twisted pair cabling rated at Category 5 or 5E. It runs from the Network Interface Device (or NID, a wiring distribution panel located near the outside data access connection) to outlets positioned in rooms throughout the home. The homeowner may choose to connect a hub at the NID or simply connect directly to an outside Internet access service, depending upon the desired complexity of the home network.

When installing residential cabling, care must be taken to preserve proper twist ratios in the cable when attaching data jacks, in

order to minimize crosstalk concerns. To avoid deformation, the cable should not be stretched or pulled around sharp corners, which could lead to performance degradation. When possible, data cabling should be routed away from cables carrying ac power to avoid noise coupling.

Certification and verification

In commercial cabling, standards are well in place for the testing and certification of structured wiring systems. Business systems are expected to place high demands on installed cabling and a myriad of standards define installation and test requirements. Such networks are certified to meet standards.

Certification refers to the process of making measurements and then comparing the results obtained to pre-defined standards, so that a pass/fail determination can be made. In the case of a Category 5E link for example, tools like the Fluke Networks OMNIScanner®2 or DSP-4300, make thousands of measurements across a bandwidth of 100 MHz and compares them to complicated formulae from agreed-upon standards.

In contrast, most home wiring systems are “verified.” Verification ensures that basic continuity and correct terminations have been applied, but does not attempt to measure the information-carrying capacity of the link. This is a reasonable simplification to make, because home networking links are considerably shorter than commercial wiring links.

Because the links are shorter, they do not



suffer nearly as much from attenuation losses. Since the signal is typically much stronger, impairments such as near end crosstalk (NEXT), far end crosstalk (FEXT), or return loss are much less of a concern. ■

For the entire article, visit our web site
at www.fluke.com/electric



Get more from your meter with Fluke accessories

T

he next time you get frustrated because you can't find the source of some stray transients that are playing havoc with your electrical system, think of the dairy cow in Minnesota that right this minute is snuggling up to a digital multimeter (DMM).

Is that a tingle she feels?

A lesson in data logging from down on the farm

Stray voltage, it turns out, can seriously stress dairy cows, inhibiting a herd's milk production. Dairy farmers for years have been on the hunt for places within barns that could produce unwanted stray voltage, from improperly grounded equipment to the metal stanchions at the cows' feeding stations. The results of the damage have been clear - injured or stressed cows at worst, reduced milk production at best - but most of the research so far has been academic, and a controlled research project in a university lab just doesn't adequately measure conditions on a real dairy farm.

That's why for the last year, Chuck and Wanda Untiedt of Lakefield, Minn., have been using Fluke digital multimeters and FlukeView™ Forms software at their Untiedt Udder Chaos Farm. They are finding out exactly what impact stray voltage is having on their herd of 350 dairy cows. FlukeView Forms allows users to take readings from Fluke meters and graphically view them on a Windows PC. While the measurements themselves yield valuable information, it is the ability to chart and analyze the results of multiple data logging sessions that is turning the farm's electrical system from a minefield of stray voltage into a safer environment for humans and animals.

The software works with a range of Fluke meters and thermometers, including the powerful 187 and 189 DMM models. Recently released FlukeView Forms V.2 displays data taken over time from up to eight meters on a single form, allowing troubleshooters to easily compare

comprehensive data that then can be printed for further analysis.

The capability to view and analyze data logged over time is particularly valuable for commercial and electrical contractors, plant maintenance engineers, electronic and R&D engineers who need to document measurements over a period of time. FlukeView Forms makes it possible to log data as events, which then are easily uploaded to a PC - either from a meter's memory or real time from the meter itself - and automatically displayed in graphs and tables.

That ability to incorporate information from multiple meters allows easy graphical comparison on the same form of data taken at different times, particularly important when performing extended tests from various locations. Time stamps record elapsed times of logged readings. And because users set the parameters of significant and insignificant readings recorded during any logging session, data is more valuable without the "noise" of irrelevant fluctuations.

FlukeView Forms can be set to automatically upload data from memory, or can log data from a meter in real time while it is connected to a PC. Graphs and tables automatically adjust to correctly display the type of readings required. The software includes many pre-defined forms from which to choose and also allows users to build customized forms using the FlukeView Forms Designer tool, which is included.

FlukeView Forms V.2 supports Windows 95, 98, NT 4.0, 2000, ME and XP. It requires only a Pentium-

TL21A Test Lead Extension Kit

- 1.5 meter silicone insulated test leads with shrouded, male connectors on both ends
- Separate female couplers convert the test leads into lead extensions

CAT III 1000 V, CAT IV 600 V
DUAL RATED



TL20 Industrial Test Lead Set

- Includes leads, probes and alligator clips

CAT III 1000 V, CAT IV 600 V
DUAL RATED



AC87 Heavy Duty Bus Bar Clips

- Plunger style, safety grip operation with insulated right angle jaws
- Adjustable jaws open to grip flat bus bars or round conductors

CAT III, 600 V, 5 A



i200/i200s AC Current Clamp

- Small size is ideal for tight spaces
- 0-200 A range
- i200 has mA output
- i200s has mV output



i410 AC/DC Current Clamp

- Jaw opening for up to 1-750 MCM or 2-500 MCM conductors



class microprocessor, 32 MB RAM and 70 MB hard disk space (100 MB to install). Software, documentation and sample forms are available in English, French, German, Spanish, Italian, Japanese and Simplified Chinese. ■

