DSX Balance Measurements eBook

Learn about new balance measurements not currently available on other field testers

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Balance measurements

The DSX-5000 and DSX-8000 CableAnalzyers offer six new balance measurements not found in any other field tester.

1. DC Resistance Unbalance within a pair
2. DC Resistance Unbalance between pairs
3. TCL (Transverse Conversion Loss)
4. ELTCL (Equal Level Transverse Conversion Transfer Loss)
5. CDNEXT (Common Mode to Differential Mode Near-End Xtalk)
6. CMRL (Common Mode Return Loss)

1 DC Resistance Unbalance within a pair

Resistance Unbalance is a measure of the difference in resistance between the two conductors in a cabling system, see figure 1. This is different to the Resistance measurement normally found in field testers, also known as DC Loop Resistance, but often abbreviated to Resistance.

The DC Loop Resistance is the sum of the two conductors, 3.7 Ω (1.87 Ω + 1.85 Ω) rounded to one decimal place on the DSX CableAnalyzer.

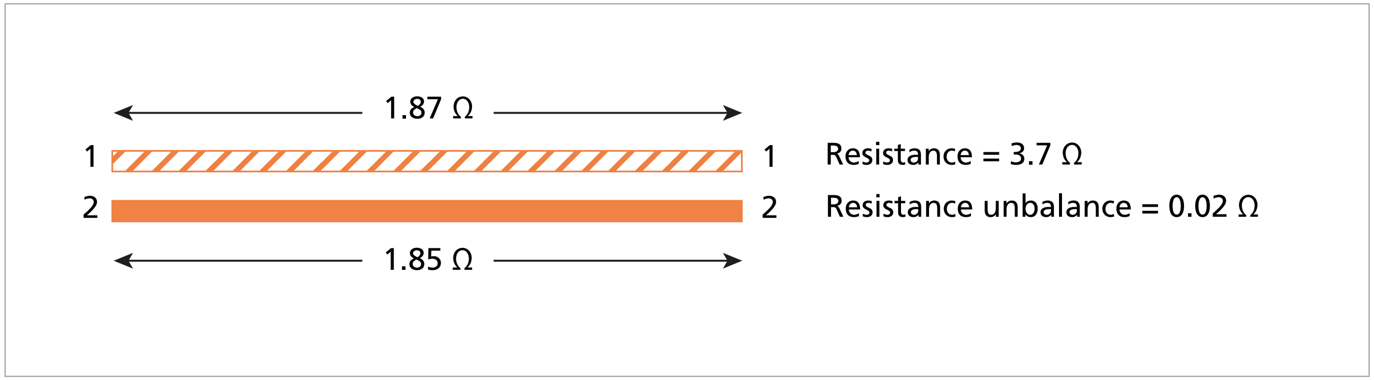

Figure 1. The DC Resistance is measured on each conductor. The difference (Resistance Unbalance) was 0.02 Ω (1.87 Ω - 1.85 Ω).

It is something you should watch out for if you intend to implement Power over Ethernet (PoE) on your network in accordance with IEEE 802.3af, IEEE 802.3at or IEEE 802.3bt. Examples of such implementations include IP telephones, wireless access points, building automation and security devices like network (IP) cameras.

Resistance unbalance results in current imbalance in the cabling channel that could cause saturation in the power-sourcing equipment (PSE) transformers. As a result, it may not deliver the PoE you need.

Field testing standards such as ANSI/TIA-1152 and IEC 61935-1 do not require this as a field measurement. However, you will find test limits in ANSI/TIA-568-C.2, ISO/IEC 11801:2010 and IEEE for Resistance Unbalance.

So why no field test requirement? Until now, there was no field tester that could do this, so it was left as a laboratory measurement only. That is no longer the case with the DSX-5000 and 8000 CableAnalyzers.

If you want Resistance Unbalanced to be measured, select a test limit on your DSX-5000 or 8000 CableAnalyzer that has a suffix of (+All) as can be seen in figure 2.

Figure 2.

