



Basic Instrumentation

- Power Analyzer Meter
- Megger Meter
- Clamp Meter
- Multi-meter

Basic Instrumentation

1. Power Analyzer Meter:

The Fluke Energy Analyzer is the ideal tool for energy logging. Utilizing the new Energy Loss Calculator function, it measures the fiscal cost of energy wasted due to poor power quality. This energy monetization capability allows you to identify the most energy-wasteful areas of your facility so you can determine potential energy saving solutions. Add basic power quality measurements to the package and you're got yourself one powerful troubleshooting tool



Basic Instrumentation

1. Power Analyzer Meter

Electrical Performance

- Voltage
- Current
- Power
- Power Factor

Power Quality

- Unbalance
- Harmonic Distortion

Mechanical Performance

- Power
- Torque
- Speed
- Overall Efficiency

Basic Instrumentation

1. Power Analyzer Meter

Key Features

- Energy loss calculator:** Classic active and reactive power measurements, unbalance and harmonic power, are quantified to pinpoint true system energy losses in dollars (other local currencies available)
- Troubleshoot real-time:** Analyze the trends using the cursors and zoom tools.
- Highest safety rating in the industry:** 600 V CAT IV/1000 V CAT III rated for use at the service entrance.
- Measure all three phases and neutral:** With included four flexible current probes with enhanced thin flex designed to fit into the tightest places.
- Automatic Trending:** Every measurement is always automatically recorded, without any set-up.
- System-Monitor:** Ten power quality parameters on one screen according to EN50160 power quality standard.
- Logger function:** Configure for any test condition with memory for up to 600 parameters at user defined intervals
- View graphs and generate reports:** With included analysis software.
- Battery life:** Seven hours operating time per charge on Li-ion battery pack.



Basic Instrumentation

CAT Ratings:

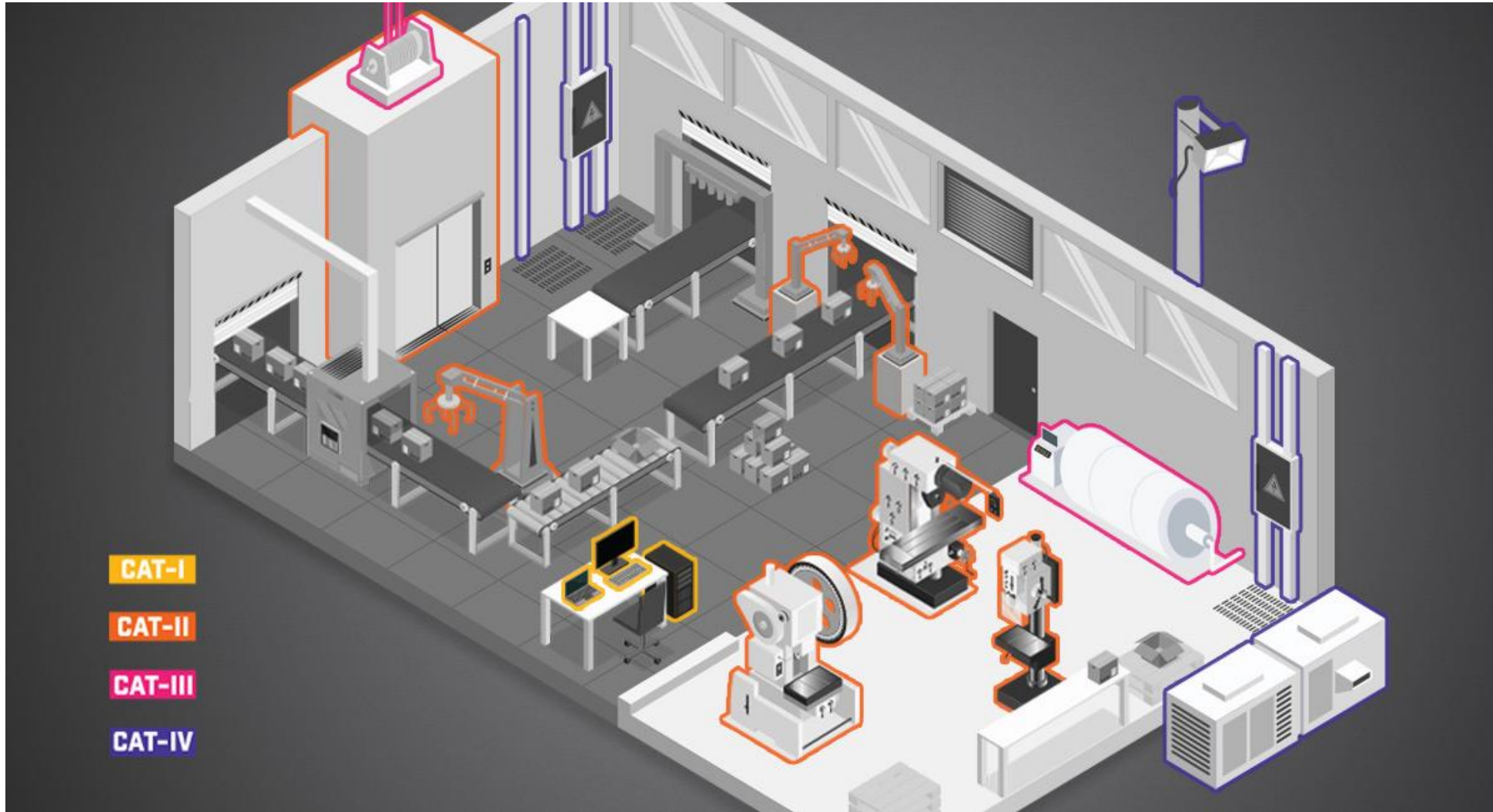
In short, the CAT rating system will inform anyone working with electrical equipment about the right tool for a job, whether a basic multimeter will suffice through to selecting the right devices for industrial utility infrastructure inspection.

