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Fluke 433, 434, 435

Three Phase Power Quality Analyzer

Service Manual

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Chapter 1

Introduction and Safety Instructions

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1.1 Introduction to Manual

The Fluke 433, 434, 435 Three Phase Power Quality Analyzer (hereafter referred to as ‘Analyzer’) offers an extensive and powerful set of measurements to check power distribution systems. This Service Manual provides the information necessary to maintain the Analyzer at customer level.

The following information is presented in this Service Manual:

Chapter 1. *Introduction and safety Instructions.* Read carefully before using or servicing the Analyzer.

Chapter 2. *Specifications.* A complete set of detailed specifications.

Chapter 3. *Performance Verification.*

Chapter 4. *Calibration Adjustment.*

Chapter 5. *Disassembling the Analyzer.*

Chapter 6. *List of Replaceable Parts.*

Important. The Main PCA in this Analyzer is only available to Fluke Service Centers due to the programming that is necessary after installation.

1.2 Safety

1.2.1 Introduction

Read these pages carefully before beginning to install and use the Analyzer.

The following paragraphs contain information, cautions and warnings which must be followed to ensure safe operation and to keep the Analyzer in a safe condition.

Warning

Servicing described in this manual is to be done only by qualified service personnel. To avoid electrical shock, do not service the Analyzer unless you are qualified to do so.

1.2.2 Safety Precautions

For the correct and safe use of this Analyzer it is essential that both operating and service personnel follow generally accepted safety procedures in addition to the safety precautions specified in this manual. Specific warning and caution statements, where they apply, will be found throughout the manual. Where necessary, the warning and caution statements and/or symbols are marked on the Analyzer.

1.2.3 Caution and Warning Statements

Caution











Used to indicate correct operating or maintenance procedures to prevent damage to or destruction of the equipment or other property.

Warning

Calls attention to a potential danger that requires correct procedures or practices to prevent personal injury.

1.2.4 Symbols

The following symbols are used on the Analyzer, in the Users Manual, in this Service Manual, or on spare parts for this Analyzer.

| | | | |
|---|--|--|---|
|  | See explanation in Users Manual |  | DOUBLE INSULATION (Protection Class) |
|  | Live voltage |  | Earth Ground |
|  | Static sensitive components (black/yellow). |  Ni MH | Recycling information |
|  | Disposal information |  | Conformité Européenne |
|  | Safety Approval |  | Safety Approval |

1.2.5 Impaired Safety

Whenever it is likely that safety has been impaired, the Analyzer must be turned off and disconnected from line power. The matter should then be referred to qualified technicians. Safety is likely to be impaired if, for example, the Analyzer fails to perform the intended measurements or shows visible damage.

1.2.6 General Safety Information

Warning

Removing the Analyzer covers or removing parts, except those to which access can be gained by hand, is likely to expose live parts and accessible terminals which can be dangerous to life.

The Analyzer shall be disconnected from all voltage sources before it is opened.

Capacitors inside the Analyzer can hold their charge even if the Analyzer has been separated from all voltage sources.

When servicing the Analyzer, use only specified replacement parts.

Chapter 2

Specifications

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2.1 Introduction

Performance Characteristics

Fluke guarantees the properties expressed in numerical values within the tolerances stated. Numerical values without tolerances are typical and represent the characteristics of an average instrument excluding accessories. The Analyzer meets the specified accuracy 30 minutes and two complete acquisitions after power-on. All operational specifications are valid under the restrictions mentioned in section 'Environmental' unless otherwise specified.

Specifications are based on a one year calibration cycle.

Environmental Data

The environmental data mentioned in this manual are based on the results of the manufacturer's verification procedures.

Safety Characteristics




The Analyzer has been designed and tested in accordance with standard EN61010-1 2nd edition (2001), Safety Requirements for Electrical Equipment for Measurements Control and Laboratory Use for Class III Pollution Degree 2 instruments.


This manual contains information and warnings that must be followed by the user to ensure safe operation and to keep the Analyzer and its accessories in a safe condition. Use of this Analyzer and its accessories in a manner not specified by the manufacturer may impair the protection provided by the equipment.

2.2 Electrical Measurements

The following specifications of the instrument are verified using the “implementation verification” table 3 as specified in 61000-4-30 chap-6-2.

INPUT CHARACTERISTICS

| Voltage inputs | |
|---|--|
| Number of inputs | 4 (3 phases + neutral) DC coupled |
|  Maximum input voltage | 1000 Vrms |
|  Nominal Voltage range | 50...500 V internally divided in three ranges 500 V, 250 V and 125 V |
|  Maximum peak voltage | 6 kV |
| Input impedance | 4 M Ω // 5 pF |
| Bandwidth | > 10 kHz, up to 100kHz 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 |
|  Nominal input Range | 0 - \pm 5.625 Vpeak, 0 - 3.97 Vrms sinewave |
| Range | 1..400 Arms with included clamps (I400S) 0.1..3000 Arms with optional clamps |
| Input impedance | 50 k Ω |
| Bandwidth | >10 kHz |
| Scaling | 0.1, 1, 10, 100, 1000 mV/A, variable, i5s and i430flex |

| Nominal frequency | 40..70 Hz |
|------------------------|--|
| Sampling system | |
| Resolution | 16 bit analog to digital converter on 8 channels |
| Maximum sampling speed | 200kS/s on each channel simultaneously |
| RMS sampling | 5000 samples on 10/12 ² cycles according IEC 61000-4-30 |
| PLL synchronization | 4096 samples on 10/12 ² cycles according IEC 61000-4-7 |

DISPLAY MODES

| | |
|------------------|--|
| Waveform display | Available in Scope and Transient mode Captures 8 waveforms simultaneously Display update rate 5x per second Up to 10/12 times horizontal zoom Cursors: Single vertical line showing min, max, avg reading at cursor position. |
| Phasor | Shows real time phasor diagram Available in Scope and Unbalance mode Display update rate 5x per second |
| Meter readings | Available in Volts/Amps/Hertz, Harmonics, Power & Energy, Flicker, Unbalance and Logger4 mode. |
| AutoTrend graph | Available in Volts/Amps/Hertz, Dips & Swells, Harmonics, Power & Energy, Flicker, Unbalance, Inrush, Mains Signaling ⁴ Logger ⁴ and Monitor mode Cursors: single vertical line showing with min, max, avg reading at cursor position. |
| Bargraph | Available in Harmonics and Monitor mode |
| Eventlist | Available in Dips & Swells Mains Signaling ⁴ , Logger ⁴ and Monitor mode |

MEASUREMENT MODES

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

ACCURACY, RESOLUTION AND RANGE

| Volt/Amps/Hertz | Measurement Range | Resolution | Accuracy |
|---|---|--|---|
| Vrms(AC+DC) Fluke 435 | 1...600 Vrms | 0.01 Vrms | ± 0.1% of nominal voltage |
| Fluke 433/434 | 600...1000 Vrms 1...1000 Vrms | 0.01 Vrms 0.1 Vrms | ± 0.1% ± 0.5% of nominal voltage |
| Vpk | 1...1400 Vpk | 1 V | 5% of nominal voltage |
| Voltage Crest Factor (CF) | 1.0 ... > 2.8 | 0.01 | ± 5% |
| Arms (AC+DC) Fluke 435 Fluke 433/434 Fluke 433/434 with i400s Fluke 435 with I430flex | 0...20.00 kArms ¹ 0...20.00 kArms ¹ 0...40 / 400 Arms 30...3000 Arms | 0,001...10 Arms ¹ 0,001...10 Arms ¹ 0.1 and 1 Arms 1 Arms | ± 0.5% ± 5 counts ³ ± 1% ± 5 counts ³ ± 1% ± 5 counts ³ ± 0.5% ± 20 counts ³ |
| Apk using 1mV/A scaling | 0 - 5500 Apk | 1A | ± 5% |
| A Crest Factor (CF) | 1 ... 10 | 0.01 | ± 5% |
| Hz ⁵ Fluke 435 @ 50Hz nominal Fluke 435 @ 60Hz nominal Fluke 433/434 @ 50Hz nominal Fluke 433/434 @ 60Hz nominal | 42.500 ... 57.500 Hz 51.000 ... 69.000 Hz 42.50 ... 57.50 Hz 51.00 ... 69.00 Hz | 0.001 Hz 0.001 Hz 0.01 Hz 0.01 Hz | ± 0.01Hz ± 0.01Hz ± 0.01Hz ± 0.01Hz |

| Dips and swells | Measurement Range | Resolution | Accuracy |
|--|---|---|--|
| Vrms ^{1/2} (AC+DC) Fluke 435 Fluke 433/434 | 0.0% ...200% of nominal voltage 0.0% ...200% of nominal voltage | 0.1Vrms 0.1Vrms | ± 0.2% of nominal voltage ± 1% of nominal voltage |
| Arms ^{1/2} (AC+DC) Fluke 435 Fluke 433/434 Fluke 433/434 with i400s Fluke 435 with i430flex | 0 ... 20,000 Arms ¹ 0 ... 20,000 Arms ¹ 0 ... 400 Arms 30 ... 3000 Arms | 0,001 Arms...10 Arms 0,001 Arms...10 Arms 0.1 Arms and 1 Arms 1 Arms | ± 1% ± 10 counts ³ ± 2% ± 10 counts ³ ± 2% ± 10 counts ³ ± 1% ± 20 counts ³ |
| Threshold levels | Programmable thresholds in percent of nominal voltage Event detection based upon 1/2 cycle rms voltages Captures Dips, Swells Interruptions and Rapid Voltage Changes | | |
| Duration | hhh,mm,ss,mmm | Half cycle | One cycle |

| Harmonics | Measurement Range | Resolution | Accuracy |
|--|---|---|--|
| Harmonic order (n) | DC, 1..50 Grouping: Harmonic groups according to IEC 61000-4-7 | | |
| Inter-Harmonic order | Off, 1..49 Grouping: Harmonic and Interharmonic subgroups according to IEC 61000-4-7 | | |
| Filtering (*) | When measuring harmonics with interharmonics off, harmonics group is used and a 1.5 s smoothing filter is active. When measuring harmonics with interharmonics on, harmonics subgroup and interharmonics centered subgroup are used and no filter is active. | | |
| Vrms Relative (%f): Fluke 435 Absolute: | 0.0 ... 100.0% 0.0 ... 1000 Vrms | 0.1% 0.1 Vrms | ± 0.1% ± n x 0.1% (± 0.4% for %r) ± 0.05% of nominal voltage if < 1% of nominal voltage ± 5% if ≥ 1% of nominal voltage |
| Fluke 433/434 Absolute: | 0.0 ... 1000 Vrms | 0.1 Vrms | |
| Arms Relative (%f): Absolute: | 0.0 ... 100.0% 0.0 ... 4000 mV x clamp scaling | 0.1% 1 mVrms x clamp scaling | ± 0.1% ± n x 0.1% (± 0.4% for %r) ± 5% ± 5 counts |
| Watts Relative: (Harmonics only) Watts Absolute: (Harmonics only) | 0.0 ... 100.0% depends on clamp and voltage scaling | 0.1% | ± n x 2% ± 5% ± n x 2% ± 10 counts |
| DC Relative: Fluke 435 Absolute V: Fluke 433/434 Absolute V: Absolute A: Absolute W: | 0.0 ... 100.0% 0.0 ... 1000V 0.0 ... 1000V 0.0 ... 4000 mV x clamp scaling depends on clamp and voltage scaling | 0.1% 0.1V 0.1V 1 mVrms x clamp scaling 0.1V depends on scaling | ± 0.1% V and A (± 2% Watt) ± 0.2% of nominal voltage ± 5% ± 10 counts ± 5% ± 10 counts ± 5% ± 10 counts |
| THD _(n=40) (relative %f or %r) | 0.0 ... 100.0 % | 0.1% | ± 2.5% V and A (± 5% Watt) |
| Hz | 0 ... 3500 Hz | 1 Hz | ± 1Hz |
| Phase angle Fluke 435 Fluke 433/434 | -360° ... +0° -360° ... +0° | 1° 1° | ± n × 1° (⁸) ± n × 1.5° (⁸) |

(*): Firmware V02.03 and onwards

| Power and Energy | Measurement Range | Resolution | Accuracy |
|--|--|--|--|
| Watt (VA, VAR) Fluke 435 Fluke 433/434 | 1.0 ... 20.00MW ¹ 1.0 ... 20.00MW ¹ | 0.1 ... 1 kW ¹ 0.1 ... 1 kW ¹ | ± 1% ± 10 counts ³ ± 1.5% ± 10 counts ³ |
| kWh ⁶ (kVA ⁶ , kVAR ⁶) | 00.00 kWhr...200.0 GWhr ¹ 00.00 kWhr...200.0 GWhr ¹ | 0.01 Xhr....100 Whr ¹ 0.01 Whr....100 Whr ¹ | ± 1% ± 10 counts ³ ± 1.5% ± 10 counts ³ |
| Power Factor | 0...1 | 0.01 | ± 0.03 ³ |
| Cos φ / DPF | 0...1 | 0.01 | ± 0.03 ³ |

| Flicker | Measurement Range | Resolution | Accuracy |
|--|--|---|--|
| Pst (1min), Pst, Plt, PF5 instantaneous Flicker | 0.00 ... 20.00 | 0.01 | Within ±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 ... ± 100.0% for Dc% and Dmax% and 0.000 ... 9.999s for Time | 0.1% for Dc% and Dmax% and 10 ms for Time | ± 1% for Dc% and Dmax% and 20 ms for Time |

| Unbalance | Measurement Range | Resolution | Accuracy |
|---|--|--------------|---------------------------------------|
| Volts Fluke 435 (neg. and zero seq.) Volts Fluke 433/434 neg. and zero seq.) | 0.0 ... 5.0% 0.0 ... 5.0% | 0.1% 0.1% | ± 0.15% ± 0.5% |
| Current (neg. and zero seq.) | 0.0 ... 20% | 0.1% | ± 1% |
| Phase angle Volts Current | -360.0° ... +0.0° -360.0° ... +0.0° | 0.1° 0.1° | ± 2 counts ± 5 counts ³ |

| Transient capture | Measurement Range | Resolution | Accuracy |
|--|--------------------------------|------------|---|
| Volts cursor reading rms reading | ± 6000 Vpk 10 ... 1000 Vrms | 1 V 1 V | ± 15% of cursor reading ± 2.5% of Vnominal |
| Minimum detect duration | 5 μs | | |
| Sampling rate | 200kS/s | | |

