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ENGINEER NEXT


NATIONAL
INSTRUMENTS™

Accelerating Mixed Signal Functional Tests using NI Source Measure Units & Digital Pattern Instruments

Archan Mudwel

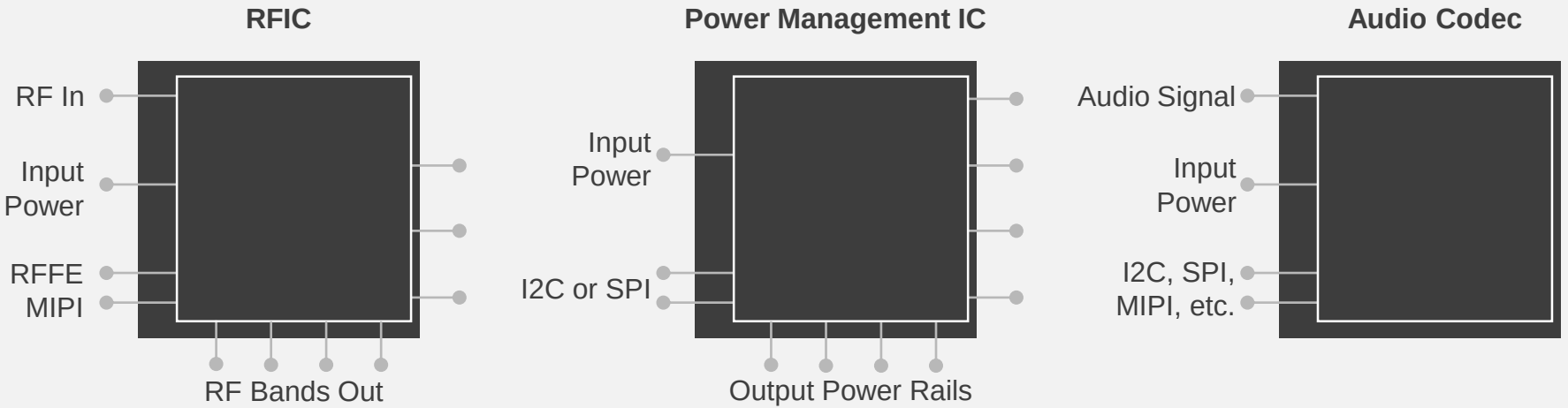
Technical Marketing Engineer

Optimizing Test Execution is a Competitive Advantage

"Some ASIC manufacturers report that testing time consumes 40-50% of the entire IC product development cycle."

Source: IC Insights, McClean Report 2015

Why Focus on Source Measure Units and Digital Instruments?



Key Innovations for Semiconductor Test

NI Vector Signal Transceiver (VST)

- FPGA-based servoing for measurement acceleration
- Up to 1 GHz instantaneous bandwidth for wide range of wireless technologies
- R&D-grade measurement performance with up to -50 dB EVM for 802.11ax

NI Source Measure Units (SMUs)

- Broad IV range: 200V(20W), 3A
- (10A pulse)
- Current resolution to 10fA
- Max sampling to 1.8MS/s
- SourceAdapt™ Technology for fast settling in presence of capacitive loads
- Best in class channel density

NI Digital Pattern Instrument

- ATE-class digital (with PPMU) in PXI
- Out of the box Digital Pattern Editor software
- Time sets, drive formats, opcodes, HRAM, Source and capture, history RAM, Shmoo

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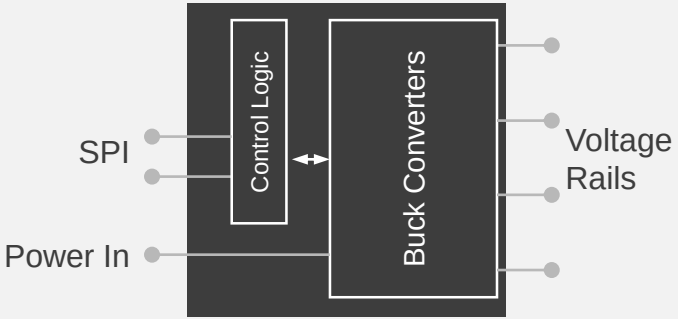
Digital Instruments

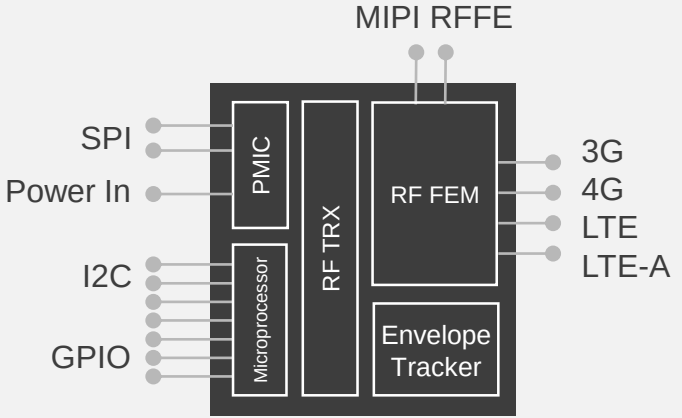
Evolution of Single-Silicon Packages to Modules



Single-Function Packaged Part

Simple Digital Interface

Limited Edge Placement Needs



Application-Specific Module

Correlated Signal Inputs and Outputs

Multiple Buses and Interface Types

Complex Edge Placement Requirements

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ATE Not Designed to Serve Validation

- Too expensive
- Custom cooling
- High power connections
- Designated space in labs
- I/O options are fixed and aging
- Renting ATE from other groups
- Trying to partner overseas to use production ATE
- Lack of ATE availability limits test productivity

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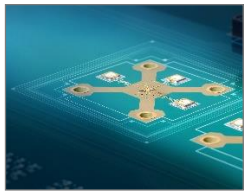
PXI Digital Pattern Instrument

PXIe-6570 Digital Pattern Instrument

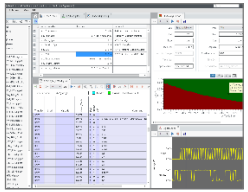
Built for Test of Semiconductor Devices

- RFICs and Transceivers
- Power Management ICs
- MEMS
- IoT Devices with Integrated MCUs and Sensors



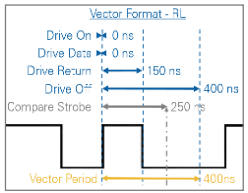
ATE Development and Debug Features

- Source and Capture Memory
- History RAM, Digital Scope, Pin View, and System View
- Shmoo Plots



ATE Test Capability

- Time Sets and Edge Placement
- Opcodes
- Multi-site Support
- Integrated Per-Pin PPMU Access
- Up to 256 Synchronized Channels



