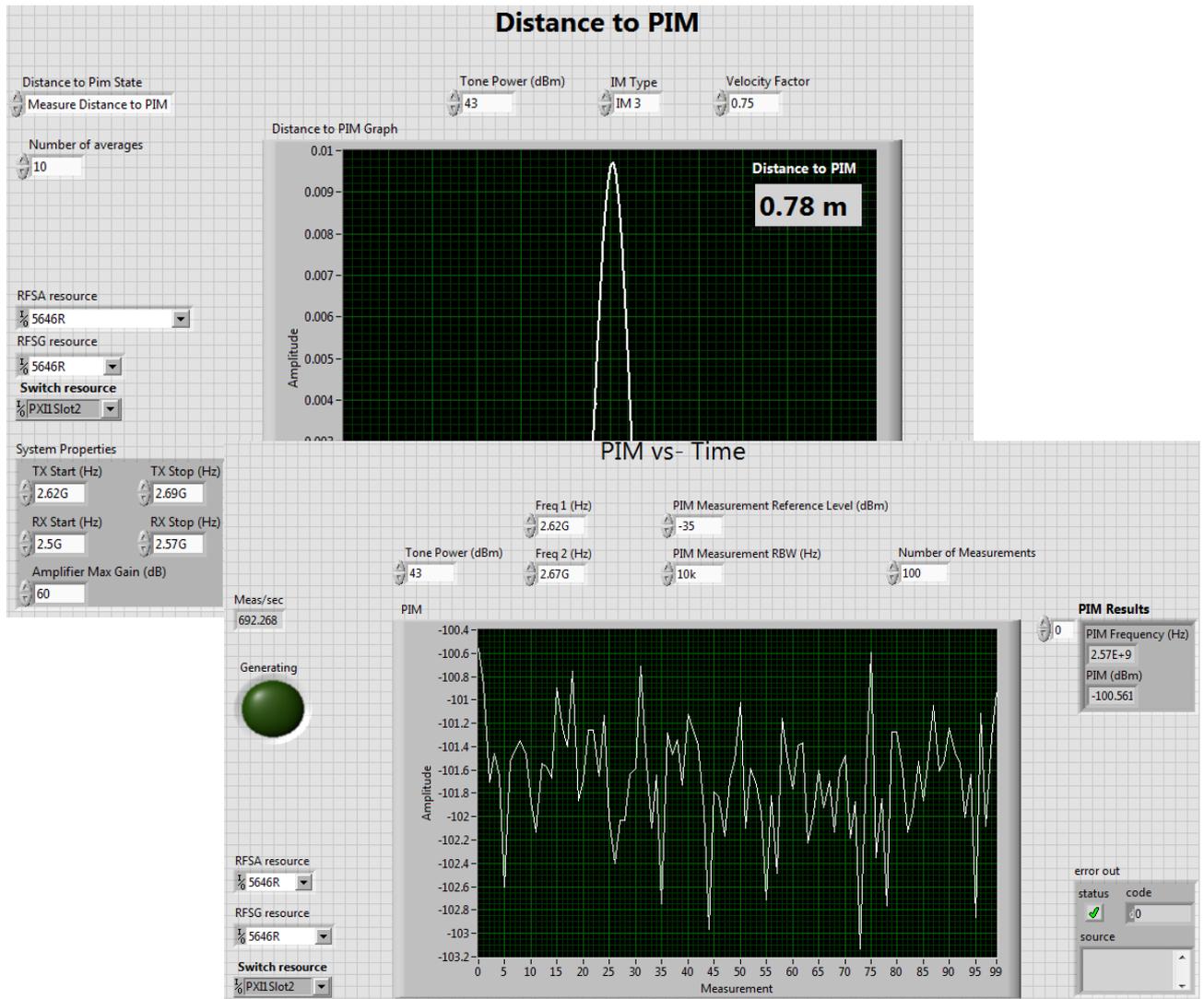


GTT PIM TOOLKIT

USER GUIDE



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1 Introduction

The GTT PIM Toolkit by Gefle Testteknik AB features LabVIEW VIs to use as a complete tool for verification of PIM (Passive InterModulation) performance of filters and antennas. The included soft front panels enable easy lab measurements and the high-level APIs makes custom sequences or fully customized soft front panels easy to make. This complete tool uses the power of NI vector signal transceiver.

Through modern signal processing super high dynamic range (close to 200dB) is achieved with medium range instrumentation and significantly less external hardware. In most cases changing to the GTT solution increases performance of the test system both in speed and dynamic and still more than halves the required hardware investment for the test.

With capabilities for swept PIM, PIM over time and distance to PIM the toolkit is a complete tool for your PIM measurement needs.

The system is built on the LabVIEW 2014 platform.

2 System Requirements

See <http://testteknik.se/content/product> for a list of SW and HW requirements for the product.

3 Installation

Start LabVIEW and VIPM with administrator rights and start the installation of the “GTT PIM toolkit” using VIPM 2014 or newer.

