PVA-PL4, PVA-LI4
Fixed Impairment Modules
for the **PhyView® Analyzer**

Product Overview

PVA-PL4 Module

The PVA **Passive Loss Module** consists of 4 channels, each with fixed, wideband (DC to 100MHz) insertion losses consisting of 1dB, 2dB, 4dB, and 8dB. Each channel provides RJ-45 connections. Using short jumper patch cables, channels may be combined to produce integer amounts of wideband insertion loss between 1dB and 15dB.

PVA-PL4 Module Applications

Validating Tx Power and PSD Metrology

The PVA-PL4 module offers a simple way to validate measurements of Tx Power and Power Spectral Distortion (PSD) along with any associated calibrations.

In Figure 1, a "known good" 10/100/1000 port with nominal (**-0.3dB**) 100Base-Tx and near nominal (**-0.7dB**) 1000Base-T Tx power levels is connected to a wideband 3dB loss produced by combining the 2dB and 1dB loss channels in the PVA-PL4 module. Using the **PVA Meters** menu in PVA Interactive, measurements are made of the following parameters:

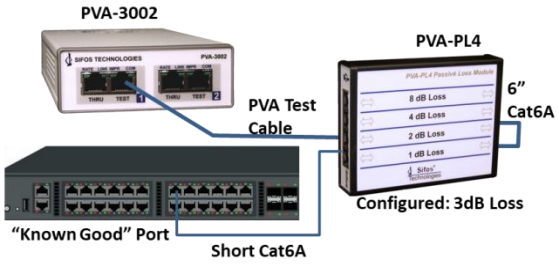

Figure 1. Tx Power & PSD Validation

Link Rate	Parameter	Pair	Direct Connection			3dB Loss Connection*		
100Base-Tx	Tx Power	2	-0.3 dB			-3.6 dB		
		3	-0.3 dB			-3.6 dB		
	PSD (*see **Figure 2** for 3dB Loss results*)		**1MHz**	**40MHz**	**70MHz**	**1MHz**	**40MHz**	**70MHz**
		2	-0.1 dB	-0.7 dB	-1.3 dB	-3.1 dB	-4.0 dB	-4.4 dB
		3	0.0 dB	-0.5 dB	-1.3 dB	-3.0 dB	-3.9 dB	-4.4 dB
1000Base-T	Tx Power	1	-0.7 dB			-4.1 dB		
		2	-0.7 dB			-4.1 dB		
		3	-0.8 dB			-4.1 dB		
		4	-0.7 dB			-4.0 dB		
	PSD (*see **Figure 3** for 3dB Loss results*)		**1MHz**	**40MHz**	**70MHz**	**1MHz**	**40MHz**	**70MHz**
		1	-0.5 dB	-0.8 dB	-1.1 dB	-3.7 dB	-4.2 dB	-4.4 dB
		2	-0.5 dB	-0.8 dB	-1.0 dB	-3.6 dB	-4.2 dB	-4.4 dB
		3	-0.3 dB	-0.8 dB	-1.1 dB	-3.6 dB	-4.3 dB	-4.6 dB
		4	-0.3 dB	-0.9 dB	-1.2 dB	-3.3 dB	-4.2 dB	-4.7 dB

* Patch cables will add some additional insertion loss

As the test data indicates, Tx Power and Wideband PSD measurements all reflect a difference of approximately 3dB on all pairs indicating that the metrology responded properly to the 3dB insertion loss channel created by the PVA-PL4 module.

