INDUSTRIAL ETHERNET CABLE TESTING

A Guide to Preventing and Solving the #1 Source of Industrial Ethernet Downtime

FLUKE networks®

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INTRODUCTION

The increasing integration of Industrial Ethernet technologies onto the plant floor is creating a new set of challenges as 4 to 20 mA analog control systems and serial digital control networks age and become more difficult to support over time. In 2020, legacy industrial protocols (Fieldbus) represent only one third of the industrial network nodes sold while Industrial Ethernet is expanding rapidly across a wide range of industrial environments. Many control environments have introduced ways to manage complex systems and support real-time applications that are essential to factory automation. As the migration to Industrial Ethernet occurs, one thing remains critical—network uptime. We know that network uptime is crucial to profitability and the quality of your output, and that one failure can trigger others and result in a significant loss of time and money.

By asking the right questions and using the right tools, it's possible to identify, troubleshoot and resolve industrial network problems. If you are a control engineer or technician, an industrial electrician or a system integrator, the tools you need depend on the job you expect to perform:

- Am I installing cabling or Industrial Ethernet devices during a new machine commissioning or while expanding a production area?
- Am I responsible of programming PLCs, VFDs, etc. and carrying out diagnosis of faults from all type of installed control systems?
- Is my job mostly about installing, maintaining and repairing equipment?
- Do I need to find and fix Industrial Ethernet cables?
- Do I need to provide documentation of my work?

It's important to know the distinction between the different instrument functionalities so you can choose the right tester for commissioning, preventive maintenance and troubleshooting of Industrial Ethernet networks.

Fluke testers are designed with a variety of focused features for particular tasks, to withstand the harsh and fast-paced industrial environment and to support different connector styles used for industrial cabling solutions. Depending on what task the test tool performs, testers can be classified into one of the three broad hierarchical categories: Advanced Cable Commissioning Tester, Cable + Network Tester or Cable Continuity Tester.

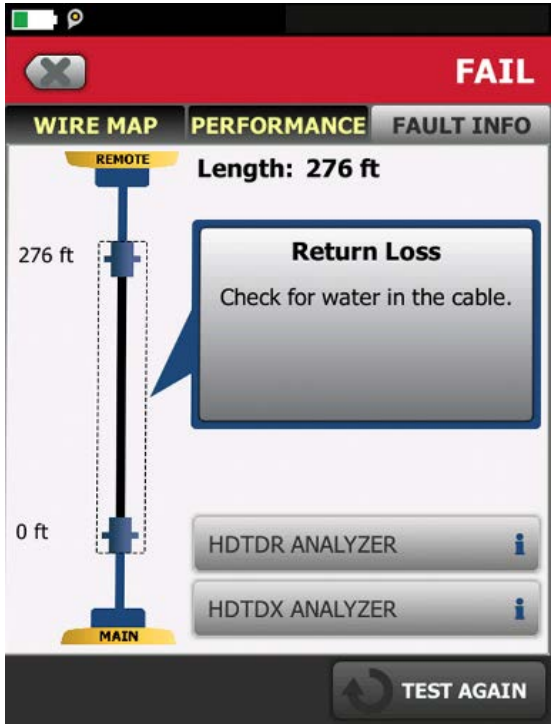
Although some features overlap between test tools, each group of testers answers unique questions:

- **Advanced Cable Commissioning Tester**: does the (installed) cable comply with the Industrial Ethernet Copper Cabling Standards developed by the International Standards Organization (ISO) or the Telecommunications Industry Association (TIA)?
- **Cable + Network Tester**: can the installed cabling link support the desired network speed, is the cable damaged, where does this cable go, what are the key switch port characteristics?
- **Cable Continuity Tester**: is this cable wired correctly?

When do you need an Advanced Cable Commissioning Tester?