| Inrush mode | Measurement Range | Resolution | Accuracy |
|-----------------|---|------------------------------|----------------------------|
| Arms (AC+DC) | 0.000 ... 20.00 kArms ¹ | 0.001.. 10 Arms ¹ | ± 1% of meas ± 5 counts |
| Inrush Duration | mm:ss:mmm between 7.5s ... 30minutes selectable | 10ms | ± 20 ms (Fnominal = 50 Hz) |

| Mains Signaling ⁴ | Measurement Range | Resolution | Accuracy |
|---------------------------------|--|------------|-------------------------|
| Threshold levels | Thresholds, limits and signaling duration is programable for two independent signalling frequencies. | | |
| Signaling frequency | 60 ... 3000 Hz | 0.1 Hz | |
| Relative V% | 0% .. 100% of | 0.1% | ± 0.4% |
| Absolute V3s (3 second average) | 0.0 ... 1000 V | 0.1 V | ± 5% 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 & Energy, Flicker, Unbalance and Mains Signaling ⁴ 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 h | 7.5 h | 15 h | 30 h | 150 hr | 450 hr | 900 hr | 75 days |
| Resolution | 1 s | 5 s | 15 s | 30 s | 60 s | 5 min. | 15 min. | 30 min. | 1 hr |

| Dips & Swells mode | | | | | | | | | | |
|--------------------|---|-------|--------|---------|---------|------|--------|--------|-------|-------|
| Sampling | 100/120 ² readings/sec continuous sampling per channel | | | | | | | | | |
| Recording time | From 90 sec with 25msec 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 hr | 7.5 hr | 15 hr | 30 hr |
| 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 ² readings/sec continuous sampling per channel | | | | | | | | | |
| Recording time | From 7.5 sec with 25msec display resolution up to 30 min with 500msec display resolution for Inrush measurements and up to 2hr 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. | 1 hr | 2hr |
| Resolution | 25 ms | 25 ms | 25 ms | 25 ms | 50 ms | 100 ms | 200 ms | 500 ms | 1 s | 2s |

| Logger mode | | | | | | | | | | |
|---|--|---------|-----------|-------|----------|----------|--------|---------|--------|--|
| Sampling | Combination of 5 readings/sec and 100/120 ² 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 ⁴ | | | | | | | | | |
| Nr of readings on 3 phases + N | 1 | | | 10 | | | 100 | | | |
| Averaging time | 0.5 s | 10 min | 2 hr | 0.5 s | 10 min | 2 hr | 0.5 s | 10 min | 2 hr | |
| Max ⁷ duration using 15MB | 66 hr | 9 years | 100 years | 6 hr | 333 days | 10 years | 18 min | 31 days | 1 year | |
| Measurement aggregation over time intervals (*) | The basic measurement time interval for parameters is a 10/12-cycle time interval for 50/60 Hz power systems. Measurement time interval aggregation is selected via the Logger averaging time setting. Note: 150/180 cycle (3 s) interval aggregation as per IEC 61000-4-30 Clauses A.7 can be selected from the SETUP, FUNCTION PREF, AGGREGation INTERVAL setting | | | | | | | | | |

(*): Firmware V02.03 and onwards

| Monitor mode | |
|---------------------|--|
| Sampling | Combination of 5 readings/sec and 100/120 ² readings/sec continuous sampling per channel depending on the parameter measured. |
| Recording time | Up to 1 week with 10 min resolution |
| 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 ² cycle contiguous non overlapping intervals using 500/416 ² samples per cycle in accordance with IEC 61000-4-30. Firmware V02.03 and onwards: 10/12 ² or 150/180 (selectable) cycle contiguous non overlapping intervals using 500/416 ² samples per cycle in accordance with IEC 61000-4-30 |
| Vpeak, Apeak | Absolute highest sample value within 10/12 ² cycle interval with 40µs 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 ^{1/2} ,Arms ^{1/2} | 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 Calculates average value of instantaneous power over 10/12 cycle period for each phase Total Active Power $P_T = P_1 + P_2 + P_3$ |
| VA | Selectable Total or Fundamental apparent power display Calculates apparent power using Vrms x Arms value over 10/12 cycle period Total Apparent Power is root mean square of real and apparent power |
| VAR | Selectable Total of Fundamental reactive power display Calculates reactive power as root of VA squared minus Watt squared over 10/12 cycle period. Capacitive and inductive load is indicated with capacitor and inductor icons |
| Power Factor | Calculated Watt / VA |
| Cos φ / DPF | Cos of angle between fundamental voltage and current |
| Unbalance | The supply voltage unbalance is evaluated using the method of symmetrical components according to IEC61000-4-30 |
| Flicker | According to IEC 61000-4-15 Flickermeter - Functional and design specification. Includes 230V 50Hz lamp and 120V 60Hz lamp models |
| Transient capture | Captures waveform triggered on signal envelope. Additionally triggers on dips, swells, interruptions and Amps level as specified by IEC61000-4-30 |
| Inrush current | 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. |

| | |
|----------------------|--|
| Mains Signaling | Measurement are based on: either the corresponding 10/12-cycle r.m.s. value interharmonic bin or the rms of the four nearest 10/12-cycle rms value interharmonic bins per IEC 61000-4-30 Limit setup for Monitor mode follows EN50160 "Meistercurve" |
| Time Synchronisation | Optional GPS430 timesync module provides time uncertainty ≤ 20 ms or ≤ 16.7 ms ² for time tagging of events and time aggregated measurements. When synchronisation becomes unavailable, time tolerance is ≤ 1 -s/24h |

2.3 Wiring Combinations

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

2.4 General

| Case | |
|---------------------|--|
| Design | Rugged, shock proof with integrated protective holster |
| Drip and dust proof | IP51 according to IEC60529 when used in tilt stand position |
| Shock and Vibration | Shock 30g, Vibration: 3g Sinusoid, Random 0.03g ² /Hz according to MIL-PRF-28800F Class 2 |



| | |
|-------------------------|--|
| Display | Bright Full-Color LCD with CCFL backlight, 80cd/m ² |
| Size | 115.2 x 86.4 mm |
| Resolution | 320 x 240 pixels |
| Contrast and brightness | User adjustable, temperature compensated |

| Memory | |
|-----------------|---|
| Screens | 50 screen memories (25 in Fluke 433) |
| Data | 10 data memories for storing data including recordings (5 in Fluke 433) |
| Logger | User configurable shared memory, up to 15 MB on Fluke 435, Up to 7 MB on Fluke 434 ⁴ |
| Limit templates | 2 preprogrammed, 2 administrator (programmable via FlukeView), 2 user locations |
| Real-time clock | Time and date stamp for AutoTrend, Transient display and SystemMonitor |

2.5 Mechanical

| | |
|--------|-------------------|
| Size | 256 x 169 x 64 mm |
| Weight | 2kg |

2.6 Power

| | |
|---|---|
|  Line power | Switchable 115V, 230V adapter with country specific plug |
|  Power Adapter input voltage | 15 ... 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 |

2.7 Standards

| | |
|--------------------------|--|
| Measurement methods used | IEC61000-4-30 class A |
| Measurement performance | Fluke 435 IEC61000-4-30 Class A, Fluke 433/434 IEC61000-4-30 Class B |
| Power Quality | EN50160 |
| Flicker | IEC 61000-4-15 |
| Harmonics | IEC 61000-4-7 |




2.8 Cross talk

| | |
|--------------------------|-------------------|
| Between V inputs | -60 dB @ Fnominal |
| Voltage to current input | -95 dB @ Fnominal |

2.9 Common Mode Rejection Ratio (CMRR)

| | |
|------|--------|
| CMRR | >60 dB |
|------|--------|

2.10 Safety

| | |
|--|---|
|  Compliance with | IEC/EN61010-1-2001, CAN/CSA C22.2 No 61010-1-04 (including cCSA _{US} approval), UL std No 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, Part 1: General requirements, Rated: 600V CAT IV 1000V 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 V _{peak} | |

2.11 Environmental

| | |
|----------------------------|---|
| Operating temperature | 0°C to +50°C battery only, 0°C to +40°C with adapter, within spec +15°C to +35° |
| Storage temperature | -20 °C to +60 °C |
| Humidity | 10 .. 30 °C: 95% RH non condensing 30 .. 40 °C: 75% RH non condensing 40 .. 50 °C: 45% RH non condensing battery only |
| Maximum operating altitude | 3000m. Derate to 1000 V CAT II / 600 V CAT III / 300 V CAT IV above 2000m |
| Maximum storage altitude | 12km |

2.12 Printers and Interface

| | |
|-------------------------------|---|
| Type | Serial, optically isolated. Compatible with PM9080 (RS-232) or OC4USB (USB) |
| Baud rate | 1200, 2400, 9600 ... 57k6 |
| Print out facility (B&W only) | Via optional adapter PM9080 or PAC 91 |
| Print protocol | Epson FX LQ, Deskjet, LaserJet , DPU-414 or PostScript |

2.13 Electro Magnetic Compatibility (EMC)

| Item | Customer Specification | Additional Information |
|-----------------------|------------------------|--|
| Emission and Immunity | EN-61326 | Fluke 433/434/435, including standard accessories, conforms with the EEC directive 89/336 for EMC immunity, as defined by EN-61326, with the addition of the table below |

| Frequency | Disturbance < 0.5 % | Disturbance < 10 % |
|--|---------------------|--------------------|
| 80 – 400 MHz | All ranges | |
| 400 – 600 MHz | All other ranges | 125 V range |
| 600 MHz – 1 GHz | All ranges | |
| The Analyzer is susceptible for RF fields with a field strength of 10 V/m, between 400 and 600 MHz (Performance criteria B). | | |

¹ depending clamp scaling, volt scaling 1:1

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

³ Add clamp accuracy and phase shift

⁴ The logger and Mains Signaling function are optional for the Fluke 434 and standard available on the Fluke 435

⁵ Measured on reference voltage input A/L1

⁶ Maximum time 9999 hours

⁷ Estimated duration

⁸ Add $\pm(n-1) \times 2.5^\circ$ for Amp. when using i430flex

Chapter 3

Performance Verification

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3.1 Introduction

Warning

Procedures in this chapter should be performed by qualified service personnel only. To avoid electrical shock, do not perform any servicing unless you are qualified to do so.

The Fluke 433/434/435 Power Quality Analyzer (referred to as Analyzer) should be calibrated and in operating condition when you receive it.

The following performance tests are provided to ensure that the Analyzer is in a proper operating condition. If the Analyzer fails any of the performance tests, calibration adjustment (see Chapter 4) and/or repair in a Fluke service center is necessary.

The Performance Verification Procedure is based on the specifications, listed in Chapter 2 of this Service Manual. The values given here are valid for ambient temperatures between 15 °C and 35 °C.

Analyzer performance can be checked with single phase 50 and 60 Hz test signals such as generated by a Calibrator Fluke 5500A or 5700A.

For Fluke 433/434 you can use a standard Calibrator (e.g. Fluke 5500A); for the more accurate model Fluke 435 you must use Fluke 5700A.

The tests mainly verify accuracy and offset of voltage and current inputs.

Tests indicated with (*) are optional. They can be done to check if the Analyzer's hardware (analog input channels) is OK. Bear in mind that the outcome of these checks is rather influenced by hardware sanity than by Calibration Adjustment.

Accuracy of all other Analyzer functions is linked to input accuracy and is embedded in the software. This link is tested extensively for each new software release.

This testing is done with the **Fluke 6100A Electrical Power Standard** and 6101A Auxiliary units. This setup allows multiphase operation and direct testing of measuring functions such as flicker, harmonics, interharmonics, fluctuating harmonics, dips & swells, unbalance and also compounds of these disturbances.

Fluke 6100A and 6101A are recommended for those who want to test all measuring functions of Fluke 433/434/435.

Tests are done in V/A/Hz mode (unless indicated otherwise).

All indicated voltages and currents are rms values.

The Performance Verification Procedure is a quick way to check most of the Analyzer's specifications. Because of the highly integrated design of the Analyzer, it is not always necessary to check all features separately.

Always put the Analyzer in STBY (Stand By) mode before changing test leads.

Fluke 5500A has separate keys for STBY and OPR (Operate): OPR mode is indicated by a green LED in the OPR key.

Fluke 5700A has a toggle key OPR/STBY with function indication in the display.

Important: during all tests, signal must be applied to voltage channel A/L1. A/L1 is the reference channel.

The verification procedure assumes that the test engineer is familiar with the operation of Analyzer and Calibrator.

3.2 Equipment Required for Verification

The primary source instrument used in the verification procedures of Fluke 433/434 is the Fluke 5500A. For Fluke 435 you must use Fluke 5700A. If not available, you can substitute another Calibrator as long as it meets the minimum test requirements.

- For Fluke 433/434: Fluke 5500A Calibrator. For Fluke 435: Fluke 5700A Calibrator.
- Test Leads (4x), as supplied with the Calibrator.
- Extra set of test leads capable to withstand 1000 V rms.
Note: for good recognition it is recommended to use a black lead between the Calibrator's LO and the Analyzer's Ground banana input.
- 50Ω Coax Cables (3 pieces required), Fluke PM9092 (0.5m, set of 3).
- Male BNC to Dual Female BNC adapter (3 pieces required), Fluke PM9093.
- Dual Banana Jack to female to male BNC (1 piece required), Fluke PM9082.
- 50Ω feed through termination (4 pieces required): Fluke PM9585.
- Battery Charger / Power Adapter, BC430.

