VIAVI Solutions

Application Note

Calibration Versus Verification

By Greg Massey, Dan Chappell; 31-July 2018

Calibration and Accuracy

Room Temperature calibration

The ONX is calibrated at room temperature. The calibration is designed so that with drift the unit will stay inside the specification limits over level and over temperature. Inside the ONX there are several attenuators and amplifiers which are turned on and off depending upon which level, internal attenuators and amplifier settings are used. The Calibration checks all these settings and will give you results like Figure 1.

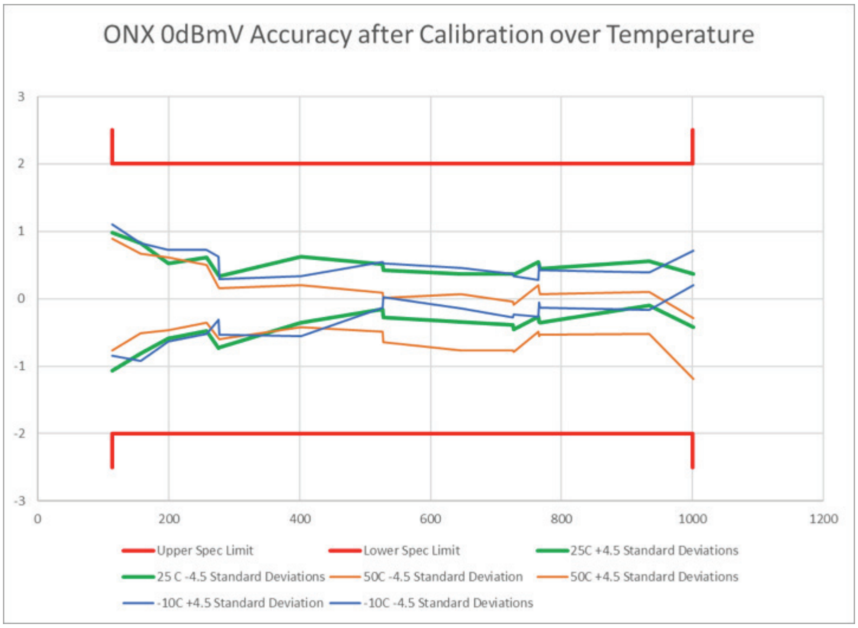


Figure 1

There are a total of 1513 measurements made during the calibration process insuring that the level, MER and BER are measured accurately during the use of the product. The levels a recalibrated such that the ONX will perform to specification over temperature, at various levels and frequencies. Additionally, the test vectors are checked such that no component has drifted out of specification, either by age or ESD and electronic overstress has caused a component to be weak.

Verification

Verification is typically taken at a single temperature (usually room temperature) and the results are compared to the specification limits. Since the unit does have some variation over temperature and corner case frequency events, a verification at room temperature could leave the product out of specifications at the corner case situations.

Traceability

The calibration system comes with a true power meter to verify that the calibration system is delivering the correct levels to the system so that unit to unit variation is very low. The calibration systems themselves are maintained at a high integrity to give the ONX the best performance possible.

Why you should calibrate rather than verify

If a verification finds that the system passes a low frequency at close to the higher limit and the high frequency is passing the lower limit, you are building in some tilt into your measurement. An installer could see that the tilt is out of specification. The tech who is sent to fix the tilt situation could have a unit that was verified with tilt in the opposite slope, and when testing the same test point, measurements indicate that the node is alright. This is a truck roll wasted, which means money wasted.

Should there be a slight notch in the system due to overstress the same could occur. The verification would not test at the notch frequency and pass the unit. If a channel is at the frequency where there is a notch, the installer would report a bad flatness in the plant. The maintenance technician would again be sent to troubleshoot an issue that does not exist.

Scenarios Using Meters Due for Recalibration

Overview

Joe and Jim work for a small cable company where they do it all: installation, in-home troubleshooting, and network maintenance. They both have meters that are in spec, but neither has been calibrated in over two years. They don't realize how much this is costing them in rework and subscriber satisfaction.

Inconsistent Limit Checks

When Jim runs an installation for a new customer, he sees several channels at the high end failing with low levels at the set-top box. MER and BER tests pass, so he notes it and plans to come back when he has more time.

The next week Joe is in the neighborhood and offers to adjust the levels. He starts with a full scan and finds the levels are good at the high end, with plenty of margin both above and below. A few channels at the low end are too low, though. He swaps an attenuator pad to raise everything by 1dB. Now his full scan shows that the low end went up, but the high end went up even more. He can't find a pad that brings all channels within their level limits.

What's happening here?

- Jim's meter is reading low at the high end, just enough to make the high-end channels' limits fail.
- Joe's meter doesn't have the same problem, so it doesn't see failures on the same channel.
- After Joe swaps the attenuation pad, the meter's AGC algorithm selects a different step on its internal attenuator. The chosen step's frequency response has enough error, and it differs enough from the previous step, that no pad will let all the channels pass.