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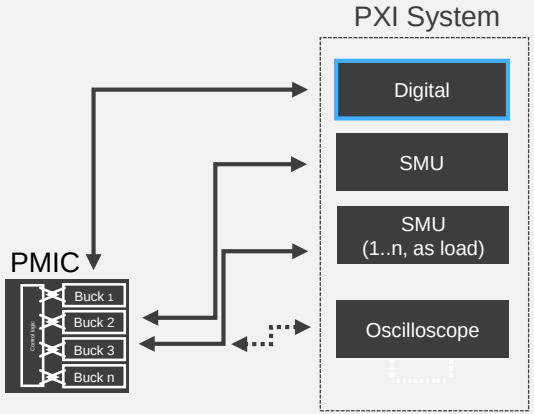
Digital: ATE-Class Instruments and Tools

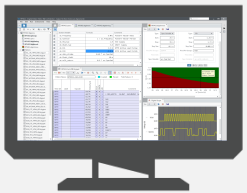
- DUT-centric paradigm: pin map assigns instrument pins to DUT pins
- Extensive test capability: timing sets, debugging tools, shmoo plotting, IV measurements
- Instrument integration: Multi-module and cross-instrument logical execution op-codes

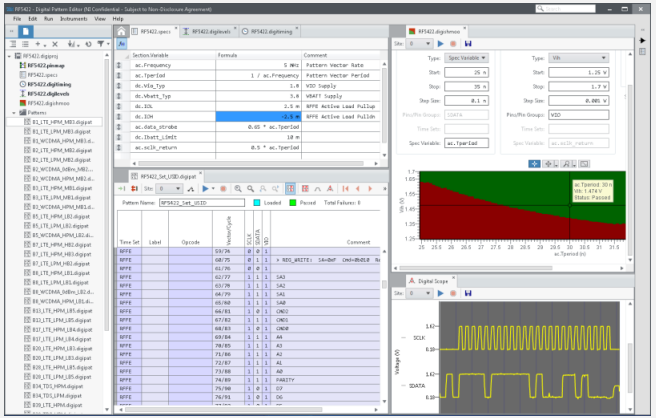
Why it matters

- ATE-class digital test instruments throughout test phases
- Consistency paves the way for code reuse and correlation with production ATEs



NI Digital Pattern Editor



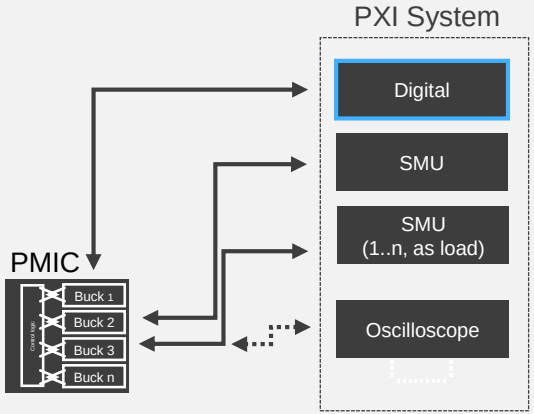


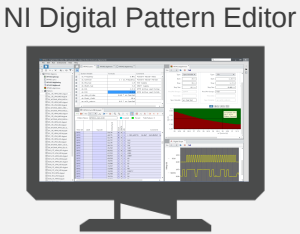
Digital: Consistent Terminology with ATE

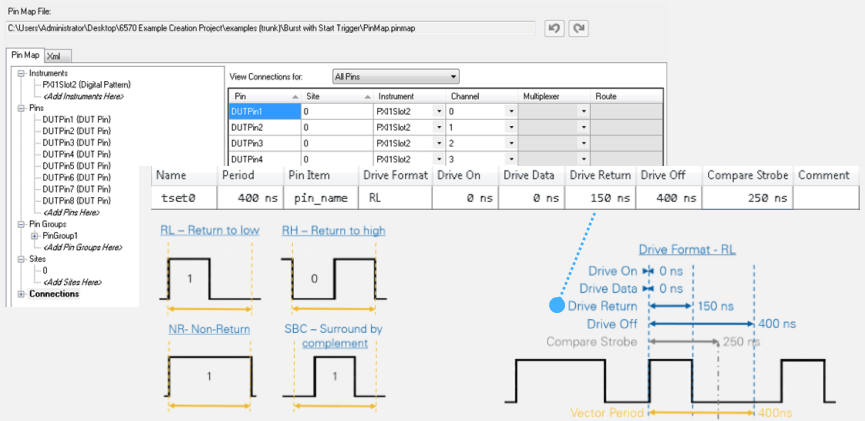
- DUT centric programming by pin
- Timing sets with cycle-to-cycle edge placement and drive formats
- Pin electronics for edge placement and IV measurements

Why it matters

- Paradigm consistency paves the way for reuse (patterns, code modules) and easier correlation with production ATEs





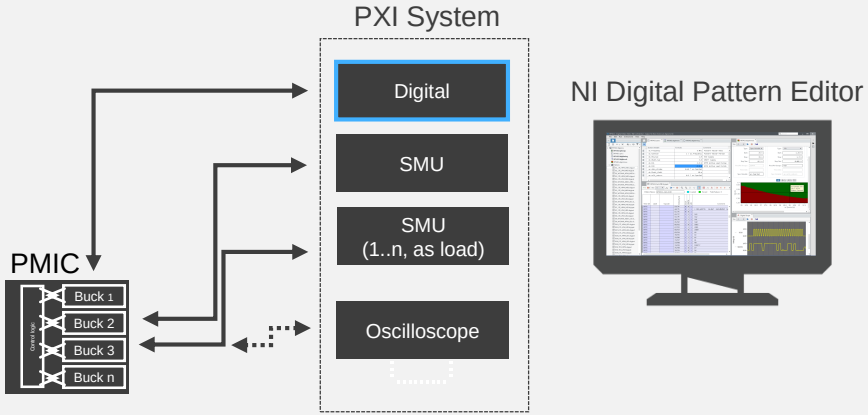


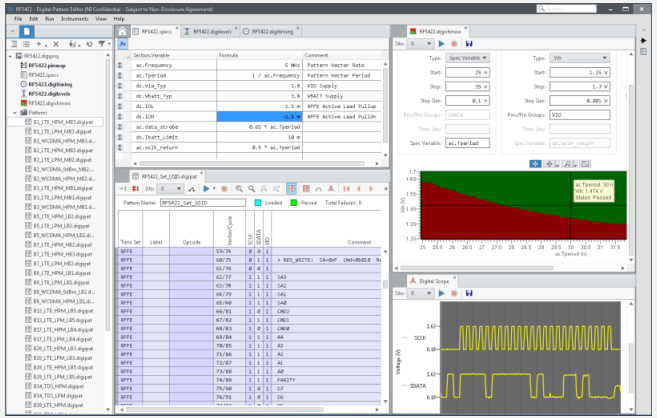
Digital: Pattern Editor Software

- Create, Edit, and Import Digital Test Patterns
- Debug tools like History RAM and Digital Scope
- Shmoo plotting for margining and characterization