The installed APIs are by default located at:
...\National Instruments\[LabVIEWInstallDir]\vi.lib\GefleTestteknik\FilterAntenna\...

Note: The system supports Windows 7, 64 bit. For other Windows versions please contact sales@testteknik.se for latest status.

3.1 To activate/deactivate a license

The distributed executables and the GTT LabVIEW libraries (*.lvlib) are licensed and have an evaluation period of 30 days and must then be activated for continued use. The license is locked to the computer that is used during installation.

We recommend using GTT licensing toolkit for activation of licenses. The built in activation tool in LabVIEW may also be used. Be aware that licenses activated in LabVIEW versions older than 2014 cannot be transferred at a later date, should it be needed.

To transfer a license it must first be deactivated on the system where it is currently active before activation on the new system. When restoring the computer from a backup image deactivation must be performed before deleting the old system.

A product can be manually activated (i.e. offline) by sending an email to sales@testteknik.se in the following format. NOTE that manually activated licenses cannot be deactivated or transferred:

Company Name:
User Name:
Executable User Code 1:
Executable User Code 2:
LabVIEW Library User Code 1:
LabVIEW Library User Code 2:

For further information refer to the preferred tool for activation.

4 HW Setup

Hardware is not part of this product. The setups presented below are typical setups and shall be seen as examples of use. For complete solutions including hardware please contact sales@testteknik.se for further information.

For measurement systems where only PIM is to be measured the hardware setup is in principal the same for Antenna and filter systems.

For setups where for instance S-parameters are to be measured in the same system please contact GTT (sales@testteknik.se) for further information.

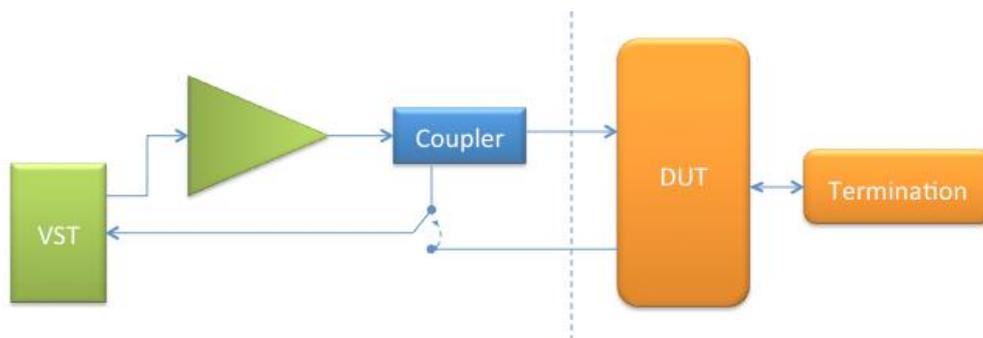


Figure 1 Typical HW setup for filter measurements

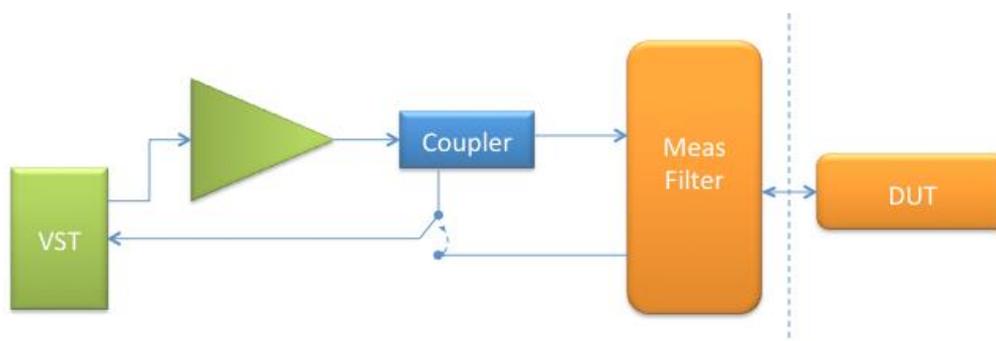


Figure 2 Typical HW setup for antenna measurements

The sample code supplied with the product is made for the above setup. For specific settings and ports refer to chapter 5 Example

5 Example

This chapter shows example of how the code can be used.

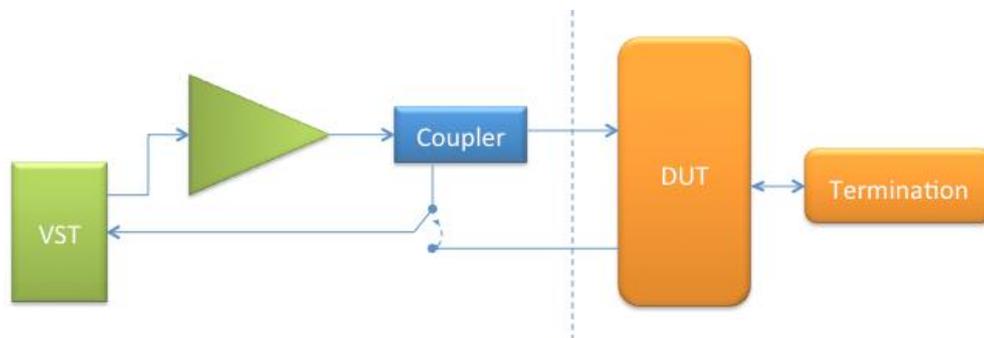
The software can handle any filter configuration and any IM product.