An Advanced Cable Commissioning Tester makes many types of measurements across predefined frequency ranges and compares the detailed results to standards. In addition, the copper cabling to be used must comply to the cable specifications defined by standards organizations and vendors, such as PROFINET, Ethernet/IP (Industrial Protocol), EtherCAT, Modbus-TCP, etc. Proper testing of the cable will require that the cable tester be set up to test different cabling configurations (Channel test, End-to-end test), different connector types following to the correct environmental classification. Both the International Standards Organization (ISO) and the Telecommunications Industry Association (TIA) developed a set of specifications to define potential environmental conditions within the industrial sites. In addition, three environmental classifications (M.I.C.E. 1,2 and 3) are determined using four categories: Mechanical, Ingress, Climatic/Chemical, and Electromagnetic Compatibility (EMC) referred to as MICE in TIA-1005A and ISO 11801:3 standards. The MICE factors are graded on a severity scale from 1 to 3, with MICE 1 defining a typical office environment, MICE 2 defining a slightly harsher environment, and MICE 3 defining heavy industrial. To meet these requirements, vendors have developed specialized cabling and connectors. This includes cabling which can operate while being crushed, heated, immersed, or exposed to caustic chemicals.

The DSX CableAnalyzer features tests to support M.I.C.E. “E” levels.

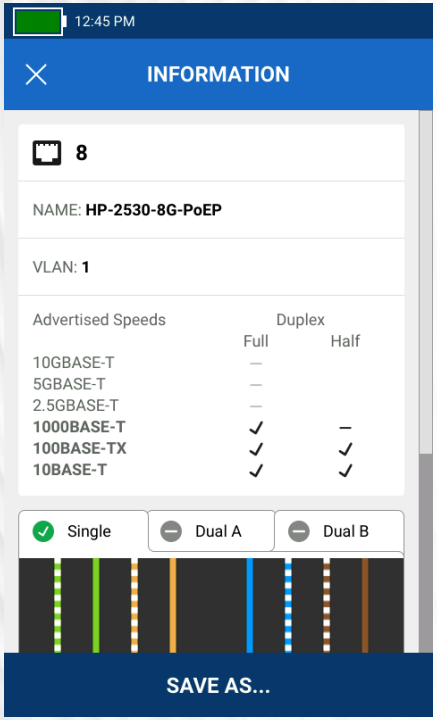


Advanced troubleshooting in the DSX can identify common and uncommon problems.

Still, more than half of Industrial Ethernet problems can be traced to cabling. Some of these show up immediately during the startup process—others can allow the connection to function properly until something such as environmental changes cause communications failures. Testing with an Advanced Cable Commissioning Tester before a machine startup is the only way to know if the cable meets all the required specifications as noted above and is the best way to prevent cabling problems. Nevertheless, even a tested cable can fail due to abuse such as being accidentally cut, pulled apart, or melted. Advanced Cable Commissioning Testers may also be used for troubleshooting, and can locate not only broken cables, but more difficult problems, such as water in a cable or a connector that is not up to specification. These tools provide testing for all the cabling parameters including crosstalk, return loss, shield integrity along the path of the cabling and TCL. TCL is a measure of the "balance" of the cable—its ability to transmit equal signals on both wires of a pair. As noted above, to address this problem, standards bodies have developed TCL requirements for cabling for MICE E1, E2, and E3 environments.

When do you need a Cable + Network Tester?

A Cable + Network Tester is designed to provide trusted cable testing along with network testing to help expertly manage industrial networks and keep production lines running smoothly and efficiently. The LinkIQ™ Industrial Ethernet Cable + Network Tester makes life easier for two main customer types. The first are maintenance and instrumentation technicians tasked with supporting Industrial Ethernet on the factory floor. With the explosion of Industrial Ethernet within the factory and machine networks, technicians are being called upon to maintain and troubleshoot this network and its associated cabling. The second customer type is controls and automation engineers tasked with designing and building automation systems and machines. As Industrial Ethernet continues to proliferate automation systems and engineers must be able to provide assurance to their end customers that the systems will operate as specified.

