PIM-10 & PIM-30

On-load impedance analysis of DC input power devices

A measurement solution for frequency response or frequency swept Impedance Analysis of DC input power devices

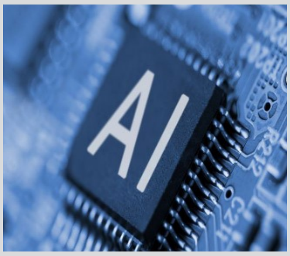
Why is this of interest?

With a constant load, losses within a pure DC system can be derived from DC impedance, which is easy to measure.
In practice however, there will usually be both AC ripple and harmonic frequency components from load step changes, which introduce AC loss components that should be quantified with AC analysis.
Since load change is by definition an on-load condition, it follows that meaningful AC impedance analysis requires an on-load measurement technique.

Who does it apply to?

The increasing use of DC power, from data centres required to meet the growing power demand of AI to telecom centres and avionics, drives a need for power conversion with high power density, increased efficiency and therefore lower losses. It follows, that manufacturers and system integrators need to quantify both DC and AC losses.

Data Centre



AI Processing power

Avionics PSU

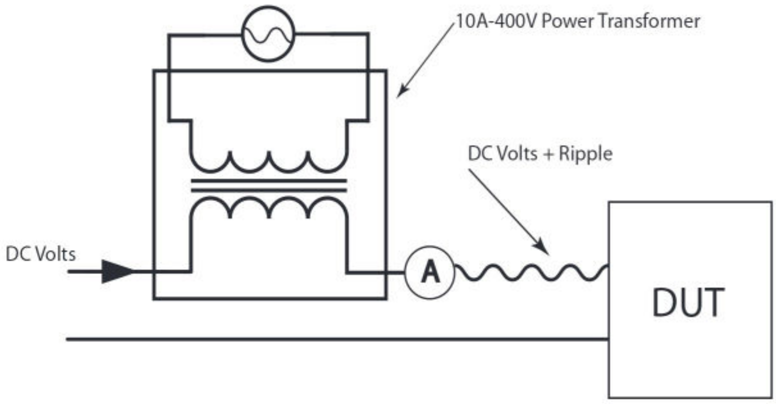
Telecoms power supplies

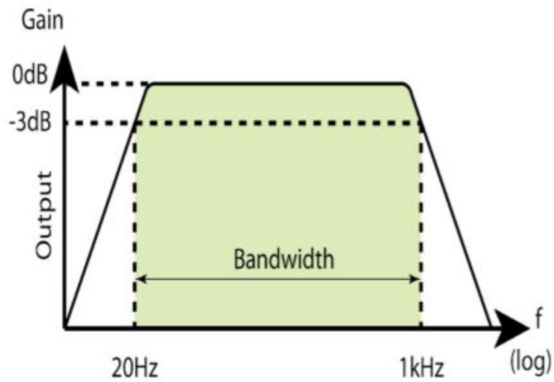
What is the typical measurement solution?

The typical method for achieving efficient design across these sectors via the accurate measurement of input impedance, is traditionally achieved via the injection of a low-level modulated signal sweep, the resulting measurements of phase and gain response are used to determine input impedance, on passive circuit designs.

However, when scaling this method to meet the requirements of on load conditions, alternative methods must be used. Often this results in using galvanostats, large-scale injection transformers, or costly power supplies with electronic loads.

What are the problems or weaknesses of typical solutions?





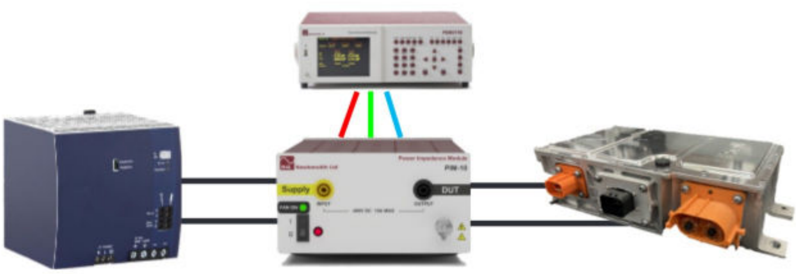
Line current injection transformer issues