By now Joe is running late, and the subscriber is more than a little annoyed about this service call. She thought her television was working fine before Joe came.

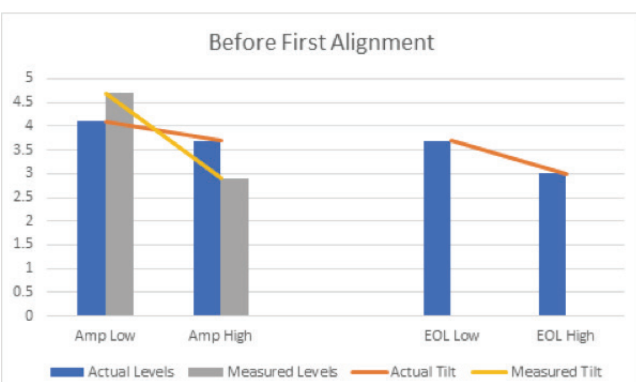
Network Alignment

Joe and Jim are balancing a network. Joe doesn't know it, but his meter measures 1.1dB low at the low pilot frequency and 0.4dB high at the high pilot. Jim's meter, on the other hand, measures 0.6dB high at the low pilot and 0.8dB low at the high pilot. These calibration drifts give Joe's meter a tilt error of +1.5dB. Jim's meter has -1.4dB tilt error.

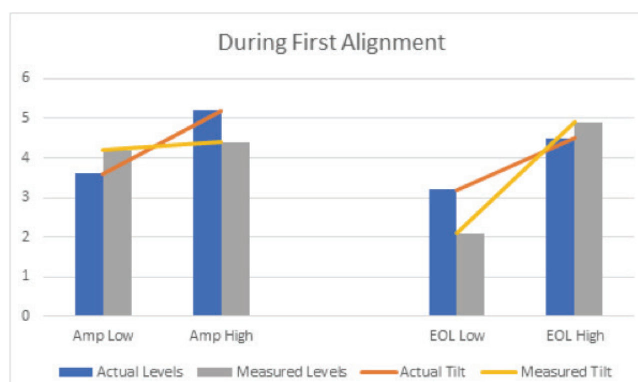
The network consists of a node and one amplifier. Joe is at the node and Jim is at the amp. Jim sees the low pilot level is 0.7dB high and there is 1.8dB negative tilt. He doesn't realize it, but most of the errors come from his own meter. He has Joe swap pads and EQs to decrease the level by a half dB and increase the tilt by 2dB.

Joe moves to the end of line, where his meter tells him the low pilot is 1.9dB too low. He also measures +2.8dB of tilt. He has Jim reduce the EQ at the amp by 3 dB and take out 2dB of pad.

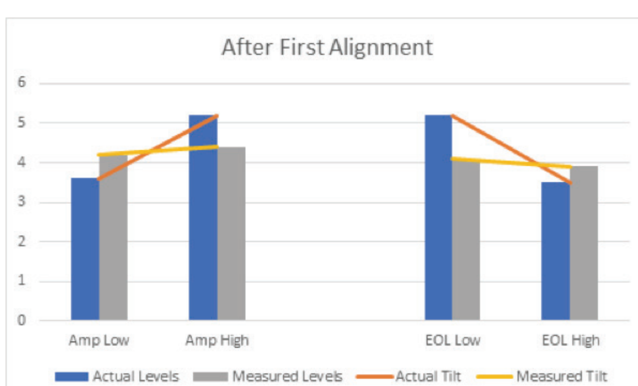
The network looks like this before they align it:



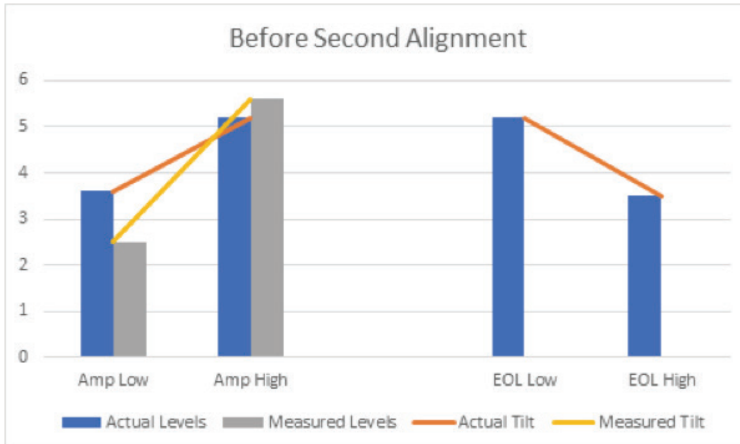
This is after aligning the node:

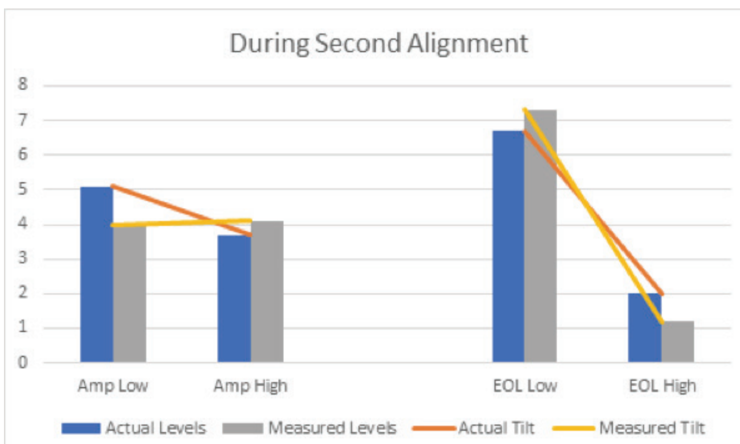


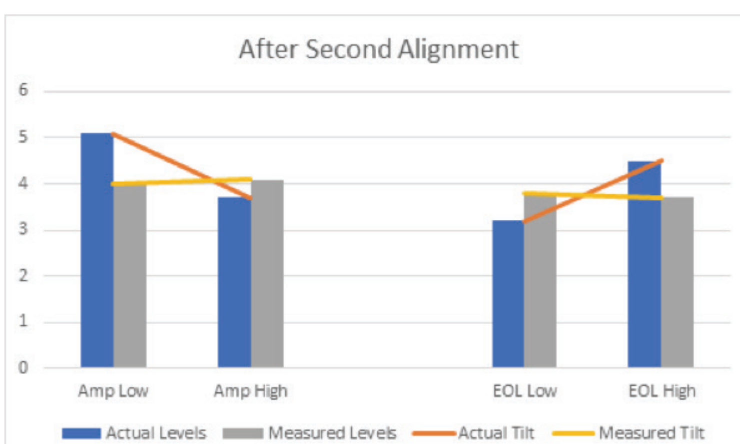
After the alignment it looks like this:



Joe and Jim come back six months later, but this time Jim works at the node and Joe goes to the amp. Then Jim goes to the end of line. They are surprised how much change in EQ is required this time. In order to keep things simple, we'll assume that neither the plant nor their meters' measurement errors changed during that time. Here are the results:







Here's a table of actual values, measured values, and changes:

	Amplifier Values						End of Line Values					
	Actual			Measured			Actual			Measured		
	Low Pilot	Tilt	High Pilot	Low Pilot	Tilt	High Pilot	Low Pilot	Tilt	High Pilot	Low Pilot	Tilt	High Pilot
Values before first alignment	0.1	−0.4	−0.3				−0.3	−0.7	−1			
Jim's meter error				0.6	−1.4	−0.8						
Jim's measurements at amp				0.7	−1.8	−1.1						
Joe's EQ and pad swaps at the node	−0.5	2										
After Joe's node changes	−0.4	1.6	1.2				−0.8	1.3	0.5			
Jim's meter error				0.6	−1.4	−0.8						
Jim's measurements at amp after swaps				0.2	0.2	0.4						
Joe's meter error										−1.1	1.5	0.4
Joe's measurements at EOL										−1.9	2.8	0.9
Jim's EQ and pad swaps at the amp							2	−3				
After Jim's amp changes							1.2	−1.7	−0.5			
Joe's meter error										−1.1	1.5	0.4
Joe's measurements at EOL after swaps										0.1	−0.2	−0.1
Values after first alignment	−0.4	1.6	1.2				1.2	−1.7	−0.5			
Values before second alignment	−0.4	1.6	1.2				1.2	−1.7	−0.5			
Joe's meter error				−1.1	1.5	0.4						
Joe's measurements at amp				−1.5	3.1	1.6						
Jim's EQ and pad swaps at the node	1.5	−3										
After Jim's node changes	1.1	−1.4	−0.3				2.7	−4.7	−2			
Joe's meter error				−1.1	1.5	0.4						
Joe's measurements at amp after swaps				0	0.1	0.1						
Jim's meter error										0.6	−1.4	−0.8
Jim's measurements at EOL										3.3	−6.1	−2.8
Joe's EQ and pad swaps at the amp							−3.5	6				
After Joe's amp changes							−0.8	1.3	0.5			
Jim's meter error										0.6	−1.4	−0.8
Jim's measurements at EOL after swaps										−0.2	−0.1	−0.3
Values after second alignment	1.1	−1.4	−0.3				−0.8	1.3	0.5			

Aligning the forward path with meters in need of calibration has caused several problems:

- Measurement errors caused techs to perform extra work.
- Leads to unnecessary disruption of subscriber service
- Resulting plant balance is now worse, not better. While more expensive than a verification, signal level meter calibration saves you money by reducing false truck rolls, ensuring proper balancing and improving technician confidence. Additionally, when your unit is calibrated, important updates are made that only qualified VIAVI service locations can provide. Simply testing a few frequencies cannot replace the thorough testing done by a VIAVI certified ATE. To get your instrument calibrated, contact VIAVI Customer Care for details.

VIAVI Solutions

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To reach the VIAVI office nearest you,
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