3.3 Relation between Characteristics and Performance Test.

Test limits used are based upon the specifications in Chapter 2 – Characteristics in this Service Manual. Accuracy requirements are as follows:

- Accuracy of current channels (page 2-7, Arms AC+DC):
433/434: 1% of measurement \pm 5 counts,
435: 0.5% of measurement \pm 5 counts.
- Accuracy of voltage channels Fluke 433/434 (page 2-7, Vrms AC+DC):
0.5% of nominal voltage V_{nom} as adjusted under SETUP, V_{nom} (120 V, 230 V, or 400 V) @ input voltage range 1 ... 1000 Vrms.
- Accuracy of voltage channels Fluke 435 (page 2-7, Vrms AC+DC):
0.1% of nominal voltage V_{nom} as adjusted under SETUP, V_{nom} (120 V, 230 V, or 400 V) @ input voltage range 1 ... 600 Vrms.
Input voltage range 600 ... 1000 Vrms: accuracy 0.1% of reading.
- Accuracy of voltage channels 6 kV (page 2-9, Transient capture rms reading):
433/434/435: 2.5% of nominal voltage V_{nom} (e.g. 400 V).
- Bandwidth of current channels (page 2-8, Arms, Absolute):
433/434/435: 5% of measurement \pm 5 counts.
Note: Bandwidth measurement is based on the accuracy of the harmonics mode. The Analyzer can measure harmonics up to the 50th. A nominal fundamental frequency of 60 Hz requires a bandwidth of $50 \times 60 = 3000$ Hz.
- Bandwidth of voltage channels (page 2-8, Vrms, Absolute):
433/434: 5% of measurement \pm 2 counts,
435: 5% of measurement.
Note: Bandwidth measurement is based on the accuracy of the harmonics mode. The Analyzer can measure harmonics up to the 50th. A nominal fundamental frequency of 60 Hz requires a bandwidth of $50 \times 60 = 3000$ Hz.
- Channel Isolation (page 2-15, Cross talk, Voltage to current input):
Cross Talk from voltage into current channels: - 95 dB (= 56,234 times).

3.4 General Instructions





Follow these general instructions for all tests:

- For all tests, power the Analyzer with the BC430 power adapter/battery charger. The battery pack must be installed and charged sufficiently.
- Allow the Calibrator to satisfy its specified warm-up period.
- For each test point, wait for the Calibrator to settle.
- Allow the Analyzer a minimum of 30 minutes to warm up.
- One division on the LCD consists of 25 pixels (1 pixel = 0.04 division).

3.5 Operating Instructions




Resetting the Analyzer

Proceed as follows:

- Press  to turn the Analyzer off.
- Press and hold .
- Press and release  to turn the Analyzer on.
- Wait until the Analyzer has **beeped twice**, and then release . When the Analyzer has beeped twice, the RESET was successful.

3.6 Display and Backlight Test

Proceed as follows to test the display and the backlight:

1. Press  to turn the Analyzer on.
2. Remove the BC430 adapter power, and verify that the backlight is dimmed.
3. Apply the BC430 adapter power and verify that the backlight brightness increases.
4. Press and hold  (Brightness), then press and release  (Function key F5).

The Analyzer shows the calibration menu in the bottom of the display.

- Do NOT press **F3** now! If you did, turn the Analyzer off and on, and start at 4.
5. Press **F1 PREVIOUS** three times. The Analyzer shows **Contrast (CL 0100)**:
 6. Press **F3 CALIBRATE**
The Analyzer shows a dark display; the test pattern as shown in Figure 3-1 may be not visible or hardly visible.
Observe the display closely, and verify that the display shows no abnormalities, as for example very light pixels or lines.

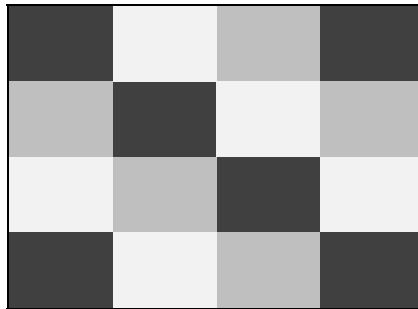


Figure 3-1. Display Pixel Test Pattern

7. Press **F2** .
The test pattern is removed; the Analyzer shows **Contrast (CL 0100)**:
8. Press **F2** again to do the next step **Contrast (CL 0110)**:
9. Press **F3 CALIBRATE**
The Analyzer shows the display test pattern shown in Figure 3-1, at default contrast. Observe the display closely, and verify that the display shows no abnormalities. Also verify that the contrast of the upper left and upper right square of the test pattern is equal.
10. Press **F2** .
The test pattern is removed; the Analyzer shows **Contrast (CL 0110)**:
11. Press **F2** again to do the next step **Contrast (CL 0120)**:
12. Press **F3 CALIBRATE**
The Analyzer shows a light display; the test pattern as shown in Figure 3-1 may not be visible or hardly visible.
Observe the display closely, and verify that the display shows no abnormalities.
13. Turn the Analyzer OFF and ON to exit the calibration menu and to return to the normal operating mode.

If the maximum, minimum, or default display contrast is not OK, then you can set these items without performing a complete calibration adjustment; refer to Section 4 for detailed information.

3.7. Verification of Current Inputs

3.7.1 Preparation

Proceed as follows:

- Reset the Analyzer.
- Press **SETUP**. Set the Analyzer to 3-phase WYE, 60 Hz, 120 V. Set Clamp for Phase and Neutral to 1 mV/A, 400 A, 1:1.
- Set the Analyzer in DEMO mode: press **SETUP**, press **F3 - FUNCTION PREF**, and select **DEMO ON** with **F1**. Demo mode gives increased sensitivity at the voltage inputs. **Input voltage must not exceed 2 V rms in DEMO mode!**

3.7.2 Accuracy

Proceed as follows:

1. Must be checked for all phases A/L1, B/L2, C/L3, and N(eutral).
2. Set the Calibrator to 1 V, 60 Hz and STBY.
3. Connect the LO output (black) with the Ground (green) input of the Analyzer. Connect the HI output (red) with all current (BNC) inputs and the A/L1, B/L2, C/L3, and N voltage banana inputs of the Analyzer. Refer to Figure 3.2.

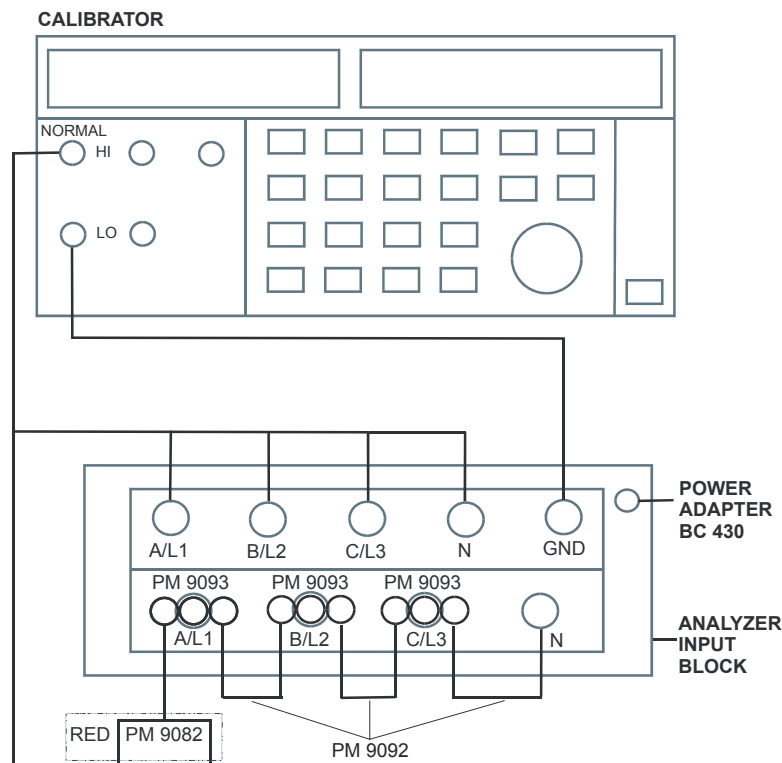


Figure 3-2. verification of Current Inputs

4. Set the Calibrator to OPR (Operate, indicated by a green LED in the OPR key or on the display).
5. On the Analyzer press **MENU**, select **Volts/Amps/Hertz**, press **F5 - OK** to enter the function.

6. Fluke 433/434: check for a current readout A rms between 985 ... 1015 A (tolerance $10 + 5 \text{ A} = 15 \text{ A}$).
Fluke 435: check for a readout between 990 ... 1010 A (tolerance $5 + 5 \text{ A} = 10 \text{ A}$). (Voltage readout V rms must be approx. 0 V at A/L1, B/L2, C/L3 and 172 V at N inputs, frequency readout between 59.88 ... 60.02 Hz, Analyzer in DEMO mode).
7. Set the Calibrator to 0 Hz, 0 V and then to OPR.
8. On the Analyzer check for a current readout A rms between 0 ... 5 A.

3.7.2 Bandwidth check of current channels (*)

Is an optional test. Proceed as follows:

1. Set the Calibrator to 1 V, 60 Hz and OPR.
2. The current channels must be checked one by one. Use the Calibrator's edit field function (5500A: FIELD EDIT key, 5700A: AMPL/FREQ key) to adjust a readout of 1000 A for the current channel to be checked.
3. Increase the frequency to 3 kHz. Check for a readout of 945 A or more.

Table 3-1. Bandwidth Check of Current Channels

| Current Channel to be verified | Readout at 60 Hz (adjust Calibrator with EDIT FIELD) | Readout at 3 kHz Fluke 433/434/435 |
|--------------------------------|--|------------------------------------|
| A/L1 | 1000 A | 945 A or more |
| B/L2 | 1000 A | 945 A or more |
| C/L3 | 1000 A | 945 A or more |
| N | 1000 A | 945 A or more |

4. Set the Calibrator to STBY.
5. Disconnect the leads from the current inputs.
6. Switch the Analyzer's DEMO mode to OFF.

3.8 Voltage Inputs

3.8.1 Introduction

WARNING

Dangerous voltages will be present on the calibration source and connecting cables during the following steps. Ensure that the Calibrator is in standby mode before making any connection between the Calibrator and the Analyzer.

Proceed as follows:

1. To check the A/L1, B/L2, C/L3 inputs, connect the N input to Ground (See Figure 3-3). N now will give zero reading.

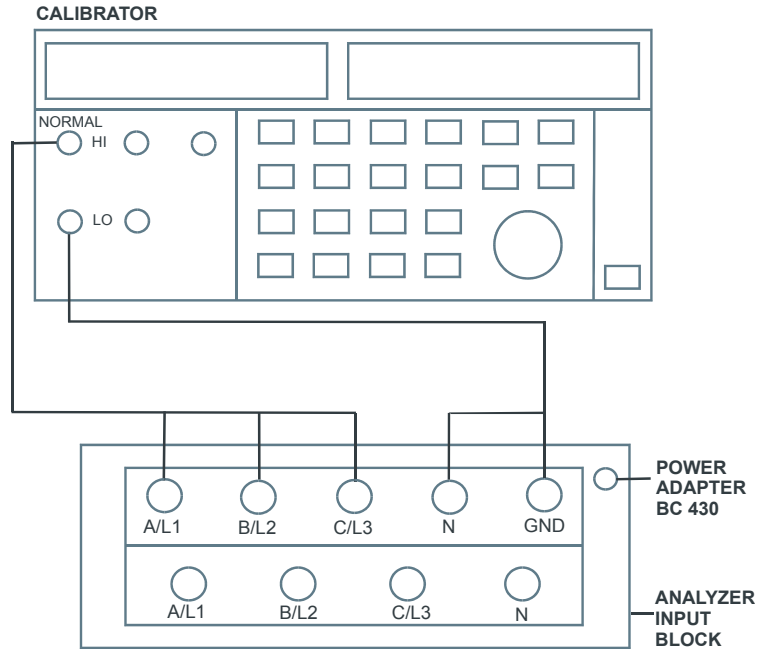


Figure 3-3. Checking the A/L1, B/L2, and C/L3 voltage inputs

2. To check the N input, connect the N input with the adjacent C/L3 input. A/L1, B/L2, C/L3 now will give zero reading. Refer to Figure 3-4.

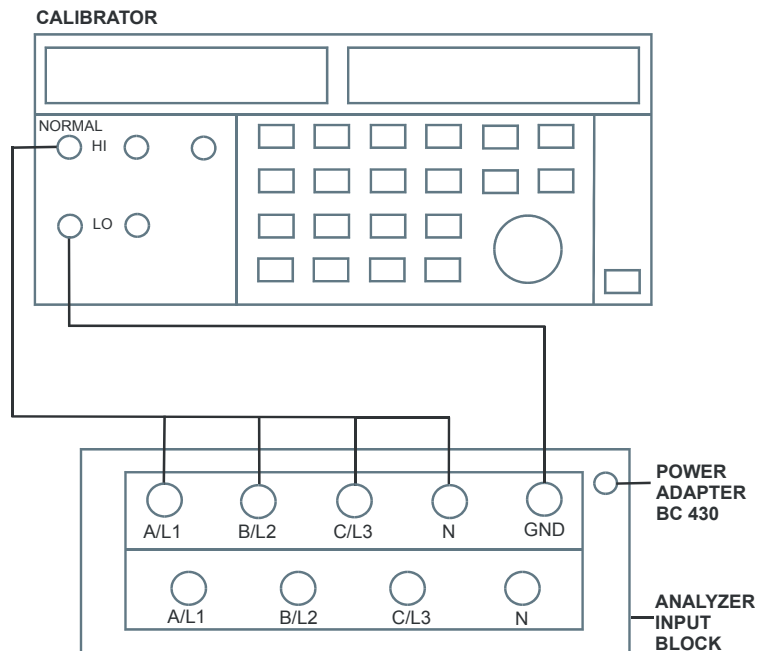


Figure 3-4. Checking the N (Neutral) voltage input

3.8.2 Verification of voltage inputs in 120 V range

Accuracy Check of Channel A/L1, B/L2, C/L3:

1. Set the Analyzer to 120 V, 60 Hz nominal (SETUP menu, arrow and ENTER keys). Press MENU, select Volts/Amps/Hertz, press F5 - OK.
2. To check the A/L1, B/L2, C/L3 inputs: connect the N input to Ground (See Figure 3-3).
3. Set the Calibrator to 60 Hz, 60 V and then to OPR.
4. Fluke 433/434: check for a voltage readout V rms between 59.4 ... 60.6 V.
Fluke 435: check for a voltage readout V rms between 59.88 ... 60.12 V.
5. Check the 120 V range according to the table below.

Table 3-2. Accuracy Check of Voltage Channels A/L1, B/L2, C/L3

| Set Calibrator to | Readout at Voltage Channels |
|-------------------|--|
| 60 V, 60 Hz, OPR | Fluke 433/434: 59.4 ... 60.6 V Fluke 435: 59.88 ... 60.12 V |
| 120 V, 60 Hz, OPR | Fluke 433/434: 119.4 ... 120.6 V Fluke 435: 119.88 ... 120.12 V |
| 240 V, 60 Hz, OPR | Fluke 433/434: 239.4 ... 240.6 V Fluke 435: 239.88 ... 240.12 V |

6. Set the Calibrator to STBY.

Optional Test. Bandwidth Check of Channel A/L1, B/L2, C/L3 (*):

7. Set the Calibrator to 120 V, 60 Hz and OPR.
8. Now check the voltage channels one by one. Use the Calibrator's field edit function (5500A: FIELD EDIT key, 5700A: AMPL/FREQ key) to adjust the Calibrator to an Analyzer readout of 120.0 V / 120.00 V.
9. Increase the frequency to 3 kHz.
Fluke 433/434: check for a readout of 113.8 V or more.
Fluke 435: check for a readout of 114.00 V or more.
Check the channels according to the table below.