- Large
- Non-linear and bandwidth limited
- May influence the frequency response of the system being measured
- Sensitive to phase changes

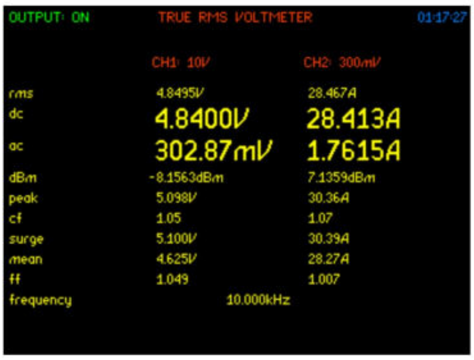
Conventional current shunt issues

- Achieving measurable signal to noise while limiting temperature
- Parasitic inductance become high relative to low resistance
- Limited wideband phase accuracy

The PIM and PSM3750 solution



Typical Test Configuration



Display of measurement channels

How does the PIM-10 & 30 overcome the problems?

The Power Impedance Module (PIM) — a versatile addition to N4L's PSM3750.

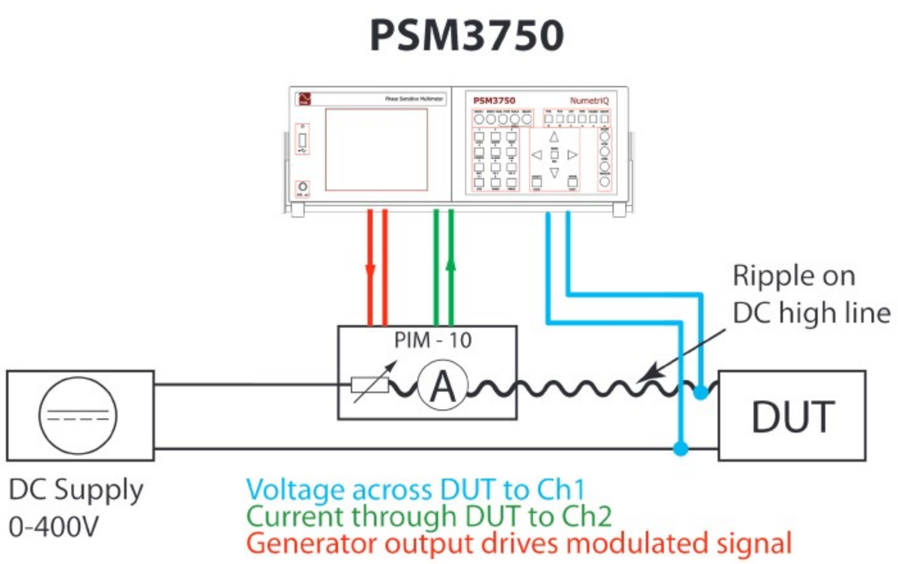
Designed for seamless integration: Both PIM models enable the user to inject small modulations into live DC powered devices up to 400V. When paired with our capable PSMComm2 software package, the PIM significantly broadens the functionality of the PSM3750, enabling enhanced testing capabilities.

