

# *SPECTRUM™ 8800-SERIES*

Open Architecture for  
Test Strategy Flexibility

**TERADYNE**



In today's demanding environment, electronics manufacturerers are being driven to adopt a vigorous "cost-down" test strategy. In the effort to cut board-test costs, most manufacturers have focused on reducing the costs of finding structural (assembly) faults on PCBs. Given the need to continuously reduce costs, however, attacking just manufacturing process test costs is not enough.

As you look beyond the process-test step for opportunities to reduce total cost and cycle time, product function test offers the most significant payoff. Teradyne research shows that functional test costs at the final-test stage are typically five to ten times more than the costs of process test.

Typically following the process test step, product function test is the "quality gate" that ensures the board operates as intended before it is packaged as an end product or integrated into a larger system. Product function test is typically performed on a "hot mockup" or "hotbed" test set up, custom rack-and-stack instrumentation, or custom-built ATE.

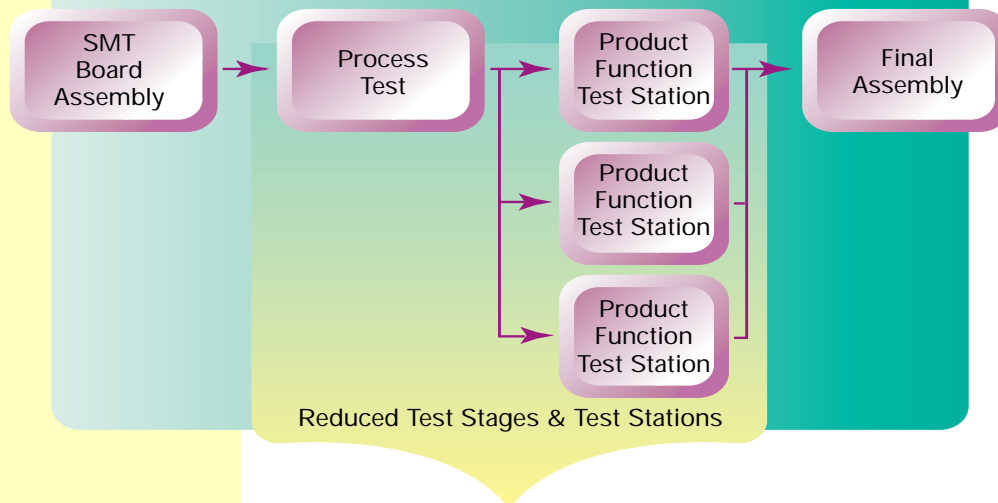
The most effective way to attack spiraling functional test costs is to migrate some or all product function tests onto a manufacturing process tester that's capable of accommodating both in-circuit and functional test. This cuts test steps and boosts final-test stage yields. This "yield-enhancement" strategy lets you trim time and costs by reducing additional handling, eliminating redundant tests between process test and functional test, and cutting overall test time. You need fewer operators and test stations, and less floorspace. WIP is reduced significantly. Earlier fault detection and faster feedback to the assembly process to correct process errors is a proven strategy to improve product reliability while reducing product cost.

The optimum degree of functional test integration on the manufacturing test platform varies by product type. Line rate, product maturity, board complexity, and conformance test requirements determine which functional tests should be migrated to the manufacturing process tester.

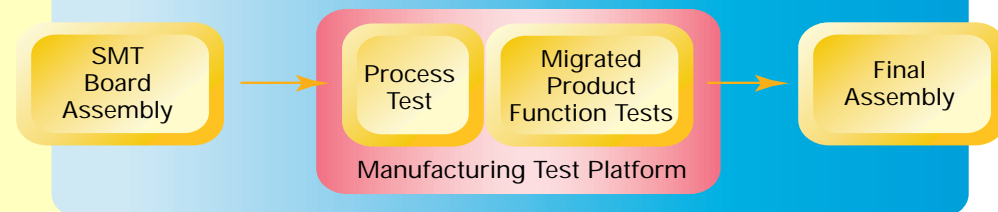
A second strategy for cost and cycle-time improvement is to migrate assembly steps such as NVM (non-volatile memory) and Flash memory programming on to the manufacturing process test system. Whether you pre-program parts or program them on-board, typical programming processes add several steps to manufacturing, increasing cost, inventory, and scrap. By migrating NVM and Flash programming to your manufacturing tester, you can also reduce process complexity, cost, and cycle time.

