Empowering Precision for Power Management Validation

Table of Contents

Introduction

Power Management Integrated Circuits (PMICs) play a crucial role in modern electronic devices, regulating power supply to ensure optimal performance and efficiency. However, the validation of these PMICs presents several challenges for engineers and product developers:

01

Instrumentation Mix adds complexity by juggling high power supplies, digital devices, oscilloscopes, and function generators.

02

Variety of PMICs in single SoC for managing 1 to 10+ LDOs, buck converters, boost converters, gate drivers, and switches all in one system.

03

Setup synchronization to ensure pinpoint accuracy in synchronizing multiple instruments for source and capture operations down to nanoseconds.

04

Test setup complexity in handling the intricacies of capturing data from multiple channels on oscilloscopes, synchronizing them, setting triggers, and dealing with transient phenomena.

05

Automation, debugging, and regression for orchestrating hundreds of test cases across numerous samples seamlessly for automation, debugging, and regression analysis.

06

Data storage and analysis for managing gigabytes to terabytes of data collected over weekend tests and performing manual analysis of screen captures.
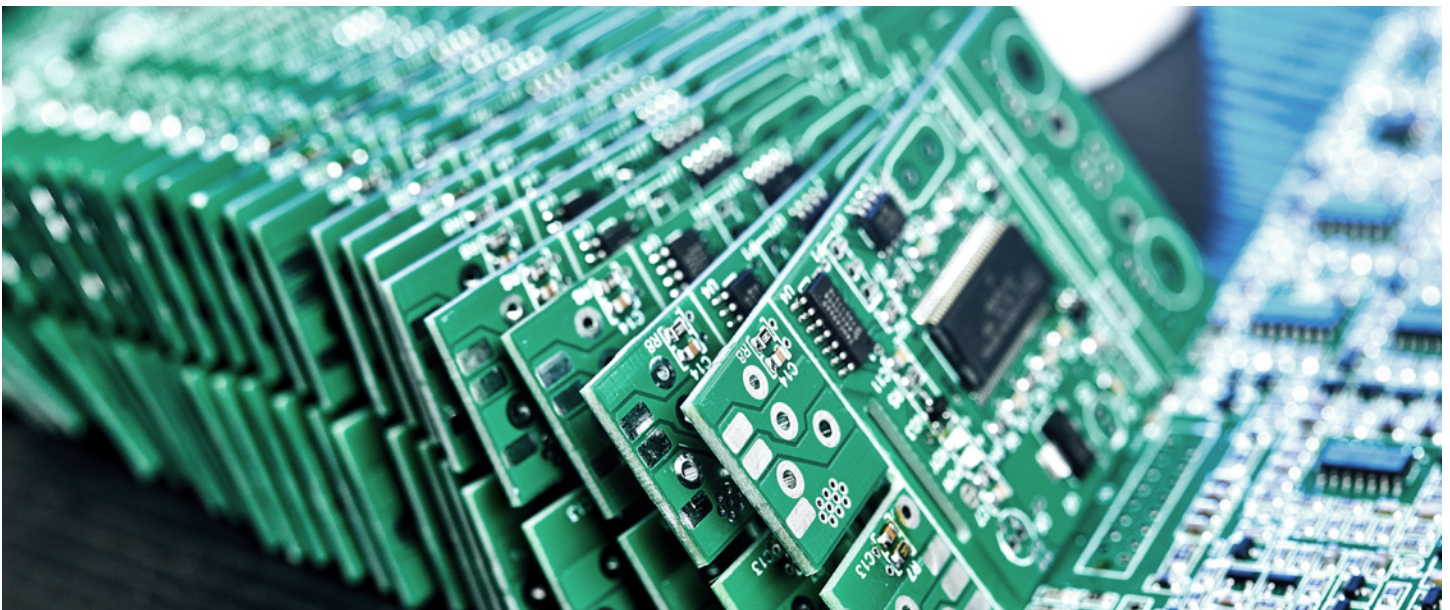
A comprehensive Power Management IC Validation Solution is imperative to address the previously mentioned challenges. Here's why:

01
Efficiency in validation workflows
A well-integrated solution streamlines the validation process, reducing the time engineers spend on software development and hardware integration. This efficiency directly contributes to faster product development cycles.

02
Seamless transition between tasks
The ability to seamlessly transition between interactive tasks (such as bring-up and debug) and automated tasks (validation and characterization) enhances overall workflow flexibility.

