

## Fluke 430 Series Three-Phase Power Quality Analyzers

### Technical Data

#### Pinpoint power problems faster, safer and in greater detail

The Fluke 434 and 435 three-phase power quality analyzers help you locate, predict, prevent and troubleshoot problems in three- and single-phase power distribution systems. Troubleshooting is faster with on-screen display of trends and captured events, even while background recording continues. The new IEC standards for flicker, harmonics and power quality are built right in to take the guess work out of power quality.



- **Troubleshoot real-time:** Analyze the trends using the cursors and zoom tools—even while background recording continues
- **Highest safety rating in the industry:** 600 V CAT IV/1000 V CAT III rated for use at the service entrance
- **Automatic Transient Mode:** Capture 200 kHz waveform data on all phases simultaneously up to 6 kV
- **Fully Class-A compliant:** Conduct tests according to the stringent international IEC 61000-4-30 Class-A standard
- **Measure all three phases and neutral:** With included four current probes
- **AutoTrend:** Every measurement you see is always automatically recorded, without any setup
- **System-Monitor:** Up to ten power quality parameters on one screen according to EN50160 power quality standard
- **Inrush mode:** For troubleshooting nuisance circuit breaker tripping
- **View graphs and generate reports:** With included analysis software
- **Logger function:** Configure for any test condition with memory for over 400 parameters at user defined intervals
- **Mains signaling:** Measure interference from ripple control signals at specific frequencies
- **Battery Life:** Seven hours operating time per charge on NiMH battery pack
- **Warranty:** Rugged, handheld troubleshooter with Fluke three-year warranty

## Applications

**Frontline troubleshooting** – quickly diagnose problems on-screen to get your operation back online

**Predictive maintenance** – detect and prevent power quality issues before they cause downtime

**Quality of service compliance** – validate incoming power quality at the service entrance

**Long-term analysis** – uncover hard-to-find or intermittent issues

**Load studies** – verify electrical system capacity before adding loads

**Energy assessments** – quantify energy consumption before and after improvements to justify energy saving devices



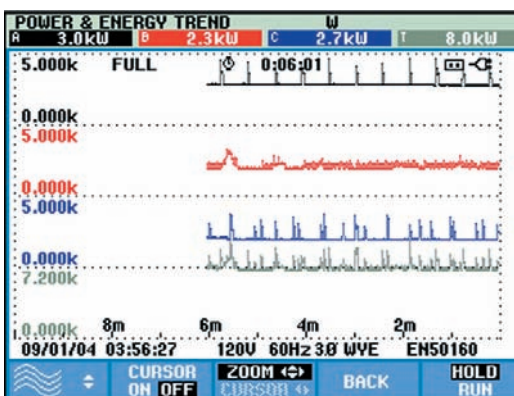
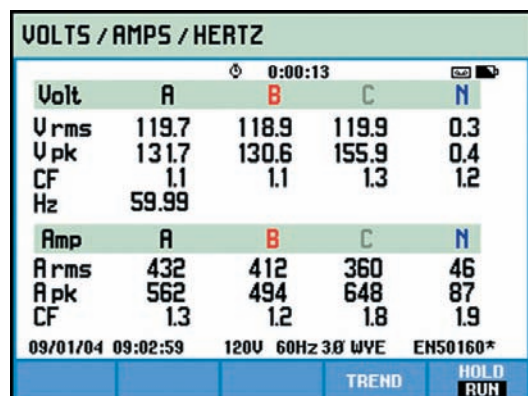
Measure all power parameters, find events and anomalies in seconds

## CAT IV 600 V and CAT III 1000 V safety rating

Designed to help protect you and your equipment, the Fluke 430 Series analyzers and accessories are all certified to meet the stringent standards for use in CAT IV 600 V and CAT III 1000 V environments. They are the first tools of their kind to carry the CAT IV rating for use in power connections and outlets throughout a low-voltage power distribution system.

## Troubleshoot real-time

AutoTrend feature provides fast insight into changes over time. Every displayed reading is automatically recorded without having to set thresholds or intervals. Analyze the trends using the cursors and zoom tools—even while background recording continues.



AutoTrend automatically records all displayed parameters in the background. Toggle between data and trend view, and use cursors and zoom to analyze measurements without interrupting the recording.



## Fully Class-A compliant

The Fluke 435 is fully compliant with the new IEC 61000-4-30 Class-A standard. With this powerful capability, all measurements will be consistent and reliable in accordance with the latest international standard.

### IEC 61000-4-30 Class-A Compliance

|                        | 435                            | 434           |
|------------------------|--------------------------------|---------------|
| Measurement algorithms | •                              | •             |
| Voltage accuracy       | 0.1 % of Vnom                  | 0.5 % of Vnom |
| Time synchronization   | optional with GPS430 accessory |               |

## Measures everything

Measure true-rms and peak voltage and current, frequency, dips and swells, transients, interruptions, power and power consumption, peak demand, harmonics up to the 50<sup>th</sup>, inter-harmonics, flicker, mains signaling, inrush and unbalance.

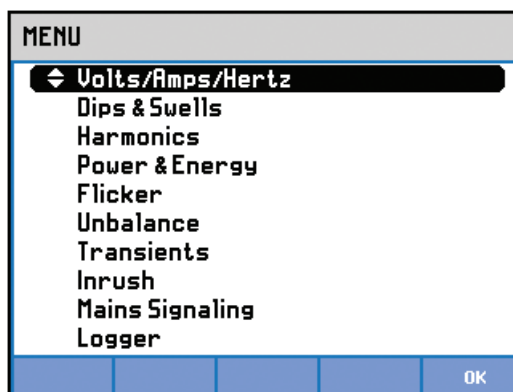
## Logger: record the detail you need

User-configurable, long-term recording of MIN, MAX and AVG readings for up to 100 parameters on all 4 phases. Enough memory is available to record 400 parameters for up to a month with 10 minute resolution, or capture smaller variations with resolution down to 0.5 seconds.

## What is Class-A conformity?

Power quality measurement is a relatively new, and quickly evolving field. There are hundreds of manufacturers around the world with unique measurement methodologies. Whereas basic single- and three-phase electrical measurements like rms voltage and current were defined long ago, many power quality parameters were not previously defined, forcing manufacturers to develop their own algorithms. With so much variation between instruments, electricians tend to waste too much time trying to understand an instrument's capabilities and measurement algorithms instead of understanding the quality of the power itself!