For demo purposes different PIM loads has been used when producing the screen shots below.

Residual and actual performance depends on the hardware used. For more information please contact sales@testteknik.se.

5.1 General HW setup and prerequisites

5.1.1 Normal Test Setup



The example test HW setup consists of the following:

- VST: NI PXIe-5646R
- PA: > 50 dB gain, > 50 dBm output
- Coupler: Coupling factor > 55 dB. The coupling factor needs to be 5-10 dB higher than the amplifier gain
- Solid state RF switch: NI PXIe-2543

Switch Port usage:

- CH1A: Receiver port (RX) on DUT.
- COMA: RFSA Input
- CH2A: Coupler forward port
- CH1B: To Power Amplifier Input
- COMB: RFSG Output
- CH2B: Cal Output

- Termination: Low PIM, > 150 W
- Low PIM RF cable: Between the DUTs antenna (common) port and the termination.
- PIM load (not shown): Used for calibrating a zero distance in the Distance to PIM measurement.

Additional hw used in the example for High Power Calibration:

- Power Sensor: NI USB-5680-01
- 30 dB High power attenuator, >150W.
- Different RF cables and adapters.

In all examples below, except High Power Calibration, the Tone Power input box is the power (in dBm) per tone.

The visible controls on the front panels are a subset of all available API calls possible to perform.

PIM measurements supports any IM-order. The examples are set up for IM3-9 but the API supports any order.

5.1.2 Calibration Setup

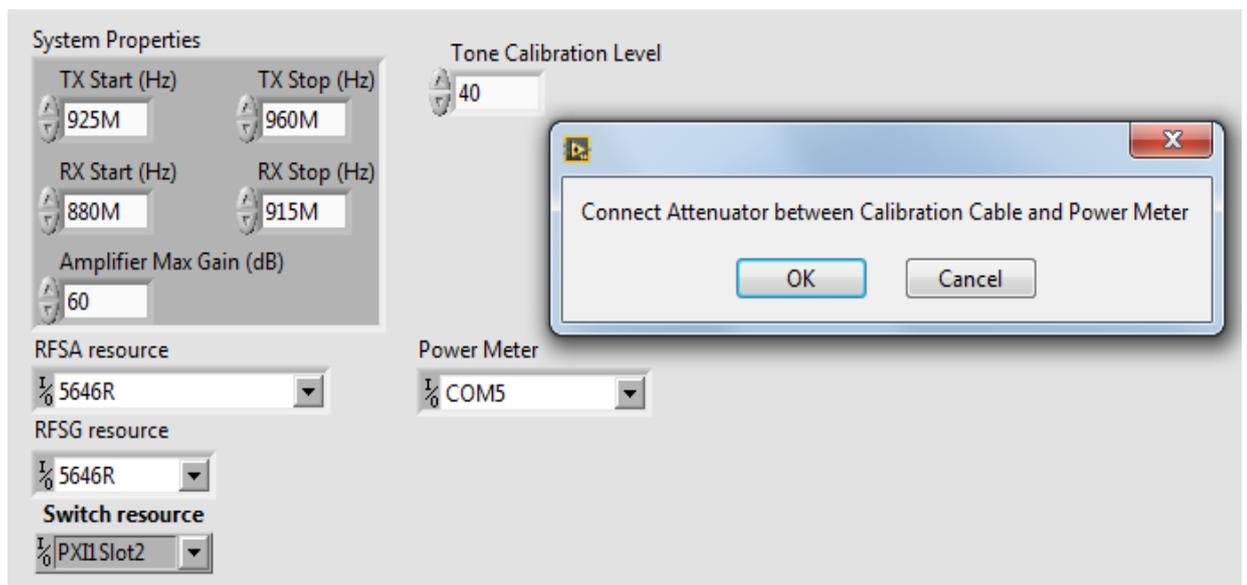
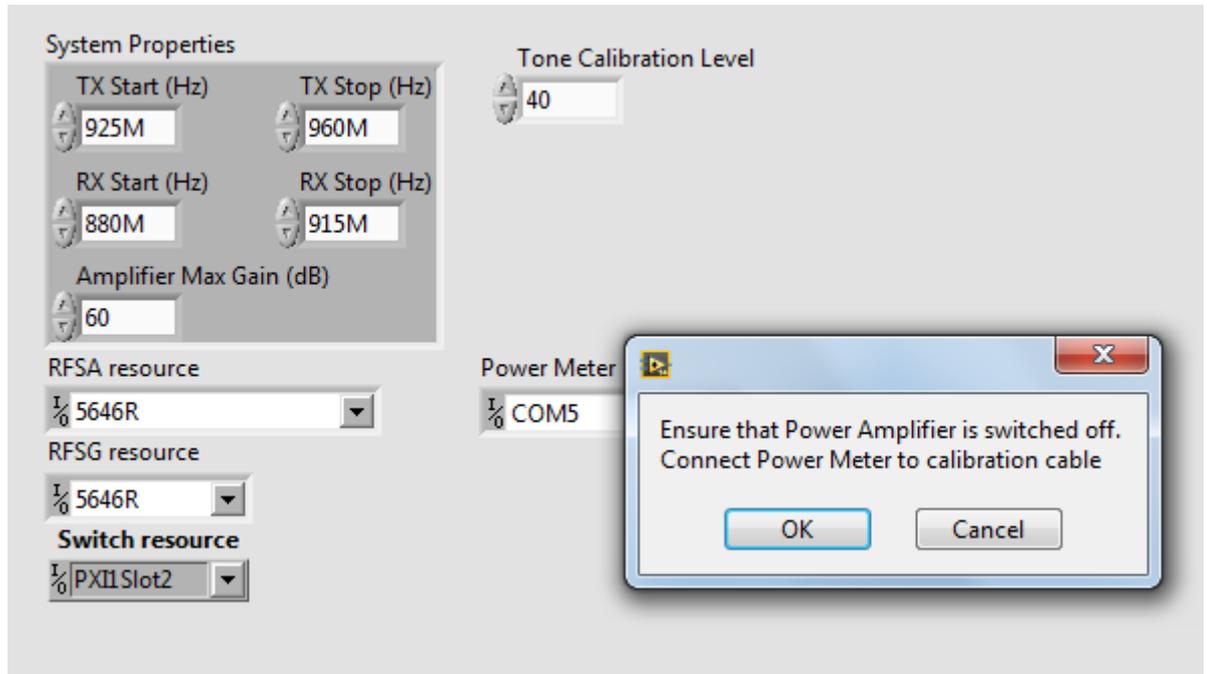
TBD

