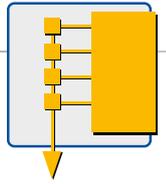


System Integration

JTAG/Boundary Scan

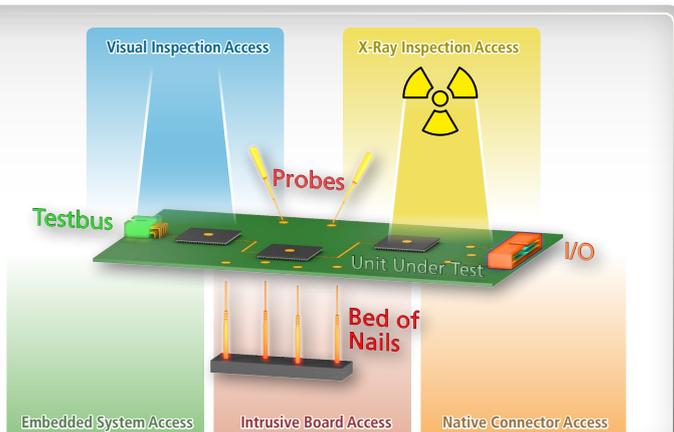


Interactive Test Strategies • ATE Platforms • Software Integration • Hardware Integration • Integration Packages • Turn-key Solutions • Process Integration

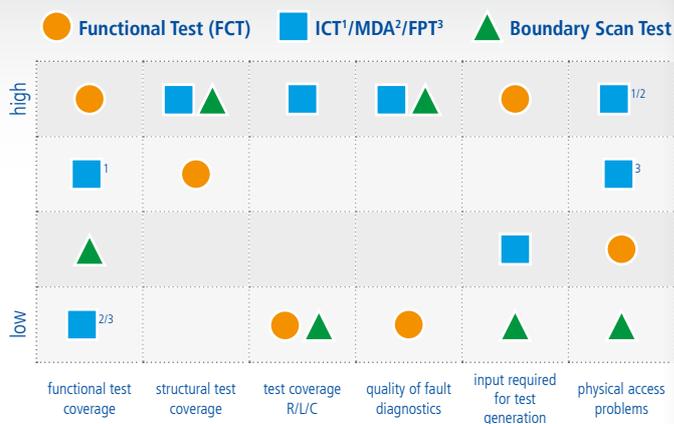
ITAG/Boundary Scan Success Through Interactive Teamwork

The Added Value of Integration

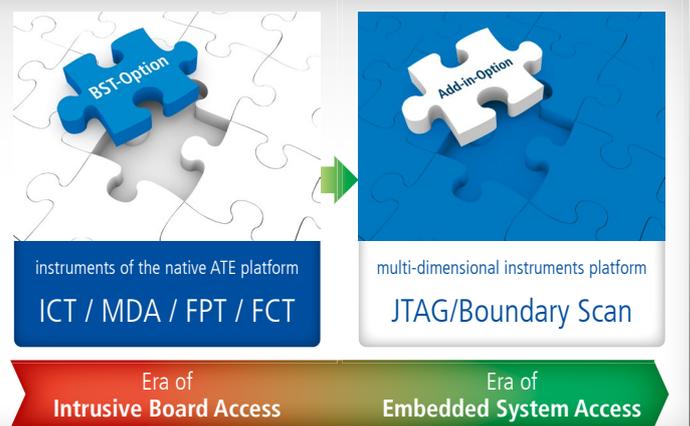
Today, we have the **broadest-ever arsenal** of strategies to assure the **quality** of modern electronic units. From a practical perspective, electrical processes as well as processes operating on the basis of optical access play a significant role in this field. Nonetheless, **no method** can meet **every requirement**, so an integrated strategy for **combining testing procedures** is necessary.



Electrical and non-electrical access strategies



Qualitative assessment of essential access strategies



Paradigm shift in ATE instrumentation

The **following objectives** play a key part in this regard:

- improved fault coverage
- more precise fault diagnostics
- increase of the test throughput
- combination of test and programming
- reduction of separate process steps
- extended system functionality

Even though users must eventually select for themselves the combination best suited to their needs, **integration capability** and **performance** of the individual components nevertheless play a **major role in the selection**. To achieve this, since the early 1990s GOEPEL electronic has introduced a number of groundbreaking principles and technologies. Special mention should be made of the **JTAG/Boundary Scan Test (BST) strategies** such as:

- In-Circuit Test (ICT)
- Manufacturing Defects Analyser (MDA)
- Flying Probe Test (FPT)
- Functional Testers (FCT)
- Automated Optical Inspection (AOI)

These lead to a range of very different effects and benefits:

Improvement	BST+ICT	BST+MDA	BST+FPT	BST+FCT	BST+AOI
Fault coverage	✓	✓	✓	✓	✓
Fault diagnosis	✓	✓	✓	✓	✓
Test throughput	-	-	✓	-	✓
Process steps	✓	✓	✓	✓	✓
System functions	-	✓	✓	-	✓

✓ typical ✓ excellent

Ideally, mixed test strategies serve to **compensate** individual **disadvantages** and to **maximise advantages**. This is especially true for the juncture between test coverage, fault diagnostics, fast test generation and potential access problems. This issue can be approached in two different ways:

- structural test procedures (ICT, MDA, FPT, BST)
- functional test procedures (FCT, cluster test)

Structural tests individually check every element and the individual connections in consistent partial groups (clusters) during functional tests, or the entire system to verify it functions properly.

Selection of the Integration Platform

While the ICT used to be the predominant primary platform, MDA, FPT or FCT are now in equally widespread use. **Decreasing access** has played an important role in the **paradigm shift** that has taken place towards an **integration platform** consisting of a multi-dimensional **JTAG/Boundary Scan** system. As a result, two options are now available for integration:

- BST integration in third party ATE platforms (Automated Test Equipment)
- integration of third-party options in BST platforms

i Further information on **integrations** as well as on technologies and products is available at goepel.com/en/esa/integration

JTAG/Boundary Scan Combination with Intrusive Board Access Procedures

Intrusive Bed-of-Nail Tester (ICT und MDA)

The **In-Circuit Test** was introduced back in the 1970s and is still used in production today. This system uses a bed of nails to access the unit under test (UUT) and is equipped with digital pin electronics to perform electric tests. In simple terms, this system functions like a series of parallel I/Os. The **Manufacturing Defects Analyser**, on the other hand, is an analog measurement electronic system in the form of a multimeter (R/L/C/U/I). This multimeter is connected sequentially to the nails and on to the UUT through multiplexers without applying operating voltage.

Intrusive Flying Probe Tester (FPT)

The **Flying Probe Test** introduced in the late 1980s uses fast traveling probes to approach the UUT. In all other respects, it is based on the same principle as an MDA. While only solutions with three or four probes from the top were available at the outset, eventually machines with movable top and bottom probes and with integrated ICT were introduced.

Integration Solutions and Principles

JTAG/Boundary Scan integration by GOEPEL electronic is **typically** based on the following **components**

- SCANFLEX® controller (PC plug-in card)
- SCANFLEX TAP transceiver
- SYSTEM CASCON™ execution package
- CASCON Link Software (CLS)

In this case, **software** and **controller** are integrated into the **control PC** of the system. During a test process, the native ATE control software serves as the master and boots the JTAG/Boundary Scan software (slave). **A broad range of features** ensures maximum test coverage and functional safety.

JTAG/Boundary Scan Feature	ICT*	MDA*	FPT*
ATPG – interaction with (flying) nails	✓	✓	✓
Fault diagnosis at pin level	✓	✓	✓
Use-of-test, emulation, programming	✓	✓	✓
Released OEM integration packages	✓	✓	✓
Target ATE-specific TAP transceiver	✓	-	✓
Active test head option for in-fixture use	✓	✓	✓