The new IEC 61000-4-30 Class-A standard takes the guesswork out of selecting a power quality instrument. The standard IEC 61000-4-30 defines the measurement methods for each parameter to obtain reliable, repeatable and comparable results. In addition, the accuracy, bandwidth and minimum set of parameters are all clearly defined.



Simple menu structure with logical function grouping gives fast access to key measurements.



Inrush function automatically triggers off of current, and captures start up measurements on motors and other devices to help determine trip levels.



## Automatic transient display

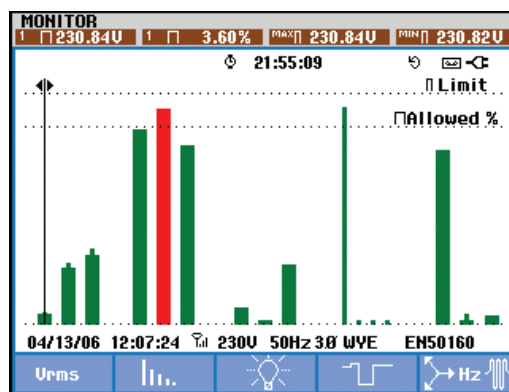
Every time an event or voltage distortion is detected, the instrument triggers and automatically stores voltage and current waveforms on all three phases and neutral. The analyzer will also trigger when a certain current level is exceeded. Up to 40 dips, swells, interruptions and transients can be captured this way. You can see voltage transients as high as 6 kV and as fast as 5 microseconds.

## System-Monitor: Summary screen of overall power quality health

A single push of the MONITOR button delivers a dashboard display of rms voltage, harmonics, flicker, interruptions, rapid voltage changes, swells, unbalance, frequency and mains signaling. The dashboard is updated live, showing compliance of each parameter to EN50160 limits or your own limits. Color-coded bars clearly show which parameters are inside (pass) or outside limits (fail). During a monitor session, you can easily drill down to more detail of any parameter to view and capture its trend for a report.

## Extensive data analysis possibilities

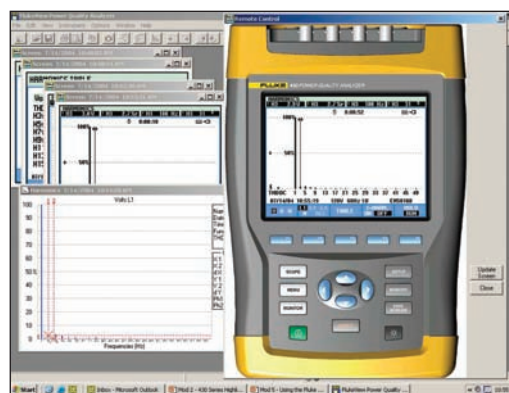
The Fluke 430 Series provides three ways to analyze measurements. Cursors and zoom tools can be used 'live' while taking measurements, or 'off line' on stored measurement data. Additionally, the stored measurements can be transferred to a PC with the included software to perform custom analysis and create reports. Measurement data can also be exported to common spreadsheet programs. Store up to 10 measurement datasets and up to 50 screen captures for use in reports.



The System-Monitor overview screen gives instant insight into whether the voltage, harmonics, flicker, frequency and the number of dips and swells fall outside the set limits.

| MONITOR EVENTS URMS                        |              |             |       |             |
|--|--------------|-------------|-------|-------------|
| START 09/01/04 07:51:38                    |              | EVENT 8 / 8 |       |             |
|  |              | 1:20:25     |       |             |
| DATE                                       | TIME         | TYPE        | LEVEL | DURATION    |
| 09/01/04                                   | 08:34:38:098 | H21         | 0.5 % | 0:00:10:000 |
| 09/01/04                                   | 08:36:38:098 | H21         | 0.5 % | 0:00:10:000 |
| 09/01/04                                   | 08:51:38:098 | H21         | 0.5 % | 0:00:10:000 |
| 09/01/04                                   | 08:53:38:098 | H21         | 0.5 % | 0:00:10:000 |
| 09/01/04                                   | 08:55:28:098 | H21         | 0.5 % | 0:00:10:000 |
| 09/01/04                                   | 09:02:58:098 | H21         | 0.5 % | 0:00:10:000 |
| 09/01/04                                   | 09:04:58:098 | H21         | 0.5 % | 0:00:10:000 |
| 09/01/04                                   | 09:08:38:098 | H21         | 0.5 % | 0:00:10:000 |
| 09/01/04 09:12:03 120V 60Hz 3Ø WYE EN50160 |              |             |       |             |
| SELECTED                                   |              | NORMAL      |       |             |
| ALL  |              | TREND       |       |             |
|  |              | BACK        |       |             |

A detailed list is given of all events falling outside the set limits. By scrolling through the events list and selecting an event, the event can be analyzed in detail.

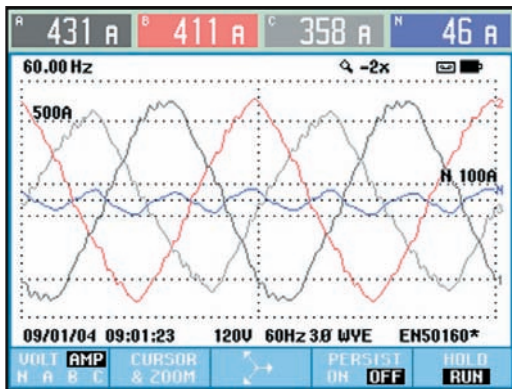


Perform custom analysis and create reports with included software. Measurement data can also be exported to common spreadsheet programs.

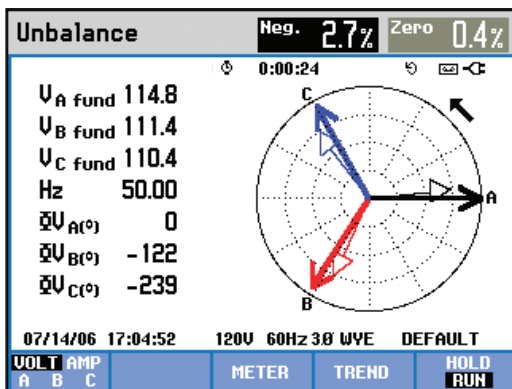


## Easy-to-use

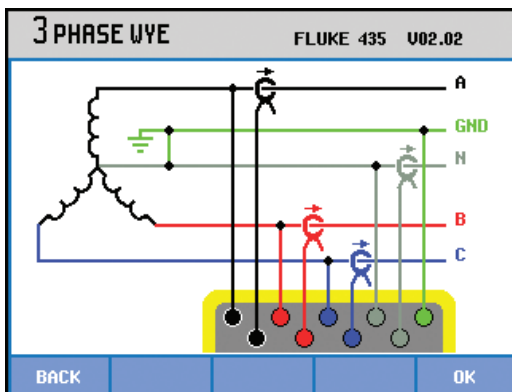
Pre-programmed setups and user-friendly screens make power quality testing as simple as you would expect from Fluke. The high-resolution color screen updates every 200 mS and displays waveforms and wiring diagrams color coded to industry standards. Handy on-screen wiring diagrams for all commonly used three-phase and single-phase configurations guide you through connections.