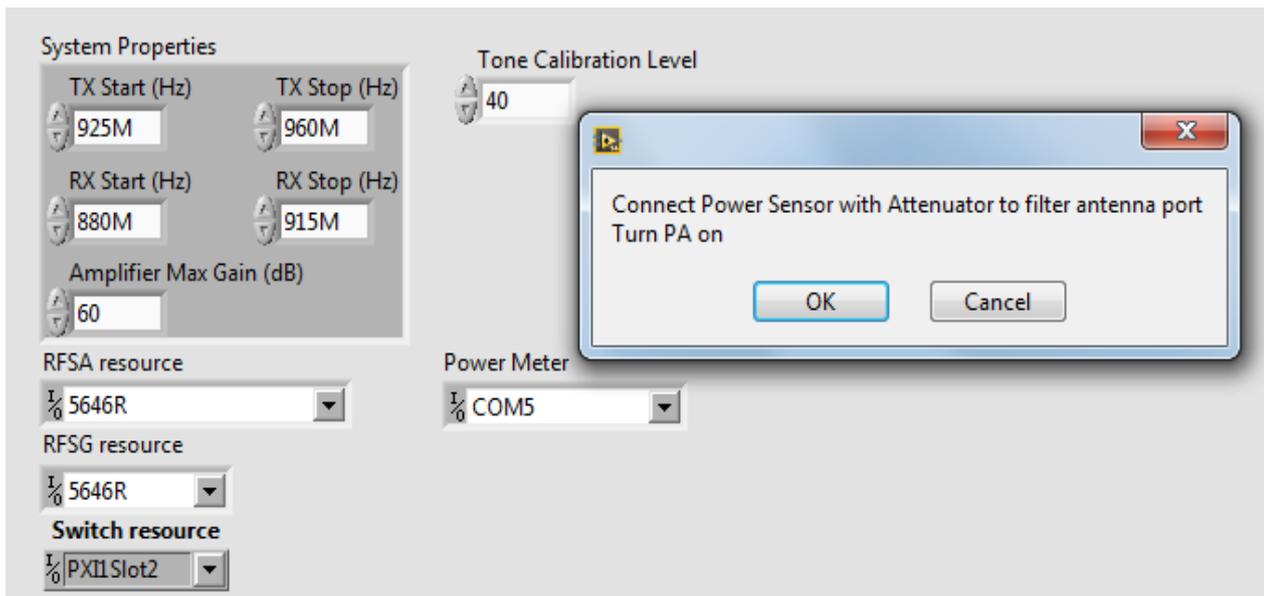
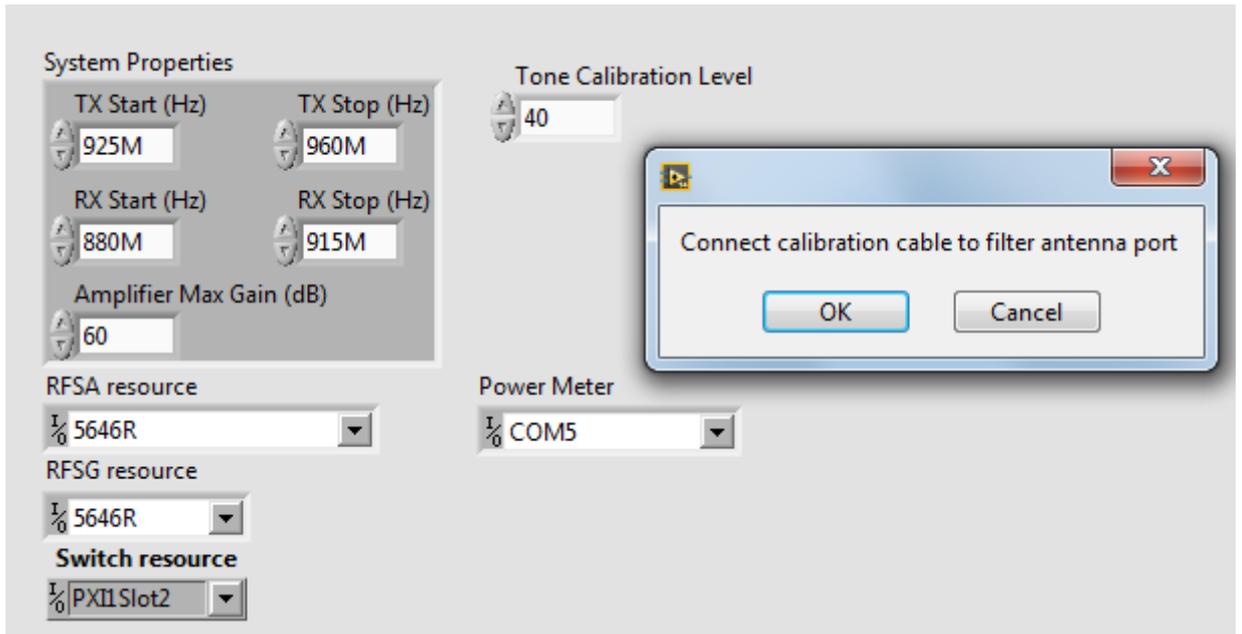
5.2 High Power Calibration