2 DC Resistance Unbalance between pairs

In order to calculate the DC resistance unbalance between pairs, the DSX-5000 and 8000 CableAnalyzers measure the individual resistances of each wire of the pair, see figure 3. With the forthcoming Type 3 and Type 4 PoE, which will deliver up to 60W and 90W over 4 pairs, it is no longer just the DC resistance unbalance on each pair you need to worry about. Excessive DC resistance unbalance between multiple pairs can also wreak havoc on data transmission and cause PoE to stop working. The result is displayed as P2P UBL, an abbreviation of Pair to Pair Unbalance, see figure 4. This test is displayed automatically if the test limit selected contains (+All) in the limit name.

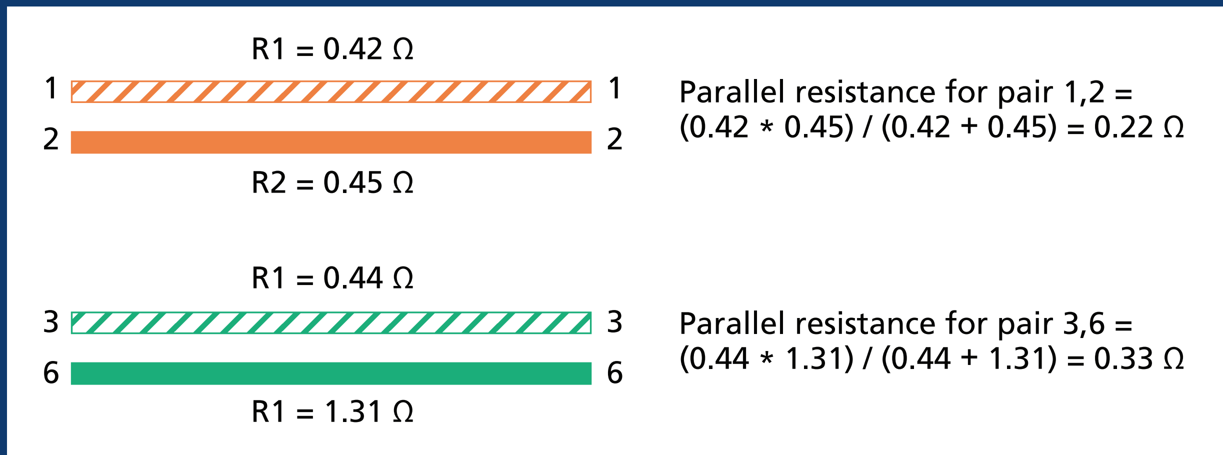

Figure 3. The DC resistance unbalance between pairs 1,2-3,6 is 0.22 Ω - 0.33 Ω = 0.11 Ω.