Scope view shows voltage and current waveforms for three phase installations. You can toggle to a phasor diagram at any time.



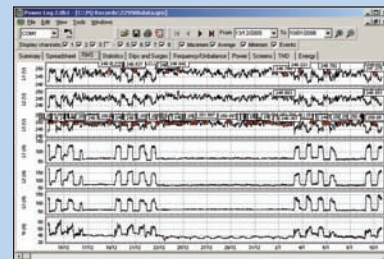
Phasor diagram shows voltage and current unbalance, and helps verify connections.



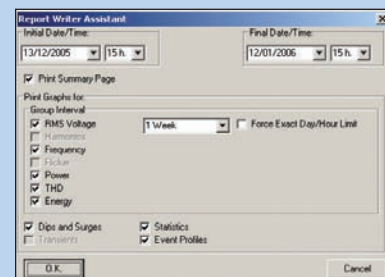
The full color display uses region specific industry-standard color-coding (user selectable) to correlate measurements with actual wiring.

## Generate reports and view graphs with Fluke Power Log Software

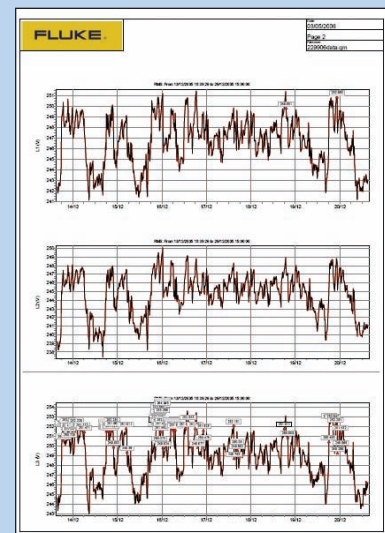
Designed to quickly view recorded data, the included Power Log software displays all recorded parameters on interactive trends. Generate a professional report with the 'Report Writer' function, or copy and paste images into report document manually.



View recorded data in simple graphs and tables.



Easily customize the report by selecting time period and measurements to include.



Create professional reports quickly and easily.

## Technical specifications

The specifications of the instrument are verified using the “implementation verification” table 3 as specified in IEC 61000-4-30 2002 Chapter 6.2. Accuracy is specified in % of reading unless otherwise specified. Specifications are valid for models Fluke 435 and Fluke 434 unless otherwise specified.

### Input characteristics

| Voltage inputs                   |   |
|----------------------------------|---|
| Number of inputs                 | 4 (3 phases + neutral) dc-coupled   |
| Maximum input voltage            | 1000 Vrms   |
| Nominal voltage range            | 50 V to 500 V according IEC 61000-4-30. Selectable from 1 V to 1000 V.  |
| Maximum peak measurement voltage | 6 kV  |
| Input impedance                  | 4 M $\Omega$ /5 pF  |
| Bandwidth                        | > 10 kHz, up to 100 kHz for transient display   |
| Scaling                          | 1:1, 10:1, 100:1, 1000:1 and variable   |
| Current inputs                   |   |
| Number of inputs                 | 4 (3 phases + neutral) dc-coupled   |
| Type                             | Clamp on current transformer with mV output   |
| Range                            | 1 Arms to 400 Arms with included clamps (i400s/Fluke 434)<br>30 A to 3000 Arms with included clamps (i430-flex/Fluke 435)<br>1 Arms to 3000 Arms with optional clamps |
| Input impedance                  | 50 k $\Omega$   |
| Bandwidth                        | > 10 kHz  |
| Scaling                          | 0.1, 1, 10, 100, 1000 mV/A, variable, i5s and i430-flex   |
| Nominal frequency                | 40 Hz to 70 Hz  |
| Sampling system                  |   |
| Resolution                       | 16 bit analog to digital converter on 8 channels  |
| Maximum sampling speed           | 200 kS/s on each channel simultaneously   |
| RMS sampling                     | 5000 samples on 10/12 <sup>2</sup> cycles according IEC 61000-4-30  |
| PLL synchronization              | 4096 samples on 10/12 <sup>2</sup> cycles according IEC 61000-4-7   |

### Display modes

|                  |   |
|------------------|---|
| Waveform display | Available in Scope and Transient mode<br>Captures 8 waveforms simultaneously<br>Display update rate 5x per second<br>Up to 10/12 <sup>2</sup> times horizontal zoom<br>Cursors: single vertical line showing min, max, avg reading at cursor position             |
| Phasor           | Shows real time phasor diagram<br>Available in Scope and Unbalance mode<br>Display update rate 5x per second  |
| Meter readings   | Available in Volts/Amps/Hertz, Harmonics, Power and Energy, Flicker, Unbalance and Logger <sup>4</sup> mode   |
| AutoTrend graph  | Available in Volts/Amps/Hertz, Dips and Swells, Harmonics, Power and Energy, Flicker, Unbalance, Inrush, Mains Signaling <sup>4</sup> Logger <sup>4</sup> and Monitor mode<br>Cursors: single vertical line showing with min, max, avg reading at cursor position |
| Bargraph         | Available in Harmonics and Monitor mode   |
| Event list       | Available in Dips and Swells, Mains Signaling <sup>4</sup> , Logger <sup>4</sup> and Monitor mode   |