03
Configurability and intuitive control
A comprehensive solution, equipped with configurable instrument control through intuitive software interfaces like InstrumentStudio™ software, empowers engineers to tailor their validation setups easily. This adaptability is crucial for addressing the complexity of PMIC functionalities.

04
Automation for time savings
Automation capabilities, such as exporting configuration settings for use with automation frameworks like TestStand or LabVIEW, significantly reduce the validation timeline. This not only accelerates time-to-market but also ensures consistent and reliable results.

05
Reliability through high-performance instrumentation
Leveraging advanced instrumentation, such as PXI Power Supply and PXI Electronic Load Module, along with other high-performance devices, guarantees accurate and reliable validation results. This reliability is crucial for meeting stringent performance standards.

In conclusion, a comprehensive Power Management IC Validation Solution is a strategic investment for overcoming the challenges in PMIC validation. By enhancing efficiency, providing configurability, and ensuring reliability, such a solution contributes directly to achieving shorter time-to-market and consistently reliable results in the dynamic landscape of semiconductor development.

Solution Overview

In the rapidly evolving landscape of electronic devices, the Power Management Integrated Circuit (PMIC) Solution stands as a cornerstone for ensuring optimal performance, energy efficiency, and reliability. This comprehensive solution addresses the intricate challenges associated with PMIC validation, offering a strategic approach for engineers and product developers.

PXIe-4151 300 W Power Supply:
1 channel, 2 PXI slots
Up to 20 V and 25 A (e.g., 20 V, 15 A or 12 V, 25 A)

PXIe-4051 300 W E-load:
1 channel, 3 PXI slots
Up to 60 V and 40 A (e.g., 60 V, 5 A or 7.5 V, 40 A)

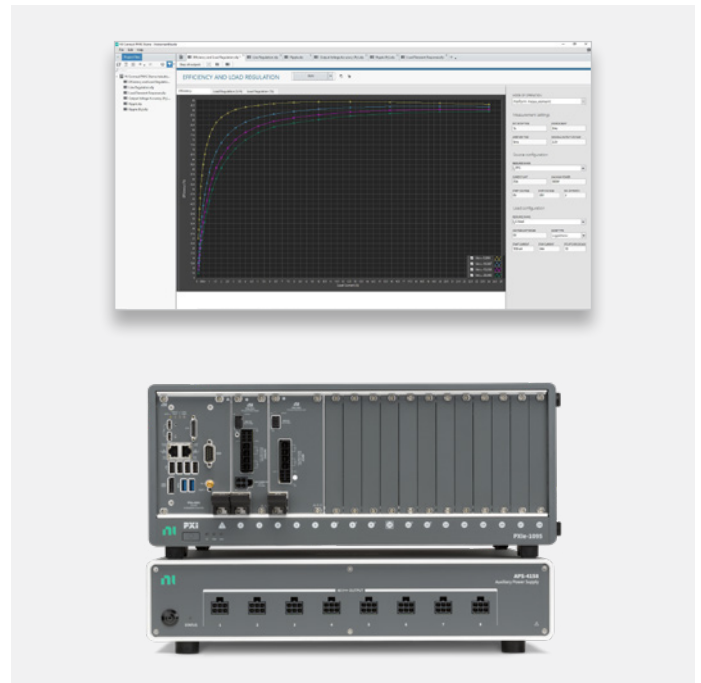| Common Features: |
|---|
| 150 V CAT I isolation |
| Simultaneous I and V measurements |
| DMM-like measurement accuracy |
| 1.8 MS/s sample rate and 100 kS/s update rate |
| Transient response tuning (SourceAdapt) |
| Advanced sequencing (per-step properties) |

FIGURE 1

Example PMIC solution hardware and software configuration. Screen is showing InstrumentStudio visual PMIC device validation results.

KEY FEATURES

Specialized instrumentation on the PXI Platform

Utilizes PXI Power Supply and PXI Electronic Load Module for precise and high-accuracy power measurements. Integrates with PXI waveform generators, source measure units (SMUs), digital multimeters (DMMs), digital instruments, and oscilloscopes for versatile testing capabilities.

Engineering workflows

Facilitates a seamless transition between interactive tasks (bring-up and debug) and automated tasks (validation and characterization). The configurable instrument control through an intuitive InstrumentStudio software panel ensures adaptability to diverse testing scenarios.

Automation capabilities

Accelerates validation processes through configurable instrument control. Features exportable configuration settings for integration with automation frameworks like TestStand or LabVIEW, promoting efficient and repeatable validation workflows.

