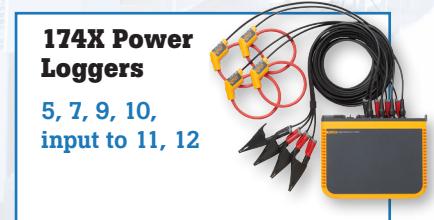


<b>IE</b>	Industrial Ethernet Cables
1	PLC – Power Supply Side & Processor
2	PLC – Input/output modules
3	Ethernet Switch
4	Power Supplies
5	Main Circuit Breaker
6	Relays (ice cube or other)
7	Circuit breakers and fuses
8	Transformer
9	Motor starters—sometimes soft start
10	Overload relay
11	VFD
12	Contactor
13	Terminal Blocks
14	Human machine interface (HMI)
15	Panel switches and buttons
16	Digital process display
17	Single loop controller
18	Emergency Stop (E-stop)

**Enclosures grounding strip  
(Not shown):**

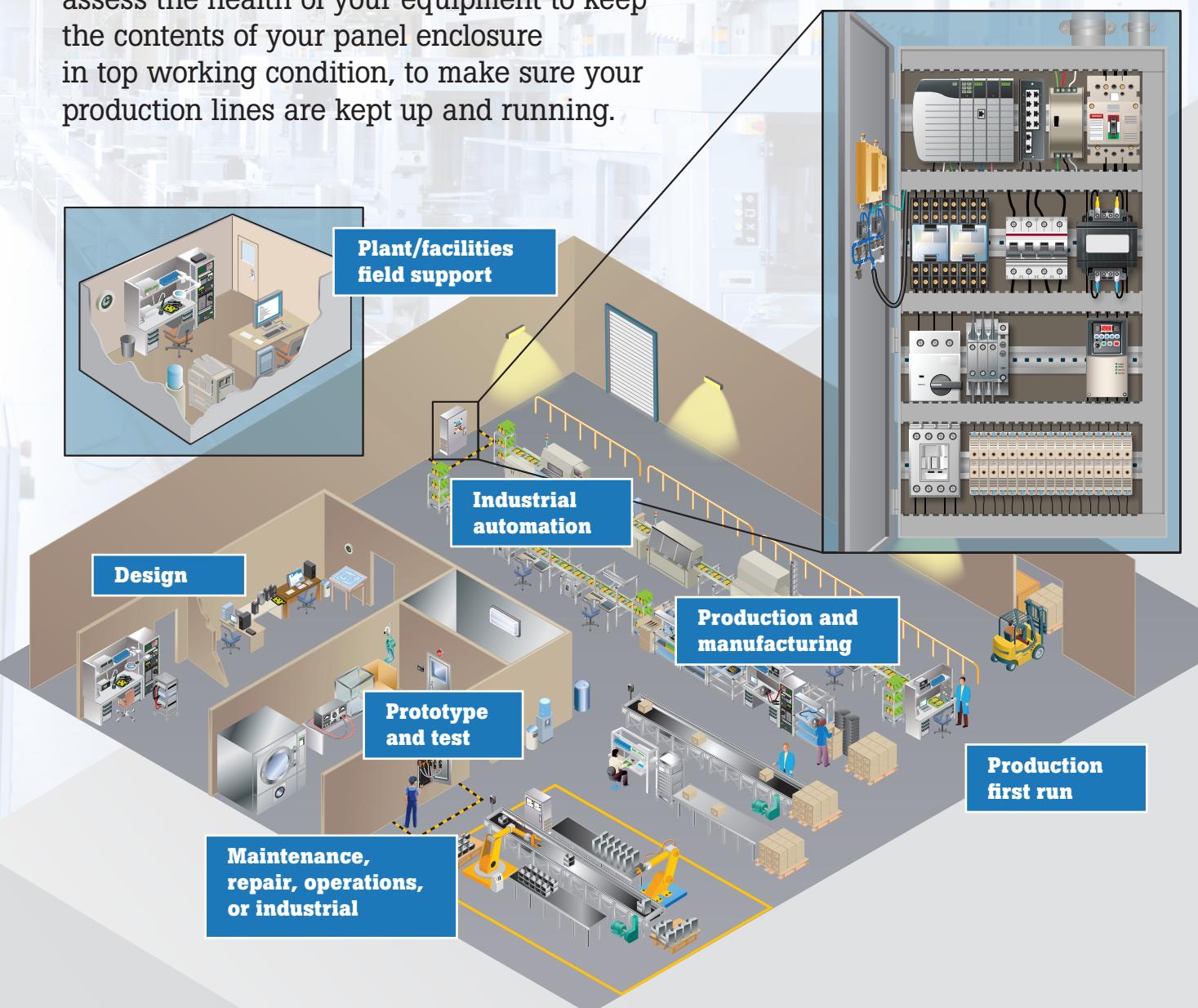
162X-2 series Earth ground  
testers or 1630-2-FC Earth  
Ground clamp



# Industrial automation

## Test and measurement solutions for control panels

Here's how your maintenance teams can avoid costly production stoppages. See how Fluke test tools can help you to easily monitor and assess the health of your equipment to keep the contents of your panel enclosure in top working condition, to make sure your production lines are kept up and running.