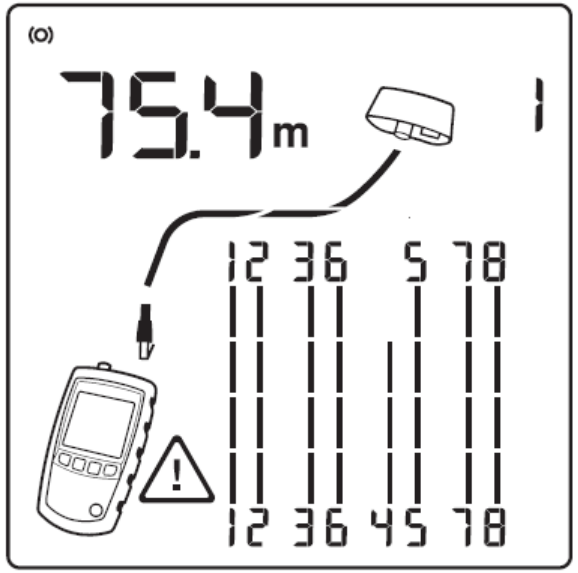


The LinkIQ-IE displays the switch name, port, and VLAN number in addition to the connection speed.

The LinkIQ-IE validates cable performance up to 10GBASE-T via frequency-based measurements and supports EtherNet/IP, PROFINET, EtherCAT design guidelines using the remote adapter equipped with RJ45, M12X, M12D and M8D connector interfaces. Beside these features related to cable performance, LinkIQ-IE also provides nearest switch diagnostics including advertised data rate, switch name, port number, and VLAN information, plus PoE testing through Hardware/Software negotiation and loaded Voltage (V) and Power (W) tests. In addition, LinkIQ-IE provides complete documentation abilities for the tests it performs, for the cable or switch it is connected to, recording all the same information as noted above. Results can be stored in the tester with descriptive names and recalled, coming up in the same format they are displayed when the test was originally run.

With all these features included, a Cable + Network Tester such as LinkIQ-IE shall be considered as the tool to have when troubleshooting an Industrial Ethernet network.

When do you need a Continuity Cable Tester?



The MicroScanner™ display shows the length of the cable and an open on wire 4 at the far end.

Continuity Cable Testers are typically used by any technician who pulls and terminates cable on site. These tools are used as a first line of defense in finding connection and wire-pairing faults.

They perform basic continuity functions, including wiremap and toning. A powerful Time Domain Reflectometer (TDR) function helps to determine the length of the cabling link or distance to a break or a short circuit in the link under test. In general, Ethernet cables are limited to 100 meters in length. Cables that are too long can cause problems since the signals might be too weak to be received properly at the far end or because the delay caused by a cable that is too long can interfere with the expected responses within a certain timeframe. In addition, a Continuity Cable Tester also detect that the cable under test in connected to an active device such as a switch.

Instrument selection guide

	MS-POE-IE	LIQ-100-IE	DSX2-5-IE-K1
	Checks cablecontinuity and interrogates PoE switch	Measures cabling bandwidth and Ethernet switch port capability	Commissions to TIA/ISO & advanced troubleshooter
Certify international standards			✓
Parametric tests on cable and connectors		Measures: NEXT, RL, IL	Full parametric bi-directional test
Test M.I.C.E. “E” Levels			✓
Shield integrity test to find connections impacting EMC/EMI			✓
Wiremap, continuity, length and tone generation	✓	✓	✓
Documentation of test results for commissioning		1000 results in tester. Document with LinkWare™ PC	12,700 Category 6A test results in tester. Document with LinkWare PC and LinkWare™ Live (Cloud)
Network Test capabilities		Switch Name, Port, & VLAN Info; Simplex/Duplex Identification; Port Blink	
Network speed	10 Mb/s to 10 Gb/s	10 Mb/s to 10 Gb/s	
Connector support	RJ45, M12D, M12X and M8D	RJ45, M12D, M12X and M8D	RJ45, M12D, M12X (Tera, GG45 and Coax optional)
Fiber optic tests			✓(requires optional fiber modules)
User Interface	Monochrome	Color “gesture-based“ touch screen	Large color “gesture-based“ touch screen, ProjX Project Management System and automated fault analysis

Ensure your network goes up and stays up!

For a complete view of cable testing technology and standards information please visit: **www.flukenetworks.com/industrialethernet**

Want to talk to an expert then locate your local contact numbers please visit: **www.flukenetworks.com/contact**

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