To pursue these cost-reduction strategies, you need a manufacturing process tester that goes beyond just providing high in-

#### Typical SMT Test Strategy



#### Yield-Enhancement Strategy



## VXI Instrumentation Standard

The VXI Consortium was formed in 1987 to define a standard for multivendor instruments on a card. The VXI (VMEbus eXtensions for Instrumentation) bus is now the established cost-and-performance leader for general-purpose instrumentation.

VXI is used in applications ranging from test and measurement and ATE to data acquisition and analysis. More than 1,000 VXI products are available today from more than 250 suppliers.

VXI offers these benefits:

- Interoperability between products from different vendors.
- Open, multivendor standards.
- Increased throughput.
- Smaller size than IEEE instruments.
- More precise timing and synchronization.
- Simplified configuration, programming and integration.

The VXI Plug&Play Consortium promotes ease of use, interoperability, and software driver standards. National Instruments and Teradyne are both members of the VXI Plug&Play Consortium.

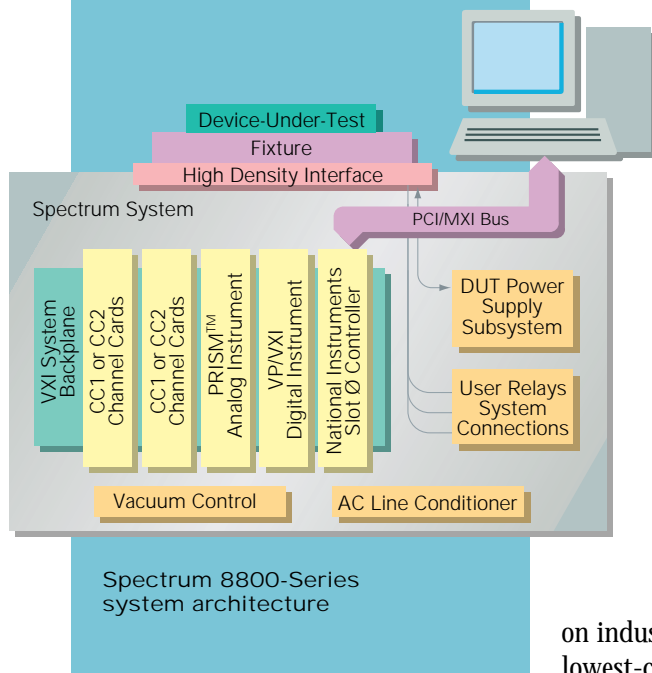
The National Instruments PCI/MXI card, Slot O Controller, and optional LabWindows/CVI software in the Spectrum 8800-Series ensure compatibility with the VXI Plug&Play standards.

## Open Systems for Manufacturing Test

Teradyne's Spectrum™ 8800-Series is the world's first open-architecture manufacturing test platform. Spectrum open-architecture test systems are based on popular industry standards: VXI, PC, Windows NT®, and LabWindows/CVI®. By building

on industry standards, Spectrum provides the lowest-cost test solutions and the greatest test-strategy flexibility.

Spectrum open test systems let you select exactly the test capability you need for each application. They can meet a wide range of in-circuit and product function test requirements cost effectively—including PC motherboards, disk drives, telecommunications, networking, wireless, contract manufacturing, and automotive electronics. And they can accommodate today's high rates of technology change without becoming obsolete themselves.



circuit fault coverage and fast cycle time. You need a Manufacturing Test Platform built around industry standards and an open software and hardware architecture. Only an *open* test system can give you the test-strategy flexibility needed to migrate product function test and assembly steps with the goal of reducing total cost and cycle time.



The Spectrum 8800-Series VXI card cage allows you to customize your Spectrum system by adding VXI instruments from other suppliers.