The measurement categories are divided into four parts, known individually as category (CAT) ratings: CAT I, CAT II, CAT III and CAT IV.

Understanding what each of these category's means is vital to choosing the right equipment for the job to avoid exposure to unnecessary risk.

Basic Instrumentation

CAT Ratings:



Basic Instrumentation

CAT Ratings:

In the CAT ratings system, the roman numerals, (i.e. I through IV) refer to the location of a circuit in relation to the power source, defined in terms of the total potential transient voltage danger.

- **CAT I** describes secondary circuits not intended to be connected to the mains electricity supply, such as electronics, including a typical laptop PC, and circuits powered by regulated low voltage sources.
- **CAT II** is defined as local-level electrical distribution, such as a standard mains socket and plug-in loads. This category includes household appliances, such as washing machines, and portable plug-in power tools.
- **CAT III** references a building's electrical installations, including circuit-breakers, wiring, switches and industrial equipment.
- **CAT IV** involves the source of the low-voltage power installation, essentially the power grid infrastructure, such as underground utility vaults or outdoor power lines.

Basic Instrumentation

1. Power Analyzer Meter

Applications

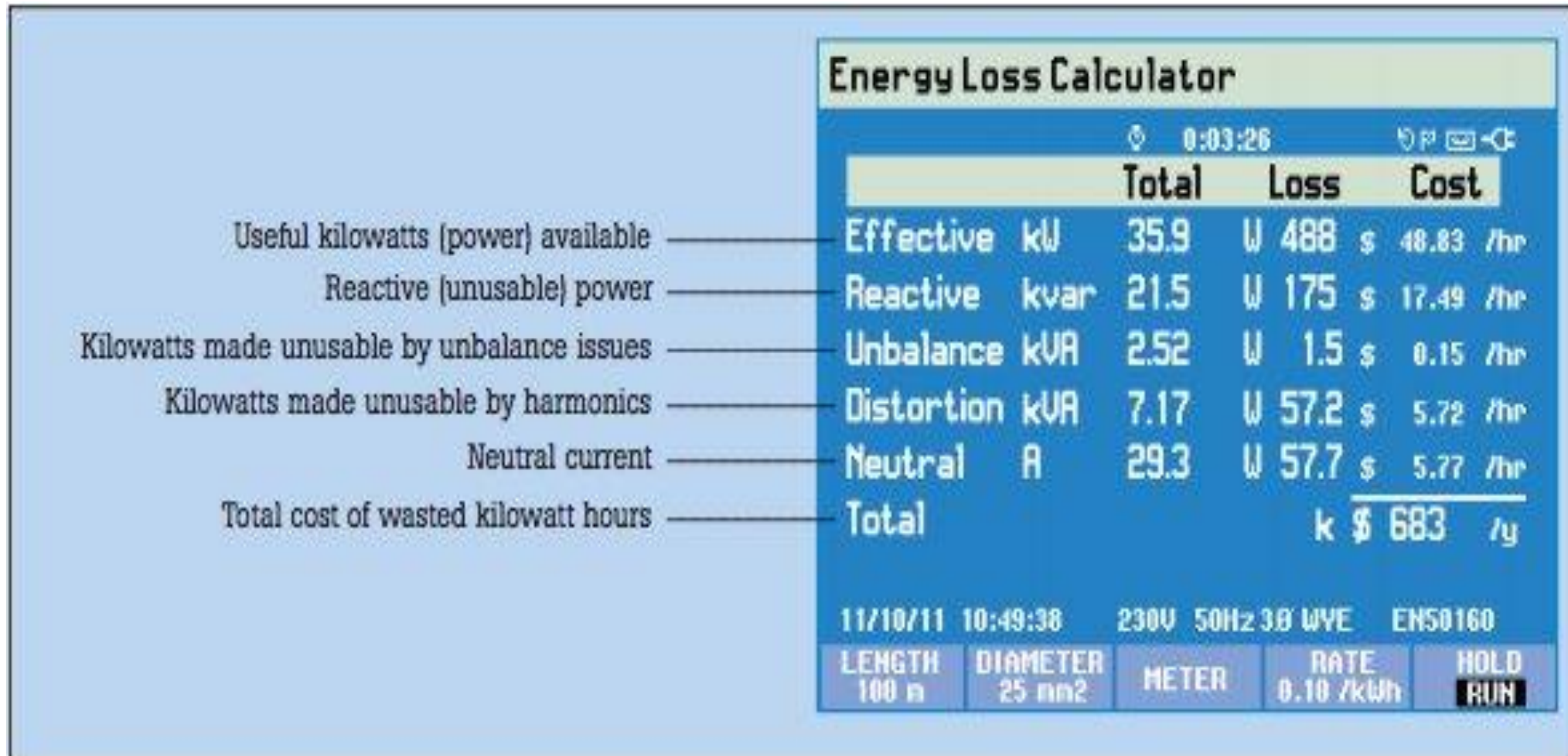
- Energy monetization - calculate the fiscal cost of energy waste due to poor power quality
- Energy assessment - quantify the before and after installation improvements in energy consumption to justify energy saving devices
- Frontline troubleshooting - quickly diagnose problems on-screen to get your operation back online
- Predictive maintenance - detect and prevent power quality issues before they cause downtime
- Long-term analysis - uncover hard-to-find or intermittent issues
- Load studies - verify electrical system capacity before adding loads