## Measurement modes

|                                    |   |
|------------------------------------|---|
| <b>Scope</b>                       | Vrms, Arms, Vcursor, Acursor, Vfund, Afund, Hz, V phase angles, A phase angles  |
| <b>Volts/Amps/Hertz</b>            | Vrms, Vpk, V Crest Factor, Arms, Apk, A Crest Factor, Hz  |
| <b>Dips and swells</b>             | Vrms $\frac{1}{2}$ , Arms $\frac{1}{2}$<br>Captures up to 1000 events with date, time, duration, magnitude and phase identification with programmable thresholds  |
| <b>Harmonics dc, 1 to 50</b>       | Harmonic Volts, THD Volt, Harmonic Amps, THD Amps, K Amps, Harmonic Watts, THD Watts, K Watts, Interharmonic Volts <sup>4</sup> , Interharmonic Amps <sup>4</sup> (relative to fundamental or to total rms)   |
| <b>Power and energy</b>            | Watts, VA, VAR, Power factor, Cos $\phi$ /DPF, Arms, Vrms, kWh, kVAh, kVARh, peak demand interval using trend, KYZ revenue meter verification via optional input.   |
| <b>Flicker</b>                     | Pst(1min), Pst, Plt, PF5, Vrms $\frac{1}{2}$ , Arms $\frac{1}{2}$ , Dc, Dmax, TD  |
| <b>Unbalance</b>                   | Vneg, Vzero, Aneg, Azero, Vfund, Afund, Hz, V phase angles, A phase angles  |
| <b>Transients</b>                  | Vrms, Arms, Vcursor, Acursor  |
| <b>Inrush currents</b>             | Inrush Current, Inrush duration, Arms $\frac{1}{2}$ , Vrms $\frac{1}{2}$  |
| <b>Mains signaling<sup>4</sup></b> | Relative signaling voltage and absolute signaling voltage averaged over three seconds for two selectable frequencies  |
| <b>Logger<sup>4</sup></b>          | Measures and records up to 100 parameters on all 4 phases simultaneously with selectable averaging time<br>Captures up to 10000 events with date, time, duration, magnitude and phase identification with programmable thresholds   |
| <b>System monitor</b>              | Vrms, Arms, Harmonic Volts, THD Volts, Plt, Vrms $\frac{1}{2}$ , Arms $\frac{1}{2}$ , Vneg, Hz, dips and swells, unbalance<br>All parameters are measured simultaneously in accordance with EN50160<br>Using Flagging to indicate unreliable readings according IEC61000-4-30 |

## Accuracy, resolution and range

|   |  | Measurement range  | Resolution   | Accuracy   |
|---|--|--|--|--|
| <b>Volt/Amps/Hertz</b>                      |  |  |  |  |
| <b>Vrms (ac+dc)</b>                         | Fluke 435  | 1 Vrms to 600 Vrms   | 0.01 Vrms  | $\pm 0.1\%$ of nominal voltage   |
|   | Fluke 434  | 600 Vrms to 1000 Vrms<br>1 Vrms to 1000 Vrms   | 0.01 Vrms<br>0.1 Vrms  | $\pm 0.1\%$<br>$\pm 0.5\%$ of nominal voltage  |
| <b>Vpk</b>                                  |  | 1 Vpk to 1400 Vpk  | 1 V  | 5 % of nominal voltage   |
| <b>Voltage Crest Factor (CF)</b>            |  | 1.0 to > 2.8   | 0.01   | $\pm 5\%$  |
| <b>Arms (ac+dc)</b>                         | Fluke 435  | 0 kArms to 20.00 kArms <sup>1</sup>  | 0.001 Arms to 10 Arms <sup>1</sup>                             | $\pm 0.5\% \pm 5$ counts <sup>3</sup>  |
|   | Fluke 434<br>Fluke 434 with i400s<br>Fluke 435 with i430Flex | 0 kArms to 20.00 kArms <sup>1</sup><br>0 Arms to 40/400 Arms<br>30 Arms to 3000 Arms   | 0.001 Arms to 10 Arms <sup>1</sup><br>0.1 and 1 Arms<br>1 Arms | $\pm 1\% \pm 5$ counts <sup>3</sup><br>$\pm 1\% \pm 5$ counts <sup>3</sup><br>$\pm 0.5\% \pm 20$ counts <sup>3</sup> |
| <b>Apk using 1 mV/A scaling</b>             |  | 0 Apk to 5500 Apk  | 1 A  | $\pm 5\%$  |
| <b>A Crest Factor (CF)</b>                  |  | 1 to 10  | 0.01   | $\pm 5\%$  |
| <b>Hz<sup>5</sup></b>                       | Fluke 435 @ 50 Hz nominal                                    | 42.500 Hz to 57.500 Hz   | 0.001 Hz   | $\pm 0.01$ Hz  |
|   | Fluke 435 @ 60 Hz nominal                                    | 51.000 Hz to 69.000 Hz   | 0.001 Hz   | $\pm 0.01$ Hz  |
|   | Fluke 434 @ 50 Hz nominal                                    | 42.50 Hz to 57.50 Hz   | 0.01 Hz  | $\pm 0.01$ Hz  |
|   | Fluke 434 @ 60 Hz nominal                                    | 51.00 Hz to 69.00 Hz   | 0.01 Hz  | $\pm 0.01$ Hz  |
| <b>Dips and swells</b>                      |  |  |  |  |
| <b>Vrms<math>\frac{1}{2}</math> (ac+dc)</b> | Fluke 435  | 0.0 % to 200 % of nominal voltage  | 0.1 Vrms   | $\pm 0.2\%$ of nominal voltage $\pm 1\%$ of nominal voltage  |
|   | Fluke 434  | 0.0 % to 200 % of nominal voltage  | 0.1 Vrms   |  |
| <b>Arms<math>\frac{1}{2}</math> (ac+dc)</b> | Fluke 435  | 0 Arms to 20,000 Arms <sup>1</sup>   | 0.001 Arms to 10 Arms  | $\pm 1\% \pm 10$ counts <sup>3</sup>   |
|   | Fluke 434<br>Fluke 434 with i400s<br>Fluke 435 with i430Flex | 0 Arms to 20,000 Arms <sup>1</sup><br>0 Arms to 400 Arms<br>30 Arms to 3000 Arms   | 0.001 Arms to 10 Arms<br>0.1 Arms and 1 Arms<br>1 Arms         | $\pm 2\% \pm 10$ counts <sup>3</sup><br>$\pm 2\% \pm 10$ counts <sup>3</sup><br>$\pm 1\% \pm 20$ counts <sup>3</sup> |
| <b>Threshold levels</b>                     |  | Programmable thresholds in percent of nominal voltage<br>Event detection based upon $\frac{1}{2}$ cycle rms voltages<br>Captures dips, swells, interruptions and rapid voltage changes |  |  |
| <b>Duration</b>                             |  | hhh,mm,ss,mmm  | Half cycle   | One cycle  |