Engineering Workflows

NI's Power Management IC Validation Solution addresses engineering workflows by providing a flexible and integrated platform. From initial bring-up and debugging to automated validation and characterization, the solution streamlines processes, enhances adaptability, and accelerates overall PMIC development cycles. The combination of specialized instrumentation, automation capabilities, and intuitive control interfaces ensures that engineers can efficiently navigate the challenges inherent in PMIC validation.

	CHALLENGES	NI SOLUTION
01 **Initial Bring-Up and Debugging**	During the initial stages, engineers face the challenge of setting up and debugging PMICs, often requiring a balance between manual interaction and precision testing.	NI's solution includes the intuitive InstrumentStudio software panel for configurable instrument control.
	Debugging intricate functionalities and ensuring correct power regulation can be time-consuming.	Engineers can seamlessly transition between interactive tasks and automated debugging, facilitating a smoother initial bring-up process.
02 **Automated Validation and Characterization**	Automated validation demands precision and repeatability, especially when dealing with intricate PMIC functionalities.	The solution streamlines the validation workflow, offering exportable configuration settings for easy integration with automation frameworks like TestStand or LabVIEW.
	Developing software for automated validation can be time-intensive and may pose integration challenges.	Automation capabilities significantly reduce the time spent on validation processes, ensuring consistent and reliable results.
03 **Workflow Flexibility**	Traditional validation setups may lack flexibility, making it challenging to adapt to evolving PMIC designs and functionalities.	The PXI platform, coupled with NI's solution, provides flexibility in configuring and adapting the validation setup to meet diverse testing scenarios.
	Rigidity in workflows may hinder the quick transition between interactive and automated tasks.	Seamless transitions between interactive tasks and automated processes enhance overall workflow flexibility.

Automation Capabilities

The automation capabilities of NI's Power Management IC Validation Solution empower engineers to expedite the validation process, reduce manual intervention, ensure repeatability, and achieve a higher level of efficiency in PMIC development workflows. Whether through configurable control interfaces, exportable settings, scripting support, or integration with established frameworks, these capabilities contribute to shorter time-to-market and more reliable PMIC validation results.

FIGURE 2

This InstrumentStudio Soft Front Panel in source and sample mode is showing chart voltage and current over time, along with monitor instrument output with debug driver technology.

InstrumentStudio Professional Software

Built to accelerate validation test, InstrumentStudio combines native instrument panels, customizable measurement plug-ins, and in-app automation for a configuration based approach to test.

- Customizable panels for instruments
- Multi-instrument and multi-measurement views
- Run measurement plug-ins (example: power management, signal chain)
- In app sequencing
- Out-of-the-box control for NI instruments
- NI shipping examples
- Automatically detect published plug-ins
- Build repositories
- Develop measurements plug-ins with LabVIEW or python templates
- Copy-paste functionality with TestStand for advanced automation

Programming languages for custom interface: LabVIEW, C/C++, C# .NET, and Python. NI instrument-class driver APIs are consistent across all past and future product variants. InstrumentStudio provides a built-in abstraction layer to prevent unnecessary code revisions when hardware is upgraded/replaced.

FIGURE 3
TestStand Automation Example Shown for Data Capture

TestStand Software

TestStand is a test executive software that accelerates system development and deployment for engineers in validation and production. TestStand automates, accelerates, and standardizes the overall test process across all of your testers with native functionality for:

- Calling and executing tests written in LabVIEW, Python, C/C++, or .NET
- Complex tasks, such as parallel testing, sweeping, looping, and synchronization
- Creating custom operator interfaces and robust tools for deployment and debugging
- Unit tracking, creating automated reports, and storing results to local or network databases

Solution Advantages

01

Precise and Accurate up to 300 W of DC power with precision voltage and current measurements at sample rates up to 1.8 MS/s, ensuring accurate testing.

02

Flexible Measurement Synchronization with PXI's architecture enables seamless coordination across multiple modules or chassis to allow for seamless system expansion.

03

Instrumentation Standardization with PXI offers seamless integration, unmatched accuracy down to nanoseconds, variety of instrumentation, fast data transfer rate, and scalability.

04

Seamlessly transition from bring-up and debug to fully automation by utilizing TestStand and pre-built interface to streamline process, ensuring efficiency and accuracy throughout.

05

Versatile Power Measurement Suite with open-source plug-ins on GitHub for InstrumentStudio Professional, with Python and LabVIEW examples for power management validation.