Basic Instrumentation

1. Power Analyzer Meter

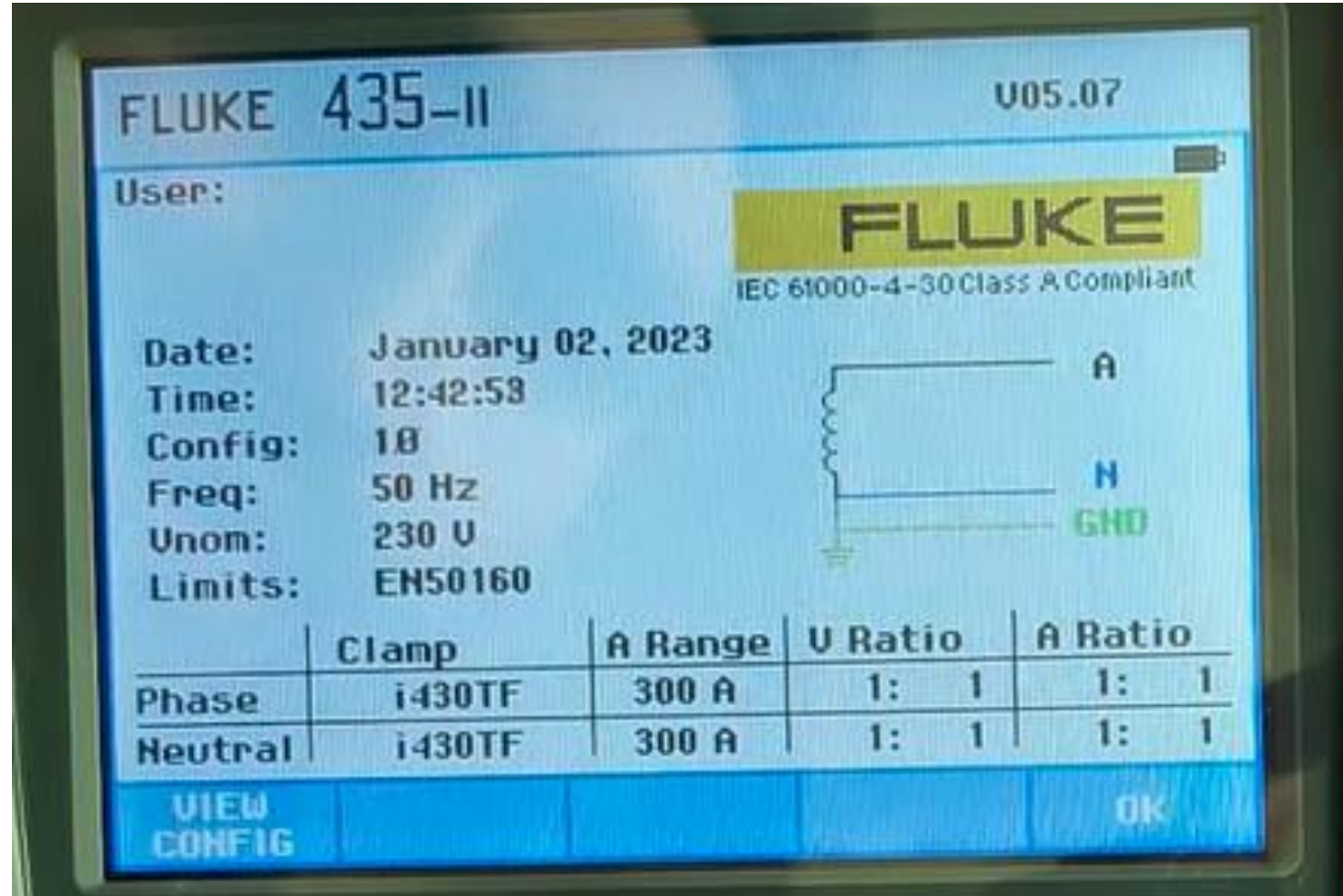
Parameters:



Basic Instrumentation

1. Power Analyzer Meter

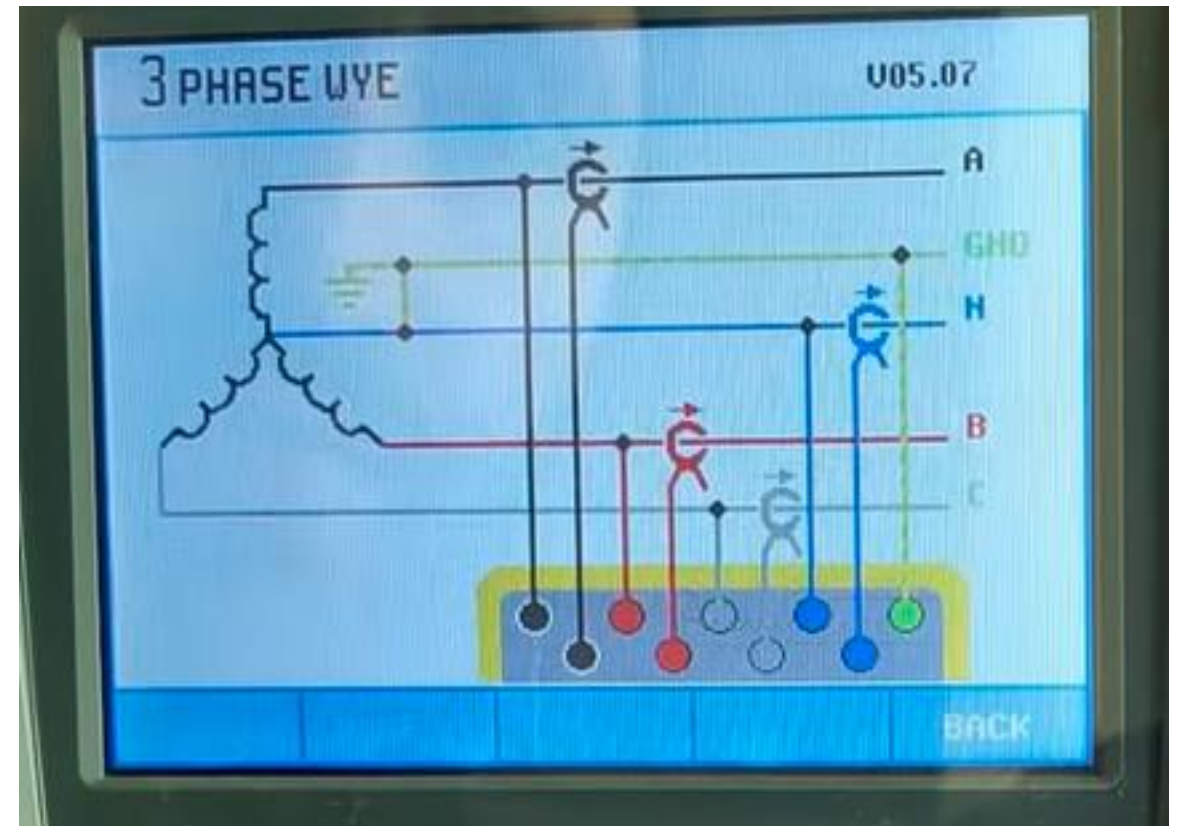
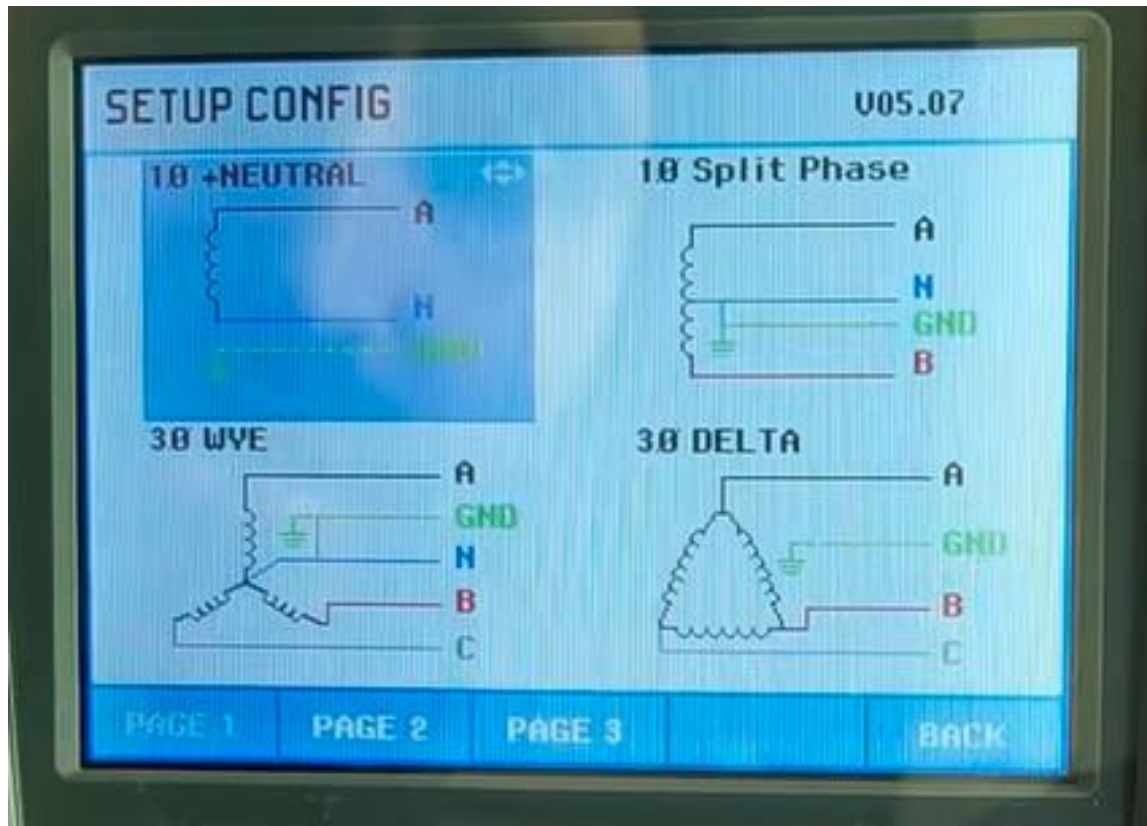
Power configuration:



Basic Instrumentation

1. Power Analyzer Meter

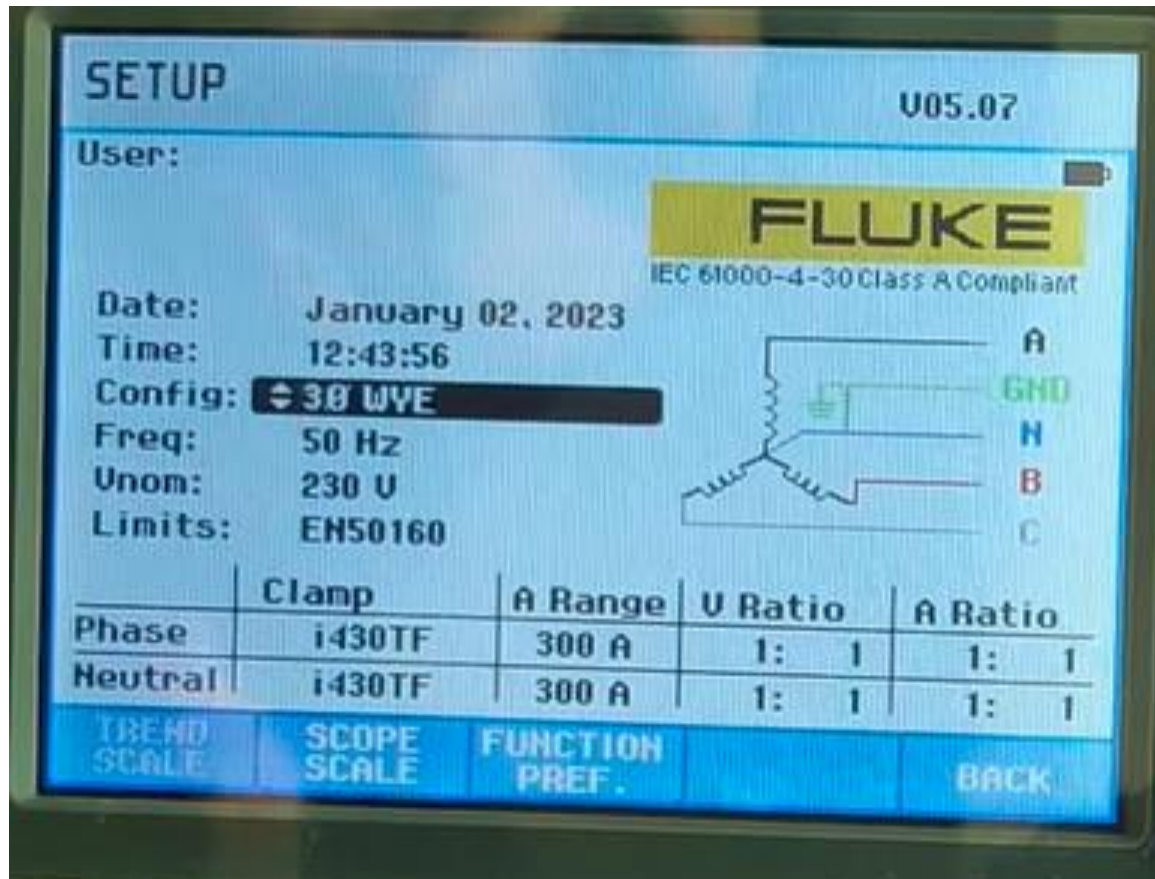
Power configuration:



Basic Instrumentation

1. Power Analyzer Meter

Parameters:



Basic Instrumentation

1. Power Analyzer Meter

Parameters:



Basic Instrumentation

1. Power Analyzer Meter

Parameters:



Basic Instrumentation

2. Megger Meter / Insulation Tester / Megohmmeter:

Insulation resistance testing with an instrument such as the insulation tester/megger can detect leaks that appear as insulation resistance slowly tapers over time a sign of normal and expected deterioration. In other cases, tests will detect a more serious issue in the moment when current suddenly drops and returns.

Megger works on the principle of electromagnetic attraction. When a primary coil that is carrying current is placed under the vicinity of a magnetic field it experiences a force. This kind of force generates a torque that is made to deflect the pointer of the device which gives some reading.



Basic Instrumentation

2. Megger Meter / Insulation Tester / Megohmmeter

Why perform an insulation resistance test?

The insulation resistance is a quality of an electrical system that reduces with time, environmental conditions such as temperature, humidity, moisture, and dust particles.

So, it becomes necessary to check the insulation resistance of the equipment at regular intervals to avoid any major electrical shock, which could be deadly. This could be a symptom that the insulation got damaged.

Basic Instrumentation

2. Megger Meter / Insulation Tester / Megohmmeter:

Why perform an insulation resistance test?

Nominal Rating of Equipment in Volts	Minimum Test Voltage, DC	Recommended Minimum Insulation Resistance in Megohms
250	500	25
600	1,000	100
1,000	1,000	100
2,500	1,000	500
5,000	2,500	1,000
8,000	2,500	2,000
15,000	2,500	5,000
25,000	5,000	20,000
34,500 and above	15,000	100,000

Basic Instrumentation

2. Megger Meter / Insulation Tester / Megohmmeter

Construction of Megger

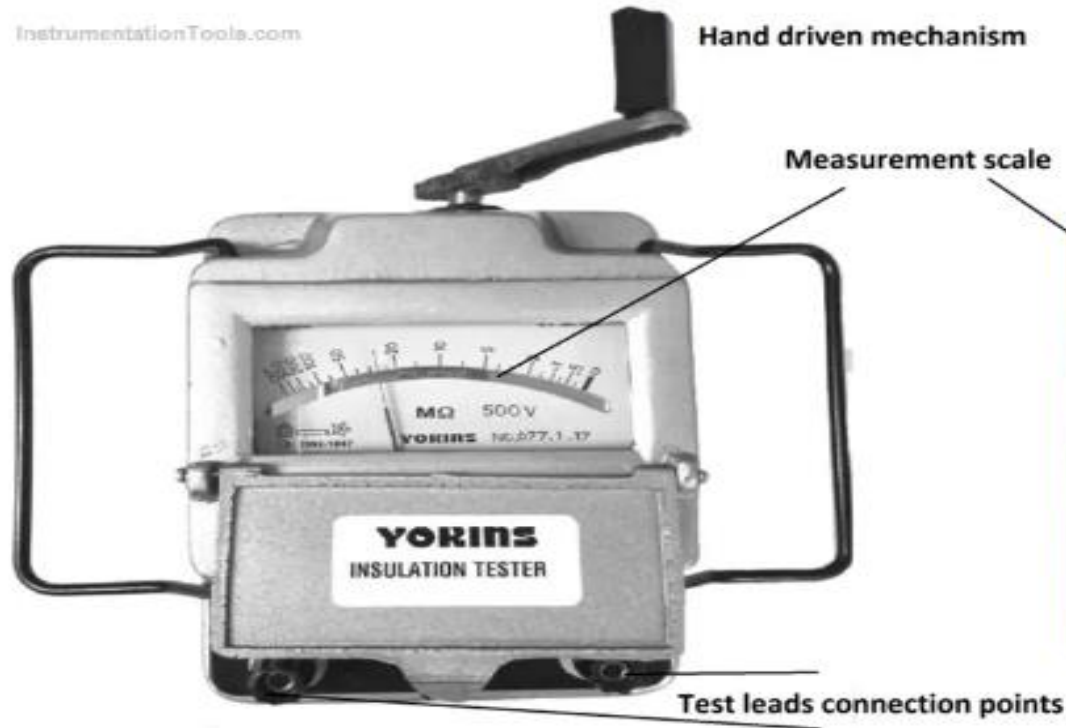


Image Credits : YOKINS

Manual Hand driven Megger



Image Credits : MECO

Electronic Megger (with Test push button)

Basic Instrumentation

2. Megger Meter / Insulation Tester / Megohmmeter

Construction of Megger

The megger consists of a DC generator, its armature is hand-driven to generate a voltage. A clutch mechanism is used to slip after reaching a certain determined speed.