How the PIM-10 & 30 Work

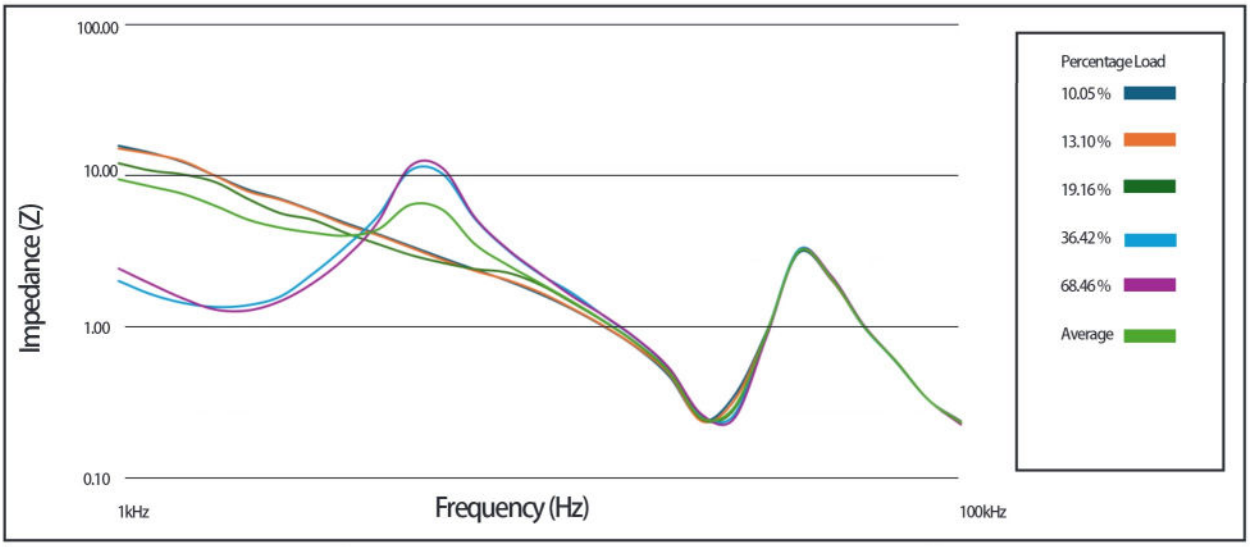
1. Steady-State Measurements: The PIM facilitates a slow frequency sweep of a live circuit, ensuring that the DUT reaches steady-state conditions at each frequency point of interest.

2. Solid State Variable Resistance: The PIM utilizes a solid-state variable resistance, driven by the PSM3750's integral signal generator.
This innovative design allows for dynamic adjustments that enhance measurement precision, when compared to to traditional solutions.

3. Integrated Measurement Channels:
Voltage Measurement: Channel 1 of the PSM3750 measures the voltage across the DUT, capturing both the DC component and the millivolt magnitude ripple superimposed by the PIM.
Current Measurement: Channel 2 measures the current flowing through the DUT using the advanced N4L preparatory shunt technology incorporated in the PIM.



The graph shows typical plots obtained using the PIM-10 to evaluate an 800W 240V, 4.5A DC input 12V DC output PSU. Each line represents the input inpedance values obtained at varying loads from 10% to 68%, plus the average value, sweeping from 1kHz to 100kHz. This type of plot provides the PSU designer with valuable data for filter design within the PSU.



Specification

Input (Specifications in blue are for the PIM-30)		Connectivity	
Maximum Supply Voltage	400VDC	DUT +ve Supply	4mm safety sockets
Maximum Supply Current	10A / 30A	Signal Input	Touch proof safety BNC
Typical Minimum AC Current	0.3A / 0.9A	Shunt Output	Touch proof safety BNC
Maximum Input VA	4kVA / 12kVA	Unit Power Supply (12VDC)	DC Power Jack
Signal Bandwidth	10Hz -100kHz		
Output		Environmental	
Maximum Output	4kVA / 12kVA	Operational Temperature	-5 to +40° C non-condensing
Maximum DUT Voltage	400VDC	Storage Temperature	-10° C to +70° C
Maximum DUT Current	10ADC / 30ADC	Humidity	20 - 95% Relative Humidity non-condensing
		Altitude	2,000 metres
Mechanical		All specifications at 23°C ± 5°C . These specifications are quoted in good faith but Newtons4th Ltd reserves the right to amend any specification at any time without notice.	
Dimensions	85 x 145 x 290mm		
Weight	2kg		

The PIM-10 & 30 are designed to be used specifically with the N4L PSM3750 due to 500V isolation of the input chanels and generator output, with common mode 500Vpk from earth. While the PSM1700 or other FRA's could be used, this would require an isolated injection transformer and differential probes. Use with alternatives would result in a compromise in performance and an increased potential for the operator to be in contact with line voltage levels, which may result in damage to the equipment and personal injury.

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