Spectrum system software is based on industry standards such as Windows NT and LabWindows/CVI.

Spectrum's open architecture based on proven industry standards enables electronics manufacturers to employ a test strategy tailored to their unique products and processes. In addition to performing in-circuit manufacturing process test to find structural defects, you can also migrate "downstream" product function tests from custom functional test setups, as well as PCB configuration steps such as Flash programming, right on to the Spectrum manufacturing test platform.

#### **Open hardware: VXI architecture**

The heart of the Spectrum system is the VXI test head cage, which houses all analog and digital instrumentation modules, channel cards, Functional Interface Boards, system controllers, and user-specific VXI modules and instruments.

The Spectrum 8800-Series VXI card cage and backplane system, channel cards, controllers, switching, and instrumentation modules are compatible with VXI specifications. Adherence to the VXI standard enables you to customize Spectrum test systems by adding commercially available C-size VXI instrumentation. The standard VXI architecture also means easy future expansion for adding test instruments not yet developed.

To adapt VXI architecture for high-volume, high-throughput production test, Teradyne designed the Spectrum 8800-Series with a unique card cage that adds a low-noise analog bus and a high-bandwidth fixture interface connection to the standard C-size VXI backplane.

#### **Open computing: PC-based**

The Spectrum 8800-Series uses a high-performance Pentium-series PC for all aspects of system operation, including test program development and production test. This familiar computer architecture provides ease of use, reduces training and support costs, and lets you take advantage of ongoing improvements in speed, price, and performance.

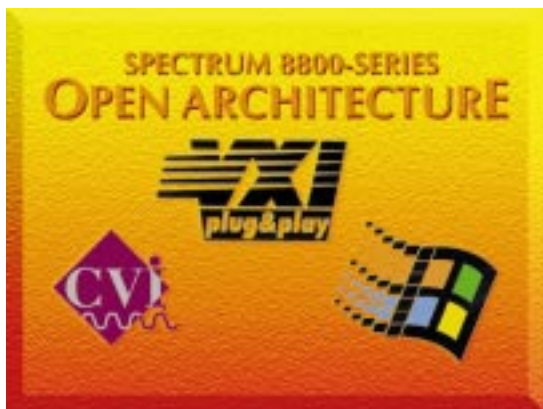
## Open runtime software: Windows NT

The Spectrum 8800-Series operates in the Windows NT environment for runtime production testing and test development. The Spectrum software fully exploits Windows NT functionality, including true multitasking and support of Windows DLL (Dynamically Linked Libraries), DDE (Dynamic Data Exchange), and OLE (Object Linking and Embedding). These standards allow communications with other Windows-based programs, locally or over a network. You can share data, control other processes, and tightly integrate multiple test processes from within the Spectrum environment.

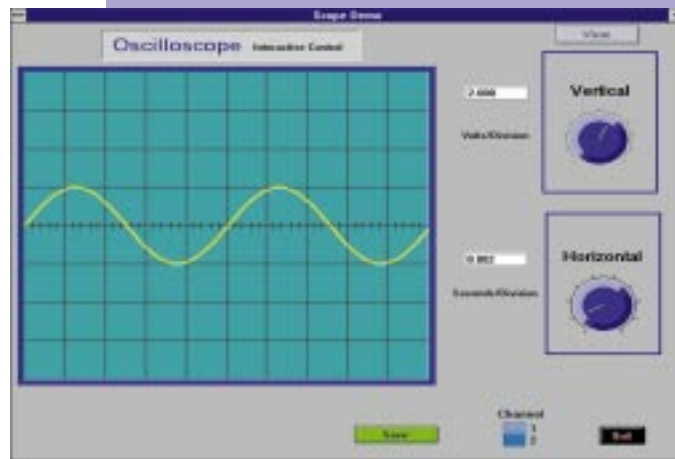
The Windows NT software platform simplifies integration of 8800-Series testers into factory networks and gives you access to hundreds of third-party Windows NT programming tools and utilities. High-level APIs (Application Programming Interfaces) give expert users control of tester functions for custom tests. You can also implement custom programs and specialized functions using C++ programming.