Resistance R_1 , R_2 connected in series with two coils, Coil A and Coil B which constitute one instrument to which an indicating pointer is attached.

Permanent magnets having North, South poles produce a magnetic field to deflect the pointer. Test terminals at X and Y are used to measure insulation resistance

Basic Instrumentation

2. Megger Meter / Insulation Tester / Megohmmeter

Procedure for Testing Insulation Resistance

The motor has three windings Red(R), blue (B), and Yellow (Y), and body.

Connect the probe of Megger one to the Line(R), and the other to the ground. After connecting the probes press the electronic megger TEST push button or by cranking the manual megger.

If there is no problem, Megger should indicate infinite insulation resistance value. If it indicates Zero, it means that insulation resistance cannot withstand heavy currents.

Repeat the process by connecting the probes to the other lines Blue (B) and then Yellow (Y). Check the insulation resistance value so that we can know whether the winding insulation resistance is good or not

Basic Instrumentation

2. Megger Meter / Insulation Tester / Megohmmeter

Advantages

- Frequent meggering makes to understand the insulation resistance of electrical equipment such as motor, transformer, etc. thereby we come to know their healthiness.
- Physical damages can be identified, which may lead to electrical shock due to leakages.

Disadvantages

- Hand-driven megger is less preferred over electronic megger because it requires two persons. One for cranking and the other for testing.
- Accuracy varies with cranking the megger

Basic Instrumentation

2. Megger Meter / Insulation Tester / Megohmmeter

Precautions

- Never touch the leads while operating, keep a safe distance.
- Isolate the electrical equipment before performing a test.
- Avoid using Megger if any part of it is damaged, as it is unsafe to use.
- Turning the Megger off, and manually discharging circuits on completion of tests is recommended, before touching any connection or circuit.
- Test leads including Crocodile clips must be in a good condition.

Basic Instrumentation

2. Megger Meter / Insulation Tester / Megohmmeter

Applications:

- Continuity test
- Insulation test
- Earth or ground test

Basic Instrumentation

3. Multi-meter:

A digital multimeter (DMM) is a versatile electronic device used to measure various electrical properties, including voltage, current, and resistance. The device displays the measurements on a digital screen, making it easy to read and understand the results accurately. Digital multimeters have replaced traditional analog meters and offer higher accuracy, reliability, and better handling of impedance.



Basic Instrumentation

3. Multi-meter

Impedance is an important concept in electrical circuits because it affects the behavior of the circuit and can impact the accuracy of measurements.

In simple terms, impedance is like a measure of the "opposition" a circuit offers to the flow of electrical current. The higher the impedance, the less current that can flow through the circuit. This can be an advantage in certain situations, such as when measuring a circuit with delicate components that could be damaged by excess current.

A high input impedance also allows for more accurate measurements of voltage and current in circuits with high impedance, as it reduces the influence of the measurement instrument on the circuit being measured. Understanding impedance is important for anyone working with electrical circuits, as it can impact the performance and accuracy of the circuit.

Basic Instrumentation

3. Multi-meter

Advantages of digital multimeters over analog meters:

Digital multimeters offer several advantages over analog meters, including:

- Accurate measurements:** Digital multimeters provide more accurate measurements than analog meters, making them ideal for precise electrical measurements. They have a higher resolution, which allows them to measure changes in small electrical signals more accurately.
- Reliable performance:** Digital multimeters have a more stable and reliable performance than analog meters. They are less susceptible to temperature changes and are less likely to drift over time.
- Handling Impedance:** Digital multimeters have a high input impedance. This helps ensure accurate measurements and prevents damage to sensitive electronic components.

Basic Instrumentation

3. Multi-meter

Types of digital multimeters

Digital multimeters can be categorized based on their count capacity, which can extend up to 20,000 counts. Additionally, they fall into several categories, including:

- General-purpose (often referred to as testers):** These digital multimeters are affordable, easy to use, and ideal for simple electrical measurements.
- Standard models:** These digital multimeters are more advanced than general-purpose models and offer additional features, including frequency measurement and diode testing.
- Advanced versions:** These digital multimeters offer even more advanced features, including data logging and wireless connectivity.
- Compact units:** These digital multimeters are small and portable, making them ideal for technicians who need to carry their tools with them.
- Wireless variants:** These digital multimeters can connect to mobile devices via Bluetooth or Wi-Fi, allowing technicians to take measurements remotely.

