CONFIGURATION
GUIDE

TestScale Instrumentation

for Electrical Functional Test

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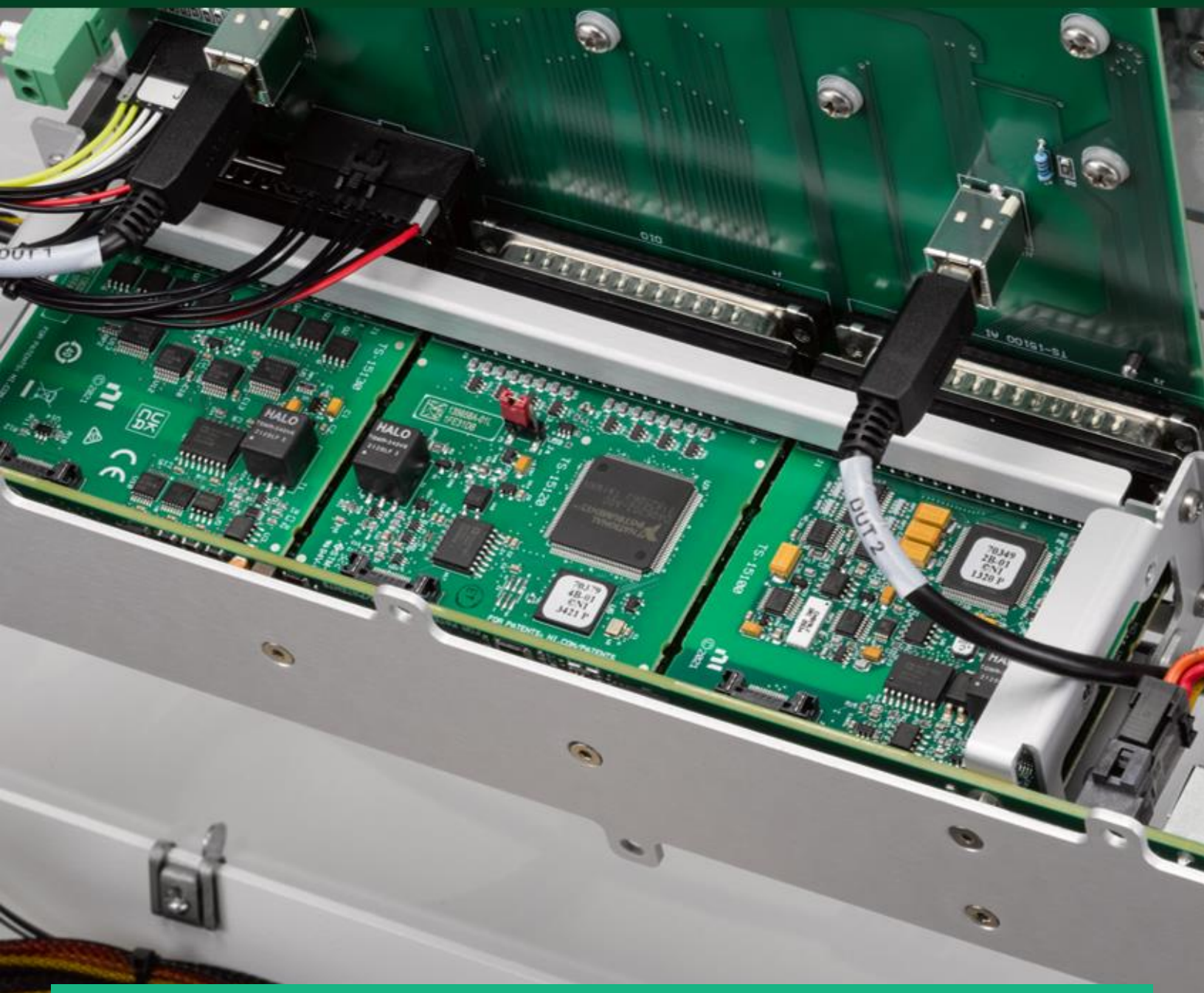

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TestScale Instrumentation

Building a distributed test station with required test coverage that's easy to scale, cost effective, and space efficient is a critical engineering challenge. It's time to leverage NI's optimized solution for high-volume production test: TestScale. This hardware solution can reduce floor space, shorten signal path, and reduce cost.