Table 3-3. Bandwidth Check of Voltage Channels A/L1, B/L2, C/L3

| Voltage Channel to be verified | Readout at 60 Hz (adjust Calibrator with EDIT FIELD) | Readout at 3 kHz |
|--------------------------------|--|---|
| A/L1 | Fluke 433/434: 120.0 V Fluke 435: 120.00 V | Fluke 433/434: 113.8 V or more Fluke 435: 114.00 V or more |
| B/L2 | Fluke 433/434: 120.0 V Fluke 435: 120.00 V | Fluke 433/434: 113.8 V or more Fluke 435: 114.00 V or more |
| C/L3 | Fluke 433/434: 120.0 V Fluke 435: 120.00 V | Fluke 433/434: 113.8 V or more Fluke 435: 114.00 V or more |

10. Set the Calibrator to STBY.

Accuracy Check of Channel N (Neutral):

11. Connect the N input with the C/L3 input (See Figure 3-4). A/L1, B/L2, C/L3 now give zero reading.
12. Set the Calibrator to 60 Hz / 60 V and then to OPR.
13. Fluke 433/434: check for a voltage readout V rms between 59.4 ... 60.6 V.
Fluke 435: check for a voltage readout V rms between 59.88 ... 60.12 V.
14. Check the 120 V range according to the table below.

Table 3-4. Accuracy Check of Voltage Channel N (Neutral)

| Set Calibrator to | Readout at Voltage Channel N |
|-------------------|--|
| 60 V, 60 Hz, OPR | Fluke 433/434: 59.4 ... 60.6 V Fluke 435: 59.88 ... 60.12 V |
| 120 V, 60 Hz, OPR | Fluke 433/434: 119.4 ... 120.6 V Fluke 435: 119.88 ... 120.12 V |
| 240 V, 60 Hz, OPR | Fluke 433/434: 239.4 ... 240.6 V Fluke 435: 239.88 ... 240.12 V |

15. Set the Calibrator to STBY.

Optional test. Bandwidth Check of Channel N (*):

16. Set the Calibrator to 120 V, 60 Hz and OPR.
17. Now check the voltage channel N. Use the Calibrator's field edit function (5500A: FIELD EDIT key, 5700A: AMPL/FREQ key) to adjust the Calibrator to an Analyzer readout of 120.0 V / 120.00 V.
18. Increase the frequency to 3 kHz.
Fluke 433/434: check for a readout of 113.8 V or more.
Fluke 435: check for a readout of 114.00 V or more.
19. Set the Calibrator to STBY.

3.8.3 Verification of voltage inputs in 230 V range

Accuracy Check of Channel A/L1, B/L2, C/L3:

1. Set the Analyzer to 230 V, 50 Hz nominal (SETUP menu, arrow and ENTER keys). Press MENU, select Volts/Amps/Hertz, press F5 - OK.
2. To check the A/L1, B/L2, C/L3 inputs: connect the N input to Ground (See Figure 3-3).
3. Set the Calibrator to 50 Hz, 115 V and then to OPR.
4. Fluke 433/434: check for a voltage readout V rms between 113.8 ... 116.2 V.
Fluke 435: check for a voltage readout V rms between 114.77 ... 115.23 V.
5. Check the 230 V range according to the table below.

Table 3-5. Accuracy Check of Voltage Channels A/L1, B/L2, C/L3

| Set Calibrator to | Readout at Voltage Channels |
|-------------------|--|
| 115 V, 50 Hz, OPR | Fluke 433/434: 113.8 ... 116.2 V Fluke 435: 114.77 ... 115.23 V |
| 230 V, 50 Hz, OPR | Fluke 433/434: 228.8 ... 231.2 V Fluke 435: 229.77 ... 230.23 V |
| 460 V, 50 Hz, OPR | Fluke 433/434: 458.8 ... 461.2 V Fluke 435: 459.77 ... 460.23 |

- Set the Calibrator to STBY.

Optional Test. Bandwidth Check of Channel A/L1, B/L2, C/L3 (*):

Note: for Fluke 435 you must use the Fluke 5700A Calibrator. This instrument is able to generate 219.99999 V as a maximum at 3 kHz. Therefore a 50 Hz reference voltage of 215 V must be adjusted.

- Set the Calibrator to 230 V (5700A: 215 V), 50 Hz and OPR
- Now check the voltage channels one by one. Use the Calibrator's field edit function (5500A: FIELD EDIT key, 5700A: AMPL/FREQ key) to adjust the Calibrator to an Analyzer readout of 230.0 V / 215.00 V
- Increase the frequency to 3 kHz.
Fluke 433/434: check for a readout of 218.3 V or more.
Fluke 435: check for a readout of 204.25 V or more.
Check the channels according to the table below.

Table 3-6. Bandwidth Check of Voltage Channels A/L1, B/L2, C/L3

| Voltage Channel to be verified | Readout at 50 Hz (adjust Calibrator with EDIT FIELD) | Readout at 3 kHz |
|--------------------------------|--|---|
| A/L1 | Fluke 433/434: 230.0 V Fluke 435: 215.00 V | Fluke 433/434: 218.3 V or more Fluke 435: 204.25 V or more |
| B/L2 | Fluke 433/434: 230.0 V Fluke 435: 215.00 V | Fluke 433/434: 218.3 V or more Fluke 435: 204.25 V or more |
| C/L3 | Fluke 433/434: 230.0 V Fluke 435: 215.00 V | Fluke 433/434: 218.3 V or more Fluke 435: 204.25 V or more |

- Set the Calibrator to STBY.

Accuracy Check of Channel N (Neutral):

- Connect the N input with the C/L3 input (See Figure 3-4). A/L1, B/L2, C/L3 now give zero reading.
- Set the Calibrator to 50 Hz / 115 V and then to OPR.
- Fluke 433/434: check for a voltage readout V rms between 113.8 ... 116.2 V.
Fluke 435: check for a voltage readout V rms between 114.77 ... 115.23 V.

14. Check the 230 V range according to the table below.

Table 3-7. Accuracy Check of Voltage Channel N (Neutral)

| Set Calibrator to | Readout at Voltage Channel N |
|-------------------|--|
| 115 V, 50 Hz, OPR | Fluke 433/434: 113.8 ... 116.2 V Fluke 435: 114.77 ... 115.23 V |
| 230 V, 50 Hz, OPR | Fluke 433/434: 228.8 ... 231.2 V Fluke 435: 229.77 ... 230.23 V |
| 460 V, 50 Hz, OPR | Fluke 433/434: 458.8 ... 461.2 V Fluke 435: 459.77 ... 460.23 V |

15. Set the Calibrator to STBY.

Optional Test. Bandwidth Check of Channel N (*):

Note: for Fluke 435 you must use the Fluke 5700A Calibrator. This instrument is able to generate 219.99999 V as a maximum at 3 kHz. Therefore a 50 Hz reference voltage of 215 V must be adjusted.

16. Set the Calibrator to 230 V (5700A: 215 V), 50 Hz and OPR.

17. Now check the voltage channel N. Use the Calibrator's field edit function (5500A: FIELD EDIT key, 5700A: AMPL/FREQ key) to adjust the Calibrator to an Analyzer readout of 230.0 V / 215.00 V.

18. Increase the frequency to 3 kHz.

Fluke 433/434: check for a readout of 218.3 V or more.

Fluke 435: check for a readout of 204.25 V or more.

19. Set the Calibrator to STBY.

3.8.4 Verification of voltage inputs in 400 V range

Accuracy Check of Channel A/L1, B/L2, C/L3:

1. Set the Analyzer to 400 V, 50 Hz nominal (SETUP menu, arrow and ENTER keys). Press MENU, select Volts/Amps/Hertz, press F5 - OK.
2. To check the A/L1, B/L2, C/L3 inputs: connect the N input to Ground (See Figure 3-3).
3. Set the Calibrator to 50 Hz, 200 V and then to OPR.
4. Fluke 433/434: check for a voltage readout V rms between 198.0 ... 202.0 V.
Fluke 435: check for a voltage readout V rms between 199.60 ... 200.40 V.
5. Check the 400 V range according to the table below.

Table 3-8. Accuracy Check of Voltage Channels A/L1, B/L2, C/L3

| Set Calibrator to | Readout at Voltage Channels |
|-------------------|--|
| 200 V, 50 Hz, OPR | Fluke 433/434: 198.0 ... 202.0 V Fluke 435: 199.60 ... 200.40 V |
| 400 V, 50 Hz, OPR | Fluke 433/434: 398.0 ... 402.0 V Fluke 435: 399.60 ... 400.40 V |
| 800 V, 50 Hz, OPR | Fluke 433/434: 798.0 ... 802.0 V Fluke 435: 799.20 ... 800.80 V |

6. Set the Calibrator to STBY.

Optional Test. Bandwidth Check of Channel A/L1, B/L2, C/L3 (*):

Note: for Fluke 435 you must use the Fluke 5700A Calibrator. This instrument is able to generate 219.99999 V as a maximum at 3 kHz. Therefore a 50 Hz reference voltage of 215 V must be adjusted.

7. Set the Calibrator to 400 V (5700A: 215 V), 50 Hz and OPR.
8. Now check the voltage channels one by one. Use the Calibrator's field edit function (5500A: FIELD EDIT key, 5700A: AMPL/FREQ key) to adjust the Calibrator to an Analyzer readout of 400.0 V / 215.00 V.
9. Increase the frequency to 3 kHz.
Fluke 433/434: check for a readout of 379.8 V or more.
Fluke 435: check for a readout of 204.25 V or more.
Check the channels according to the table below.

Table 3-9. Bandwidth Check of Voltage Channels A/L1, B/L2, C/L3

| Voltage Channel to be verified | Readout at 50 Hz (adjust Calibrator with EDIT FIELD) | Readout at 3 kHz |
|--------------------------------|--|---|
| A/L1 | Fluke 433/434: 400.0 V Fluke 435: 215.00 V | Fluke 433/434: 379.8 V or more Fluke 435: 204.25 V or more |
| B/L2 | Fluke 433/434: 400.0 V Fluke 435: 215.00 V | Fluke 433/434: 379.8 V or more Fluke 435: 204.25 V or more |
| C/L3 | Fluke 433/434: 400.0 V Fluke 435: 215.00 V | Fluke 433/434: 379.8 V or more Fluke 435: 204.25 V or more |

10. Set the Calibrator to STBY.

Accuracy Check of Channel N (Neutral):

11. Connect the N input with the C/L3 input (See Figure 3-4). A/L1, B/L2, C/L3 now give zero reading.
12. Set the Calibrator to 50 Hz / 200 V and then to OPR.

13. Fluke 433/434: check for a voltage readout V_{rms} between 198.0 ... 202.0 V.
Fluke 435: check for a voltage readout V_{rms} between 199.60 ... 200.40 V.
14. Check the 400 V range according to the table below.

Table 3-10. Accuracy Check of Voltage Channel N (Neutral)

| Set Calibrator to | Readout at Voltage Channel N |
|-------------------|--|
| 200 V, 50 Hz, OPR | Fluke 433/434: 198.0 ... 202.0 V Fluke 435: 199.60 ... 200.40 V |
| 400 V, 50 Hz, OPR | Fluke 433/434: 398.0 ... 402.0 V Fluke 435: 399.60 ... 400.40 V |
| 800 V, 50 Hz, OPR | Fluke 433/434: 798.0 ... 802.0 V Fluke 435: 799.20 ... 800.80 V |

15. Set the Calibrator to STBY.

Optional Test. Bandwidth Check of Channel N (*):

Note: for Fluke 435 you must use the Fluke 5700A Calibrator. This instrument is able to generate 219.99999 V as a maximum at 3 kHz. Therefore a 50 Hz reference voltage of 215 V must be adjusted.

16. Set the Calibrator to 400 V (5700A: 215 V), 50 Hz and OPR.
17. Now check the voltage channel N. Use the Calibrator's field edit function (5500A: FIELD EDIT key, 5700A: AMPL/FREQ key) to adjust the Calibrator to an Analyzer readout of 400.0 V / 215.00 V.
18. Increase the frequency to 3 kHz.
Fluke 433/434: Check for a readout of 379.8 V or more.
Fluke 435: Check for a readout of 204.25 V or more.
19. Set the Calibrator to STBY.

3.8.5 Verification of voltage inputs in 6 kV range (Transients)

Note: the tests in this paragraph can be skipped for Fluke 433.

Set the Analyzer to Transients mode (Analyzer remains in 400 V, 50 Hz nominal).

Press MENU, select Transients, then F5 – OK.

In the START screen: Voltage Swell must be on; the other 4 functions must be off.

Then press F5 - START.

Accuracy Check of Channel A/L1, B/L2, C/L3:

1. To check the A/L1, B/L2, C/L3 inputs: connect the N input to Ground (See Figure 3-3).
2. Set the Calibrator to 50 Hz, 400 V and then to OPR.
3. Check for a voltage readout V_{rms} between 390 ... 410 V in the screen header.

4. Check the 6 kV range according to the table below.

Table 3-11. Accuracy Check of Voltage Channels A/L1, B/L2, C/L3

| Set Calibrator to | Readout at Voltage Channels |
|--------------------|-----------------------------|
| 400 V, 50 Hz, OPR | 390 ... 410 V |
| 1000 V, 50 Hz, OPR | 990 ... 1010 V |

5. Set the Calibrator to STBY.

Optional Test. Bandwidth Check of Channel A/L1, B/L2, C/L3 (*):

Note: for Fluke 435 you must use the Fluke 5700A Calibrator. This instrument is able to generate 219.99999 V as a maximum at 3 kHz. Therefore a 50 Hz reference voltage of 215 V must be adjusted.

6. Set the Calibrator to 400 V (5700A: 215 V), 50 Hz and OPR.
7. Now check the voltage channels one by one. Use the Calibrator's field edit function (5500A: FIELD EDIT key, 5700A: AMPL/FREQ key) to adjust the Calibrator to an Analyzer readout of 400 V / 215 V.
8. Increase the frequency to 3 kHz.
Fluke 434: check for a readout of 378 V or more.
Fluke 435: check for a readout of 204 V or more.
Check the channels according to the table below.