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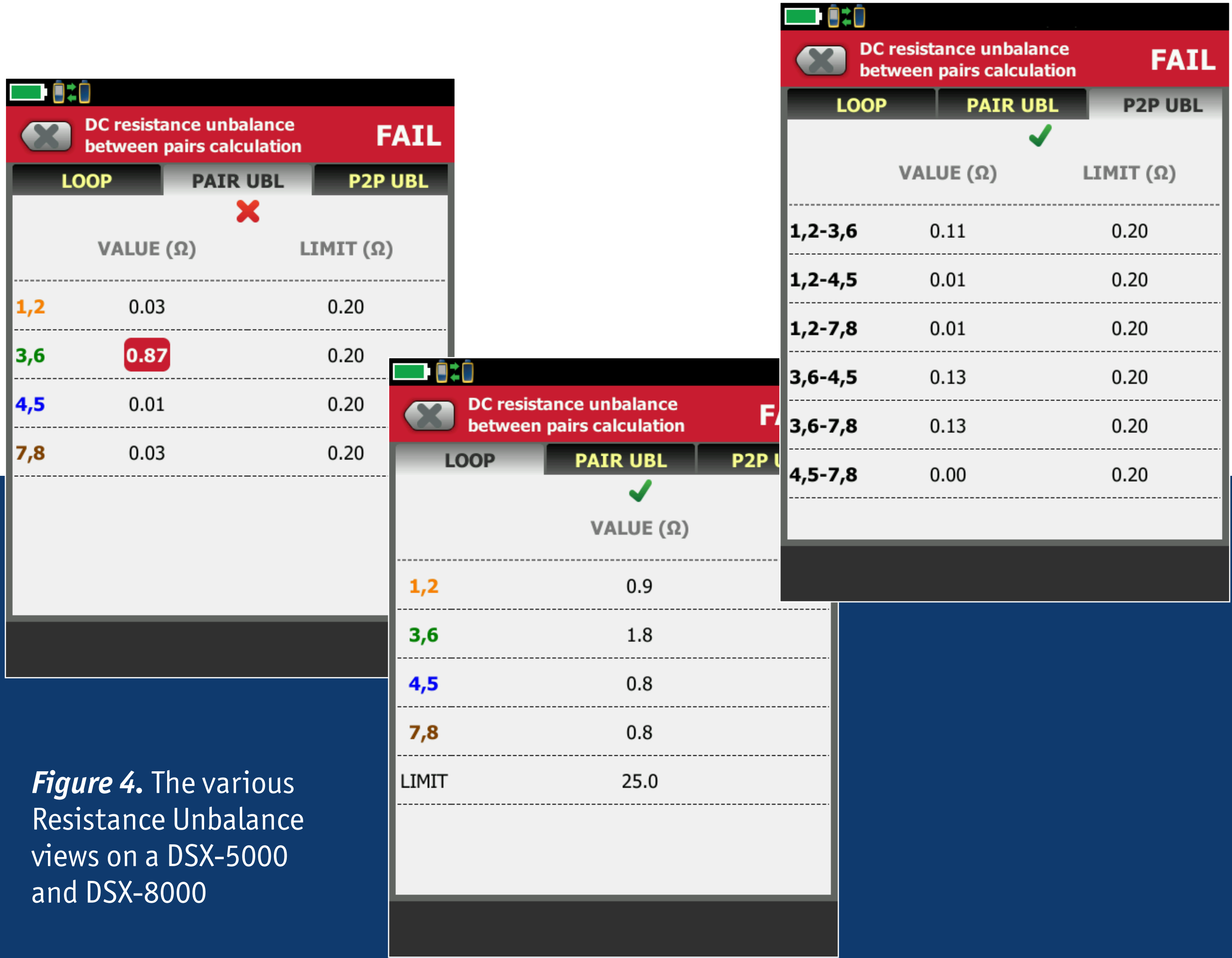

Figure 4. The various Resistance Unbalance views on a DSX-5000 and DSX-8000

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3 TCL (Transverse Conversion Loss)

TCL is one of two balance measurements found in ANSI/TIA-568-C.2, ANSI/ TIA-1005 and ISO/IEC 11801 Edition 2.2 2011-06. The other is ELTCTL.

To explain TCL and ELTCTL (described in the following section) it is important to understand the difference between common mode (unbalanced) and differential mode (balanced), see figure 5. Ethernet signals are applied in differential mode to conductors of a pair where opposite positive and negative voltages reference each other. In contrast, noise signals are injected into the conductors of a pair in common mode, which travels simultaneously and are referenced to ground.