This document will walk you step-by-step through the decisions you need to make to configure a system to meet your specific test specification. It will cover the following:

- System Overview
- Selecting the right backplane
- Selecting the right modules
- Selecting which cables and accessories are needed
- Software options

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System Overview

TestScale systems start with a test fixture containing 1-N DUTs, where N represents the level of parallelization in your specific fixture/station. When designing a test station, engineers should consider how the test instrumentation is mounted inside the test station, and subsequently, how the instrumentation I/O connects to the DUTs' test points. TestScale instrumentation can electrically connect to the DUT either directly via an interposer board or through a cabled interface. TestScale, which consists of a backplane and modules enclosed in a mounting frame, gets connected to a host PC containing software with NI test development tools or third-party languages.

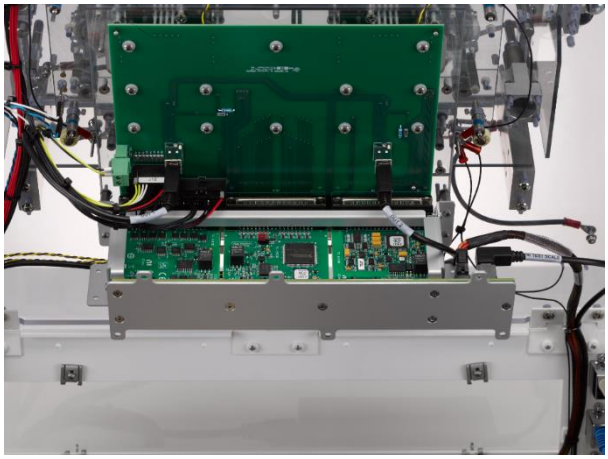


Figure 1: TestScale mounted directly beneath the DUT inside a fixture

Backplane Variants

TestScale has two backplane variants with multiple mounting options ready to be deployed into a variety of environments, providing the best adaptability to fit in new and already existing test stations.

TS-15000: In-Fixture Variant

(*Direct Mount* and *Fixture Mount* options)

Choose this option to reduce floor space and cost by removing the need for a test rack. This backplane option can attach to the pan of the fixture by wiring to the interposer and using a variety of mounting bracket options—or it can connect directly to the interposer to further reduce the signal path and failure points. The fixture mount variant will contain multiple brackets for mounting options, while the direct mount variant will contain the proper parts to mount directly to an interposer board without the need for cables.

Fixture Mount PN: 788266-01
Direct Mount PN: 788267-01

TS-15010: Rack Mount Variant

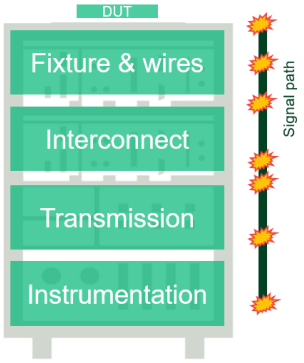
Choose this option to accommodate existing test architectures utilizing a rack. This backplane option can be inserted directly into a rack, fixed with a 1U slot using half-rack width. When purchasing the rackmount backplane, you will have the option to choose between a single and dual mount accessory kit, which contains the necessary components to implement one or multiple TestScale systems into a rack.

Rack Mount PN: 788268-01
Single Mount Accessory PN: 788598-01
Dual Mount Accessory PN: 788598-02

TestScale Mounting Variants

Rack Mount
(in rack)

Fixed with 1U slot using half-rack width. Align to existing test architectures



Signal path ~ 1.6m
Failure points ~ 7

Fixture Mount
(in fixture)

Attaches to the pan of the fixture, wired to the interposer. Reduce floorspace and cost.

Signal path ~ 0.4m
Failure points ~ 3

Direct Mount
(in fixture)

Connect directly to the interposer. Reduce signal path and failure points.