**Accuracy, resolution and range** cont.

|  |   | Measurement range   | Resolution   | Accuracy   |
|--|---|---|--|--|
| <b>Harmonics</b>   |   |   |  |  |
| Harmonic order (n)   |   | DC, 1 to 50 grouping: harmonic groups according to IEC 61000-4-7  |  |  |
| Inter-Harmonic order   |   | Off, 1 to 49 grouping: harmonic and interharmonic subgroups according to IEC 61000-4-7  |  |  |
| Vrms   | Relative (%f):<br>Fluke 435 Absolute:<br><br>Fluke 434 Absolute:                          | 0.0 % to 100.0 %<br>0.0 Vrms to 1000 Vrms<br><br>0.0 Vrms to 1000 Vrms  | 0.1 %<br>0.1 Vrms<br><br>0.1 Vrms  | $\pm 0.1 \% \pm n \times 0.1 \% (\pm 0.4 \% \text{ for } \%r)$<br>$\pm 0.05 \% \text{ of nominal voltage if } < 1 \% \text{ of nominal voltage}$<br>$\pm 5 \% \text{ if } \geq 1 \% \text{ of nominal voltage}$<br>$\pm 5 \% \pm 2 \text{ counts}$ |
| Arms   | Relative (%f):<br>Absolute:   | 0.0 % to 100.0 %<br>0.0 mV to 4000 mV x clamp scaling   | 0.1 %<br>1 mVrms x clamp scaling   | $\pm 0.1 \% \pm n \times 0.1 \% (\pm 0.4 \% \text{ for } \%r)$<br>$\pm 5 \% \pm 5 \text{ counts}$  |
| Watts<br>(Harmonics only)  | Relative:<br>Absolute:  | 0.0 % to 100.0 %<br>depends on clamp and voltage scaling  | 0.1 %  | $\pm n \times 2 \%$<br>$\pm 5 \% \pm n \times 2 \% \pm 10 \text{ counts}$  |
| DC   | Relative:<br>Fluke 435 Absolute V:<br>Fluke 434 Absolute V:<br>Absolute A:<br>Absolute W: | 0.0 % to 100.0 %<br>0.0 V to 1000 V<br>0.0 V to 1000 V<br>0.0 mV to 4000 mV x clamp scaling<br>depends on clamp and voltage scaling | 0.1 %<br>0.1 V<br>0.1 V<br>1 mVrms x clamp scaling 0.1 V<br>depends on scaling | $\pm 0.1 \% \text{ V and A } (\pm 2 \% \text{ Watt})$<br>$\pm 0.2 \% \text{ of nominal voltage}$<br>$\pm 5 \% \pm 10 \text{ counts}$<br>$\pm 5 \% \pm 10 \text{ counts}$<br>$\pm 5 \% \pm 10 \text{ counts}$                                       |
| THD <sub>(n=40)</sub>  | (relative % of or %r)   | 0.0 % to 100.0 %  | 0.1 %  | $\pm 2.5 \% \text{ V and A } (\pm 5 \% \text{ Watt})$  |
| Hz   |   | 0 Hz to 3500 Hz   | 1 Hz   | $\pm 1 \text{ Hz}$   |
| Phase angle  | Fluke 435<br>Fluke 434  | -360 ° to +0 °<br>-360 ° to +0 °  | 1 °<br>1 °   | $\pm n \times 1 ^\circ (^\circ)$<br>$\pm n \times 1.5 ^\circ (^\circ)$   |
| <b>Power and energy</b>  |   |   |  |  |
| Watt (VA, VAR)   | Fluke 435<br>Fluke 434  | 1.0 MW to 20.00 MW <sup>1</sup><br>1.0 MW to 20.00 MW <sup>1</sup>  | 0.1 kW to 1 kW <sup>1</sup><br>0.1 kW to 1 kW <sup>1</sup>                     | $\pm 1 \% \pm 10 \text{ counts}^3$<br>$\pm 1.5 \% \pm 10 \text{ counts}^3$   |
| kWh <sup>6</sup> (kVA <sup>6</sup> , kVAR <sup>6</sup> )               |   | 00.00 kWhr to 200.0 GWhr <sup>1</sup><br>00.00 kWhr to 200.0 GWhr <sup>1</sup>  | 0.01 Xhr to 100 Whr <sup>1</sup><br>0.01 Whr to 100 Whr <sup>1</sup>           | $\pm 1 \% \pm 10 \text{ counts}^3$<br>$\pm 1.5 \% \pm 10 \text{ counts}^3$   |
| Power Factor   |   | 0 to 1  | 0.01   | $\pm 0.033$  |
| Cos φ/DPF  |   | 0 to 1  | 0.01   | $\pm 0.033$  |
| <b>Flicker</b>   |   |   |  |  |
| Pst (1min), Pst, Plt, PF5 instantaneous Flicker                        |   | 0.00 to 20.00   | 0.01   | Within $\pm 5 \%$ of tabulated values according IEC61000-4-15  |
| Dc%, Dmax% and Time d(t) exceeds limits as described per IEC 61000-3-3 |   | 0.0 % to $\pm 100.0 \%$ for Dc% and Dmax% and 0.000 s to 9.999s for Time  | 0.1 % for Dc% and Dmax% and 10 ms for Time                                     | $\pm 1 \% \text{ for Dc\% and Dmax\% and } 20 \text{ ms for Time}$   |
| <b>Unbalance</b>   |   |   |  |  |
| Volts  | Fluke 435 (neg. and zero seq.)<br>Fluke 434 (neg. and zero seq.)                          | 0.0 % to 5.0 %<br>0.0 % to 5.0 %  | 0.1 %<br>0.1 %   | $\pm 0.15 \%$<br>$\pm 0.5 \%$  |
| Current  | (neg. and zero seq.)  | 0.0 % to 20 %   | 0.1 %  | $\pm 1 \%$   |
| Phase angle  | volts<br>current  | -360.0 ° to 0.0 °<br>-360.0 ° to 0.0 °  | 0.1 °<br>0.1 °   | $\pm 2 \text{ counts}$<br>$\pm 5 \text{ counts}^3$   |
| <b>Transient capture</b>   |   |   |  |  |
| Volts  | cursor reading<br>rms reading   | $\pm 6000 \text{ Vpk}$<br>10 Vrms to 1000 Vrms  | 1 V<br>1 V   | $\pm 15 \% \text{ of cursor reading}$<br>$\pm 2.5 \% \text{ of Vnominal}$  |
| Minimum detect duration  |   | 5 μs  |  |  |
| Sampling rate  |   | 200 kS/s  |  |  |
| <b>Inrush mode</b>   |   |   |  |  |
| Arms (ac+dc)   |   | 0.000 kArms to 20.00 kArms <sup>1</sup>   | 0.001 Arms to 10 Arms <sup>1</sup>   | $\pm 1 \% \text{ of meas } \pm 5 \text{ counts}$   |
| Inrush Duration  |   | mm:ss:mmm between 7.5 s to 30 minutes selectable  | 10 ms  | $\pm 20 \text{ ms (Fnominal} = 50 \text{ Hz)}$   |
| <b>Mains Signaling<sup>4</sup></b>                                     |   |   |  |  |
| Threshold levels   |   | Thresholds, limits and signaling duration is programable for two independent signaling frequencies                                  |  |  |
| Signaling frequency  |   | 60 Hz to 3000 Hz  | 0.1 Hz   |  |
| Relative V%  |   | 0 % to 100 % of Vnominal  | 0.1 %  | $\pm 0.4 \%$   |
| Absolute V3s (3 second average)  |   | 0.0 V to 1000 V   | 0.1 V  | $\pm 5 \% \text{ of nominal voltage}$  |