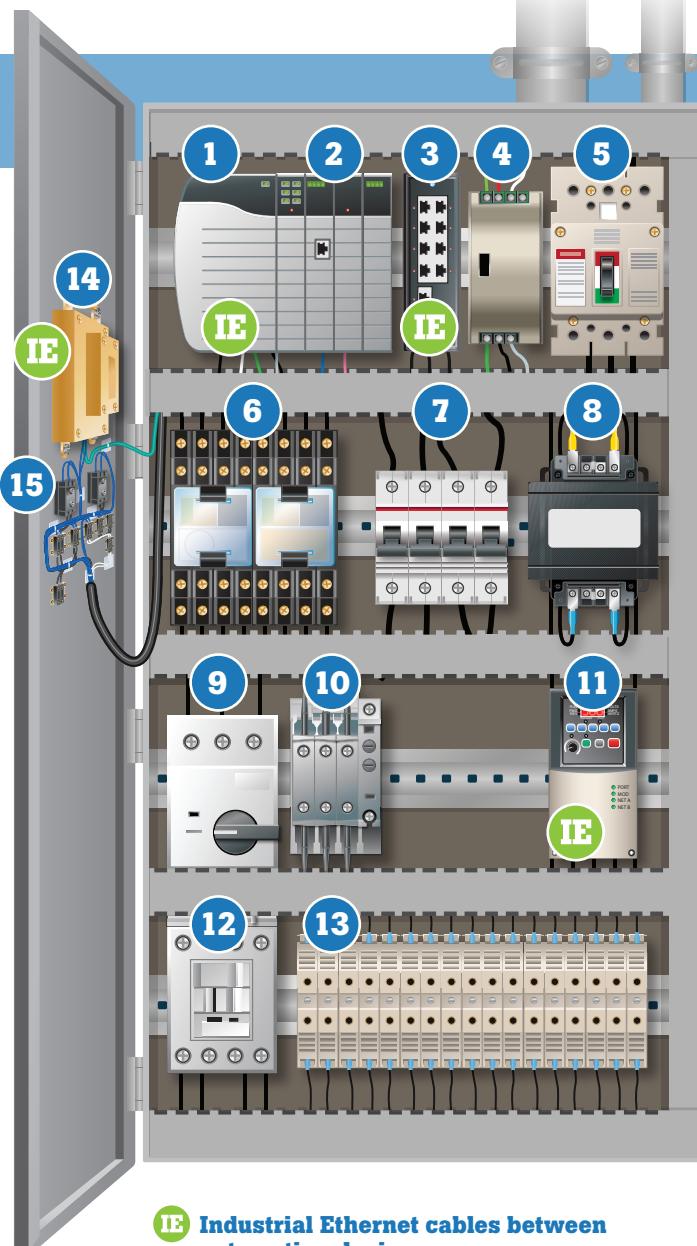


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### IE Industrial Ethernet cables between automation devices

**Pain:** The #1 cause of Industrial Ethernet failures is cabling - improper installation or damage from industrial environments.

**Solution:** LinkIQ connects to RJ-45, M8 and M12-D or-X connectors, and with one touch, verifies cabling performance and pinpoints failures. Also displays switch name, port number, VLAN, speed and Power over Ethernet.

### 1. PLC – Power supply side + processor:

**Pain:** Need to verify proper input power to PLC unit to startup/troubleshoot code with laptop

**Solution:** 289, 87V DMMs or a meter like a 1587 Insulation resistance/DMM tool, that will look at proper volt/ohm/amp readings and perform VFD output tests or wire/winding insulation test

### 2. PLC Input/output modules:

**Pain:** Measure without breaking the control loop or taking the sensor, process, or system offline

**Solution:** Read and/or source analog, digital, or power signals for troubleshooting and calibration

### 3. Ethernet Switch:

**Pain:** Low power, blown fuse, or circuit breaker stops or creates unstable communication

**Solution:** Validate power using the Infrared Camera on the 279 FC and verify voltage and/or continuity from power supply to the terminal block through the fuse to the switch using the digital multimeter

### 4. Power Supplies:

**Pain:** Unstable, poor voltage may create transmitter signal errors and loss production time

**Solution:** View heat distribution to and around the power supply while logging and recording data with Fluke Connect enabled products to communicate condition

### 5. Main Circuit Breaker:

**Pain:** Improper incoming power or power quality issues can create issues throughout panel and to devices outside the panel that can cause faults, tripping or lessened life

**Solution:** Clamp or DMM to measure Volts, Amps, Freq for standard power parameters and 3 phase Power Quality analyzers to determine if incoming power to the panel has quality loss

### 6. Relays (ice cube or other):

**Pain:** Not working properly, this can cause a field device to stop working or you can lose your redundant backup to a critical tag that can cause downtime

**Solution:** Identify hot spots due to corrosion, under/over torqued screws, etc. that will show up as additional heat that will easily be detected by the right thermal imager

### 7. Circuit breakers and fuses:

**Pain:** Blown fuses or tripping breakers shut systems down and can cause quality issues & lost production

**Solution:** A thermal image of these components can quickly show if failure is soon or a poor connection causing a variety of intermittent issues

### 8. Transformer:

**Pain:** Improper volts/amps on the primary and secondary side can cause you to lose power and damage other devices or shut down systems

**Solution:** Measurements confirming step up/down volts/amps between primary and secondary side determine if your transformers are working properly

### 9. Motor Starters sometimes soft starts:

**Pain:** AC/DC motors can prematurely fail due to excessive inrush current on startup and can kick back and damage all components in line with them.