Signal path ~ 0.05m
Failure points ~ 2

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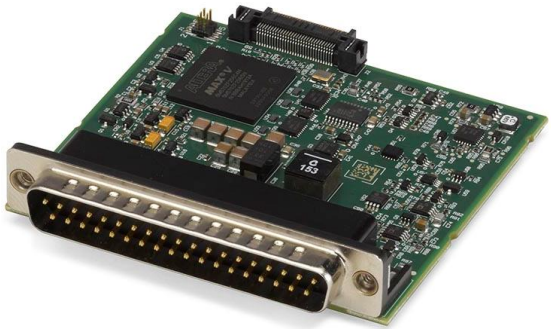
Core Module

Regardless of which backplane is chosen, the core module must be purchased as a required accessory. It provides 8 DIO channels as well as includes necessary functionality to the backplane. The core module is equipped with a different backplane-to-module connector to help differentiate from the measurement and power modules and should be inserted in the dedicated labeled slot.



Module PN: 788596-01

Modules

TestScale's modular form factor has five available slots per backplane and is compatible with a range of I/O measurement and power modules built to NI's high performance and reliability standards.

Measurement Modules

NI offers a selection of measurement IO module options, all featuring a standard 37 pin DSUB connector, high channel density, and high measurement quality to meet your test requirements.

TS-15100
Analog Input Module
250 kS/s, 16 bit, 32 ch

Choose the AI module if your test application requires any of the following measurements: single-point voltage, waveform voltage, current, resistance, frequency, or voltage accuracy—or if you need to have peak detection or time intervals between user-defined events.

Module PN: 788269-01

TS-15110
Analog Output Module
10 V, 16 bit, 4 ch

Choose the AO module if you require programmable voltage reference, a waveform generator, or a tone generator to generate a sinusoid at a particular frequency.

Module PN: 788270-01

TS-15120
Digital I/O Module
5 V/3.3 V, 32 ch

Choose the DIO module if your test application requires any of the following: TTL input/output, basic LED test, event counters, button test, open/short test, relay drivers, or PWM.

Module PN: 788271-01

TS-15130
Digital Output Module
60 VDC, 32 ch

Choose the DO module if you need to drive digital output for higher voltage components or if your test application requires a low-side relay.

Module PN: 788272-01

Power Module

NI offers a programmable power supply with full scale current and voltage ranges, simultaneous voltage and current measurements, remote sense readback with closed loop, and protection features.

TS-15200 Programmable Power Supply: 6 V, 3 A, 18 W, 1 ch

Choose the 6 V DC power supply if your test application requires power measurements, basic resistance measurements, CV or CC modes, if you need to measure sleep versus active state current, or if you need current accuracy and resolution as a function of device specifications and averaging/aperture.

Module PN: 788265-01

Example Module Configurations

These examples are designed to provide context for the backplane and module decisions you will need to make. It is likely that your specification will not match either of these scenarios exactly—but by reading these two examples, you should be better placed to create your own customer setup. And of course, we are here to help, so give NI a call and we will assist.

Scenario 1:

I need to build a functional tester for our in-house manufacturing line that can test two DUTs in parallel (2-up), which would increase the throughput from our existing 1-up test architecture. Each DUT has the following test coverage requirements:

- Input power and current measurements for different DUT states
- Single-point voltage measurements for limit tests
- Voltage ramp stimulus
- Digital I/O
- 24 V relay control

I have new needs for additional AIO/DIO, but I am out of space in my mass interconnect to add more rack mount instrumentation. I saw that NI now has an in-fixture instrumentation option. Previously, I had some basic AC/DC power supplies and relays in my fixture, but it would be great to get more instrumentation in the fixture for density/footprint reasons. In the past, we have had issues sourcing quality cables and debugging bad cables in our production testers.

Recommendation: For this configuration, you will first need a backplane. Since the goal is to increase channel density and decrease footprint while also reducing the need for additional cabling, the best choice would be the In-Fixture: Fixture Mount option, which contains the necessary panels and supports required to mount the TestScale instrumentation to the fixture pan. You would also need a Core Module to go in the “C” slot. For I/O modules, you will need:

- Two TS-15200 Programmable Power Supply modules
- One TS-15100 Analog Input module
- One TS-15110 Analog Output module
- One TS-15120 Digital Input Output module
- One TS-15130 Digital Output module

To connect from each module to the DUT inside the fixture, ribbon cables are recommended.