Why it matters

- Out-of-the-box functionality to import/create, debug and burst patterns
- Go from configuration to test faster with out-of-the-box application software



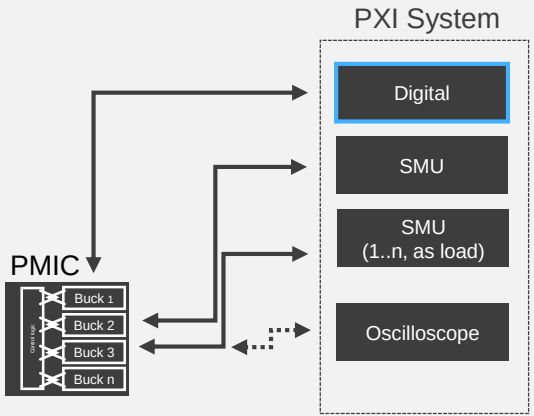


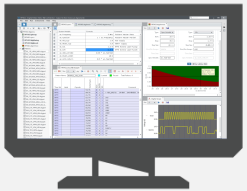
Digital: Test System Integration

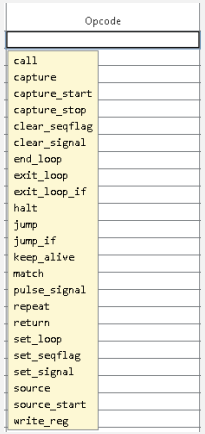
- Logical operations within patterns like looping, jumping, and matching
- Multi-module, cross-module, and cross-instrument operations

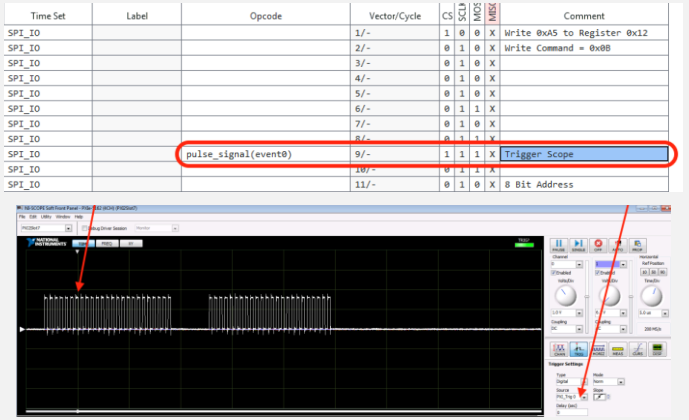
Why it matters

- Flexible execution of patterns including dynamic source and capture memory operations
- Integrated measurement capability of all instruments within a digital pattern









PXI Digital Pattern Instrument

PXIe-6570 Digital Pattern Instrument

NI Semiconductor Test System (STS)

Pin Electronics	DCL: -2V to +6V, 32 mA PPMU: -2V to +6V, 32 mA Active load: 24 mA
Channels	32, in 2 PXI Express Slots
Vector Rate	100 MHz (10 ns vector period)
Pattern Timing	31 Timing Sets, Edge Placement Resolution 39.0625 ps
Pattern Formats	Non-Return, Return to Low, Return to High (100 MHz max) Surround By Complement (50 MHz max)
Vector Memory Depth	128 M/Channel
Opcode Functionality	Flow Control, Sequencer Flags and Registers, Signal, Source and Capture, Subroutine
Source and Capture Engines	4 each, 1 M/channel, Included with Product, Not Separately Licensed
SCAN Support	Flattened SCAN Patterns, up to 128 M
Operating System Support	Windows 7, 64-bit; Windows 10, 64-bit

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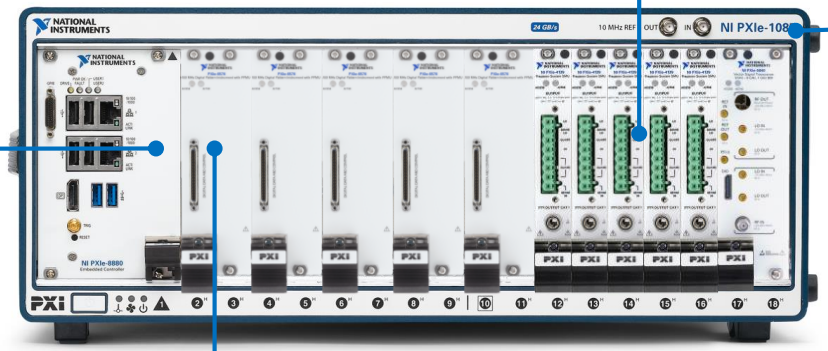
A Modular Approach to Digital Test



Synchronized PXI Instruments

- Expand Digital Count to Up to 256 Channels per PXI System
- Sub-Nanosecond Synchronization with other PXI Modules
- Full Suite of Instruments from DC to mmWave

PXIe-8880 Controller

- Intel Xeon 8 Core Processor (2.3 GHz)
- 24 GB/s System Bandwidth
- Up to 24 GB DDR4 1866 MHz RAM
- Gen 3 PCIe Express Technology

PXIe-6570 Digital Pattern Instrument

- 32 Channels per Module
- Up to 256 Synchronized Channels
- 31 Timing Sets
- 100 MHz Vector Rate
- 128 M Vector Memory

PXIe-1085 Chassis

- 18 PXI Express slots
- Up to 24 GB/s System Bandwidth
- Peer-to-Peer Data Streaming
- 10 MHz OCXO
- Gen 3 PCIe Express Technology

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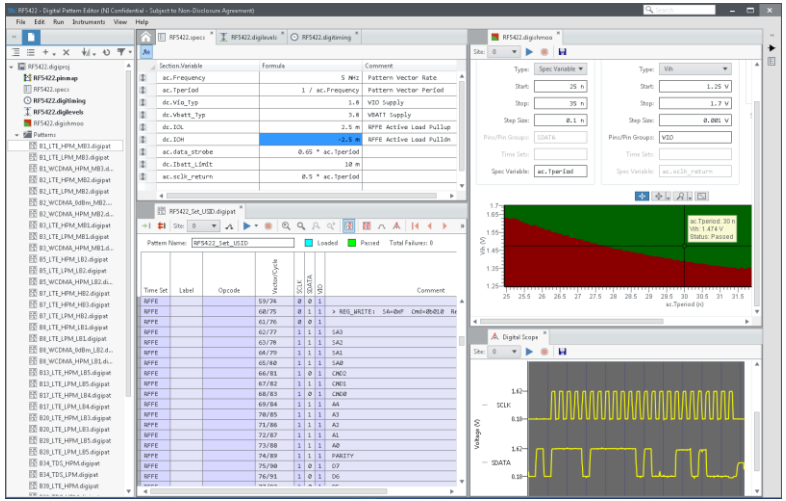
NI Digital Pattern Editor