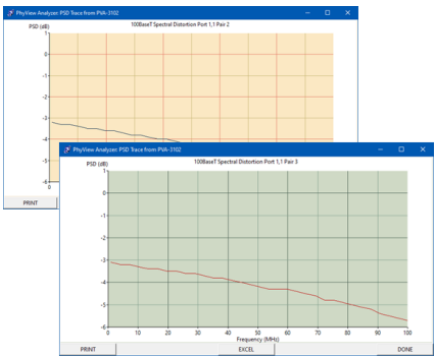

Figure 2. 100Base-Tx PSD -3dB

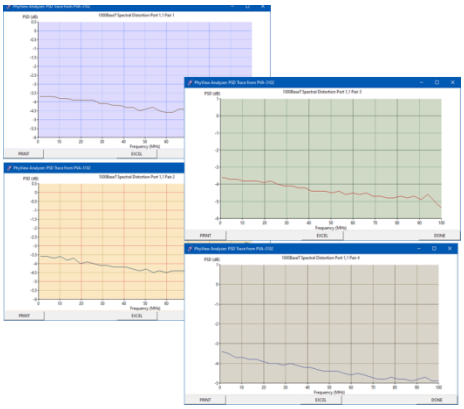

Figure 3. 1000Base-T PSD -3dB

Evaluating 1000Base-T Wideband Loss Response

Certain "industrial" 10/100/1000 transceivers in the market were designed to configure receiver AGC (gain control) based upon narrow band, low frequency power instead of the more typical wideband power assessment. These ports, when linking to 1000Base-T, evaluate power loss at low frequency and then "extrapolate" that based upon a typical 100 meter cat5e cable insertion loss. In other words, if they measure 2dB loss at 1 MHz, they expect loss at 100MHz to exceed 20dB.

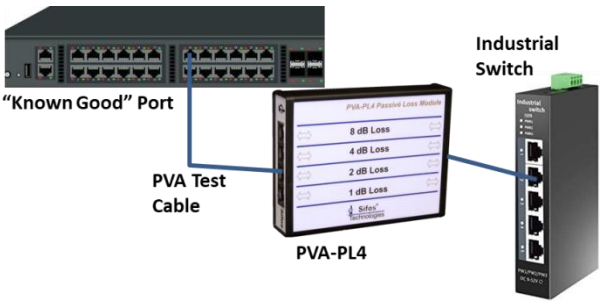

Figure 4. Evaluating 1000Base-T Response to Wideband Loss

A wideband 2dB loss channel, if inserted between one of these ports and most any other "known good" 10/100/1000 port, may result is failed 1000Base-T link-ups. This is because the receiver AGC gain in the aforementioned industrial transceiver goes into overdrive with the 2dB fixed wideband loss.

More typical 10/100/1000 transceivers in the market will tolerate at least 8 dB of wideband fixed insertion loss in a 1000Base-T link.

PVA-LI4 Module

The PVA **Line Impairment Module** consists of 4 channels providing the following fixed impairments:

Wideband Return Loss of -14 dB on all four wire pairs (< 100Ω)
Wideband Return Loss of -16.8 dB on all four wire pairs (> 100Ω)
Wideband Crosstalk of -32.5 dB between Pairs 1,2 and -23.4dB between pairs 3,4
IEEE MDI Limit Line Return Loss: (Clause 40 Specification)

- 1-40 MHz: -16 dB 40-100 MHz: -10 + 20LOG(MHz / 80)
- Measured from source impedance of 85Ω or 115Ω
- Pairs 1 and 2: -21.3dB @ 1MHz, -18dB @ 40MHz, -15dB @ 70MHz
- Pairs 3 and 4: -22.5dB @ 1MHz, -18.5dB@ 40MHz, -15.2dB @ 70MHz

Validating Return Loss Calibrations and Metrology

A primary purpose of the PVA-LI4 is to validate wideband return loss local calibrations and general metrology. In Figure 5, the PVA test port is connected through the -14dB Return Loss channel to a "known good" 10/100/1000Base-T port where baseline direct measurement of wideband return loss reported by the PVA-3000 is -26dB, the measurement floor for wideband return loss.

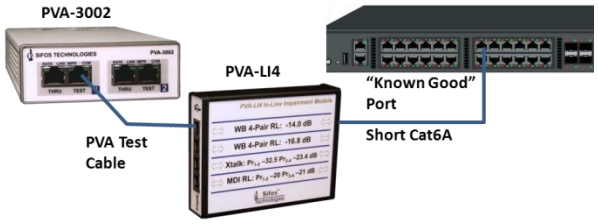

Figure 5. Evaluating 14dB Return Loss using "Known Good" 1000Base-T Port

	Pair 1	Pair 2	Pair 3	Pair 4
Baseline	-26.0 dB	-26.0 dB	-26.0 dB	-26.0 dB
-14.0 dB	-14.2 dB	-14.5 dB	-15.9 dB	-13.5 dB
-16.8 dB	-16.8 dB	-17.4 dB	-17.2 dB	-16.3 dB

The table above shows that the port-under-test is truly "known good" with -26dB readings on all four pairs in the absence of any impairment. With the -14dB channel, actual readings are in the -14dB range and with the -16.8dB channel, actual readings are in the -16.8dB range. Because -14dB and -16.8dB are much higher than the -26dB baseline measurements, there is only a very minor impact by small return loss differences that might exist between different pairs below the -26dB measurement floor of the PVA-3000.