Measurement I/O Type	Per DUT Channels	Total Test Station Channels	Measurement Methodology	TestScale Module
Sleep and active state power and current measurements	1	2	Constant-voltage mode. Readback voltage and current.	TS-15200 (1 ch) x2
Single-point voltage	10	20	Analog input voltage task	TS-15100 (32 ch)
Output ramp	2	4	Analog output function generation task	TS-15110 (4 ch)
3.3 V TTL digital input	4	8	Digital input task	Core Module (8 ch)
24 V relay control	10	20	Software-timed digital output control	TS-15130 (32 ch)

Scenario 2

I am updating a 4-up functional tester (four DUTs tested in parallel). I have an existing test rack with common, standardized functionality that I want to add onto, so having a solution that fits into my current architecture is a key requirement. Each DUT has the following test coverage requirements:

- Waveform voltage measurements
- Providing a programmable voltage reference
- Performing a button test
- Implementing a low-side relay to ground
- Measure power and take resistance measurements

I also need to expand IO coverage past the capabilities of one backplane.

Recommendation: For this configuration, you will need two rackmount backplanes and a dual mount accessory kit, which contains the necessary mounting components and brackets to fit both backplanes into a standard 19-inch rack. You would also need two core modules to go in the “C” slot of each backplane. For I/O modules, you will need:

- Two TS-15100 Analog Input modules
- Two TS-15110 Analog Output modules
- One TS-15120 Digital Input/Output module
- One TS-15130 Digital Output module
- Four TS-15200 Programmable Power Supplies

You will need a USB 2.0 Cable, 0.5 m, Type A to Type B to daisy chain your backplanes together. To connect each module to the DUT, shielded cables are recommended.

Measurement I/O Type	Per DUT Channels	Total Test Station Channels	Measurement Methodology	TestScale Module
Waveform voltage	12	48	Analog input voltage task	TS-15100 (32 ch) x2
Programmable voltage reference	2	8	Analog output voltage task (16-bit voltage set point generation)	TS-15110 (4 ch) x2
Button test	4	16	Digital input task (read emulated button actuation)	TS-15120 (32 ch) x1
Low-side relay	4	16	Digital output task (enable line to sink power to ground)	TS-15130 (32 ch) x1
Current draw and power measurements Resistance measurements	1	4	Set desired rail voltage and current limit. Readback voltage and current. Switch in TS-15200 channels in DUT powered-down state. Set appropriate current and voltage level and calculate resistance (R = V/I)	TS-15200 (1 ch) x4
Frequency measurement	4	16	Taken through the TS-15050 DIO P0 lines	Core Module (8 ch) x2

Software

TestScale is closely integrated for best user experience with NI's industry-leading software products including LabVIEW, TestStand, and SystemLink™ Software. TestScale is open and can be used with most common languages—and has drivers for LabVIEW, Python, C/C++, and .NET, as well as support for common Linux desktop distributions.

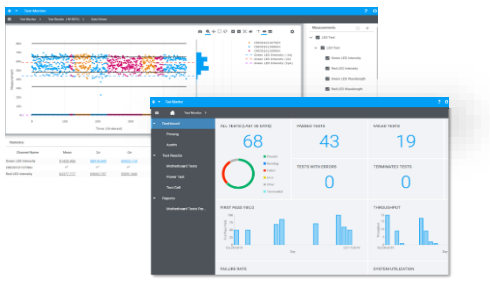
Test Workflow Pro: Recommended Software Bundle for TestScale Development

Test Workflow Pro is a bundle of select NI software featuring engineering-specific tools that help test professionals accomplish anything from their day-to-day work to overcoming their most challenging obstacles. Test Workflow includes nine separate software products including:

- LabVIEW is a graphical programming environment engineers use to develop automated research, validation, and production test systems.
- TestStand is test management software that helps you develop, debug, and deploy test systems and provides full visibility into testing process and results.
- DIAdem is data management software for measurement data aggregation, inspection, analysis, and reporting.