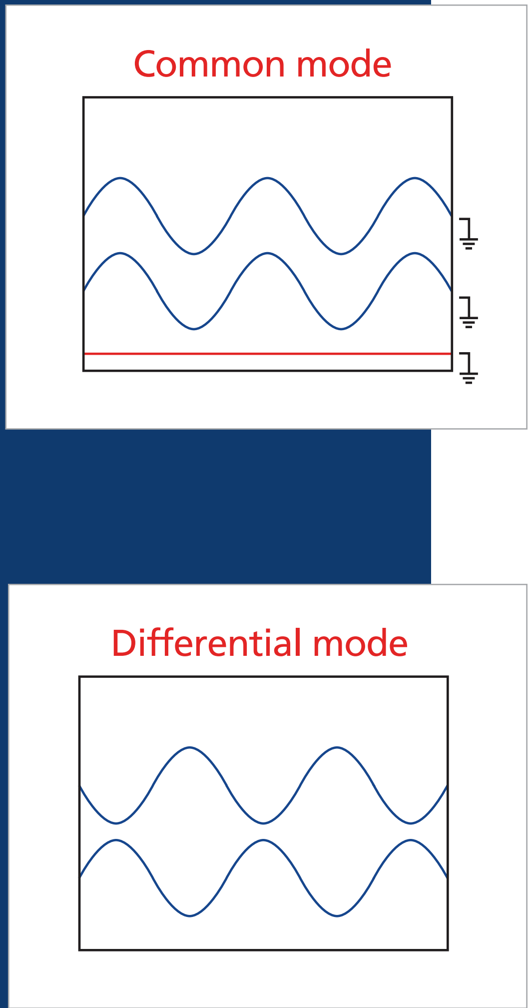

Figure 5.

When noise is injected into a cable, a portion of this common mode signal can be converted to differential mode and become a part of the Ethernet signal. This phenomenon, referred to as mode conversion, is detrimental to Ethernet transmission because it can cause the differential signal of Ethernet to no longer be balanced, leading to potential bit errors and retransmissions. Transverse Conversion Loss (TCL) measures mode conversion within a pair at one end. This is done by injecting a differential mode signal onto the pair and measuring any common mode signal returned on the same pair at the same end, see figure 6. The smaller the common mode signal returned, the better the balance.

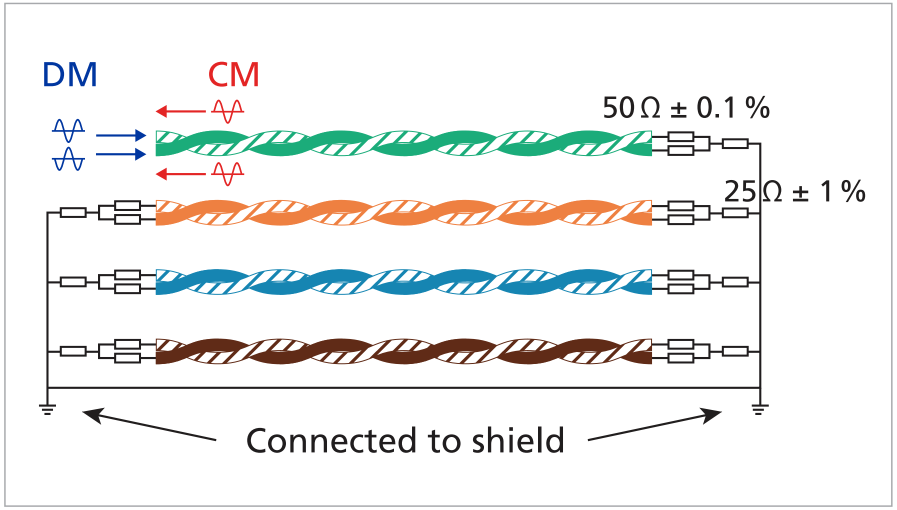

Figure 6.

Evidence is accumulating proving that failed TCL may cause 1GBASE-T and 10GBASE-T to malfunction, even when all other transmission parameters provide good margins above the standard limits. For example, a user tested the link to ISO/IEC 11801 Edition 2.2 2011-06 Class EA. It passed with good margins, see figure 7.

However, the Gigabit Switch kept backing down from 1000 Mbps to 100 Mbps; note this was a compliant 500 MHz cabling system.

Figure 7.

As part of a troubleshooting exercise, the user tested this link for TCL and compared the results to the normative requirements of ISO/IEC 11801 Edition 2.2 2011-06 for a Class EA Channel using a DSX-5000 CableAnalyzer. The link failed to meet the TCL performance requirements for an ISO/IEC 11801 Edition 2.2 2011-06 Class EA Channel with a negative margin of -6.6 dB, see figure 8. Given 6 dB represents a factor of two, we can say this link exhibited more than double the permitted TCL.