Power calibration data is needed before any of the PIM measurements can begin.

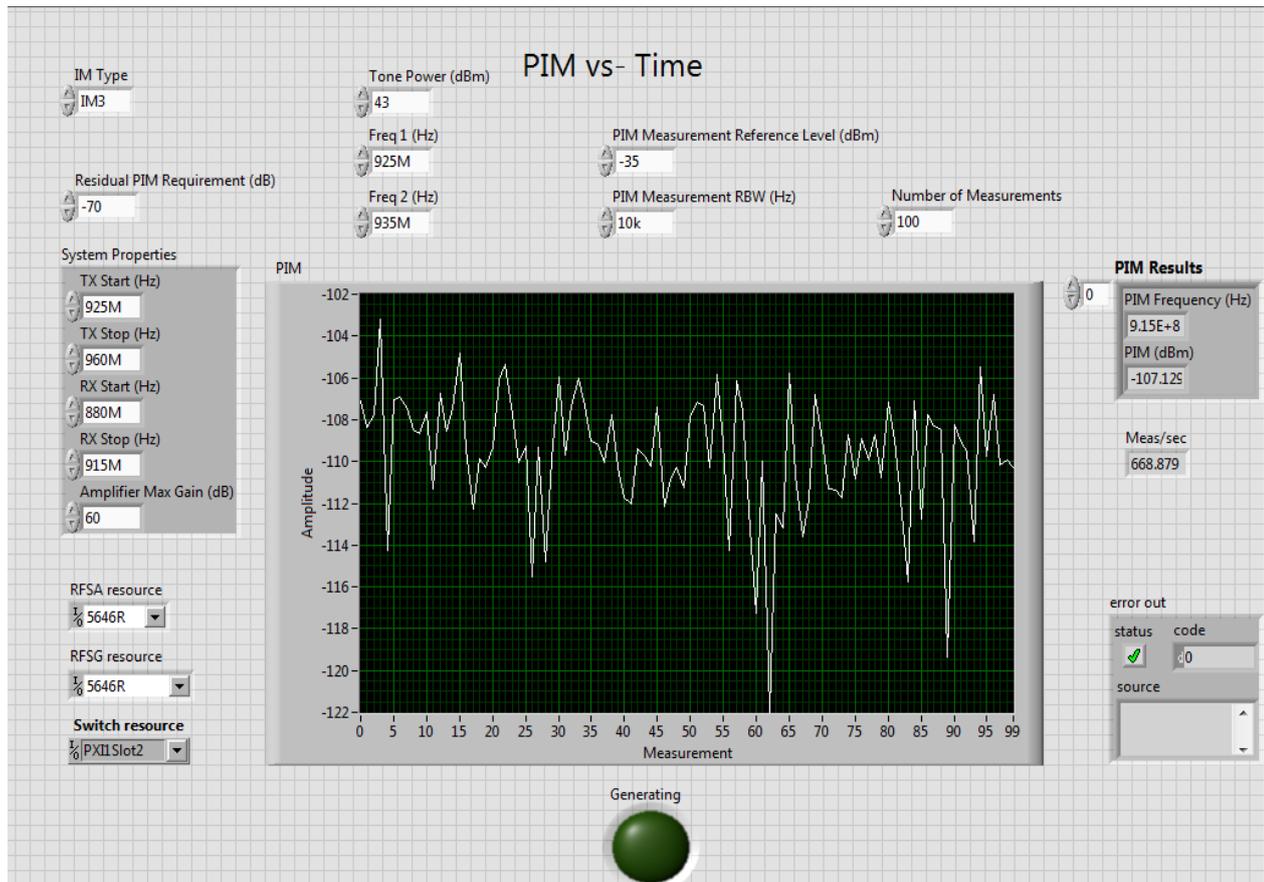
This example provides the user with correctly formatted data on disk which is later used during the actual PIM measurements.