Developing, Editing, or Importing Digital Patterns

Pin and Channel Map
Specifications, Timing, Levels, and Pattern Files
Standard ASCII Format for Pattern Files

Debugging Tools for Digital Tests

History RAM Overlay and Viewer
Pin and System Views
Digital Scope

Shmoo Plot Tool

Sweep Specifications, Timing, and Voltage Levels
Sweep Multiple Sites in Parallel

Integration with TestStand Semiconductor Module

STDF Reports, Binning, Handler Integration
Add Break Points in Code to Debug

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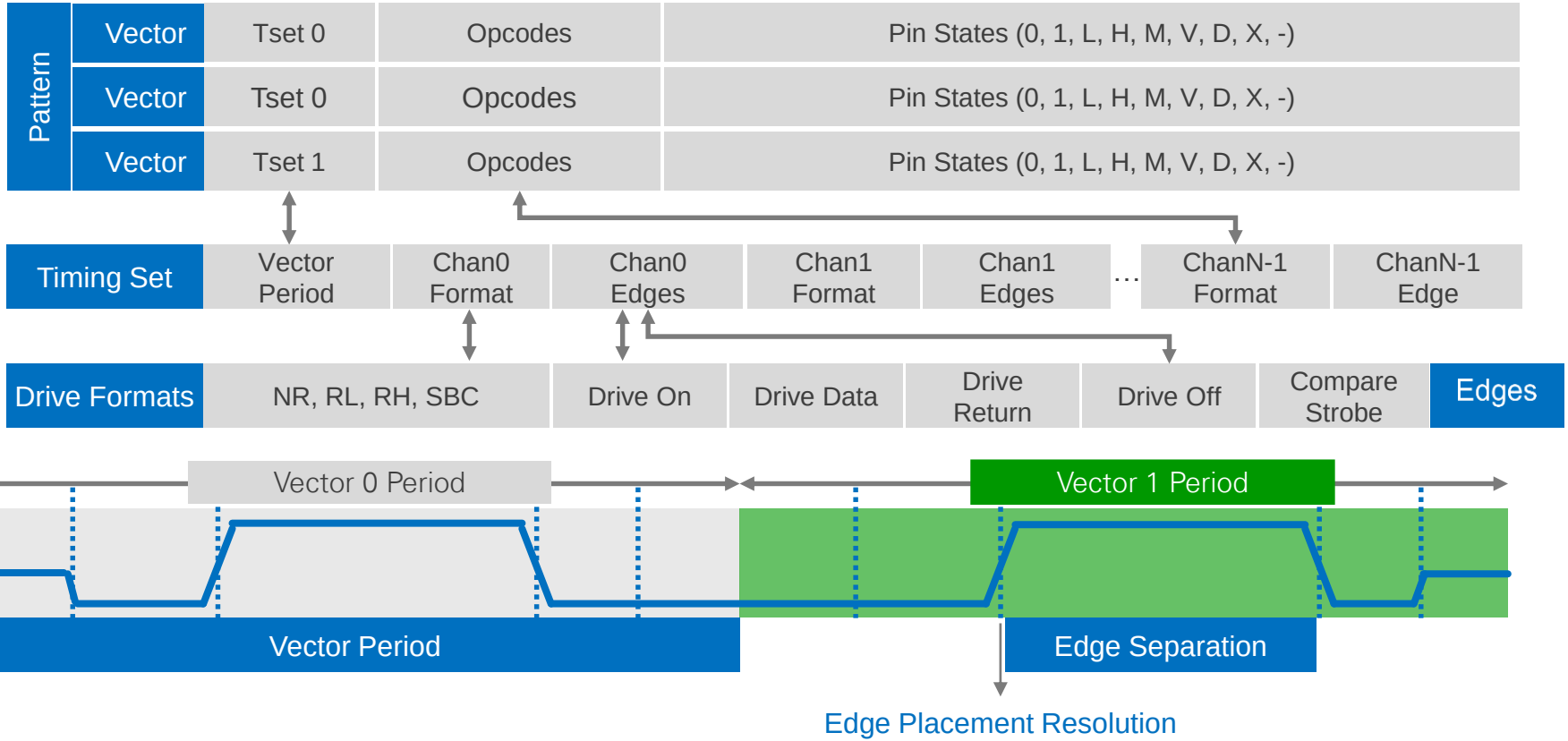
Semiconductor ATE Digital



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Source Measure Units

Functionality of Source Measure Units

DC VOLTAGE SOURCE

DC CURRENT SOURCE

PULSE GENERATOR

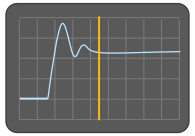
WAVEFORM GENERATOR

VOLTMETER

AMMETER

OHMMETER

ISOLATED DIGITIZER



PROGRAMMABLE LOAD

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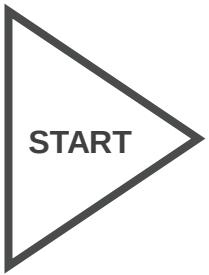
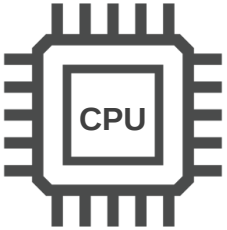
SMU Measurement Flow