SystemLink

SystemLink eliminates the manual tasks related to keeping test systems current and healthy. From automating software updates to monitoring system health, SystemLink delivers key information that improves situational awareness and test readiness. Leveraging an automation and connectivity framework, SystemLink aggregates test and measurement data from all test systems into a centralized data repository. Users have ready access to asset utilization, calibration forecasts, and test-result history, trends, and production metrics data to make proactive decisions on capital expense, maintenance events, and test or product modifications.



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Accessories

Each TestScale system will require a power supply and cable. Please review your options from the table below.

Name	Part Number	Description	Use Case
TS-15422	788308-02	TestScale Power Cable (Pigtail to Ultra-Fit), 2m	Connecting DC power supply to TestScale backplane
TS-15420	788308-0R5	TestScale Power Cable (Ultra-Fit to Ultra-Fit), 0.5 m	Daisy-chaining power bus between multiple backplanes
TS-15421	788308-0R25	TestScale Power Cable (Ultra-Fit to Ultra-Fit), 0.25 m	
PS-14	783167-01	24 VDC, 3.3 A, 100-240 VAC/110-300 VDC Input Power Supply	Provides required DC VSUP and VAUX power rails to backplane
PS-15	781093-01	24 VDC, 5 A, 100-120/200-240 VAC Input, Spring-Clamp Terminals Power Supply	
PS-16	781094-01	24 VDC, 10 A, 100-120/200-240 VAC Input, Spring-Clamp Terminals Power Supply	
PS-17	781095-01	24 VDC, 20 A, Universal Power Input, Spring-Clamp Terminals Power Supply	

I/O cables are also needed to connect the modules' I/O connectors and the DUT. For TestScale systems directly mounted to the DUT interposer board, I/O cables are not required.

Name	Part Number	Description
SH37F-37M-1	778621-01	37-Pin Female to Male Shielded I/O Cable, 1 m
SH37F-37M-1	778621-02	37-Pin Female to Male Shielded I/O Cable, 2 m
R37F-37M-1	779195-01	37-Pin Female to Male Ribbon I/O Cable, 1 m
R37F-37M-1	779195-0R5	37-Pin Female to Male Ribbon I/O Cable, 0.5 m
R37F-37M-1	779195-0R25	37-Pin Female to Male Ribbon I/O Cable, 0.25 m

Lastly, your application may require USB cables for various use cases, such as connecting to the host computer machine, daisy-chaining multiple backplanes, and connecting to peripheral devices. Each TestScale backplane is equipped with a built-in USB hub and three USB connectors. The Type B connector is upstream-facing (points toward the host), and the Type A connectors are downstream-facing (points away from the host).

Part Number	Description	Use Case
184125-01	USB 2.0 Cable, 1 meter, Type A to Type B	Connect host to backplane only or daisy-chain
184125-02	USB 2.0 Cable, 2 m, Type A to Type B	Connect host to backplane only or daisy-chain
184125-0R5	USB 2.0 Cable, 0.5 m, Type A to Type B	Daisy-chain backplanes side to side
184125-0R25	USB 2.0 Cable, 0.25 m, Type A to Type B	Daisy-chain backplanes top to bottom
788548-01	USB 2.0 Cable, 1 m, Right Angle Type B to Type A	Connect host to backplane only
788548-02	USB 2.0 Cable, 2 m, Right Angle Type B to Type A	Connect host to backplane only
788547-0R25	USB 2.0 Cable, 0.25 m, Right Angle Type A to Right Angle Type B	Daisy-chain backplanes top to bottom
788549-0R5	USB 2.0 Cable, 0.5 m, Right Angle Type A to Type B	Connect to third-party equipment
788549-02	USB 2.0 Cable, 2 m, Right Angle Type A to Type B	Connect to third-party equipment

In the case that additional screws or standoffs are needed, spare parts sets are available.

Part Number	Description	Use Case
868022-01	TestScale In-Fixture Screws/Standoffs Set	Spare screws and standoffs for In-Fixture variant (10 each)
868022-02	TestScale In-Fixture Screws/Standoffs Set	Spare screws and standoffs for Rack Mount variant (10 each)