The example generates a single tone (CW) during the calibration.





5.3 PIM over Time



Performs an IM measurement on a fixed IM frequency settable by the user. “Freq1 (Hz)” and “Freq2 (Hz)” are the two IM generating tones. Both tones are fixed in frequency.

The measurement performance is determined by “PIM Measurement Reference Level (dBm)” and “PIM Measurement RBW (Hz)”.

The “PIM Measurement Reference Level (dBm)” is a direct adjustment of the RFSA Reference Level.

The “PIM Result” box is scrollable and shows all performed measurements over time in the present session.

5.4 Distance to PIM

This measurement will use the duplexer and the low PIM RF cable, connected to the antenna (common) port, as a part of the test system.

The end of the low PIM RF cable will become the test port.

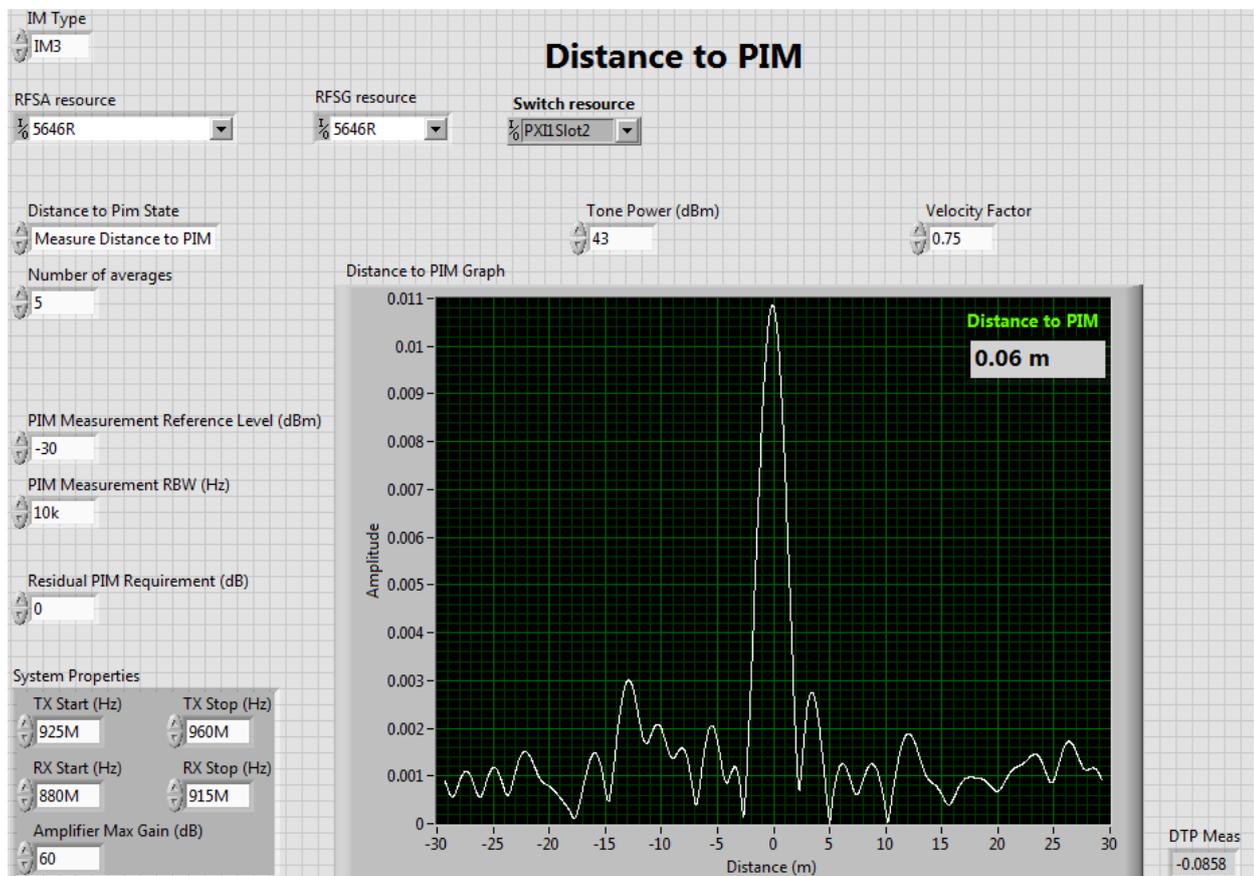
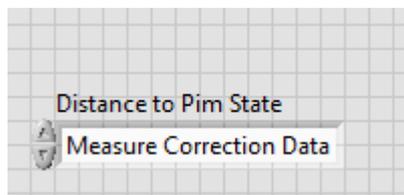
The Distance to PIM measurement is divided in two states; a correction measurement state and a measuring state. The state is chosen in the “Distance to PIM State” box.