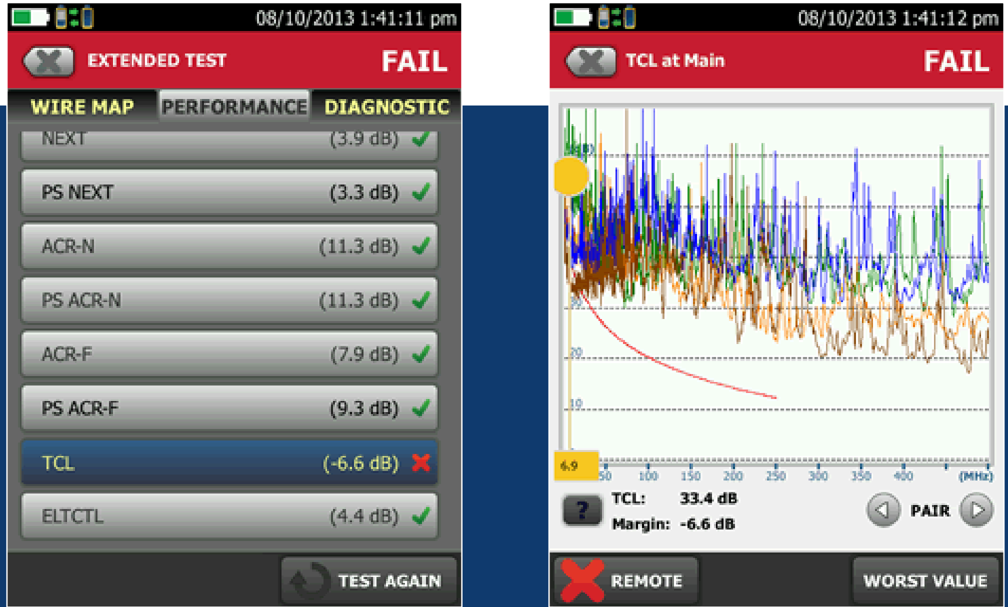

Figure 8. TCL summary of FAIL as well as the graph.

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The user replaced the connectors in the hope they were the cause. Sadly, the TCL was still poor and more importantly, the 1000 Mbps switch still kept backing down to 100 Mbps. This indicated a cable issue, so a new cable was sourced and terminated with the original connectors. The TCL test was conducted again resulting in a PASS and a significant improvement in TCL margin. And this time, the switch operated at 1000 Mbps and did not back down to 100 Mbps.

In the absence of a mandatory field test for these conformance parameters, it is left to the decision of the installer/customer as to whether the installation will be assessed for TCL (and ELTCTL) compliance. Certainly in the situation where an otherwise conformant channel is exhibiting application errors or other application issues, additional balance measurements are something you may wish to consider in order to investigate any otherwise hidden problems.

4 ELTCTL (Equal Level Transverse Conversion Transfer Loss)

Besides being measured via TCL, mode conversion is measured via Transverse Conversion Transfer Loss (TCTL). The difference with TCL is that the mode conversion measurement within a pair is now made at the opposite end. Instead of measuring any common mode signal returned, TCTL is measured by injecting a differential mode signal onto the pair and measuring any common mode signal at the other end of the link. Again, the smaller the common mode signal, the better the balance.

Because the amount of common mode signal in TCTL testing is dependent on the length of the link due to insertion loss, equalization must be applied to take this into account. That's where we get ELTCTL, or Equal Level TCTL.

Testing for these TCL and ELTCTL mode conversion parameters only adds about 6 seconds to the typical test time. This can be done by selecting your test limit with a suffix of (+ALL). Not only does this give you peace of mind in manufacturer claims, but this method of determining noise immunity is far less time consuming compared to complex field testing for alien crosstalk.

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5 CDNEXT (Common Mode to Differential Mode Near-End Xtalk)

CDNEXT is a troubleshooting tool only at this time for Channel Alien Xtalk testing issues. There are no test limits in ANSI/TIA-568-C.2, ANSI/ TIA-1005 or ISO/IEC 11801:2010. However, you will find it discussed in TIA-TSB-1197.

Poor CDNEXT is primarily a connector choice issue. Although unlikley, it could be a workmanship issue too.

The measurement is made by injecting a differential mode signal (DM) into one twisted pair, then measuring the common mode signal (CM) on another pair. The smaller the CM signal returned, the better the CDNEXT.