## Trend recording

|   |  |         |           |         |          |          |         |         |        |        |       |
|---|--|---------|-----------|---------|----------|----------|---------|---------|--------|--------|-------|
| Method  | AutoTrend automatically records min, max and average values over time for all readings being displayed for the 3 phases and neutral simultaneously                                   |         |           |         |          |          |         |         |        |        |       |
| Volts/Amps/Hertz, Harmonics, Power and Energy, Flicker, Unbalance and Mains Signaling <sup>4</sup> mode |  |         |           |         |          |          |         |         |        |        |       |
| Sampling  | 5 readings/sec continuous sampling per channel   |         |           |         |          |          |         |         |        |        |       |
| Recording time  | From 30 min with 1 second display resolution up to 450 days with 6 hour display resolution.  |         |           |         |          |          |         |         |        |        |       |
| Zoom  | Up to 6x horizontal zoom   |         |           |         |          |          |         |         |        |        |       |
| Memory  | 1800 min, max and avg points for each reading  |         |           |         |          |          |         |         |        |        |       |
| Duration  | 30 min.  | 2.5 hrs | 7.5 hrs   | 15 hrs  | 30 hrs   | 150 hrs  | 450 hrs | 900 hrs | 75 d   | 225 d  | 450 d |
| Resolution  | 1 s  | 5 s     | 15 s      | 30 s    | 60 s     | 5 min.   | 15 min. | 30 min. | 1 hr   | 3 hrs  | 6 hrs |
| Dips and Swells mode  |  |         |           |         |          |          |         |         |        |        |       |
| Sampling  | 100/120 <sup>2</sup> readings/sec continuous sampling per channel  |         |           |         |          |          |         |         |        |        |       |
| Recording time  | From 90 sec with 25 msec display resolution up to 450 days with 3 hr display resolution  |         |           |         |          |          |         |         |        |        |       |
| Zoom  | Up to 12x horizontal zoom  |         |           |         |          |          |         |         |        |        |       |
| Memory  | 3600 min, max and avg points for each reading  |         |           |         |          |          |         |         |        |        |       |
| Duration  | 90 s   | 180 s   | 6 min.    | 12 min. | 30 min.  | 1 hr     | 2.5 hrs | 7.5 hrs | 15 hrs | 30 hrs |       |
| Resolution  | 25 ms  | 50 ms   | 100 ms    | 200 ms  | 500 ms   | 1s       | 2.5 s   | 7.5 s   | 15 s   | 30 s   |       |
| Inrush currents and flicker PF5 mode  |  |         |           |         |          |          |         |         |        |        |       |
| Sampling  | 100/120 <sup>2</sup> readings/sec continuous sampling per channel  |         |           |         |          |          |         |         |        |        |       |
| Recording time  | From 7.5 sec with 25 msec display resolution up to 30 min with 500 msec display resolution for Inrush measurements and up to 2 hr with 2.5 sec display resolution for PF5 recordings |         |           |         |          |          |         |         |        |        |       |
| Zoom  | Up to 12x horizontal zoom  |         |           |         |          |          |         |         |        |        |       |
| Memory  | 3600 min, max and avg points for each reading  |         |           |         |          |          |         |         |        |        |       |
| Duration  | 7.5 s  | 15 s    | 30 s      | 90 s    | 180 s    | 6 min.   | 12 min. | 30 min. |        |        |       |
| Resolution  | 25 ms  | 25 ms   | 25 ms     | 25 ms   | 50 ms    | 100 ms   | 200 ms  | 500 ms  |        |        |       |
| Logger mode   |  |         |           |         |          |          |         |         |        |        |       |
| Sampling  | Combination of 5 readings/sec and 100/120 <sup>2</sup> readings/sec continuous sampling per channel depending on the parameter measured  |         |           |         |          |          |         |         |        |        |       |
| Recording time  | Depends on selected readings and averaging time  |         |           |         |          |          |         |         |        |        |       |
| Zoom  | Two zoom positions, display all or 1x  |         |           |         |          |          |         |         |        |        |       |
| Memory  | User configurable shared memory, up to 15 MB on Fluke 435, up to 7 MB on Fluke 434 <sup>4</sup>  |         |           |         |          |          |         |         |        |        |       |
| No. of readings on 3 phases + N   | 1  |         |           | 10      |          |          | 100     |         |        |        |       |
| Averaging time  | 0.5 s  | 10 min. | 2 hrs     | 0.5 s   | 10 min.  | 2 hrs    | 0.5 s   | 10 min. | 2 hrs  |        |       |
| Max <sup>7</sup> duration using 15 MB   | 66 hrs   | 9 years | 100 years | 6 hrs   | 333 days | 10 years | 18 min. | 31 days | 1 year |        |       |
| Monitor mode  |  |         |           |         |          |          |         |         |        |        |       |
| Sampling  | Combination of 5 readings/sec and 100/120 <sup>2</sup> readings/sec continuous sampling per channel depending on the parameter measured  |         |           |         |          |          |         |         |        |        |       |
| Recording time  | Up to 1 week with 10 min resoluton   |         |           |         |          |          |         |         |        |        |       |
| Memory  | 1008 min, max and avg points for each reading, 10 minute resolution  |         |           |         |          |          |         |         |        |        |       |
| Limits  | According EN50160 or customer definable  |         |           |         |          |          |         |         |        |        |       |