## Open control: MXI

The Spectrum system PC communicates with the test head VXI bus directly via a high-speed Multisystem eXtension Interface (MXI) bus. A National Instruments PCI/MXI-2 adapter card in the PC and VXI/MXI-2 controller in the VXI cage provide this high-speed link, making the test system perform as though it were plugged directly into the PC's PCI bus.



Spectrum open architecture systems employ popular industry standards.

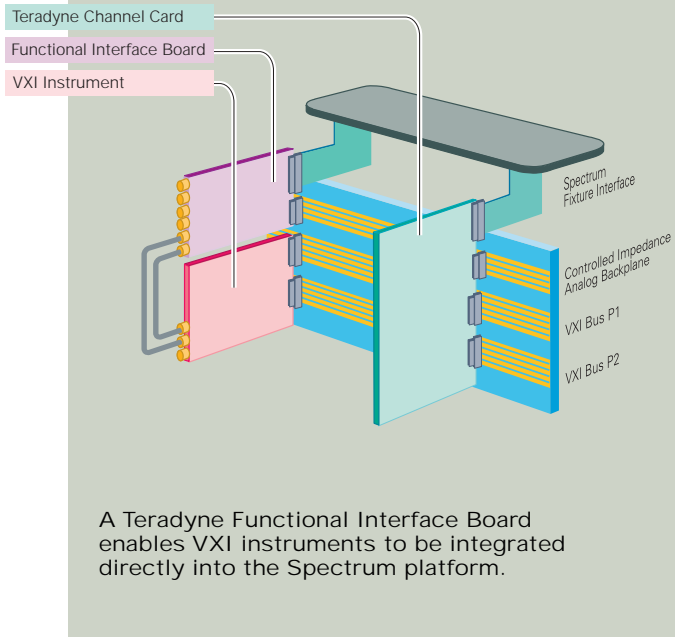


National Instruments LabWindows/CVI software is used to develop functional tests for the Spectrum 8800-Series.

## Open instrumentation: LabWindows/CVI

National Instruments LabWindows/CVI software is the accepted industry standard for graphical development of product functional tests for VXI and IEEE instruments. Based on the C programming language, it is the most popular graphical programming environment for VXI and IEEE. Over 500 hundred LabWindows/CVI device drivers are available for a wide range of VXI, IEEE, and GPIB instrumentation.

LabWindows/CVI runs on a PC—the most popular platform for functional test development and operation. Its easy-to-use graphical user interface streamlines test design and debugging. The intuitive, high-level “virtual instrument” panels resemble familiar benchtop and rack-and-stack instrument controls. These panels free users from dealing with low-level instrument commands and simplify test development.



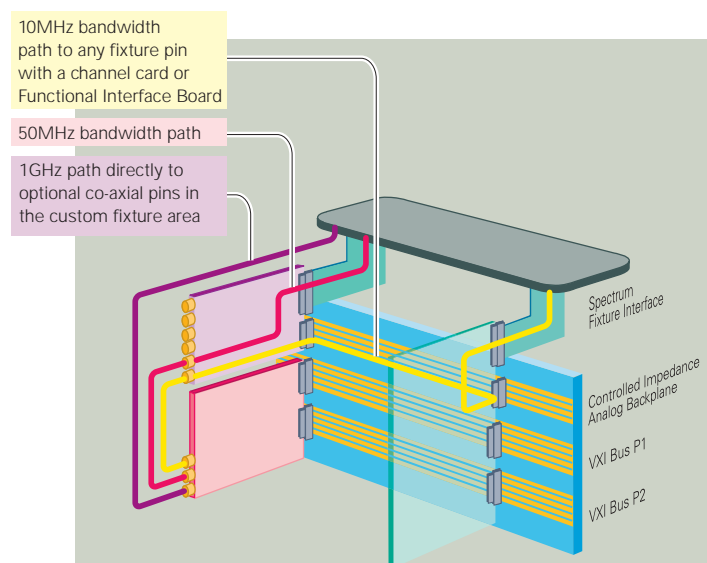
## Flexible signal routing paths

The Spectrum system provides several ways to bring instrument signals to the board-under-test through the fixture interface.