06

Accelerate Test Time with PXI platform's high-speed data transfer, boasting up to 132 MB/s per slot, enabling swift handling of large datasets for streamlined testing processes.
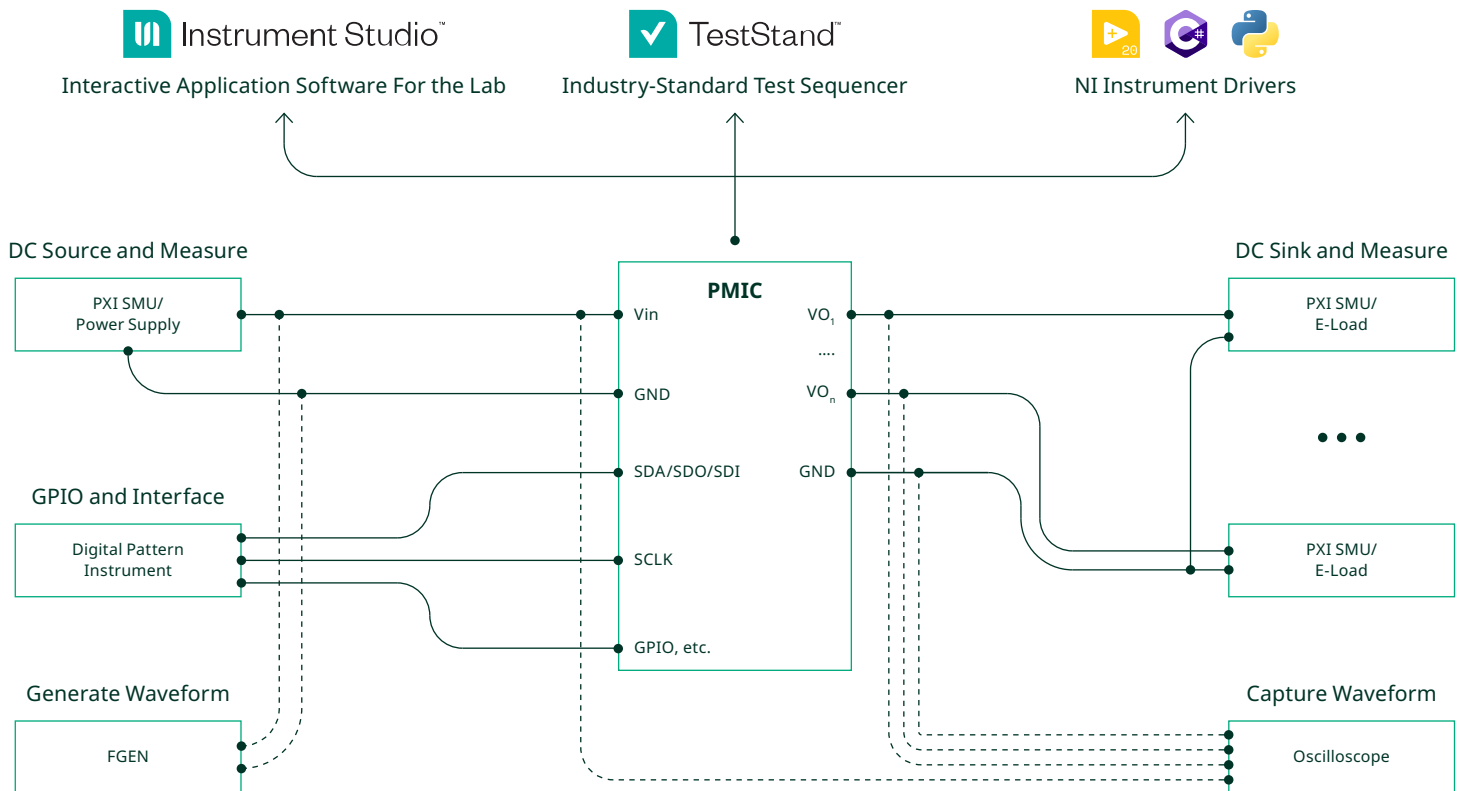

FIGURE 4

PMIC Validation Setup

Testimonials

I couldn't believe the transformation in our PMIC validation process since implementing NI's Power Management IC Validation Solution! The seamless integration into our existing workflows was a game-changer. The configurable instrument control through InstrumentStudio is so intuitive; it feels like the instruments are reading our minds.