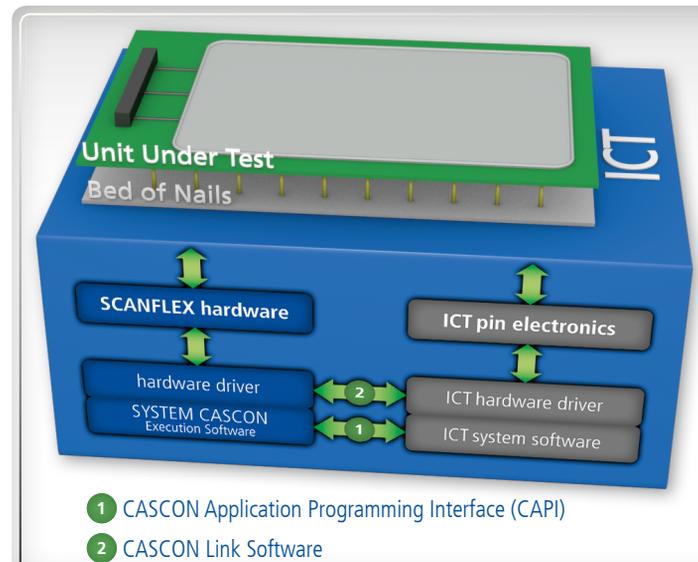
*typical data for supported ATE models

Interaction of the systems enable the technologies

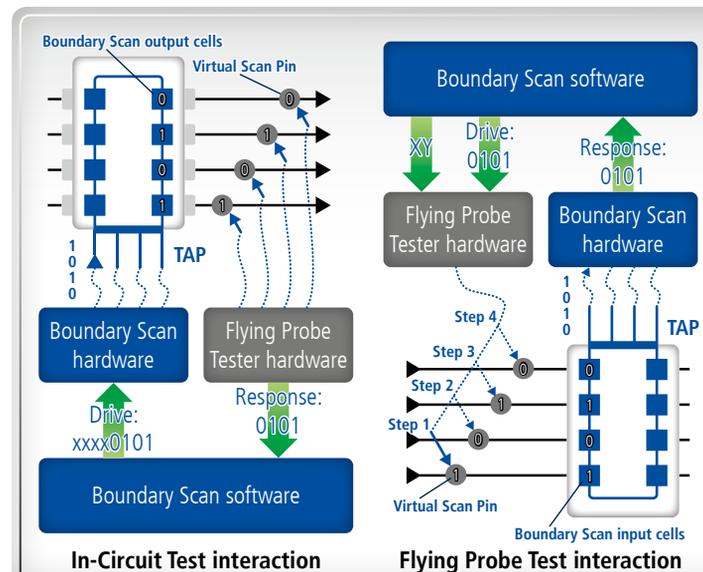
- HYSCAN™ (Hybrid Scan)
- Virtual Scan Pin™

HYSCAN makes it possible to define virtual digital pin electronics within the SYSTEM CASCON development environment and, as a result, to provide for the synchronous output of serial and parallel vectors. The parallel vectors are thus able to access and control the electronic system of the ICT or the MDA through link software.

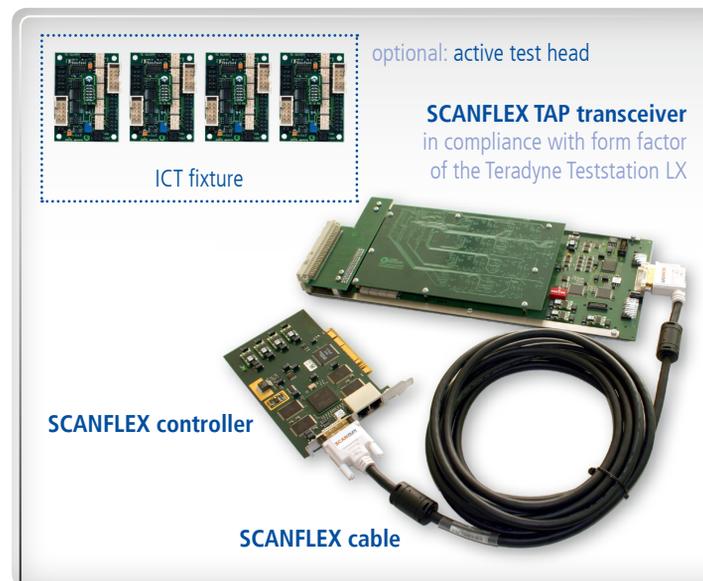
Virtual Scan Pin technology was introduced by GOEPEL electronic as early as 1995 in the context of combining JTAG/Boundary Scan with Flying Probe Testers. This function makes it possible to define the nails as virtual Boundary Scan access points for the generation of automated test programs (ATPG). The interactive use of both processes greatly enhanced the testability of the function. This principle was later also extended to ICT/MDA integrations.



Integration of JTAG/Boundary Scan in an In-Circuit Tester



Principle of HYSCAN and Virtual Scan Pin in In-Circuit/Flying Probe Test



Example of an integration package

Combination with Functional Test and Optical Inspection Procedures

Functional Test via Native Connector Access

Functional Testing uses the native interfaces of the UUT for access and emulates the application environment. The integration platform is a key factor for the performance and the expandability of these systems, whereby certain integration platforms are especially significant:

- PCI/PCI Express (integration through PC plug-in cards)
- PXI/PXI Express (integration through rack plug-in cards)
- LXI (rack and stack integration)

The PXI/PXI Integration Platform

The **PXI** standard offers an especially high degree of **openness** and **modularity**. This standard makes it possible to create highly **compact** systems and is supported by more than 150 vendors. GOEPEL electronic offers the broadest product range on the market for JTAG/Boundary Scan. This range includes:

- PXI/PXIe SCANFLEX controllers (standard/compact/fixture)
- PXI JTAG digital I/O (low-speed/high-speed)

With three different basic types of PXI controllers, this system offers **tried and tested solutions** even for applications with critical signal environments. It includes pre-installed interfaces for commercial interchangeable test adapters (ITA – Interchangeable Test Adapter) from the manufacturers Virginia Panel and MAC Panel.