- ◆ VXI instruments can be connected directly to the Functional Interface Board with a 50 MHz bandwidth connection.
- ◆ A 10 MHz bandwidth path is provided to any fixture pin through the analog backplane.
- ◆ You can also directly connect instruments via optional 1 GHz coaxial pins in a custom fixture receiver area in the fixture interface.

The Functional Interface Board lets you integrate VXI instruments directly into the Spectrum platform. The Functional Interface Board occupies the space above a C-sized VXI instrument, providing a high-bandwidth connection to the fixturing interface and the analog test bus. The combination of an instrument and a Functional Interface Board can be installed in any channel card slot in the system. Together, the instrument plus a Functional Interface Board create a fully qualified system resource with full backplane and fixture interface access.

A key element to transferring VXI from the lab to the production floor, the Functional Interface Board routes instrument signals cleanly to the fixture interface through a 50 MHz direct connection. The Functional Interface Board is equipped with 16 standard analog channels and 8 SMB connections. Current capacity is 1 amp, and there are 12 general-purpose user relays.



Instrument signals may be routed to the board-under-test in several ways.

## Flexible Extension of the Manufacturing Process Tester

The Spectrum 8800-Series is the first open-architecture VXI manufacturing test platform. Spectrum open systems provide the most cost-effective route to expand the manufacturing test platform beyond process test and add the appropriate functional test capability for your test strategy.

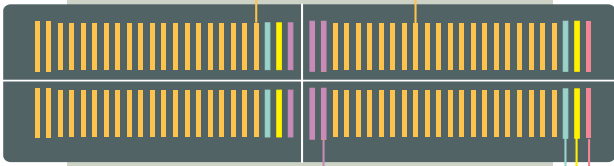
The Spectrum 8800-Series provides a flexible extension of the manufacturing process test platform, letting you migrate “downstream” test steps from final test to the Spectrum manufacturing test platform. Similarly, you can move product configuration steps like Flash programming on to the 8800-Series.

## Flexible instrumentation platform

Spectrum’s open architecture accommodates all popular types of instrumentation, including VXI instruments, IEEE devices, and custom hardware and software.

VXI instruments plug directly into the Spectrum backplane for control and use the Teradyne Functional Interface Board for signal routing between the instrument, fixture receiver, and system analog backplane. IEEE 488 and custom instruments can be connected through the Functional Interface Board or through dedicated fixture interface pins. IEEE instruments use the IEEE controller in the PC for control.

1,280 pins per quadrant for in-circuit or functional test



Removable functional pin blocks are for custom interfacing e.g. co-axial pins, high-voltage pins, custom bus

Fixture ID, Serial ports etc.

MultiScan II resource pins

10A high current DUT power supply pins

The Spectrum 8800-Series high-density fixture interface

### High-density fixture interface

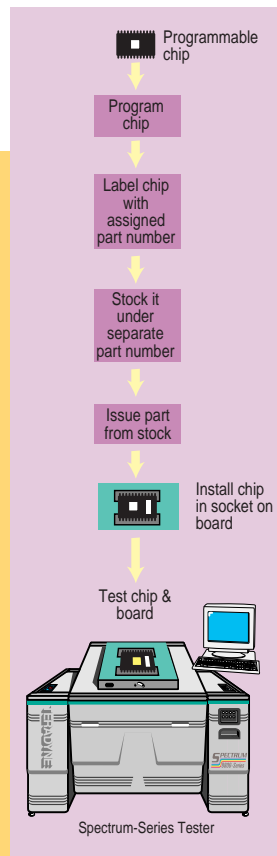
The high-density fixture interface provides flexible options for routing functional signals and power. Each quadrant has 1,280 pins for in-circuit or functional test. In addition, there are dedicated pins for routing VP/VXI signals and functional signals, as well as high-current pins for supplying device-under-test power. A removable connector area for custom interfacing lets you route high-current or high-frequency signals up to 1 GHz (e.g. co-axial pins, high-current pins, custom bus, etc.). The interface offers connection paths for high frequency (to 50 MHz) and high voltage (to 100V).