The correction measurement must be performed once before a real measurement of a test object can be performed.

5.4.1 Measure Correction Data for Distance to PIM

To set up the correction measurement, choose “Measure correction Data” in the “Distance to PIM State” box.

The velocity factor for RF components between the test port and the test object must be entered. 0.7-0.75 is a normal figure for most high grade RF components.



This picture shows the result after the correction data measurement has been performed.

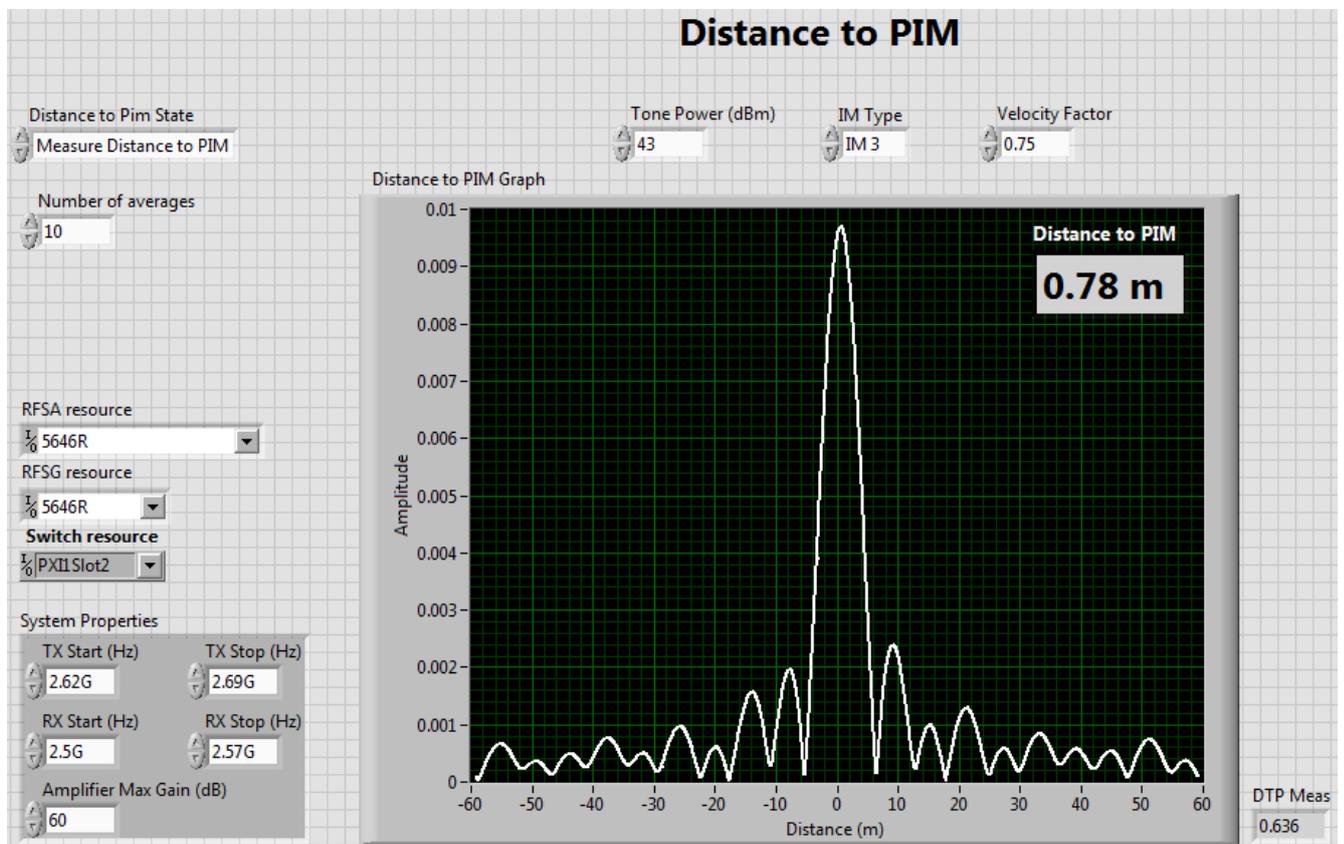
To measure the correction, a PIM load is used. The load will generate a PIM reflection and is in this case inserted between the low PIM RF cable and the PIM termination to create a zero distance reference point.