**Solution:** Check inrush current with clamp or with PQ analyzer to determine working properly or good connections (DMM or Clamp) or potential quantifiable issue with unbalance, harmonics, single phasing

### 10. Overload Relay:

**Pain:** Downtime-tripping relays can stop the process due to unbalance or overload

**Solution:** record measurements over time with PQ or clamp that record to understand if it's inrush (clamp or PQ) or if it's power quality due to unbalanced load, harmonics, etc.

### 11. VFD:

**Pain:** Tripping drives, throwing error codes, undue wear on industrial motors, VFD output reflections, power and cabling issues, high voltage spikes, high noise levels, etc., all cause downtime

**Solution:** Measure 50/60 Hz drive input power and simply let the 3 phase PQ analyzer show you what's going on and then use the 4 channel scopemeter for the higher frequency output power and compare to the baseline measurements you have to get down to root cause, check power wiring and motor windings insulation integrity (1587, 155x depending on motor voltage size)

### 12. Contactor:

**Pain:** Degradation of controlled power via voltage and current reduces motor life

**Solution:** Capture key electrical parameters to compare with motor nameplate–Voltage, current, power, power factor with 50/60 Hz applications using PQ Analyzers

### 13. Terminal Blocks:

**Pain:** Over/under-torqued conductors/loose strands generate high resistance, heat, and signal loss

**Solution:** Quickly identify hot spots to help isolate where an issue is or might be soon and use DMM for standard testing and troubleshooting

### 14. HMI (Human Machine Interface):

**Pain:** Over/under-torqued conductors/loose strands generate high resistance, heat, and signal loss

**Solution:** Quickly identify hot spots to help isolate where an issue is or might be soon and use DMM for standard testing and troubleshooting

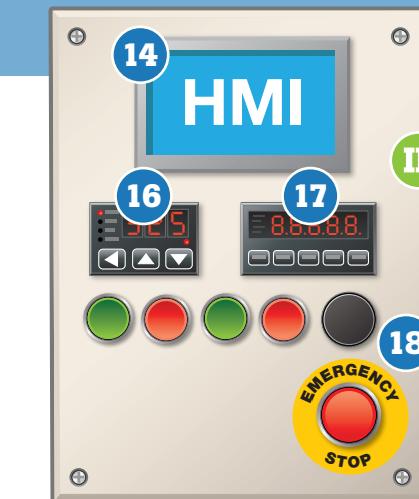
### 15. Panel Switches & buttons:

**Pain:** Over/under-torqued conductors/loose strands generate high resistance, heat, and signal loss

**Solution:** Quickly identify hot spots to help isolate where an issue is or might be soon and use DMM for standard testing and troubleshooting

### Tips:

Proper grounding and bonding for all electrical and industrial electronics is key to reducing the likelihood of intermittent issues and ground faults for the panel and your overall facility. All panel doors must also be grounded to the rest of the panel enclosure. Make sure you have proper earth ground testing done annually



### 16. Digital Process Display:

**Pain:** Incorrect process control signal in loop can lead to process inconsistency or poor quality

**Solution:** Process Calibration and Troubleshooting tools such as 789 to source, simulate or measure process parameters to determine if out of calibration, faulty equipment, wiring, power supply, etc., in the control loop. Use the 773 to measure the 4-20mA signal without breaking the loop and use the 754 to calibrate and document the results to maintain proper consistency with process

### 17. Single Loop Controller:

**Pain:** Incorrect process control signal in loop can lead to process inconsistency or poor quality

**Solution:** Process pressure or temperature Calibration to validate equipment is giving repeatable data showing proper process conditions to stay competitive in the marketplace. As found test shows current condition and calibrator then allows you to calibrate to your facilities standards and automatically document the results.

### 18. E-Stop or Emergency Stop:

**Pain:** Over/under-torqued conductors/loose strands generate high resistance, heat, and signal loss

**Solution:** Quickly identify hot spots to help isolate where an issue is or might be soon and use DMM for standard testing and troubleshooting

### Enclosures:

**Pain:** Floating voltages, overvoltage or overcurrent protection may cause faults, incorrect readings or safety issues

**Solution:** Verify proper ground to meet safety and compliance

Transmitters/transducers are common components that are powered by these panels and only require grounding on one side of them to reduce the likelihood of "ground loops". Typically they are all grounded at the transmitter, however, check with your facility to verify .