TRIGGER → SOURCE → MEASURE → PROCESS

You can take high precision measurements quickly

Removing small inefficiencies in timing can reduce your cost of test

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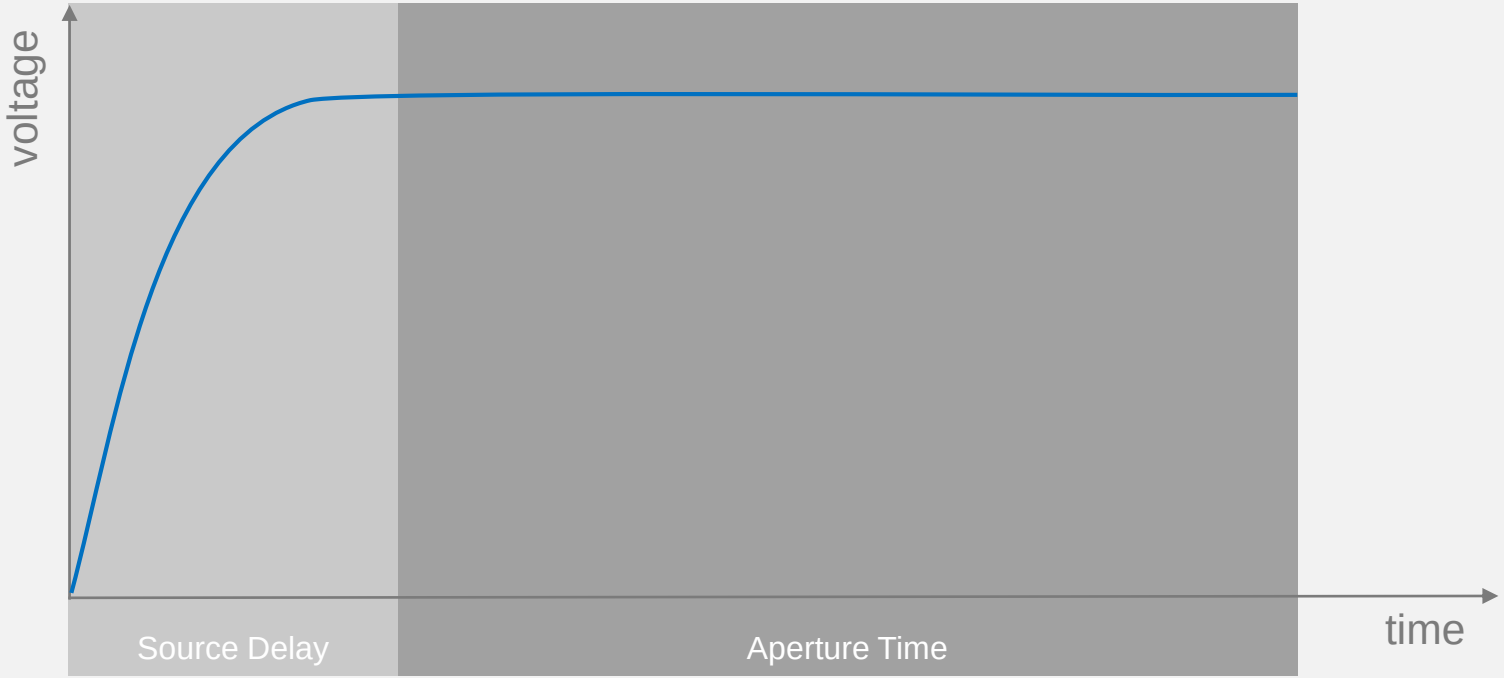
Measurement Cycle



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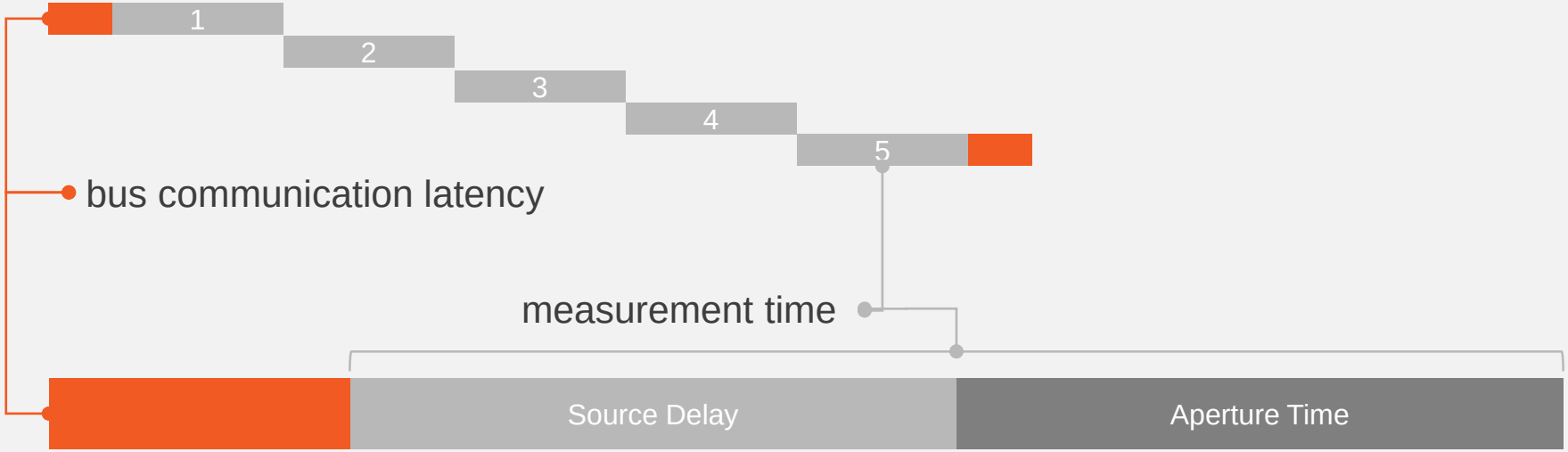
Measurement vs. Overhead



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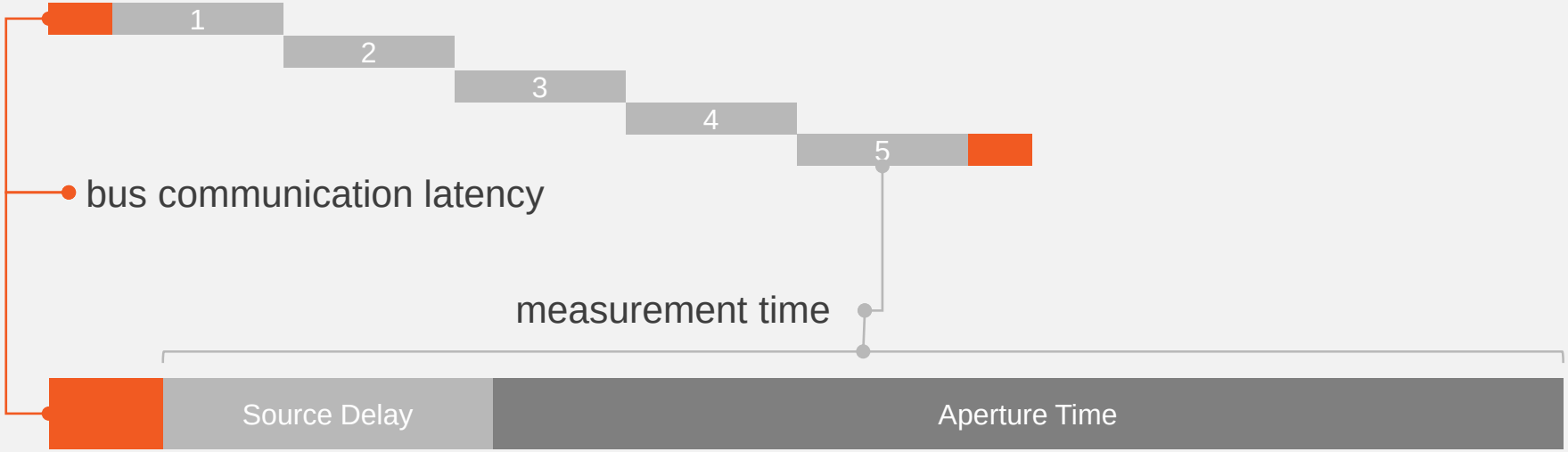