The zero distance reference point will be at the end of the low PIM RF cable connected to the duplexer's antenna (common) port.

The "System Properties" defines the parameters for the chosen duplexer that is being used in terms of frequency coverage. The "Amplifier Max Gain" is set according to used power amplifier in the HW setup.

5.4.2 Perform a Distance to PIM Measurement

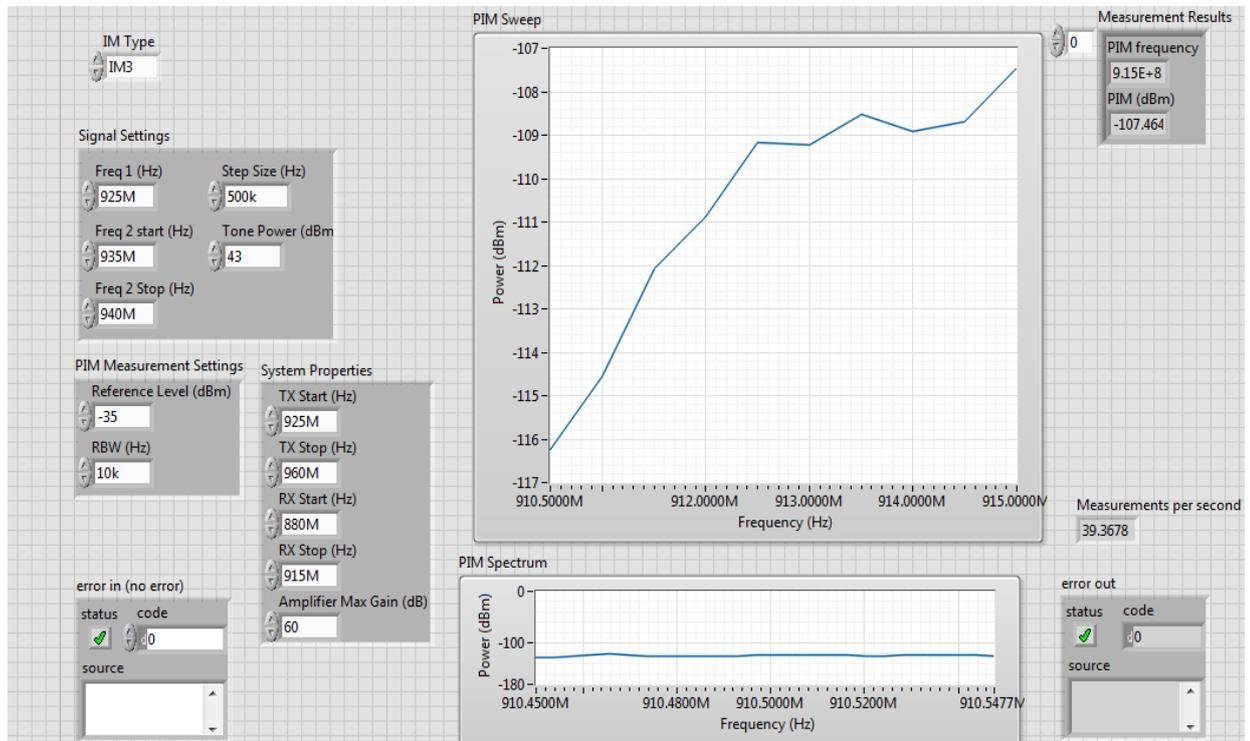
To set up the Distance to PIM measurement, choose "Measure Distance to PIM" in the "Distance to PIM State" box.



The DUT in this case is a normal non PIM specified high power RF terminator, connected via a 75cm RF cable to the test port.

The "Distance to PIM" result in the graph is an average of the results based on the number of measurements stated in "Number of Averages". The DTP Meas output box shows the last measurement of that series.

5.5 PIM over Frequency



In this test the 2nd IM generating tone is moved in frequency within the TX band whilst the 1st IM tone remains fixed.

The number of frequency points and frequency span is determined by “Freq 2 Start (Hz)”, “Freq 2 Stop (Hz)” and “Step Size (Hz)”.

The measurement performance is determined by “PIM Measurement Reference Level (dBm)” and “PIM Measurement RBW (Hz)”.

The “PIM Measurement Reference Level (dBm)” is a direct adjustment of the RFSA Reference Level.

The “PIM Sweep” graph shows the finalized IM measurement over frequency and the “PIM Spectrum” graph shows the actual frequency being measured.

The “PIM Result” box is scrollable and shows all performed IM measurements over frequency in the present session.

6 User Interface (API)

Refer to the context help in the LabVIEW block diagrams for details.