Both the -14dB and -16.8dB wideband return loss channels are way outside the 802.3 Clause 40 limit line for Return Loss. The MDI RL channel is designed to represent what a marginally compliant return loss would look like given that the source impedance of the measuring instrument is the nominal 100Ω. Return loss is specified by Clause 40 to

be less than -16dB in the 1-40MHz range as measured from a source impedance ranging from 85Ω to 115Ω. So to a measuring device with the nominal 100Ω source impedance, that return loss must measure more like -20dB to -21dB in that same 1-40MHz range.

Because -21dB is only 5dB removed from the PVA-3000 measurement floor, variations in actual return loss below -26dB will substantially influence return loss measurements going from pair to pair through the MDI RL channel. For this reason, instead of connecting to a "known good" port as shown in Figure 5, the MDI RL channel must be connected to the same PVA port utilized for Return Loss (Echo) calibrations (see Figure 6). Ideally, the connection to that calibration partner port should be a very short (e.g. 6 inch) Cat6A patch cable.

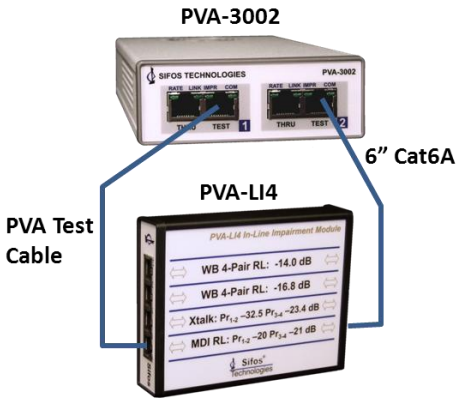

Figure 6. Evaluating IEEE MDI Return Loss using PVA calibration partner port

With the setup of Figure 6, measurements produced the following:

	Pair 1	Pair 2	Pair 3	Pair 4
MDI RL	-20.4 dB	-20.9 dB	-22.5 dB	-21.8 dB

As explained in Section 1.3.8 of the PVA-3000 Reference Manual, when the measured wideband return loss is in the -19dB to -20dB range, it is likely that the measured pair is near or just outside the IEEE 802.3 limit line for return loss. This is evidenced by the measurements of the IEEE MDI return loss channel where the readings are in the vicinity of -20 dB. In the -21.5 dB to -26 dB range, the measured pair is very likely compliant for 1000Base-T return loss.

Validating Crosstalk Calibrations and Metrology

A second purpose of the PVA-LI4 is to validate wideband crosstalk local calibrations and general metrology. In Figure 7, the PVA test port is connected through the crosstalk (Xtalk) channel to a "known good" 10/100/1000Base-T port where baseline direct measurement of wideband crosstalk reported by the PVA-3000 on all pair combinations is -39dB, the measurement floor for wideband crosstalk. The crosstalk channel should degrade this to produce a crosstalk of -32.5 dB between Pairs 1 to 2 and -23.4dB between Pair 3 to 4. Other pair combinations are unaffected.

	Pair 1 to 2	Pair 3 to 4
Baseline	-39.0 dB	-39.0 dB
Xtalk Chan.	-32.8 dB	-22.9 dB

The table here shows that the port-under-test is truly "known good" with -39 dB readings on all pair combinations including Pair 1 to 2 and Pair 3 to 4 in the absence of any impairment. With the -32.5dB impairment on Pairs 1 to 2, -32.8dB is measured and with the -23.4dB impairment on Pairs 3 to 4, -22.9dB is measured. All other pair combinations will continue to measure -39 dB.

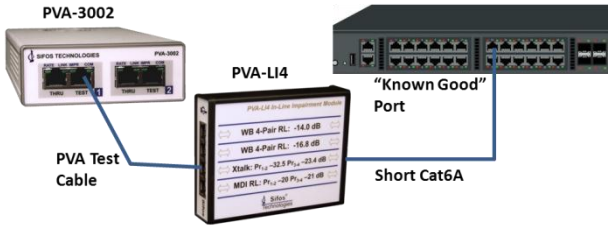

Figure 7. Evaluating Crosstalk using "Known Good" 1000Base-T Port

Ordering Information

PVA-PL4	In-Line Quad Passive Loss Module (1, 2, 4, & 8 dB)
PVA-LI4	In-Line Quad Line Impairment Module (3 Mismatches, 1 Crosstalk)

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