Table 3-12. Bandwidth Check of Voltage Channels A/L1, B/L2, C/L3

| Voltage Channel to be verified | Readout at 50 Hz (adjust Calibrator with EDIT FIELD) | Readout at 3 kHz |
|--------------------------------|--|--|
| A/L1 | Fluke 434: 400 V Fluke 435: 215 V | Fluke 434: 378 V or more Fluke 435: 204 V or more |
| B/L2 | Fluke 434: 400 V Fluke 435: 215 V | Fluke 434: 378 V or more Fluke 435: 204 V or more |
| C/L3 | Fluke 434: 400 V Fluke 435: 215 V | Fluke 434: 378 V or more Fluke 435: 204 V or more |

9. Set the Calibrator to STBY.

Accuracy Check of Channel N (Neutral):

10. Connect the N input with the C/L3 input (See Figure 3-4). A/L1, B/L2, C/L3 now give zero reading.
11. Set the Calibrator to 50 Hz / 400 V and then to OPR.
12. Check for a voltage readout V rms between 390 ... 410 V.
13. Check the 6 kV range according to the table below.

Table 3-13. Accuracy Check of Voltage Channel N (Neutral)

| Set Calibrator to | Readout at Voltage Channels N |
|--------------------|-------------------------------|
| 400 V, 50 Hz, OPR | 390 ... 410 V |
| 1000 V, 50 Hz, OPR | 990 ... 1010 V |

14. Set the Calibrator to STBY.

Optional Test. Bandwidth Check of Channel N (*):

Note: for Fluke 435 you must use the Fluke 5700A Calibrator. This instrument is able to generate 219.99999 V as a maximum at 3 kHz. Therefore a 50 Hz reference voltage of 215 V must be adjusted.

15. Set the Calibrator to 400 V (5700A: 215 V), 50 Hz and OPR.

16. Now check the voltage channel N. Use the Calibrator's field edit function (5500A: FIELD EDIT key, 5700A: AMPL/FREQ key) to adjust the Calibrator to an Analyzer readout of 400 V / 215 V.

17. Increase the frequency to 3 kHz.

Fluke 434: check for a readout of 378 V or more.

Fluke 435: check for a readout of 204 V or more.

18. Set the Calibrator to STBY.

Note: bandwidth will be slightly higher than in V/A/Hz mode because a low pass filter in the analog input channel is off during Transients mode.

3.9 Channel Isolation (*)

This optional test verifies cross talk from voltage channels to current channels. Voltage channels normally get high voltages while the current channels have a sensitivity of a couple of volts. This way of testing verifies the most critical situation.

Proceed as follows:

1. Connect the Analyzer's A/L1, B/L2, C/L3, and N voltage inputs with the HI output of the Calibrator.
 Connect the Analyzer's GND input with the LO output of the Calibrator.
2. Set all current channels to 1 mV/A, 400 A, 1:1 (SETUP menu, arrow and ENTER keys).
 Put the Analyzer in 3-phase WYE, 50 Hz, 400V, and V/A/Hz mode.
3. Short-circuit the four current inputs with a termination piece of 50 Ω or lower. Refer to Figure 3-5.
4. Set the Calibrator to 800 V, 50 Hz, and OPR.
5. Check that the readout on all current channels does not exceed 19 A (this includes the 5 A basic error of the current channels).
6. Set the Calibrator to STBY.
7. Disconnect all test leads.

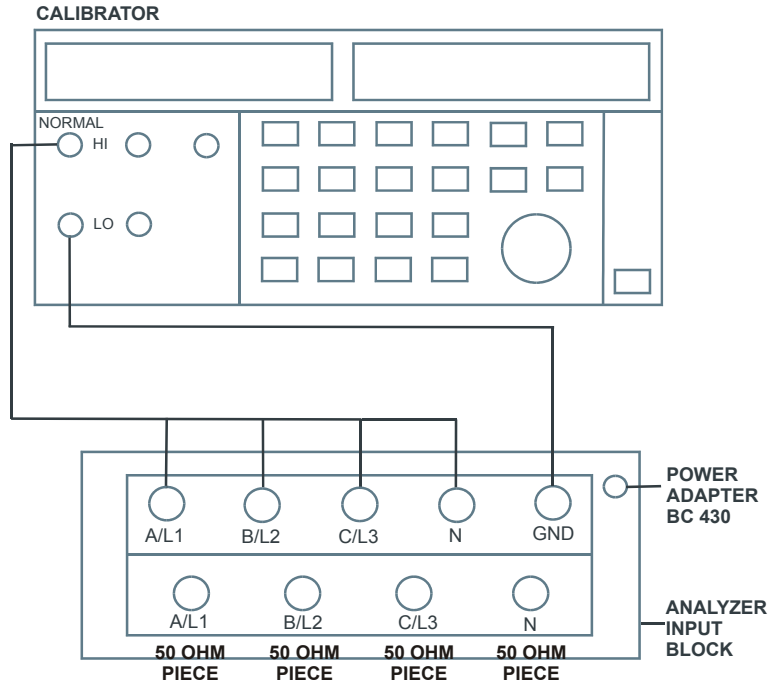


Figure 3-5. Checking the Channel isolation.

Chapter 4

Calibration Adjustment

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4.1 General

4.1.1 Introduction

The following information, provides the complete Calibration Adjustment procedure for the Fluke 433/434/435 Power Quality Analyzer (referred to as Analyzer). The Analyzer allows closed-case calibration using known reference sources. It measures the reference signals, calculates the correction factors, and stores the correction factors in RAM. After completing the calibration, the correction factors can be stored in FlashROM.

The Analyzer should be calibrated after repair, or if it fails the performance test. The Analyzer has a normal calibration cycle of one year.

4.1.2 Calibration number and date

When storing valid calibration data in FlashROM after performing the calibration adjustment procedure, the calibration date is set to the actual Analyzer date, and calibration number is raised by one. To display the calibration date and - number:

1. Press **SETUP**, then press **F2** to see the Version & Calibration data (see Figure 4.1).
2. Press **F5** to return to exit the Version & Calibration screen.

| SETUP VERSION & CAL | | FLUKE 435 U02 | |
|-----------------------|-----------------|---------------|------|
| VERSION & CALIBRATION | | | |
| Model Number | 435 | | |
| Serial Number | 19491107 | | |
| Calibration nr | #1 | | |
| Calibration Date | 04/11/2006 | | |
| Options | Transients | | |
| | Inrush | | |
| | Interharmonics | | |
| | Energy | | |
| | Memory | | |
| | Mains Signaling | | |
| | Logger | | |
| INSTALL OPTION | | | BACK |

Figure 4-1. Version & Calibration data.

Note:

The calibration date and calibration number will not be changed if only the Contrast Calibration Adjustment is changed

4.1.3 General instructions

Follow these general instructions for all-calibration steps:

- Allow the Calibrator to satisfy its specified warm-up period. After each change of output conditions, wait for the Calibrator to settle. It may take a couple of seconds for the output voltage to stabilize!
- The required warm up period for the Analyzer is included in the Warming Up period (Calibration step CL 0200).
- Ensure that the Analyzer battery is charged sufficiently.
- Power the Analyzer via the BC430 Battery Charger/Power Adapter

4.1.4 Equipment required for calibration

The primary source instrument used in the calibration procedures for Fluke 433/434 is the Fluke 5500A; for Fluke 435 you must use the Fluke 5700A Calibrator because of its higher accuracy. If the required type is not available, you can substitute another Calibrator as long as it meets the minimum test requirements.

- Fluke 433/434: Fluke 5500A Multi Product Calibrator.
Fluke 435: Fluke 5700A Calibrator.
- Test Leads (4x), as supplied with the Calibrator.
- Extra set of test leads capable to withstand 1000 V rms.
Note: for good recognition it is advised to use a black lead between the Calibrator's LO output and the Analyzer's Ground banana input.
- 50Ω Coax Cables (3 pieces required): Fluke PM9092 (0.5m, set of 3, 1 set required).
- Male BNC to Dual Female BNC adapter: Fluke PM9093 (3 pieces required).
- Dual Banana Jack to female to male BNC: Fluke PM9082 (1 piece required).
- Battery Charger / Power Adapter: BC430.

4.2 Calibration Procedure Steps

To do a **complete** calibration adjustment you must do all following steps:


1. Select the Calibration Mode, section 4.3
2. Do the Contrast Calibration Adjustment, section 4.4
3. Do the Warming Up, section 4.5
4. Do the Final Calibration, section 4.6
5. Save the Calibration Data and Exit the calibration mode, section 4.7









The following **partial** calibration is allowed:

- Contrast calibration, do the above-mentioned steps 1, 2, and 5.
If during normal operation the display cannot be made dark or light enough, or if the display after a Analyzer reset is too light or too dark, you can do this calibration.

4.3 Starting The Calibration

Follow the steps below to start the calibration:




1. Power the Analyzer via the power adapter input using the BC430 power adapter.
2. Press  and check the actual Analyzer date. If necessary adjust the date (the calibration date will become the Analyzer date when saving the calibration data):

- Operate   to highlight the Date.
- Press  to open the SETUP DATE menu.
- Operate   to select in sequence Year, Month, and Day.
- Operate   to adjust each selected item Year, Month, and Day.
- Press  to leave the SETUP DATE menu.
- Fluke 435: in the SETUP menu adjust the Current Clamp for Phase and Neutral to 1 mV/A, 400 A, 1:1.

3. Select the calibration mode.

The Calibration Adjustment Procedure uses built-in calibration setups, that can be accessed in the calibration mode.

To enter the calibration mode proceed as follows:

- Press and hold , press and release , then release .






The display shows the **CAL MODE** (Calibration Adjustment) screen.

The display shows the calibration step **Warming Up (CL 0200)**, the calibration status **:IDLE (valid)** or **:IDLE (invalid)**, and the soft key menu.

Continue as indicated in section 4.2.

You can leave the calibration mode without changing the calibration data by turning the Analyzer off.





Explanation of screen messages and key functions.

When the Analyzer is in the calibration Mode, only the  to  soft keys, the   and the  key can be operated, unless otherwise stated.

The calibration adjustment screen shows the actual calibration step (name and number) and its status: **Cal Name (CL nnnn) :Status (...)**

| | |
|-----------------------------|---|
| Cal Name | Name of the selected calibration step, e.g. Warming Up |
| (CL nnnn) | Number of the calibration step |
| Status (...) can be: | |
| IDLE (valid) | After (re)entering this step, the calibration process is not started. The calibration data of this step are valid. This means that the last time this step was done, the calibration was successful. It does not necessarily mean that the unit meets the specifications related to this step! |
| IDLE (invalid) | After (re)entering this step, the calibration process is not started. The calibration data are invalid. This means that the last time this step was done, the calibration was not successful. Most probably the unit will not meet the specifications if the actual calibration data are saved. |
| BUSY aaa% bbb% | Calibration adjustment step in progress; progress % for Input A and Input B. During Warming Up the elapsed time is shown. |
| READY | Calibration adjustment step finished. |

Functions of the keys F1-F4 are:

| | | |
|---|-------------|---|
|  | PREV | select the previous step |
|  | NEXT | select the next step |
|  | CAL | start the calibration adjustment of the actual step |
|  | EXIT | leave the calibration mode |

4.4 Contrast Calibration Adjustment

After entering the calibration mode the display shows:

WarmingUp (CL 0200):IDLE (valid)

Do not press **F3** now! If you did, turn the Analyzer off and on, and enter the calibration mode again.

Proceed as follows to adjust the maximum display darkness (CL 0100), the default contrast (CL 0110) , and the maximum display brightness (CL 0120).

1. Press **F1** three times to select maximum darkness calibration **Contrast (CL 0100)**:
2. Press **F3 CALIBRATE** . The display will show a dark test pattern, see Figure 4-2
3. Using **▲ ▼** adjust the display to the maximum darkness at which the test pattern is only just visible.
4. Press **F2** to return to the soft key menu.
5. Press **F2** to select default contrast calibration **Contrast (CL 0110)**:
6. Press **F3 CALIBRATE**. The display shows the test pattern at default contrast.
7. Using **▲ ▼** set the display to optimal (becomes default) contrast.
8. Press **F2** to return to the soft key menu.
9. Press **F2** to select maximum brightness calibration **Contrast (CL 0120)**:
10. Press **F3 CALIBRATE**. The display shows a bright test pattern.
11. Using **▲ ▼** adjust the display to the maximum brightness, at which the test pattern is only just visible.
12. Press **F2** to return to the soft key menu.
13. Now you can either
 - Exit, if only the Contrast had to be adjusted. Continue at Section 4.7.
 - or**
 - Do the complete calibration. Press **F2** to select the next step (Warming Up), and continue at Section 4.5.

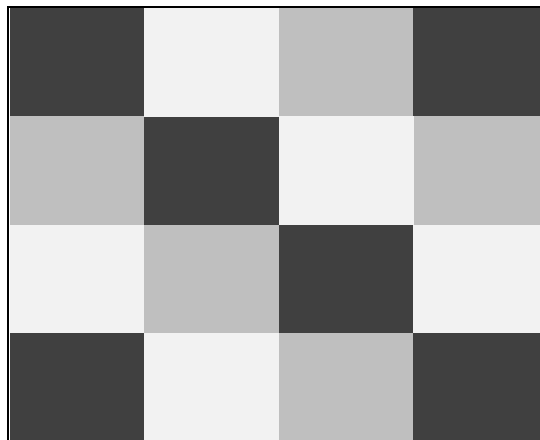


Figure 4-2. Display Test Pattern

Note: After having left calibration step CL 0120 in instruments with V01.00 software, the display contrast stays in the state as adjusted for maximum brightness. Because of this, menu visibility is insufficient. For instruments where this occurs it is recommended to save calibration data and exit as explained in Chapter 4.7. Then select calibration mode again and continue with calibration step CL 0200 (WarmingUp).

4.5 Warming Up

The Warming Up state will be entered after entering the calibration mode (section 4.3), or after selecting the next step if you have done the Contrast Calibration step CL 120 (section 4.4). The display will show

WarmingUp (CL 0200):IDLE (valid) or (invalid).

Unless you want to calibrate the display contrast only, you must always start the calibration adjustment at the **Warming Up (CL 0200)** step. Starting at another step will make the calibration invalid!

The Warming Up consists of a 30 minutes warming-up period.