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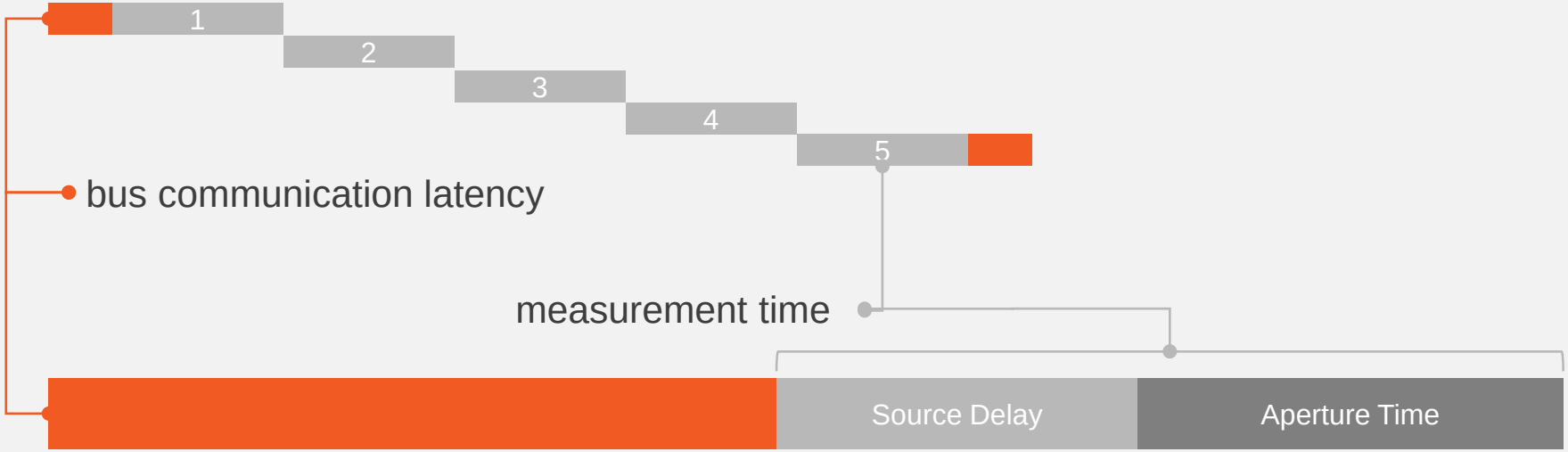

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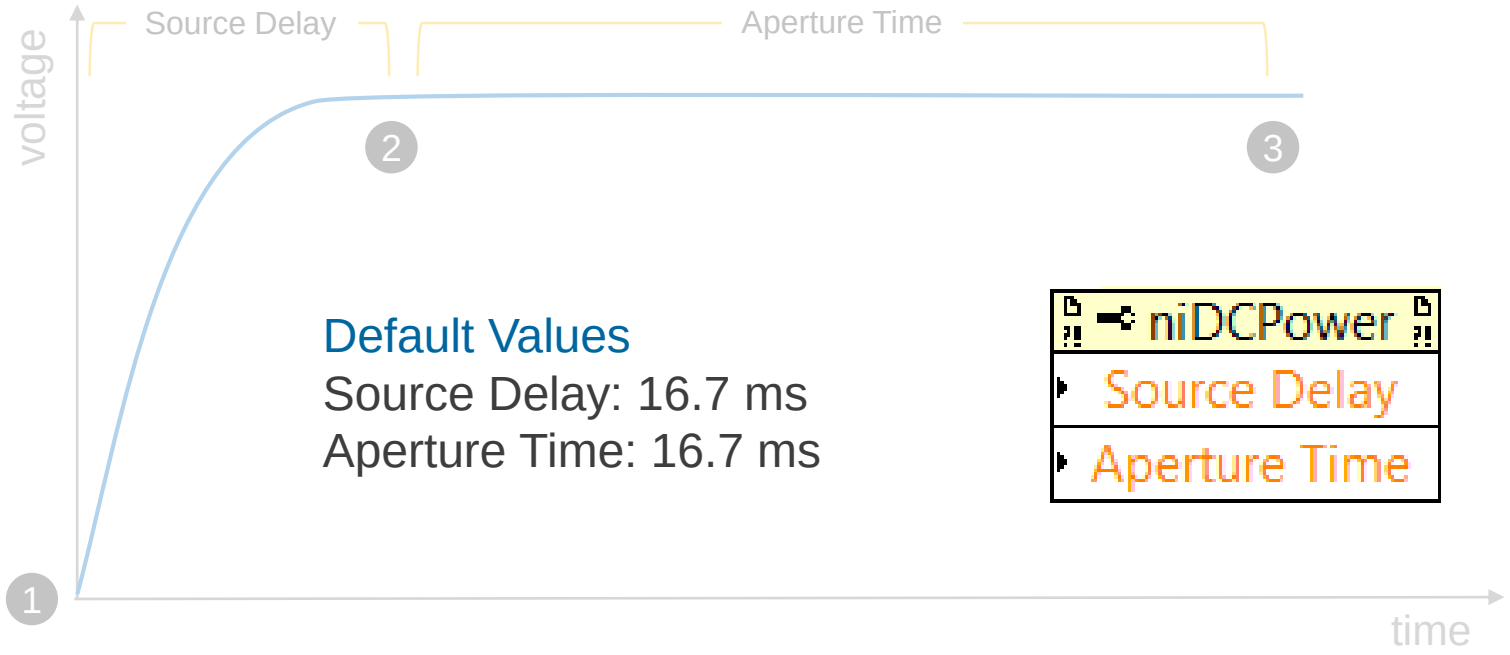
Source and Measure Cycle



