Stressing Your Circuits to Determine Balance

Chris Dunford, Product Manager, Access Business Unit, EXFO

Ensuring that voice and DSL-based circuits are balanced and fault-free are the cornerstones for the quality of service required by today's operators to meet the needs of consumers, who are pushing for more bandwidth and better service quality for all connected devices. Traditionally, operators have relied on performing resistive and capacitive tests to determine the balance of tip and ring (A and B) leads in relation to ground (earth). A balanced pair helps mitigate noise, which can impact voice and DSL communications. Part of the testing challenge stems from the fact that to obtain accurate resistive balance results, the far end of the circuit must be shorted; however, to obtain accurate capacitive balance results, the far end must be open.

Examples of Faults that Can Impact Balance

- High-resistance opens
- Conductor imbalance
- Battery crosses
- Grounds
- Split pairs

Another method for determining balance makes use of longitudinal balance (ITU-T O.9 or G.117). The traditional course of action for this type of balance measurement is to rely on power influence (PI) and circuit noise (CN), and to calculate the difference between these measurements (PI – CN). Unfortunately, this method utilizes certain rules that make it unusable when trying to achieve the golden rule of a balance of > 60 dB for voice circuits. A better method is to actually measure the longitudinal balance of the circuit per O.9/G.117. This is therefore a viable method for both voice and DSL circuits in terms of determining a circuit ability to reject noise at different frequencies. However, proper measurement of PI, CN, and longitudinal balance requires drawing dial tone (current) and connecting to a device capable of providing a quiet termination. Although testing to an open is acceptable, quiet termination is the preferred method in this case. But what if the circuit is on the verge of a breakdown? Typically, running a combination of measurements, such as high-voltage leakage/isolation resistance and longitudinal balance, will indicate whether the circuit has a leakage and/or a balance problem. Nonetheless, running two separate tests is often time-consuming.

A Stressed Balance test is another industry-accepted method that could be considered synonymous with "killing two birds with one stone" in that it determines circuit balance by placing a high voltage onto the line to stress it. In addition, this method does not require detection of a dial tone to connect to a quiet termination. The MaxTester's Stressed Balance test applies a voltage onto the circuit, temporarily creating power influence on it, following which the MaxTester measures the stressed noise of the circuit. If there are any faults on the line, the balance between the tip and ring is skewed, resulting in high stressed noise as a result of poor balance (a good ground is still a requirement, as is the case with all measurements). Without this applied voltage generating a suitable level of power influence to force current flow and excite faults (i.e., if only a longitudinal balance test was used), some faults would remain hidden.

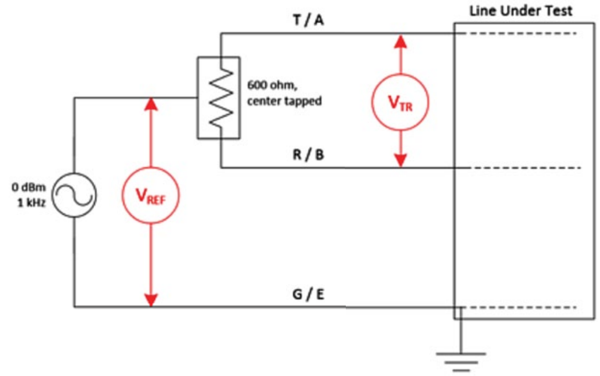


Figure 1. How a longitudinal balance test works: add high-voltage output to get the Stressed Balance test

The following are the expected results collected with the Stressed Balance test:

Grade	Stressed Balance Result
Acceptable	< 20 dBrnC
Marginal	20-30 dBrnC
Unacceptable	> 30 dBrnC

The Stressed Balance results are expressed in dBrnC units to improve the accuracy (noise immunity) of measurement, during which a C-message filter is applied. The C-message filter is used for both ANSI and ITU settings in the MaxTester. Although a psophemetric filter type is typically used with the ITU setting, C-message and psophometric filter characteristics are very similar, and therefore the result will not be affected.

The following procedures can be used in conjunction with the MaxTester to verify circuit quality:

Verification of Good Ground

Although the MaxTester features many tests that are capable of verifying whether the ground is good (i.e., ground resistance), the Stressed Balance test offers yet another method.

1. Open the pair at the subscriber network interface device (NID).
2. Connect the MaxTester to the tip, ring and ground at the subscriber NID, facing toward the CO/Exchange. The CO/Exchange should remain connected, but it is not mandatory.
3. Run the Stressed Balance test.
4. Remove either the tip or the ring lead from the circuit while the Stressed Balance test is running.
5. The ground is good if the Stressed Balance reading is > 70 dBrnC.
6. Return the tip or ring lead to continue normal Stressed Balance testing.