Proceed as follows to do the Warming Up:

1. Remove all input connections from the Analyzer.
2. Press **F3** to start the Warming-Up.
The display shows the calibration step in progress, and its status.
The display shows **WarmingUp (CL 0200) :BUSY 00:29:59** . The warming-up period is counted down from 00:29:59 to 00:00:00
3. Wait until the display shows **Warmingup: READY**
If you turn off the Analyzer now by accident, turn it on again immediately; now you can select the calibration mode, and continue with step 4 below (press **F2** **NEXT** several times, see 4.6).
If you turn off the instrument now, and you do not turn on immediately, the Analyzer has cooled down, and you must repeat the Warming Up (select the calibration mode and start at CL 0200).
4. Press **F2** **NEXT** and continue at Section 4.6.

4.6 Final Calibration

Before starting the final calibration you must have done the Warming Up (section 4.5)!

The final calibration is simple and straightforward and consists of the following elements:

- Offset adjustment of voltage and current inputs (0 V input signal).
- Low voltage adjustment of voltage and current inputs (0.67 V rms, 50 Hz input signal).
- Voltage gain adjustment of voltage inputs (120/230/480/600 V rms, 50 Hz input).

The final calibration requires input conditions that will be described in each step. You must always start the Final Calibration at the first step, see Section 4.6.1. Starting at another step will make the calibration invalid!

If you proceeded to calibration step N (for example step CL 0320), then return to a previous step (for example step CL 0310), and then calibrate this step, the complete final calibration becomes invalid; then you must repeat the calibration starting at 4.6.1.

It is allowed to repeat a step that shows the status **:READY** by pressing **F3** again.

4.6.1 Offset adjustment

Proceed as follows to do the Offset adjustment of all inputs:

1. Connect the Analyzer to the Calibrator as shown in Figure 4-3.

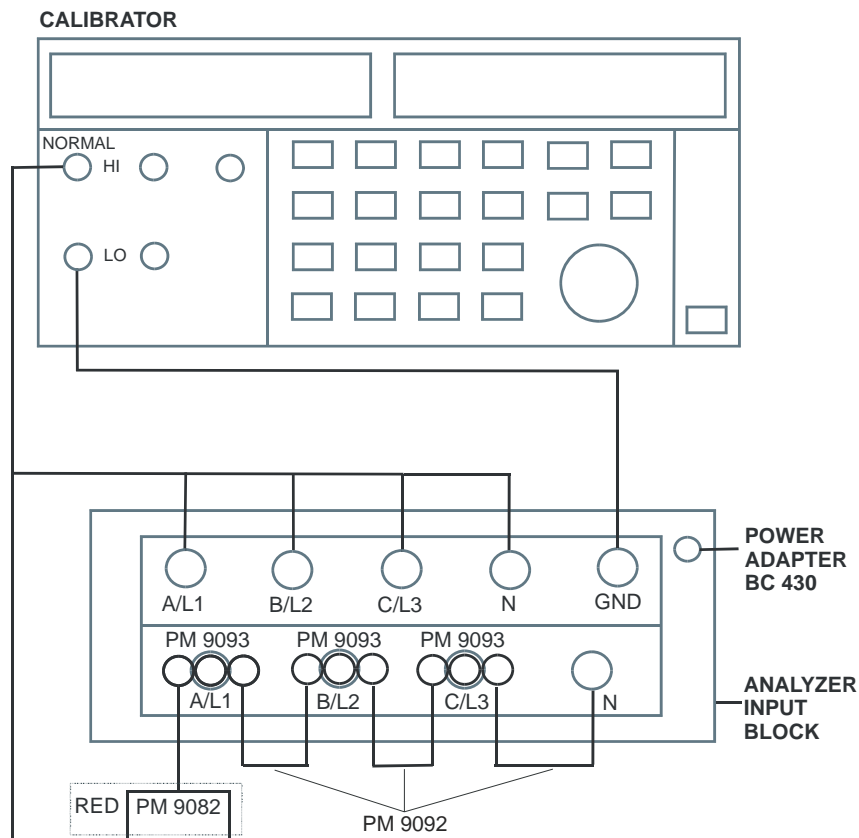


Figure 4-3. Offset, Low Voltage, and Current Gain Adjustment

2. The display must show step CL 0300.
If it does not, then press **F1** or **F2** to select the first calibration step in Table 4-1.
3. Set the Calibrator output to source the signal 0 Hz, 0 V required for the calibration steps in Table 4-1.
4. Set the Calibrator in operate (OPR) or standby (STBY) as indicated.
5. Press **F3** to start the calibration.
6. Wait until the display shows calibration status **:READY**.
7. Press **F2** to select the next calibration step, and start the calibration.
Continue through all calibration points of Table 4-1.
8. When you are finished, set the Calibrator to Standby (STBY).
9. Continue at Section 4.6.2.

Table 4-1. Offset Adjustment of all Inputs

| Cal step | Description | Calibrator Setting |
|----------|---------------|--------------------|
| CL 0300 | OffsetLowVolt | 0 V, 0 Hz, OPR |
| CL 0310 | Offset125Volt | 0 V, 0 Hz, OPR |
| CL 0320 | Offset250Volt | 0 V, 0 Hz, OPR |
| CL 0330 | Offset500Volt | 0 V, 0 Hz, OPR |
| CL 0340 | Offset6KVolt | 0 V, 0 Hz, OPR |
| --- | --- | STBY |

4.6.2 Low voltage and current gain adjustment

Proceed as follows to do the Low Voltage and Current Gain Adjustment:

1. Press **F2** to select calibration step CL 0400.
2. Keep the Analyzer connected to the Calibrator as shown in Figure 4-3.
3. Set the Calibrator to source 0.67 V, 50 Hz.
4. Set the Calibrator to operate (OPR).
5. Press **F3** to start the calibration.
6. Wait until the display shows calibration status **:READY**.
7. Set the Calibrator to Standby (STBY).

4.6.3 Voltage gain adjustment

Proceed as follows to do the Voltage gain Adjustment.

1. Press **F2** to select the first calibration step in Table 4-2 (CL 0410).
2. Connect the Analyzer to the Calibrator as shown in Figure 4-4: disconnect the current inputs!

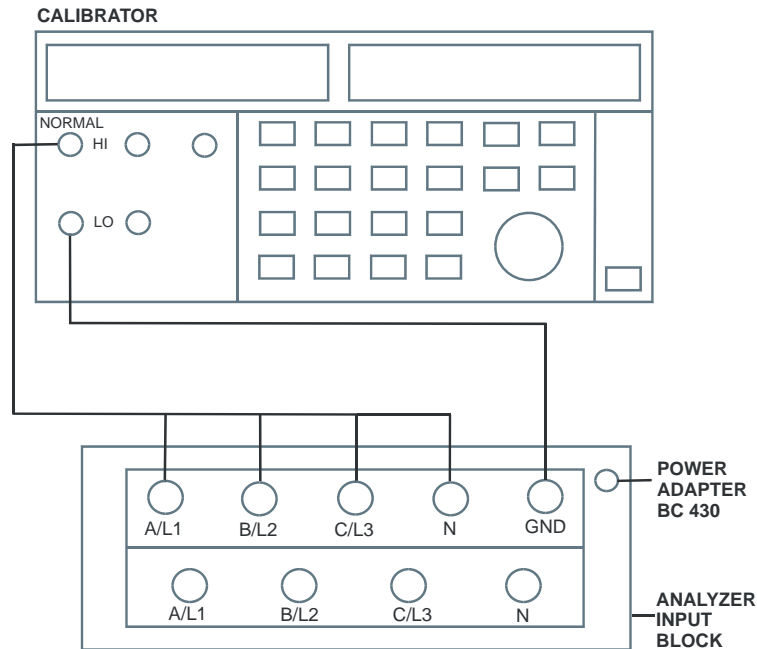


Figure 4-4. Voltage Gain Adjustment

3. Set the Calibrator to supply 120 V, 50 Hz.

Warning

Dangerous voltages will be present on the calibration source and connection cables during the following steps. Ensure that the Calibrator is in standby (STBY) mode before making any connection between the Calibrator and the Analyzer.

4. Set the Calibrator to operate (OPR).
5. Press **F3** to start the calibration.
6. Wait until the display shows calibration status **:READY**.
7. Press **F2** to select the next calibration step, set the Calibrator to the next calibration point, and start the calibration. Continue through all calibration points of Table 4-2.
8. Set the Calibrator to STBY (Standby).

Table 4-2. Voltage Gain Adjustment

| Cal step | Description | Calibrator Setting |
|----------|-------------|--------------------|
| CL 0410 | Gain125Volt | 120 V, 50 Hz, OPR |
| CL 0420 | Gain250Volt | 230 V, 50 Hz, OPR |
| CL 0430 | Gain500Volt | 480 V, 50 Hz, OPR |
| CL 0440 | Gain6KVolt | 600 V, 50 Hz, OPR |
| --- | --- | STBY |

9. Continue at section 4.7

4.7 Save Calibration Data And Exit

Proceed as follows to save the calibration data, and to exit the Maintenance mode:

1. Remove all test leads from the Analyzer inputs.
2. Press **F5** **EXIT**. The Analyzer will display:

**Calibration data valid.
Save data and exit maintenance mode?**

Note

Calibration data valid indicates that the calibration adjustment procedure is performed correctly. It does not necessarily mean that the Analyzer meets the characteristics listed in Chapter 2.

3. Press **F5** **YES** to save and exit.

Note 1

After saving the calibration data, the calibration number and - date will be updated if the calibration data have been changed and the data are valid. The calibration number and - date will not change if:

- the calibration mode is entered and left without doing a calibration adjustment.
- only the contrast calibration adjustment (4.4) and/or the probe calibration is done.

Note 2

*If you press **F4** **NO**, the Analyzer returns to the calibration mode. You can either calibrate the Analyzer again, or press **F5** **EXIT**, **F5** **YES** to save and exit.*

Possible error messages.

The following messages can be shown on the Analyzer display:

**WARNING: Calibration data not valid.
Save data and exit maintenance mode?**

Proceed as follows:

- If you did the Warming Up and Pre-Calibration successfully (section 4.5), and you want to store the Pre-Calibration data before continuing with the Final Calibration:

⇒ Press **F5** **YES**.

When turning the Analyzer off and on again, it will show the message:

**The instrument needs calibration.
Please contact your service center.**

The calibration date and number will not be updated. You must continue with the Final Calibration!

- To return to the Maintenance mode, if you want to repeat the complete calibration:

⇒ Press **F4** **NO**.

Now press **F1** until the display shows **Warming Up (CL 0200):IDLE**, and calibrate the Analyzer, starting at section 4.5.

- If you want to exit and maintain the old calibration data:

Turn the Analyzer off.

Chapter 5

Disassembling the Analyzer

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5.1. Introduction

This section provides the required disassembling procedures. The printed circuit assembly removed from the Analyzer must be adequately protected against damage.

Warning

To avoid electric shock, disconnect test leads, probes and power supply from any live source and from the Analyzer itself. Always remove the battery pack before completely disassembling the Analyzer. Only qualified personnel using customary precautions against electric shock should work on a disassembled unit with power on

5.2. Disassembly & Reassembly Procedures

5.2.1 Required Tools

To access all the assemblies, you need the following:

- Static-free work surface, and anti-static wrist wrap.
- #10 Torx screwdriver.
- Cotton gloves (to avoid contaminating the lens, PCA, and flat cable contacts).

5.2.2 Removing the Tilt Stand & Hang Strap

Use the following procedure to remove the tilt stand and hang strap (Figure 5-6, item 15 and item 10).

1. Set the tilt stand to a 45-degree position relative to the Analyzer bottom.
2. The hinge consists of a circular raised rim in the tilt stand that is located over a circular lowering in the bottom case. Pull sideward on the front edge of the tilt stand until the hinge releases. Then rotate the stand to the rear to remove it.
3. The figure below shows how to remove and install the hang strap.

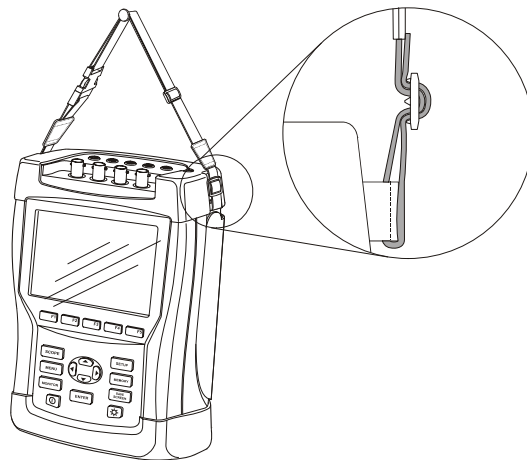


Figure 5-1. How to remove and fix the hang strap

5.2.3 Replacing the Side-Strap, Changing the Side-Strap Position

The side-strap (figure 5-6, item 16) can be attached at the right or left side of the Analyzer. Use the following procedure to replace the strap, or to change the strap position.

1. To remove the strap, unfold the strap ends (provided with Velcro tape), and pull the ends out of the strap holders (item 17).
2. To change the strap position open the Analyzer (see Section 5.2.4), remove the strap with the strap holders, attach them to the other side, and reassemble the Analyzer.

5.2.4 Opening the Analyzer, Removing the Battery

Use the following procedure to open the Analyzer, and to remove the battery:

1. Loosen the two M3 Torx screws that secure the input cover (Figure 5-2).
Note: fix the screws firmly when installing the input cover again. This assures that the housing is closed sufficiently.
2. Loosen the two M3 Torx screws that secure the bottom holster (Figure 5-3).
3. Pull off the input cover and the bottom holster (Figure 5-4).
4. Unscrew the two screws that lock the bottom case.
5. Lift the bottom case at the lower side to remove it.
6. Unplug and lift out the battery pack (Figure 5-5).
7. Unplug the cable leading to the Main PCA (pull the cable gently backwards).