Basic Instrumentation

3. Multi-meter

Applications of digital multimeters:

Digital multimeters find application in a wide range of industries and scenarios. They are indispensable tools for diagnosing and maintaining electrical circuits and electronic devices, testing and characterizing electronic components, evaluating the performance of batteries, diagnosing electrical issues in vehicles, checking outlets, switches, and wiring for safety and functionality, monitoring and maintaining complex machinery in industrial settings, and more.

Some common applications of digital multimeters are:

- Troubleshooting Electrical Issues:** Technicians use digital multimeters to identify faults, shorts, or open circuits in electrical systems. They can quickly measure voltage, current, and resistance to pinpoint problems.
- Electronics Testing:** In electronics laboratories, digital multimeters are used to test and characterize components like resistors, capacitors, and diodes. They help ensure components are within their specified tolerance levels.
- Battery Testing:** Digital multimeters assist in evaluating the performance of batteries, both rechargeable and non-rechargeable. By measuring voltage and resistance, they can determine the health and charge status of batteries.

Basic Instrumentation

3. Multi-meter:

Applications of digital multimeters:

Automotive Diagnostics: Mechanics use digital multimeters to diagnose electrical issues in vehicles. They can check the voltage of the battery, test sensors, and troubleshoot the vehicle's electrical systems.

•**Home Electrical Work:** Digital multimeters are handy for homeowners and DIY enthusiasts when dealing with electrical repairs or installations. They can check outlets, switches, and wiring for safety and functionality.

•**Industrial Maintenance:** In industrial settings, digital multimeters are essential for monitoring and maintaining complex machinery. They can detect irregularities in electrical systems to prevent costly breakdowns.

•**HVAC (Heating, Ventilation, and Air Conditioning):** Digital multimeters are used to diagnose electrical issues in HVAC systems, measure temperature, and check the functioning of electrical components.

•**Renewable Energy:** Digital multimeters are used to measure the output of solar panels, wind turbines, and other renewable energy systems.

Basic Instrumentation

4. Clamp Meter:

A clamp meter is a clothespin-shaped instrument that can be clamped around a live wire to measure the current it's carrying. As a measurement principle, clamp meters detect the magnetic field emitted by current flowing in a wire to measure the current value.

Unlike instruments like multimeters, this design has the advantage of being able to measure current without requiring that the circuit under measurement be cut.

Broadly speaking, there are two types of clamp meter:

- **Models designed to measure load current**
- **Models designed to measure leakage current**



Basic Instrumentation

4. Clamp Meter:

Instruments can be further classified based on other differences, for example whether they measure direct current (DC) or alternating current (AC), and whether they use mean value rectification or the RMS method. Load current models are used to measure normal AC circuits. Some recent clamp meter models can measure both load current and leakage current.

Once you're ready, open the clamp meter's jaws and clamp them around the wire you wish to measure. Position the wire in the center of the clamp for maximum measurement accuracy.



Position of the wire is in the center of the clamp (recommended)



Position of the wire is out of the center of the clamp (discouraged)

Basic Instrumentation

4. Clamp Meter:

Key Features:

Originally designed for specific testing purposes, modern digital clamp meters now offer expanded measurement functions, increased accuracy, and, in some cases, specialized features. They encompass most basic functions of a digital multimeter (DMM), including voltage, continuity, and resistance measurements. Notable clamp meter features include:

- Current-sensing jaw.
- Tactile barrier (for finger protection from shocks).
- Hold button: Freezes the display reading; released with a second button push.
- Dial (also known as the rotary switch).
- Display.
- Backlight button.
- Min Max button: Displays maximum input on the first push; subsequent pushes show minimum and average inputs in current, voltage, and frequency modes.

Basic Instrumentation

4. Clamp Meter:

Key Features:

- Inrush current button.
- Zero button (yellow): Removes DC offset from DC current measurements and serves as the dial's shift button for selecting yellow functions.
- Jaw release lever.
- Alignment marks: Conductor alignment required to meet accuracy specifications.
- Common input jack.
- Volts/ohm input jack.
- Input for flexible current probe.

Basic Instrumentation

4. Clamp Meter:

Why use a clamp meter ?

Clamp meters have gained popularity for two main reasons:

- Safety:** clamp meters allow electricians to avoid the traditional method of cutting into a wire and inserting test leads for an in-line current measurement.
- Convenience:** There's no need to shut off the circuit carrying current during a measurement, significantly enhancing efficiency.

Clamp meters are preferred for measuring high levels of current. Digital multimeters cannot measure 10 A of current for more than 30 seconds without risking damage to the multimeter.

These meters typically offer a minimum current range of 0 A to 100 A, with many models extending up to 600 A, 999 A, or even 1400 A. Some plug-in clamp accessories, such as the inflex[®], can measure as high as 2500 A.

Basic Instrumentation

4. Clamp Meter:

Applications:

Digital clamp meters find application in various settings, including industrial equipment, controls, residential/commercial/industrial electrical systems, and commercial/industrial HVAC.

They are primarily utilized for service, installation, and maintenance purposes, offering a valuable tool for system troubleshooting and scheduled preventative maintenance.