### In-Line Device Programming

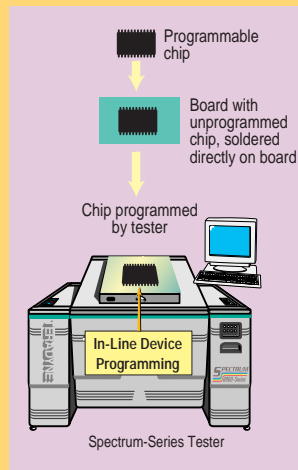
All Spectrum systems are equipped with the capability to program on-board Flash memories, EEPROM, and FPGAs. The In-Line Device Programming (ILDP) capability allows for straightforward programming of variable data including lot code, serial number, test code, program code, or product configuration code.

The ILDP capability provides high-throughput device programming. Programming algorithms are executed by the DSP on the VP/VXI board. The in-line device programming capability is available on all digital pins in the system. Four flexible serial ports on the VP also allow for embedded serial EEPROM programming.

#### Traditional method



#### On-board programming



### Flash Programming Streamlines Assembly Process

Many electronics manufacturers want to eliminate assembly process steps in order to cut costs and cycle time. One option is to program non-volatile memories such as Flash and EEPROM at the in-circuit test stage, on the manufacturing test platform—instead of the traditional method of programming parts on a separate PROM programmer.

The advent of devices capable of being programmed while soldered to the final board gives manufacturers the opportunity to eliminate much of this costly process. Components such as EEPROM, Flash ROM, and in-system programmable (ISP) logic are designed allow on-board programming after board assembly.

Programming the on-board device on a Spectrum 8800-Series test system shortens cycle time by eliminating an entire manufacturing step, reduces costs by cutting the number of operators and machines, and simplifies parts flow and inventory control. For example, if the device code changes, a simple programming modification at the 8800-Series handles it.

## General System Features

- ◆ VXI system architecture for in-circuit and product function test
- ◆ PC-based test programming and system control
- ◆ Windows NT operating system
- ◆ Optional LabWindows/CVI software for functional test development
- ◆ Non-multiplexed driver/receiver architecture for in-circuit test
- ◆ Modular architecture for flexible configurations and upgrades
- ◆ Up to 5120 non-multiplexed channels
- ◆ High-performance PRISM DSP-based analog system
- ◆ Comprehensive MultiScan vectorless test toolset
- ◆ Digital vector testing for SSI, LSI, VLSI, and boundary-scan test
- ◆ Support for TTL, 3V, low-voltage CMOS, and ECL logic levels
- ◆ 5 MHz digital data rate
- ◆ Fully synchronized testing of mixed-signal devices such as ADCs, DACs, and CODECs
- ◆ Optional VICTORY boundary-scan software
- ◆ Standard integrated test generation and fixture development environment, including CAD translation, testability analysis, and fixture design
- ◆ “Language-free” worksheet-based programming
- ◆ Comprehensive, easy-to-use tools for test creation and debug
- ◆ Ergonomic design with tiltable console
- ◆ Bosch frames for in-line integration and adding accessories
- ◆ Adjustable height for in-line use with SMEMA-compatible equipment
- ◆ Compact footprint
- ◆ ProcessWatch Monitor real-time data collection and analysis software
- ◆ Optional paperless repair system
- ◆ ProcessWatch Parametrics statistical-analysis control software ensures transportable, repeatable test programs
- ◆ Networking and remote access
- ◆ “Personality Plates” and translators for migrating from other test systems
- ◆ Program and fixture compatibility with Z1800-Series
- ◆ Flexible instrumentation platform for VXI, IEEE, and custom hardware and software
- ◆ Flexible signal routing for bringing instrument signals to the device-under-test
- ◆ In-Line Device Programming capability for programming Flash, EEPROM, and programmable logic devices

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