## Measurement method

|   |   |
|---|---|
| Vrms, Arms                                | 10/12 <sup>2</sup> cycle contiguous non overlapping intervals using 500/416 <sup>2</sup> samples per cycle in accordance with IEC 61000-4-30  |
| Vpeak, Apeak                              | Absolute highest sample value within 10/12 <sup>2</sup> cycle interval with 40 µs sample resolution   |
| V Crest Factor                            | Measures ratio between the Vpeak and Vrms   |
| A Crest Factor                            | Measures ratio between the Apeak and Arms   |
| Hz  | Measured every 10 sec in accordance with IEC61000-4-30  |
| Vrms <sup>1/2</sup> , Arms <sup>1/2</sup> | Value is measured over 1 cycle, commencing at a fundamental zero crossing, and refreshed each half-cycle. This technique is independent for each channel in accordance with IEC 61000-4-30. |
| Harmonics                                 | Calculated from 10/12-cycle gapless harmonic group measurements on Voltage and Amps according to IEC 61000-4-7  |
| Watt                                      | Selectable Total or Fundamental real power display<br>Calculates average value of instantaneous power over 10/12 cycle period for each phase<br>Total Active Power $P_T = P_1 + P_2 + P_3$  |

## Measurement method cont.

|                                  |  |
|----------------------------------|--|
| <b>VA</b>                        | Selectable total or fundamental apparent power display<br>Calculates apparent power using $V_{rms} \times I_{rms}$ value over 10/12 cycle period<br>Total apparent power is root mean square of real and reactive power  |
| <b>VAR</b>                       | Selectable total of fundamental reactive power display<br>Calculates reactive power as root of VA squared minus watt squared over 10/12 cycle period<br>Capacitive and inductive load is indicated with capacitor and inductor icons   |
| <b>Power Factor</b>              | Calculated watt/VA   |
| <b>Cos <math>\phi</math>/DPF</b> | Cos of angle between fundamental voltage and current   |
| <b>Unbalance</b>                 | The supply voltage unbalance is evaluated using the method of symmetrical components according to IEC61000-4-30  |
| <b>Flicker</b>                   | According to IEC 61000-4-15 flickermeter—functional and design specification<br>Includes 230 V 50 Hz lamp and 120 V 60 Hz lamp models  |
| <b>Transient capture</b>         | Captures waveform triggered on signal envelope<br>Additionally triggers on dips, swells, interruptions and Amps level as specified by IEC61000-4-30  |
| <b>Inrush current</b>            | The inrush current begins when the Arms half cycle rises above the inrush threshold, and ends when the Arms half cycle rms is equal to or below the inrush threshold minus a user-selected hysteresis value. The measurement is the square root of the mean of the squared Arms half cycle values measured during the inrush duration. Each half-cycle interval is contiguous and non-overlapping as recommended by IEC 61000-4-30. Markers indicate inrush duration. Cursors allow measurement of peak Arms half cycle. |
| <b>Mains signaling</b>           | Measurements are based on: either the corresponding 10/12-cycle rms value interharmonic bin or the rms of the four nearest 10/12-cycle rms value interharmonic bins per IEC 61000-4-30<br>Limit setup for Monitor mode follows EN50160 "Meistercurve"  |
| <b>Time synchronization</b>      | Optional GPS430 timesync module provides time uncertainty $\leq 20$ ms or $\leq 16.7$ ms <sup>2</sup> for time tagging of events and time aggregated measurements. When synchronisation becomes unavailable, time tolerance is $\leq 1$ -s/24h   |

## Wiring configurations

|                         |  |
|-------------------------|--|
| <b>1Ø + NEUTRAL</b>     | Single phase with neutral  |
| <b>1Ø SPLIT PHASE</b>   | Split phase  |
| <b>1Ø IT NO NEUTRAL</b> | Single phase system with two phase voltages without neutral                              |
| <b>3Ø WYE</b>           | Three phase four wire system WYE   |
| <b>3Ø DELTA</b>         | Three phase three wire system Delta  |
| <b>3Ø IT</b>            | Three phase system without neutral WYE   |
| <b>3Ø HIGH LEG</b>      | Four wire three phase Delta system with center tapped high leg                           |
| <b>3Ø OPEN LEG</b>      | Open delta three wire system with 2 transformer windings                                 |
| <b>2-ELEMENT</b>        | Three phase three wire system without current sensor on phase L2/B (2 watt meter method) |
| <b>2½-ELEMENT</b>       | Three phase four wire system without voltage sensor on phase L2/B                        |

## General specifications

|                                |   |
|--------------------------------|---|
| <b>Case</b>                    |   |
| <b>Design</b>                  | Rugged, shock proof with integrated protective holster  |
| <b>Drip and dust proof</b>     | IP51 according to IEC60529 when used in tilt stand position   |
| <b>Shock and vibration</b>     | Shock 30 g, vibration: 3 g sinusoid, random 0.03 g <sup>2</sup> /Hz according to MIL-PRF-28800F Class 2 |
| <b>Display</b>                 |   |
| <b>Type</b>                    | Bright full-color LCD with CCFL backlight, 80 cd/m <sup>2</sup>   |
| <b>Size</b>                    | 115.2 mm x 86.4 mm (4.5 in x 3.4 in)  |
| <b>Resolution</b>              | 320 x 240 pixels  |
| <b>Contrast and brightness</b> | User-adjustable, temperature compensated  |
| <b>Memory</b>                  |   |
| <b>Screens</b>                 | 50 screen memories  |
| <b>Data</b>                    | 10 data memories for storing data including recordings  |
| <b>Logger</b>                  | User configurable shared memory, up to 15 MB on Fluke 435, Up to 7 MB on Fluke 434 <sup>4</sup>         |
| <b>Limit templates</b>         | 2 preprogrammed, 2 administrator (programmable via FlukeView®), 2 user locations                        |
| <b>Real-time clock</b>         | Time and date stamp for AutoTrend, Transient display and SystemMonitor                                  |