For the entire article, visit our web site at www.fluke.com/electric

80i-400 Current Clamp

- Jaw opening for up to one 750 MCM or two 500 MCM conductors
- 400 A range with shrouded banana plugs and mA output



C510 Leather Meter Case

- Large belt loop and top flap to secure meter
- Designed for most Fluke DMMs, thermometers and process meters



i1000s AC Current Clamp

- Round jaw opens to accommodate up to 1-1000 MCM conductor
- 1000 A range with BNC termination and 1 mV, 10 mV and 100 mV outputs



C550 Tool Bag

- Rugged fabric case with metal frame and heavy duty hardware
- Several inside and outside pockets and zippered main compartment



H3 Clamp Meter Holster

- Rugged fabric holster includes flap for lead storage and built-in belt loop
- For Fluke 330 Series Clamp Meters



H5 Electrical Tester Holster

- Rugged fabric holster includes flap for lead storage and built-in belt loop
- Holds T3 or T5 electrical testers



C43 Nylon Meter Case

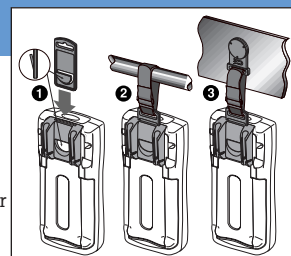
- Zippered carrying case with inner front pocket, removable handle/shoulder strap
- External dimensions: 12.5" x 7.5" x 3.5"



ToolPak

The meter hanging solution

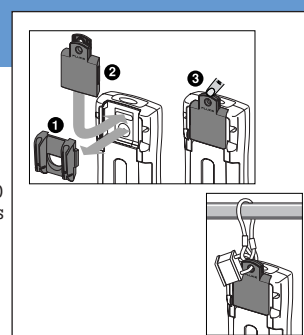
- Kit includes, universal hanger clips (2), hook & loop straps (2 lengths), adapter and strong magnet
- Combine components to meet most hanging needs
- Attaches to back of many Fluke meters, including 110, 170, 180 Series, 80 Series IV DMMs, 725 Process Calibrator, 70 Series III DMMs and 50 Series II Digital Thermometers.



LockPak

The meter locking solution

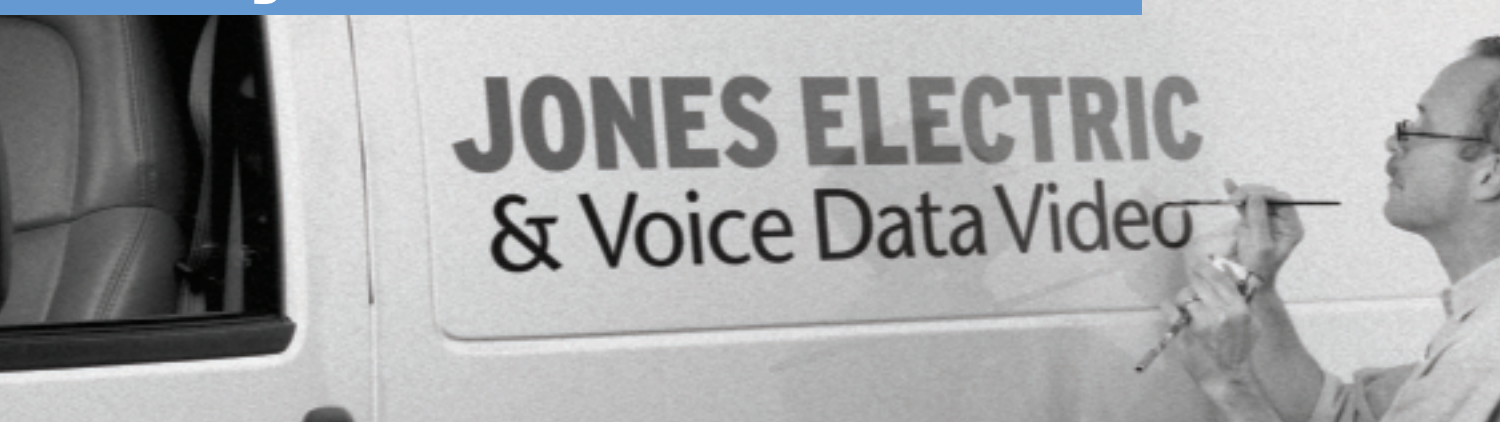
- Kit includes a locking accessory
- Attaches to back of a 80 Series IV and 180 Series meters or a Fluke 725 Process Calibrator to help deter theft
- Accepts most common locks (not included)



Harley® contest winner!

Palmer Thornton, of Sawdy Electric in Palmetto, Florida is the winner of the Fluke's "Take a Test Drive Sweepstakes." Palmer has been an electrician since 1981. Sawdy Electric is a two person firm specializing in residential and light commercial electrical work. Palmer entered the sweepstakes at Rexel Consolidated in Bradenton, Florida. His Rexel salesperson was John Fox.

Add a new business to your business.



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a Casio handheld
2.5" color television



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Fluke Networks' new MicroScanner™ Pro can practically double your business by adding Voice-Data-Video testing to the wire contracts you're already doing.

It's a pocket-sized low-voltage tester that:

- Checks wire continuity and configuration.
- Pinpoints open, shorts, crossed and split pairs.
- Measures length and distance to fault with patented TDR technology.
- Locates hidden cables in walls, ceilings and wire closets.

For a limited time the MicroScanner Pro comes with the "Business in a Box" CD that includes training aids, installation instructions, verification data, and troubleshooting tips.

Test drive this product before you buy
www.fluke.com/electric

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