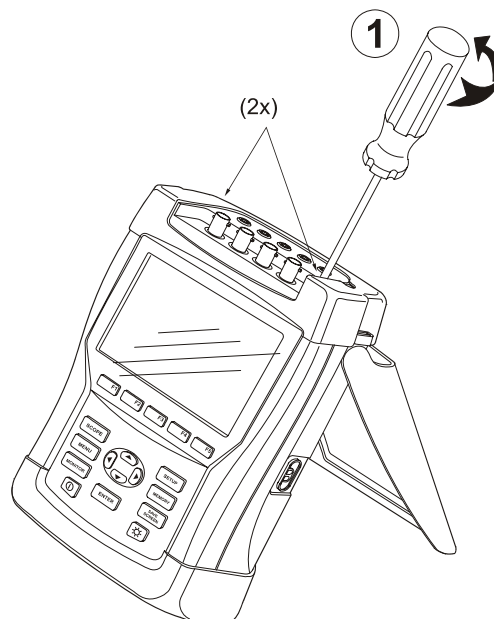


Figure 5-2. Loosen 2 Input Cover Screws

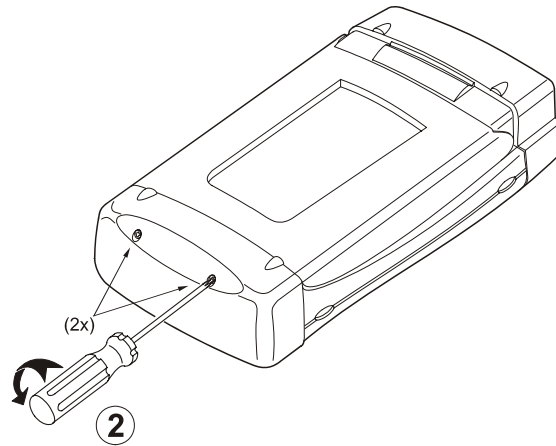


Figure 5-3. Loosen 2 Bottom Holster Screws

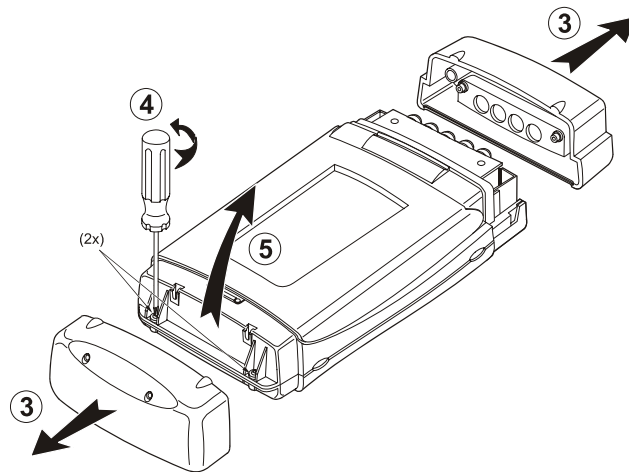


Figure 5-4. Opening the Analyzer

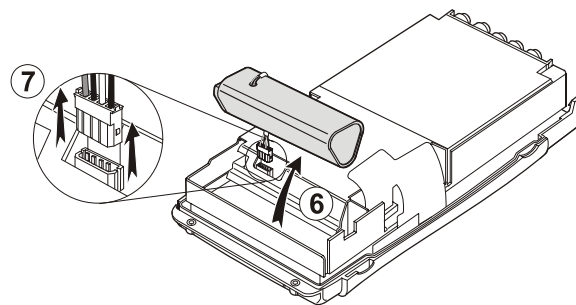


Figure 5-5. Removing the Battery Pack

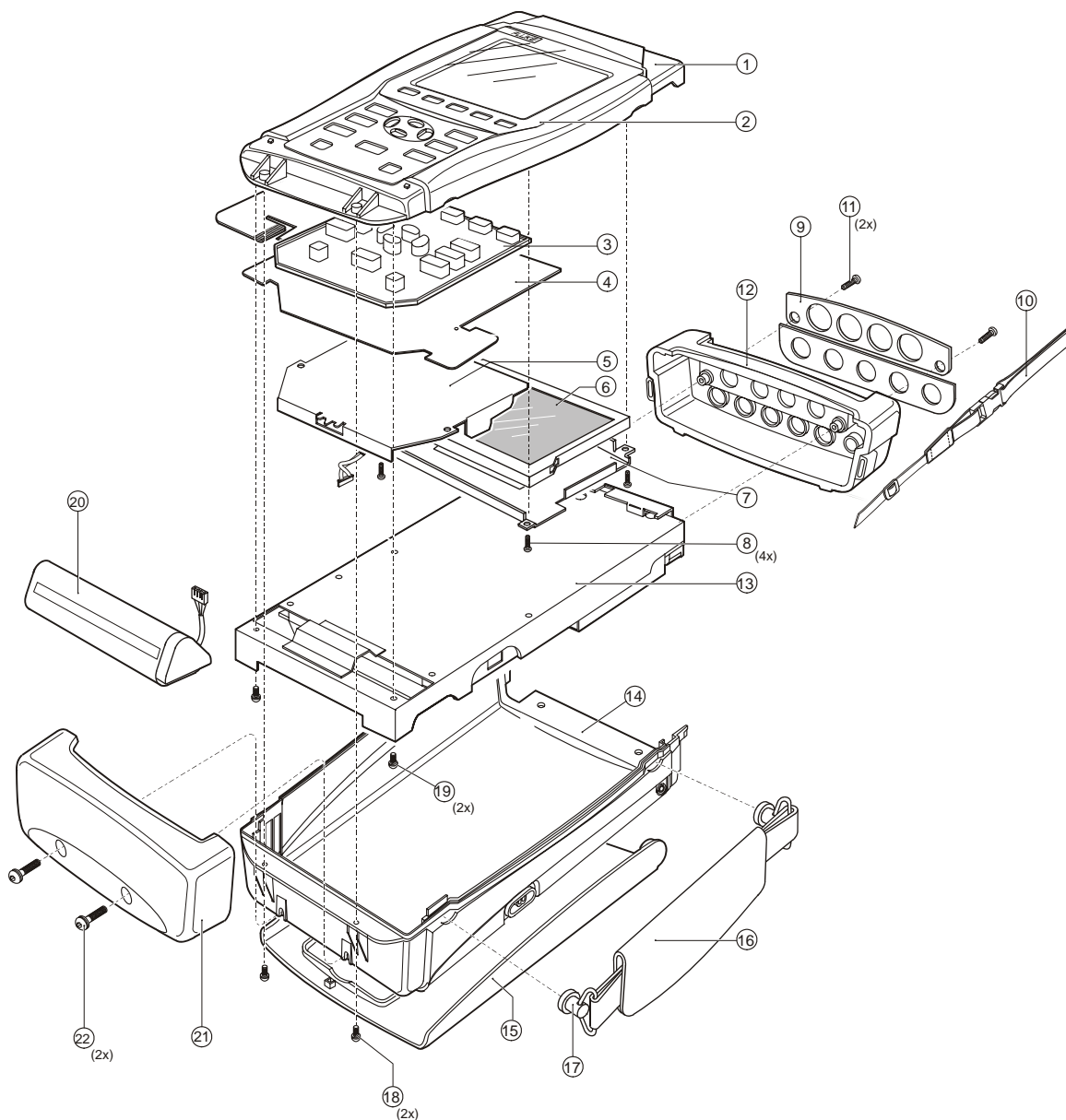


Figure 5-6. Final Assembly Details

5.2.5 Removing the Main PCA Unit

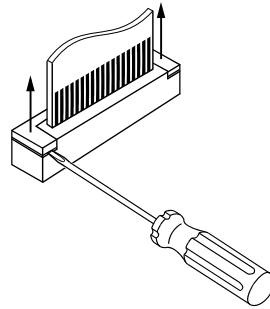
Caution

To avoid contaminating the flex cable contacts with oil from your fingers, do not touch the contacts (or wear gloves). Contaminated contacts may not cause immediate instrument failure in controlled environments. Failures typically show up when contaminated units are operated in humid areas.

Referring to Figure 5-6, use the following procedure to remove the main PCA unit.

1. Open the Analyzer (see Section 5.2.4).
2. Disconnect the blue keypad foil (item 4) flat cable, and the white LCD (item 6) flex cable. Unlock each cable by lifting the connector latch at the left and right edge

using a small screw-driver, see Figure 5-7. The latch remains attached to the connector body.



ST8682

ST8682.WMF

Figure 5-7. Flex Cable Connectors

3. Unplug the two-wire backlight cable.

Warning

If the battery pack or the power adapter is connected, the LCD backlight voltage on the wire cable is 400V ! (when the Analyzer is on).

4. Remove the two screws (item 19) that secure the Main PCA unit to the top case.
5. Gently unlock the flaps of the keypad foil (item 4) that are stuck on to the metal shielding box.
6. Unlock the plastic clamps at the inputs side and remove the Main PCA unit.

5.2.6 Removing the Display Assembly

There are no serviceable parts in the display assembly. Referring to Figure 5-6, use the following procedure to remove the display assembly.

1. Remove the main PCA unit (see Section 5.2.5).
2. Unscrew the four screws item 8.
3. Remove the display assembly (item 6) with its mounting frame (item 7).
To prevent finger contamination, wear cotton gloves, or handle the display assembly by its edges.
4. Remove the display from the mounting frame.

5.2.7 Replacing the LCD Window/Decal

The LCD window/decal (Figure 5-6, item 2) is glued on the top cover. To replace it do the following:

1. From the inside of the top cover push the window outwards until it comes off.
2. Carefully remove remains of glue from the top cover. The bulk of the glue can be removed with sticky tape. This action must be completed by cleaning the surface with alcohol. A clean surface assures a well-closed cabinet after installation of the new window.
This is an important safety issue!
3. Remove the protection foil from the new window
4. Firmly press the new window on the top cover.

5.2.8 Removing the Keypad and Keypad Foil

Caution

To avoid contaminating the keypad contacts, and the keypad foil contacts with oil from your fingers, do not touch the contacts (or wear gloves). Contaminated contacts may not cause immediate instrument failure in controlled environments. Failures typically show up when contaminated units are operated in humid areas.

Referring to Figure 5-6, use the following procedure to remove the keypad and the keypad foil.

1. Remove the display assembly (see Section 5.2.6).
2. Remove the keypad support plate item 5.
3. Remove the keypad foil item 4. Notice the keypad foil positioning pins in the top case when reassembling.
4. Remove the keypad item 3.

5.2.9 Disassembling the Main PCA Unit

Caution

To avoid contaminating the main PCA with oil from your fingers, do not touch the contacts (or wear gloves). A contaminated PCA may not cause immediate instrument failure in controlled environments. Failures typically show up when contaminated units are operated in humid areas.

Referring to Figure 5-8, use the following procedure to disassemble the main PCA unit.

1. Unscrew the seven M3x8 Torx screws (items 8,10) that secure the shielding covers (item 7 and 9), and remove the shielding covers. The covers are interlocking
2. Unscrew four M3x16 standoffs (item 4) and one M3x12 standoff (item 3) that secure the PCA to the shielding box item 2.
3. Remove the PCA from the shielding box.
4. To separate the Input block (item 1) from the PCA, unsolder 5 + 8 leads from the PCA. Then separate the input block from the PCA. The input block is locked with 4 studs that fit into 2 holes in the PCA and 2 holes in the bottom case.

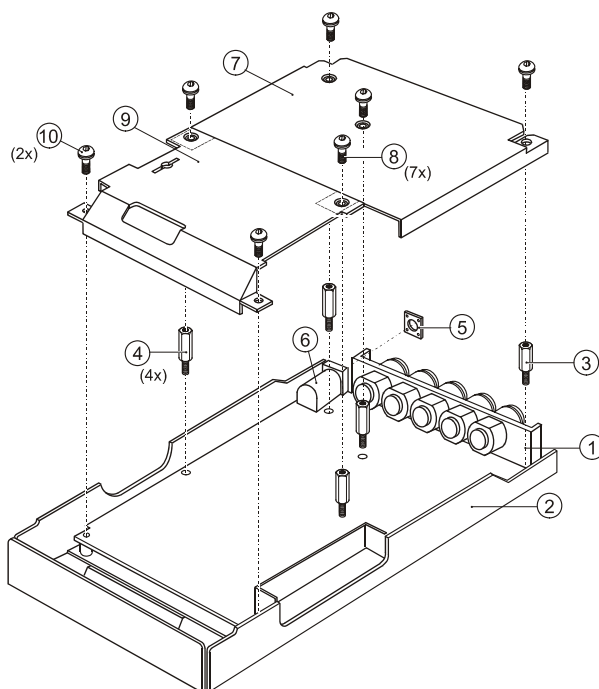


Figure 5-8. PCA Unit Assembly

5.2.10 Reassembling the Main PCA Unit

Reassembling the main PCA unit is the reverse of disassembly (see figure 5.8). However you must follow special precautions when reassembling the main PCA unit.

1. Put the PCA in the shielding box, and fasten the 5 hexagonal standoffs (item 3,4).
2. Lock the shielding covers (item 7 and 9) and fix them with 7 M3x8 Torx screws. Ensure that the small optical gate PCA mounted on the main PCA sticks through the slot in the shielding cover (item 9).
3. Ensure that the rubber sealing ring (item 5) for the power connector is present .

5.2.11 Reassembling the Analyzer

Reassembling the Analyzer is the reverse of disassembly. However you must follow special precautions when reassembling the Analyzer. Refer to figure 5-6.

Reassembling procedure for a completely disassembled unit:

1. Clean the inside of the lens with a moist soft cloth if necessary. Keep the lens free of dust and grease.
2. Install the keypad item 3. Press the edges of the keypad into the sealing groove of the top case. Ensure that the keypad lays flat in the top case, and that all keys are correctly seated.
3. Install the keypad foil item 4. Align the positioning holes in the keypad foil to the positioning pins in the top case.
4. Install the keypad support plate item 5.
5. Clean the display glass with a moist soft cloth if necessary. Install the display assembly and its mounting frame, and fasten the 4 screws (item 8).

6. Slide the Main PCA unit into the Top Case. Lock the plastic clamps at the inputs side on to the Top Case. Fasten with the 2 screws (item 19).
7. Stick the flaps of the keypad foil (item 4) to the metal shielding box
8. Verify that the backlight wires are twisted to minimize interference voltages. Reattach the backlight cable. Reattach the LCD flex cable, secure that cable in the connector with the connector latch.
9. The keypad foil is provided with a grounded shielding flap that covers the backlight cable. This decreases the electromagnetic emission. The flap should cover the cable connection area and lay over the PCA shield. Reattach the keypad flex cable, secure the flat cable in the connector with the connector latch.
10. Install the battery pack, and re-attach the cable.
11. Install the bottom case with the strap holders and strap (take care of correct position), and fasten the 2 screws item 18.
12. Fix the bottom holster (item 21) with 2 screws (item 22).
13. Slide the input cover on and fasten with the 2 M3 Torx screws (item 11). The screws must be tightened firmly to assure that the cabinet is well closed.
This is an important safety issue!
14. Calibrate the display contrast (see section 4.4) if you replaced the display.