Default Values

Source Delay: 16.7 ms

Aperture Time: 16.7 ms

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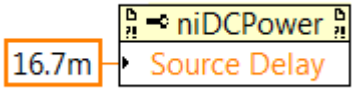
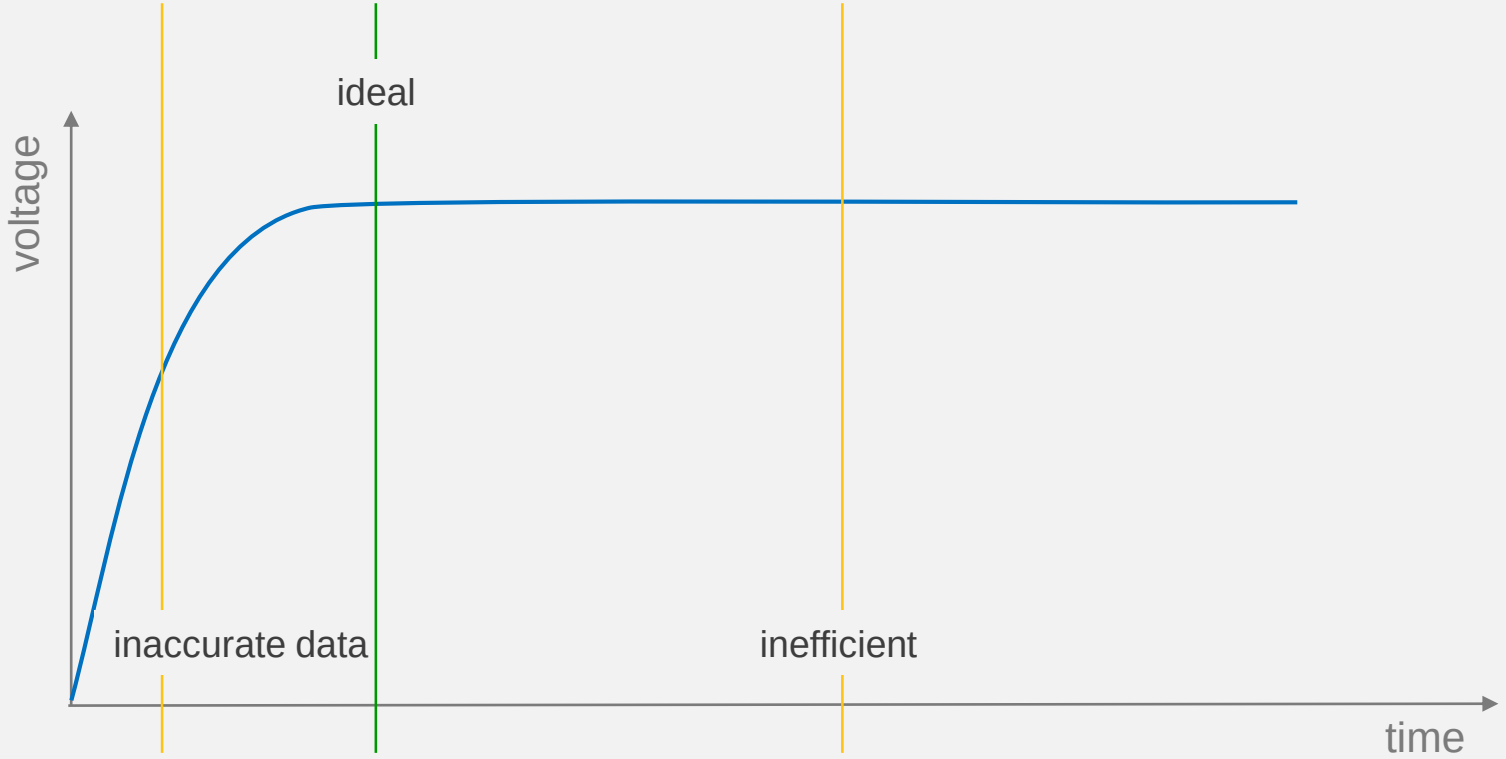
Source Delay





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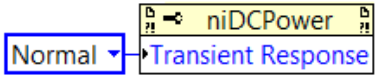
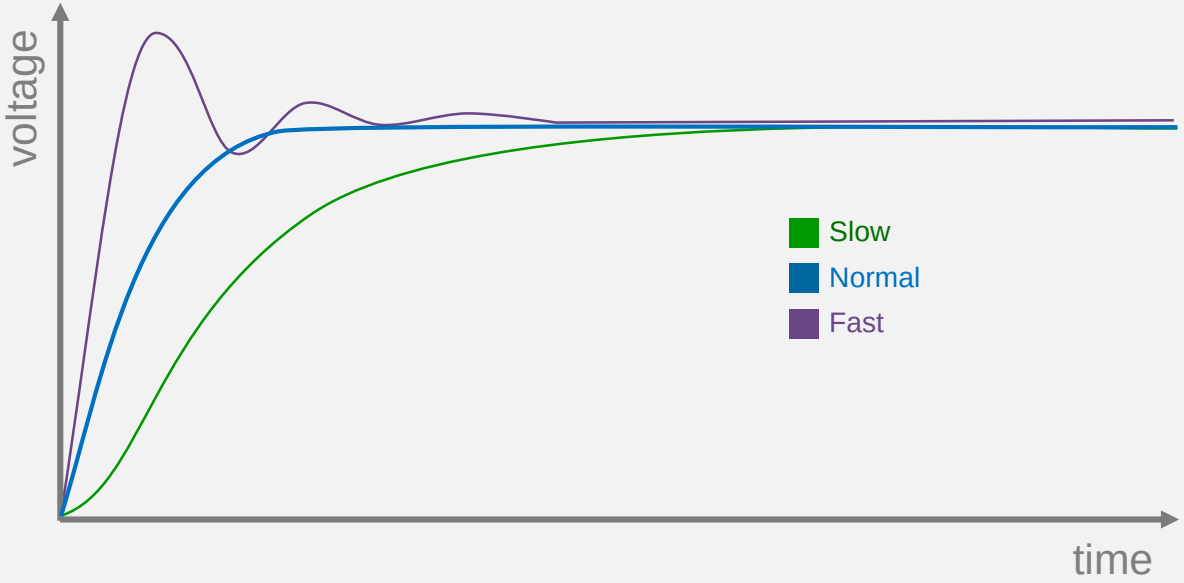
Optimizing Source Delay





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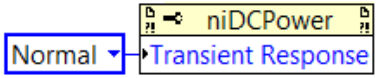
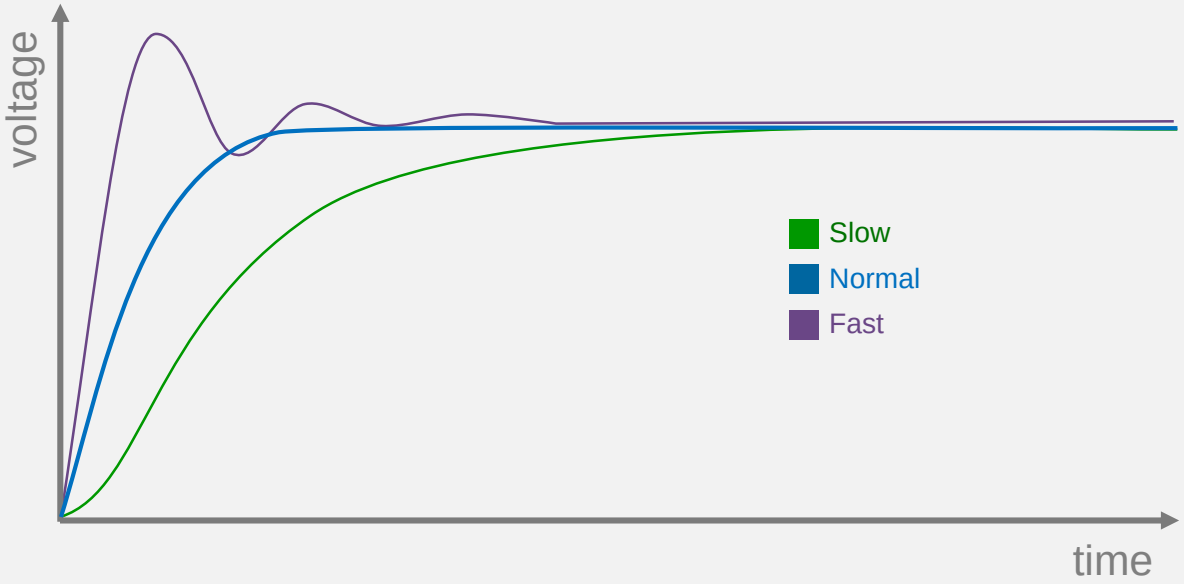
Transient Response and Rise Time