## General specifications cont.

|                                  |  |
|----------------------------------|--|
| Mechanical                       |  |
| Size                             | 256 mm x 169 mm x 64 mm (10 in x 6.5 in x 2.5 in)  |
| Weight                           | 2 kg (4.5 lb)  |
| Power                            |  |
| Line power                       | Switchable 115 V, 230 V adapter with country specific plug   |
| Power adapter output voltage     | 15 V dc to 23 V dc; use only power adapter BC430   |
| Battery power                    | Rechargeable NiMH BP190 (installed)  |
| Battery operating time           | > 7 hours  |
| Battery charging time            | 4 hours, 8 hours for/006 version (instrument off)  |
| Power saving                     | Adjustable time for dimmed backlight with on screen power indicator  |
| Standards                        |  |
| Measurement methods used         | IEC 61000-4-30 Class-A   |
| Measurement performance          | Fluke 435 IEC 61000-4-30 Class-A, Fluke 434 IEC 61000-4-30 Class-B   |
| Power quality                    | EN 50160   |
| Flicker                          | IEC 61000-4-15   |
| Harmonics                        | IEC 61000-4-7  |
| Cross talk                       |  |
| Between V inputs                 | -60 dB @ nominal frequency   |
| Voltage to current input         | -95 dB @ nominal frequency   |
| Safety                           |  |
| Compliance                       | IEC/EN 61010-1-2001<br>CAN/CSA C22.2 No 61010-1-04<br>UL std No 61010-1<br>Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, Part 1: General requirements<br>Rated: 600 V CAT IV/1000 V CAT III Pollution Degree 2 |
| Max voltage on banana input      | 1000 V CAT III/600 V CAT IV  |
| Max voltage on current BNC input | 42 Vpeak   |
| Environmental                    |  |
| Operating temperature            | 0 °C to +50 °C (32 °F to 122 °F) battery only, 0 °C to +40 °C (32 °F to 104 °F) with adapter, within spec +15 °C to +35 °C (59 °F to 95 °F)  |
| Storage temperature              | -20 °C to +60 °C (-4 °F to +140 °F)  |
| Humidity                         | 10 °C to 30 °C: 95 % RH non-condensing;<br>30 °C to 40 °C: 75 % RH non-condensing;<br>40 °C to 50 °C: 45 % RH non-condensing battery only  |
| Maximum operating altitude       | 3000 m. Derate to 1000 V CAT II/600 V CAT III/300 V CAT IV above 2000 m  |
| Maximum storage altitude         | 12 km  |
| Warranty                         | Three-years on mainframe, one-year on included accessories   |
| Printers and Interface           |  |
| Type                             | Serial, optically isolated. Compatible with PM9080 (RS-232) or OC4USB (USB)  |
| Baud rate                        | 1200, 2400, 9600 to 115 kB   |
| Print out facility (B&W only)    | Via optional adapter PM9080 or PAC 91  |
| Print protocol                   | Epson FX/LQ, Deskjet, LaserJet , DPU-414 or PostScript   |

## Electro Magnetic Compatibility (EMC)

|  |                     |   |
|--|---------------------|---|
| Emission and immunity  | EN61326-1           | Fluke 434/435, including standard accessories, conforms with the EEC directive 89/336 for EMC immunity, as defined by EN61326, with the addition of the table below |
| Frequency  | Disturbance < 0.5 % | Disturbance < 10 %  |
| 80 MHz to 400 MHz  | All ranges          |   |
| 400 MHz to 600 MHz   | All other ranges    | 125 V range   |
| 600 MHz to 1 GHz   | All ranges          |   |
| The Analyzer is susceptible for RF fields with a field strength of 10 V/m, between 400 MHz and 600 MHz (Performance criteria B). |                     |   |

<sup>1</sup>Depending on clamp scaling, volt scaling 1:1

<sup>2</sup>50 Hz/60 Hz nominal frequency according to IEC 61000-4-30

<sup>3</sup>Add clamp accuracy and phase shift

<sup>4</sup>The logger and mains signaling function are optional for the Fluke 434 and standard on the Fluke 435

<sup>5</sup>Measured on reference voltage input A/L1

<sup>6</sup>Maximum time 9999 hours

<sup>7</sup>Estimated duration

<sup>8</sup>Add ±(n-1) x 2.5 ° for amplitude when using i430-flex-4pk

## Power quality analyzer selection table

|  | 435                                | 434*                 |
|--|------------------------------------|----------------------|
| Measures voltage, current, dips, swells, interruptions, harmonics, inter-harmonics, flicker, power, energy, transients, frequency, unbalance, inrush, EN50160 overview | •                                  | •                    |
| Logger function with multi-parameter logging   | •                                  | optional*            |
| Mains signaling  | •                                  | optional*            |
| Memory size  | 16 MB                              | 8 MB                 |
| Current probes   | 3000 A flexible (4)                | 40 A/400 A clamp (4) |
| Carrying case  | water-tight hard case with rollers | rugged hard case     |
| Software   | Fluke Power Log and FlukeView®     | FlukeView®           |

\*Optional functionality can be added with upgrade kit.



### Ordering information

|           |                                    |
|-----------|------------------------------------|
| Fluke-435 | Three-Phase Power Quality Analyzer |
| Fluke-434 | Three-Phase Power Quality Analyzer |

### Optional accessories

|               |  |
|---------------|--|
| i400s         | 40 A/400 A switchable current clamp (included w/434)   |
| I5sPQ3        | 3 pack of 5 A precision current clamps   |
| i430-flex-4pk | 4 pack of 3000 A flexible current probes (included w/435)  |
| C435          | Water-tight hard case with rollers (included w/435)  |
| GPS430        | GPS time synchronization module for Fluke 430 series   |
| Fluke 434/LOG | Upgrade kit for 434, includes Power Log software and enables logger and mains signaling function (accuracy and memory not upgradeable) |



**435 Includes:** Hard carrying case with rollers, four flexible current probes (i430-flex), five test leads and clips, battery charger, FlukeView software, Power Log software, optical USB cable, color localization set, Getting Started manual, Users manual on CD-ROM.



**434 Includes:** Hard carrying case, four current probes (i400s), five test leads and clips, battery charger, FlukeView software, optical USB cable, color localization set, Getting Started manual, Users manual on CD-ROM.

**Fluke.** *Keeping your world up and running.™*

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