If you wish to add CDNEXT to your standard Category 5e, 6, 6A or Class D, E or EA test, select your test limit with a suffix of (+ALL).

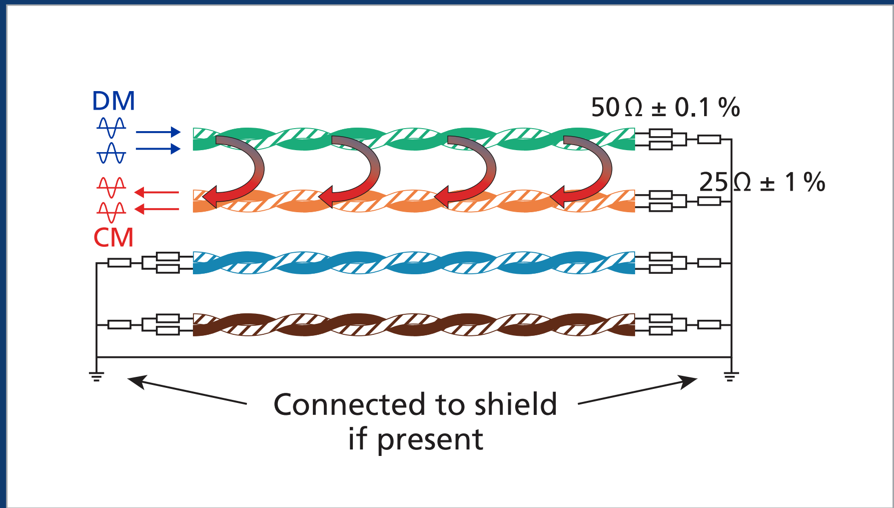

Figure 9.

6 CMRL (Common Mode Return Loss)

CMRL is a measurement of interest to those developing systems beyond 10GBASE-T.

There are no test limits in ANSI/TIA-568-C.2, ANSI/TIA-1005 or ISO/IEC 11801:2010.

The measurement is made by injecting a common mode signal (CM) into one twisted pair, then measuring the CM signal returned on that same pair, see figure 10. The smaller the CM signal returned, the better the CMRL.

If you wish to add CMRL to your standard Category 5e, 6, 6A or Class D, E or EA test, select your test limit with a suffix of (+ALL).

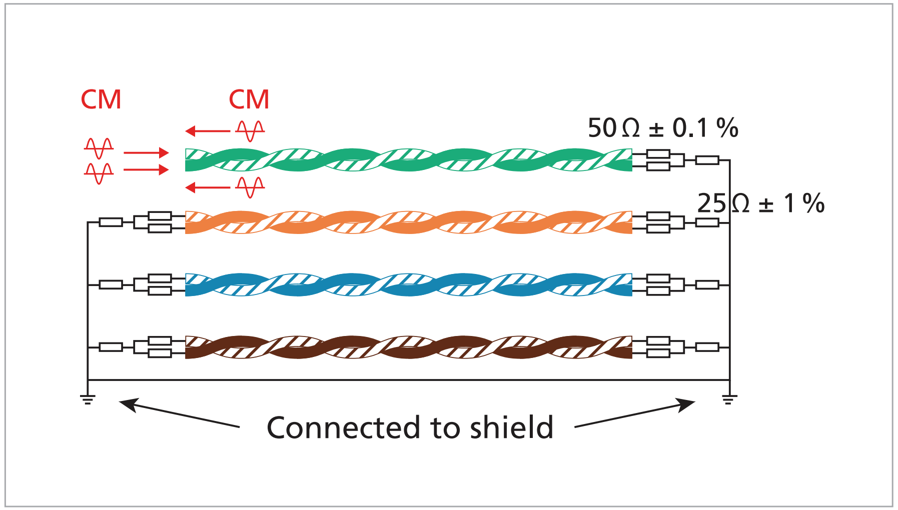

Figure 10.

For additional resources to help you establish Copper Testing Best Practices visit: **www.flukenetworks.com/CBPPG**

Want to talk to an expert then locate your local contact number on: **www.flukenetworks.com/contact**

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