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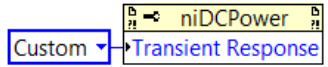

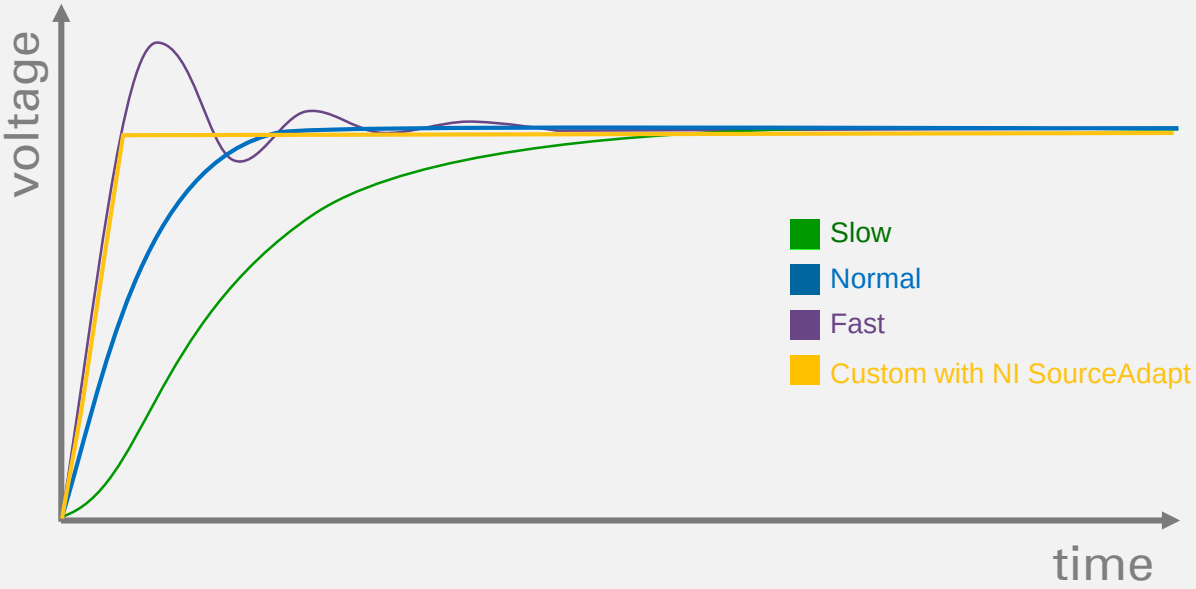

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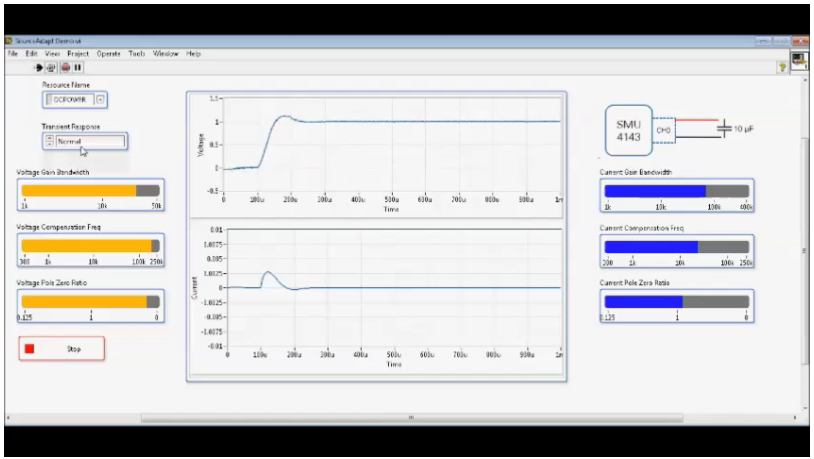
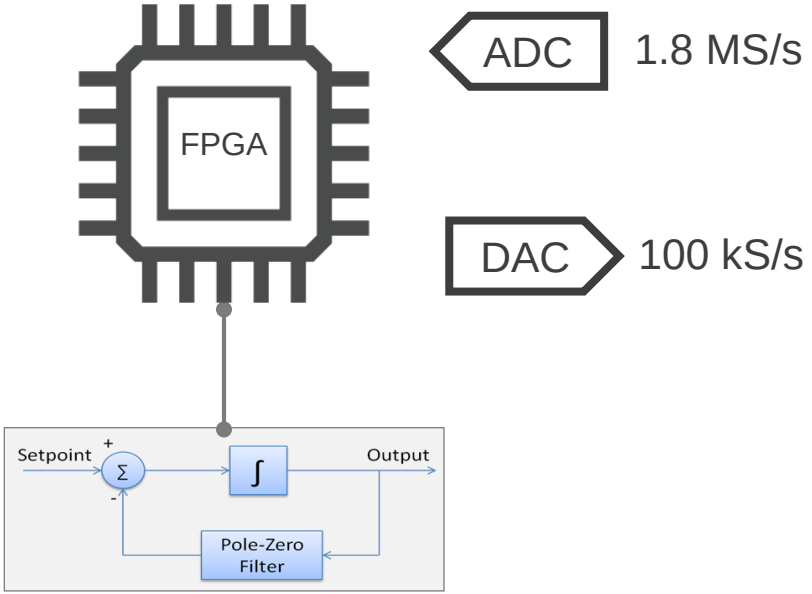
SourceAdapt: Digital Control Loop





V/I CONTROL

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Labs

A Smarter Approach

Production Floor

Same Platform

- Maximize Leverage
  - Code, setup, training
- Simpler correlation
- Faster test cycles
- Lower cost

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Smarter Test System

- Open, Flexible Software
- Modular Hardware
- Vibrant Ecosystem
- “Customer knows best”
- Deployable from Validation to Production

A smart test system is more than a fixed-functionality instrument—
it is built for automation and customization, across validation to production,
with ultimate goal of meeting business needs.

ni.com/smarter-test

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