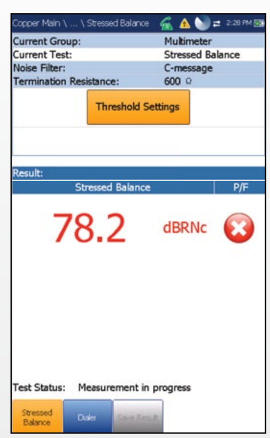


Figure 2. Stressed Balance ground verification

Note 1: If standard methods and procedures within your organization require you to test suitability of station ground/ground resistance, run the MaxTester's Ground Resistance test to ensure that grounding towards the CO/Exchange is < 25 ohms.

Local Loop Testing—Does a Fault Exist?

The Stressed Balance test provides a quick way to determine whether the circuit is balanced or whether there is a series resistance fault on the line.

1. Open the pair at the subscriber NID.
2. Connect the MaxTester to the tip, ring and ground at the subscriber premise looking towards the CO/Exchange. For the best results, make sure that the pair is open at the CO/Exchange, because the electronics inside the CO/Exchange can influence the Stressed Balance results.
3. Run the Stressed Balance test.
4. If the results are greater than 20 dBrnC or 30 dBrnC (your settings for marginal or unacceptable values), there is a fault in the local loop. Working your way towards the CO/Exchange, open the pair, and then test in both directions (towards CO/Exchange and towards subscriber) until you find the problematic section.

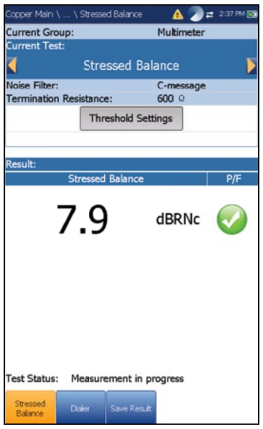


Figure 3. Checking circuit balance and faults with the Stressed Balance test

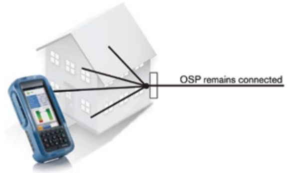
Note 2: The Stressed Balance reading will show increasingly higher values the closer you get to the fault.

Note 3: If there is less than 300 m/1000 ft of copper pair BEYOND the fault, the Stressed Balance test may show < 30 dBrnC (resulting in a good or marginal PASS). Reducing the benchmark for pass/fail in this case will be of benefit to the technician. For example, if the circuit is less than 300 m/1000 ft, using a benchmark of < 3 dBrnC for GOOD is advisable.

Inside Wiring (IW) Testing—Does a Fault Exist?

The Stressed Balance test provides a quick way to determine whether the circuit is balanced or whether there is a series resistance fault on the line.

1. Make sure that the pair at the subscriber NID is connected towards the CO/Exchange.
2. Remove the subscriber equipment from the interworking (IW) interfaces/jacks (i.e., DSL modem or phones).
3. Connect the MaxTester to the IW (tip, ring and ground) at each IW jack location.



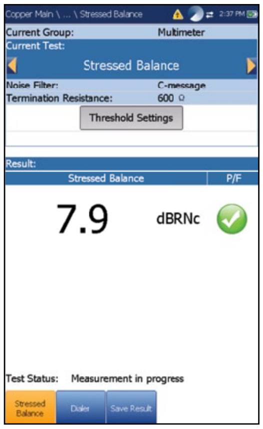


Figure 4. Using the Stressed Balance test to check the inside wiring

4. Run the Stressed Balance test.
5. If Stressed Balance results are similar to the values obtained during local loop testing, the problem is NOT within the inside wiring.
6. If the Stressed Balance results are high, continue testing each IW jack, moving towards the NID until the faulted section is identified.

INTERMITTENT FAULTS

The Stressed Balance test may expose some hard-to-discover intermittent faults which may surface only in the presence of the high voltage generated during this test, and which might disappear in cases when the environment changes (water ingress as a result of precipitation, high humidity, rectified loops, etc.). As a result, paying close attention to how stable the Stressed balance reading is may assist in troubleshooting intermittent faults. For instance, a quick dip from good to unacceptable levels or wide fluctuations between the two may also be an indication of a problem on the line.

SUMMARY

In accordance with good test and measurement methodologies, it is also recommended to run prerequisite tests such as voltage, resistance, capacitance and current to ensure that there is no unwanted equipment or severe faults on the line that could impact the Stressed Balance measurement and cause a misrepresentation of the balance results.

EXFO Headquarters > Tel.: +1 418 683-0211 | Toll-free: +1 800 663-3936 (USA and Canada) | Fax: +1 418 683-2170 | info@EXFO.com | **www.EXFO.com**

EXFO serves over 2000 customers in more than 100 countries. To find your local office contact details, please go to **www.EXFO.com/contact**.

APNOTE307.1AN

Printed in Canada 14/09