The automation capabilities have slashed our validation timelines, allowing us to bring our products to market faster than ever. The exportable configuration settings feature makes automated testing a breeze, and our team has never been more productive. The solution's reliability has given us the confidence that our PMICs will perform consistently in any application.
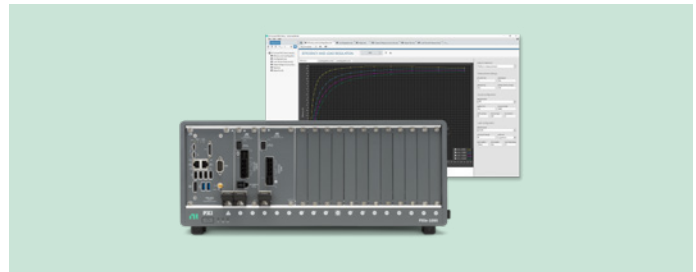
"NI's solution is not just a tool; it's a partner in our success. I highly recommend NI's Power Management IC Validation Solution to any engineering team looking to supercharge their validation process!"

Lead Power Electrical Engineer
Leading Semiconductor Company

Technical Specifications

Due to the detailed and dynamic nature of technical specifications, we encourage you to visit the NI website for the most up-to-date and comprehensive information. The technical specifications for NI's Power Management IC Validation Solution, including instrumentation details, software capabilities, and system requirements, are regularly updated on **NI.com**.

Visit the **NI Power Management IC Validation Solution page** for in-depth technical specifications, including:

- **Instrumentation details**
  Explore the specifications of specialized instruments such as PXI Power Supply, PXI Electronic Load Module, PXI Waveform Generators, PXI Source Measure Units (SMUs), PXI Digital Multimeters (DMMs), PXI Digital Instruments, and PXI Oscilloscopes.

- **Software capabilities**
  Learn about the features and capabilities of InstrumentStudio, TestStand integration, and other software components that enhance the configurability and automation of the validation solution.

- **System requirements**
  Understand the system requirements for implementing NI's Power Management IC Validation Solution, including hardware and software compatibility.

- **Additional resources**
  Access white papers, application notes, and documentation that provide detailed insights into the technical aspects of the solution.

Example Configurations

For more information, reach out to your local sales representative or **contact us directly**.

Example PMIC 1 Bundle
PXIe-8881 Controller x1
PXIe-1092 Chassis x1
PXIe-4151 PPS x1
PXIe-4051 E-load x1
APS-4158 Aux Power Supply x1
Aux Cable for APS-415x x1
Power Cord, AC, U.S, 120 VAC, 2.3 meters x2

Example PMIC 2 Bundle
PXIe-8881 Controller x1
PXIe-1095 Chassis x1
PXIe-4151 PPS x3
PXIe-4051 E-load x3
APS-4159 Aux Power Supply x1
Aux Cable for APS-415x x3
Power Cord, AC, U.S, 120 VAC, 2.3 meters x2

Example Optional Add-Ons
PXIe-5162 Scope 4-channel x1
PXIe-4081 DMM x1
PXIe-6571 Digital Pattern Instrument (DPI) (8 channel) x1
PXIe-6571 DPI (32 channel) x1
PXIe-5444 FGEN x1

Recommended Software and Drivers
InstrumentStudio Professional
DC-Power driver (for use with the PPS and E-load)
LabVIEW (for user-defined tests and to pull into TestStand)
InstrumentStudio (for interactive measurements)
TestStand (for automation)
NI-Digital (optional when using DPI)
NI-Scope (optional when using a scope)
NI-DMM (optional when using a DMM)
NI-FGEN (optional when using an FGEN)
Python (optional for users who want to use Python API of DCPower Driver)

How to Get Started

To delve into the intricacies of high-power DC-DC converter measurements using the NI PXI System, access the dedicated **High-Power DC-DC Converter Measurements Using the NI PXI System** application note. Upon finding the application note, you can download it or follow the provided instructions to gain valuable insights into effectively conducting measurements with high-power DC-DC converters using the NI PXI System.

System Integration on Your Terms

NI offers a variety of solution integration options customized to your application-specific requirements. You can use your own internal integration teams for full system control or leverage the expertise of our worldwide network of NI Partners to obtain a turnkey system.

Contact your account manager or call or email us to learn more about how NI can help you increase product quality and accelerate test timelines at (888) 280-7645 or **info@ni.com**.

NI Services and Support

Consulting and Integration

Global Support

Turnkey Solution Delivery and Support

Prototyping and Feasibility Analysis

Repair and Calibration

Training and Certification

ni.com