Chapter 6

List of Replaceable Parts

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6.1 Introduction

This chapter contains an illustrated list of replaceable parts for the models 433, 434, and 435 Power Quality Analyzer. Parts are listed by assembly; alphabetized by item number. Each assembly is accompanied by an illustration showing the location of each part and its item number. The parts list gives the following information:

- Item number
- Description
- Ordering code



Caution

The above symbol indicates a component that may be damaged by static discharge. Especially the active components in this Analyzer are static sensitive. Always take the appropriate precautions for handling these components!

6.2 How to Obtain Parts

Contact an authorized Fluke service center, see section 6.3.

In the event that the part ordered has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

To ensure prompt delivery of the correct part, include the following information when you place an order:

- Instrument model (for example Fluke-434), 12 digit instrument code (9444), and serial number (DM.....). The items are printed on the type plate on the bottom cover.
- Ordering code
- Item number
- Description
- Quantity

6.3 Service Centers

To locate an authorized service center, call Fluke using any of the phone numbers listed below, or visit on the World Wide Web: www.fluke.com

USA and Canada: 1-888-99-FLUKE (1-888-993-5853)

Europe: +31-40-2675200

Japan: +81-3-3434-0181

Singapore: +65-679 95588

Anywhere in the world: +1-425-446-5500

6.4 Final Assembly Parts

See Table 6-1 and Figure 6-1 for the Final Assembly parts.

Table 6-1. Final Assembly Parts

| Item | Description | Ordering Code |
|------|---|----------------|
| 1 | Top case assembly Fluke 433, 434, 435 (without LCD, without window/decals, incl. sealing strips) | 4022 244 98511 |
| 2 | Display window/decals Fluke 433 | 0040 243 00031 |
| | Display window/decals Fluke 434 | 0040 243 00071 |
| | Display window/decals Fluke 435 | 0040 243 00161 |
| 3 | Keypad | 0040 243 00022 |
| 4 | Keypad foil | 0040 245 00022 |
| 5 | Keypad support assembly | 4022 244 98521 |
| 6 | Display unit Color | 4022 244 93261 |
| | Flat cable for display unit | 4022 303 40111 |
| 7 | Display mounting frame | 4022 243 09773 |
| | Rubber buffer (self-adhesive, 2 pcs. at rear side of mounting frame) | 4022 110 00511 |
| | Contact finger strip (self-adhesive, 1 pce. at rear of mounting frame) | 4022 244 94751 |
| 8 | EJOT Pt self tapping screw | 4022 244 92551 |
| 9 | Decal set for input sockets, colored | 0040 241 00412 |
| 9 | Decal set for input sockets, black & white | 0040 241 00401 |
| 9 | Decal set for input sockets, as supplied to USA/Canada | 0040 241 00761 |
| 10 | Hang strap | 946769 |
| 11 | Combiscrew (black) to fix input cover | 4022 244 90862 |
| 12 | Input cover | 0040 243 00041 |
| 13 | Main PCA unit for Fluke 433/434 or 435. The Main PCA in this Analyzer is only available to Fluke Service Centers due to the programming that is necessary after installation. | --- |
| 14 | Bottom case assembly, incl. isolation foil for optical RS232 port | 4022 244 98501 |
| 15 | Tilt stand (bail) | 4022 244 98211 |
| 16 | Strap | 4022 244 98191 |
| 17 | Strap holder (2 pcs per instrument) | 4022 244 98201 |
| 18 | Combi-screw Torx M3x10 (screw + split spring) | 4022 244 91231 |
| 19 | Combi-screw Torx M3x10 | 4022 325 42101 |
| 20 | Battery Pack (see note below) | BP190 |
| 21 | Bottom holster | 4022 244 98221 |
| 22 | Combi-screw Torx M3x10 (screw + flat washer) | 4022 244 91231 |

Note



The Analyzer contains a Ni-MH battery (item 20). Do not mix with the solid waste stream. Spent batteries should be disposed of by a qualified recycler or hazardous materials handler.

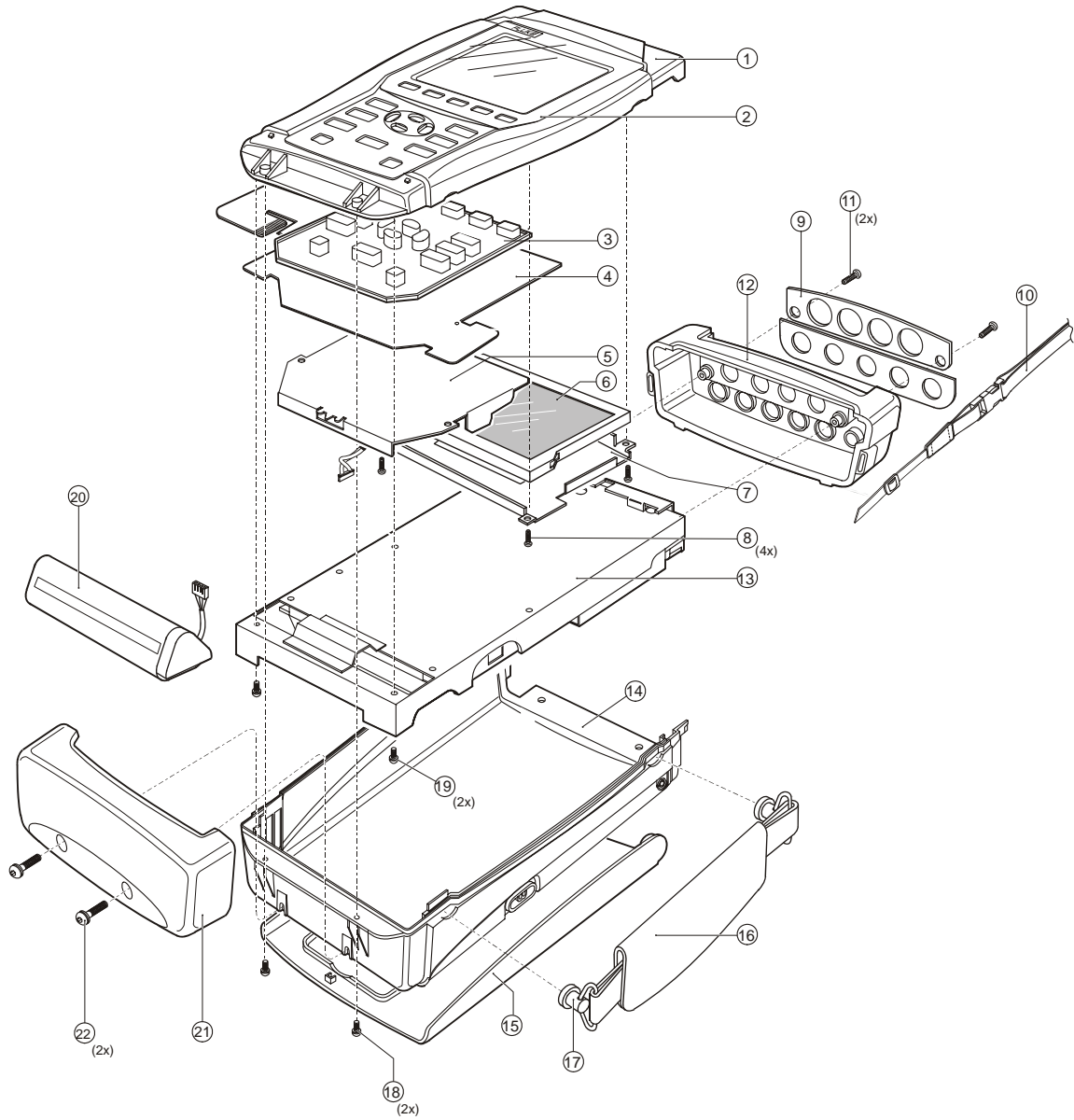


Figure 6-1. Final Assembly Details

6.5 Main PCA Unit Parts

See Table 6-2 and Figure 6-2 for the main PCA Unit parts.

Table 6-2. Main PCA Unit Parts

| Item | Description | Ordering Code |
|------|---|----------------|
| 1 | Input block | 0040 240 00011 |
| 2 | Shielding box assy | 0040 242 00022 |
| 3 | Hexagonal standoff M3x12 (1 pce per instrument) | 4022 108 00831 |
| 4 | Hexagonal standoff M3x16 (4 pcs per instrument) | 4022 108 00821 |
| 5 | Sealing ring for power connector | 4022 244 98331 |
| 6 | Supply power input connector | 4022 244 92561 |
| 7 | Attenuator shielding complete | 0040 242 00012 |
| 8 | Combi screw M3x8 | 4022 325 42081 |
| 9 | Shielding cover | 4022 243 08933 |
| 10 | Combi screw M3x8 | 4022 325 42081 |

Note 1

If the main PCA must be replaced, you must order the complete main PCA Unit.

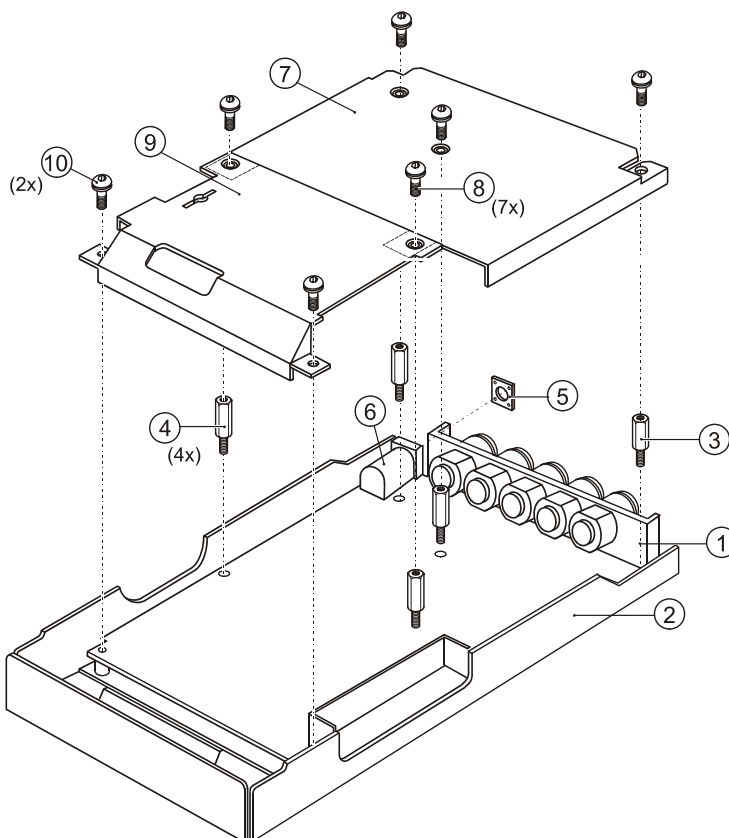


Figure 6-2. Main PCA Unit

6.7 Accessories

Table 6-3. Standard Accessories

| Item | Ordering Code |
|---|----------------------------|
| <p>Battery Charger /Power Adapter, available models: Universal 115/230 V, 50 and 60 Hz Japanese version 100 V, 50 and 60 Hz</p> <p><i>To accommodate connection to various line power sockets, the BC430 Battery Charger / Power Adapter is equipped with a male plug that must be connected to a line plug adapter appropriate for local use. Since the Charger is isolated, you can use line plug adapters with or without a protective ground terminal.</i></p> <p><i>The 230 V rating of the BC430 is not for use in North America. A line plug adapter complying with the applicable National Requirements may be provided to alter the blade configurations for a specific country.</i></p> | <p>BC430 BC430/806</p> |
| <p>Test Lead Set 2.5 m including Alligator Clips (5 pieces of each item)</p> | <p>TLS430</p> |
| <p>Rechargeable NiMH battery</p> | <p>BP190</p> |
| <p>AC Current Clamp Set (set of 4 pieces): 400 A (1 mV/A) and 40 A (10 mV/A) switchable. Supplied with Fluke 434.</p> | <p>i400s</p> |
| <p>Flexible AC Current Clamp Set (4 pieces). Supplied with Fluke 435.</p> | <p>i430flex-4pk</p> |
| <p>Set with Color Coding Clips for Test Leads</p> | <p>0040 244 00071</p> |
| <p>Optical Cable for USB</p> | <p>OC4USB</p> |
| <p>Hard Case. Supplied with Fluke 434.</p> | <p>C430</p> |
| <p>Heavy Duty Trolley Style Case. Supplied with Fluke 435.</p> | <p>C435</p> |

Table 6-4. Users Manuals

| Item | Ordering Code |
|--|----------------|
| Getting Started Manual (English, French, Spanish, Portuguese) | --- |
| Getting Started Manual (English) | --- |
| Getting Started Manual (English, French, German, Spanish, Italian, and Norwegian safety text) | --- |
| Getting Started Manual (English, Russian, Japanese, Chinese, Korean) | --- |
| CD with Users Manuals and Getting Started Manuals (All languages): This CD can be ordered as a spare part and contains all manuals in all languages | 0040 247 00023 |

Table 6-5. Optional Accessories

| Item | Ordering Code |
|---|----------------|
| Advanced Functions for Fluke 434 (Mains Signaling, Logging). | Fluke-434/Log |
| Optical Isolated RS-232 Cable | PM9080 |
| GPS Synchronization Unit | GPS430 |
| Print Adapter for Parallel Printers | PAC91 |
| Optical Isolated Trigger Probe (to test energy meters) | ITP120 |
| AC Current Clamp 200 A (10 mV/A) and 20 A (100 mV/A) switcheable. | i200s |
| AC Current Clamp 2000 A (1 mV/A) and 200 A (10 mV/A) switcheable, flexible. | i2000flex |
| AC Current Clamp 1000 A (1 mV/A), 100 A (10 mV/A), and 10 A (100 mV/A) switcheable. | i1000s |
| AC Current Clamp 3000 A (0.1 mV/A), 300 A (1 mV/A), and 30 A (10 mV/A) switcheable. | i3000s |
| AC/DC Current Clamp 100 A (10 mV/A) and 10 A (100 mV/A) switcheable. | 80i-110s |
| AC Current Clamp 5 A (400 mV/A, 3 pack) | i5s PQ3 (*) |
| CD with Service Manual for Fluke 433/434/435 (English), Revision 2 (Sept. 2006) | 4822 872 05392 |