PXI/PXIe Contoller Feature	Standard	Compact	Fixture
TAP transceiver	external	internal	internal
Active in-fixture test heads	optional	-	✓
max. no. of TAPs	8	4	4
max. TCK	80 MHz	80 MHz	80 MHz
ITA support	-	✓	✓

In addition, I/O modules are available: these modules enable the combination of JTAG/Boundary Scan with functional testing for asymmetrical (single-ended) and symmetrical (differential) I/O.

PXI JTAG Digital I/O Feature	PXI 52xx	PXI 5350	PXI 5396
Signal transmission	asymmetrical	symmetrical	asymmetrical
max. no. of channels	192	50	96
max. clock rate	1 MHz	1 MHz	100 MHz
max. pin memory	-	-	64 MB
FPGA IP download	-	-	✓
ITA support	✓	✓	✓

The interaction between controllers and I/O modules is based on **HYSCAN** and **Virtual Scan Pin**; in other words, on the same technology as ICT or FPT. In addition, the JTAG/Boundary Scan software SYSTEM CASCON offers by default a **vector interface to enable transparent I/O control**. Therefore, it is possible to use programming languages such as Pascal, C/C++ or Basic for defining and analysing drive and response vectors. For software packages such as **LabVIEW** or **TestStand**, **preinstalled** connections by way of **plug-in solutions** are available.

Integration of Optical Inspection Systems

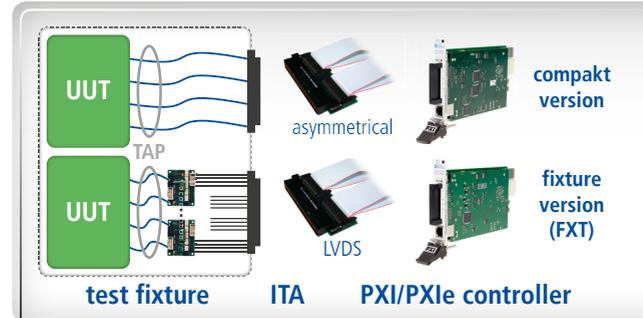
By **combining** JTAG/Boundary Scan **with optical inspection**, various scenarios are possible, such as:

- true parallel execution (increased throughput)
- synergetic platform use (reduced handling)
- interactive optoelectronic testing of LEDs, displays, etc.

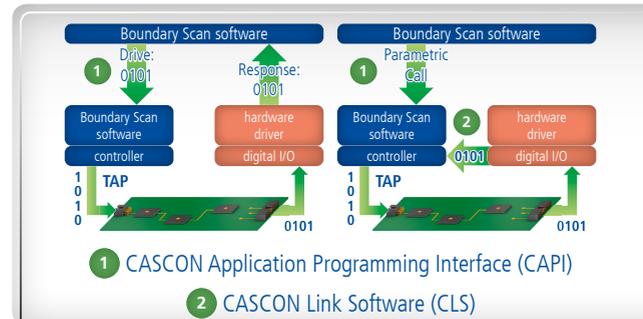
We support all integrations by default and have for some time offered optical inspection systems with a „**Boundary Scan ready**“ option.



SCANFLEX controllers for PXI/LXI and PXI JTAG digital I/O



Application of compact and fixture controllers



Boundary Scan software in transparent or master mode



Industrial Vision Solutions: Boundary Scan ready



Automated Optical Inspection: Boundary Scan ready

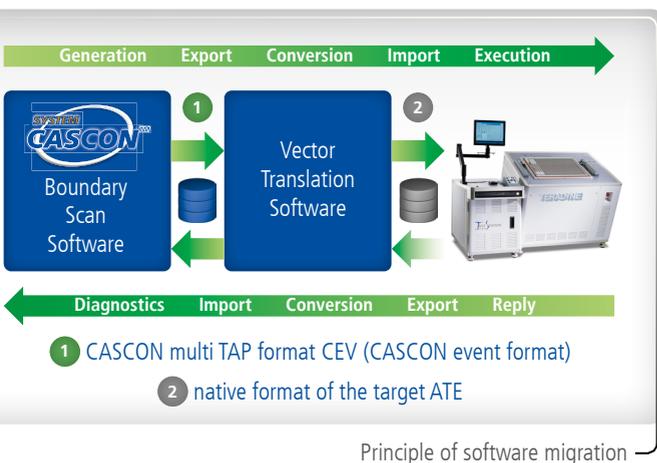
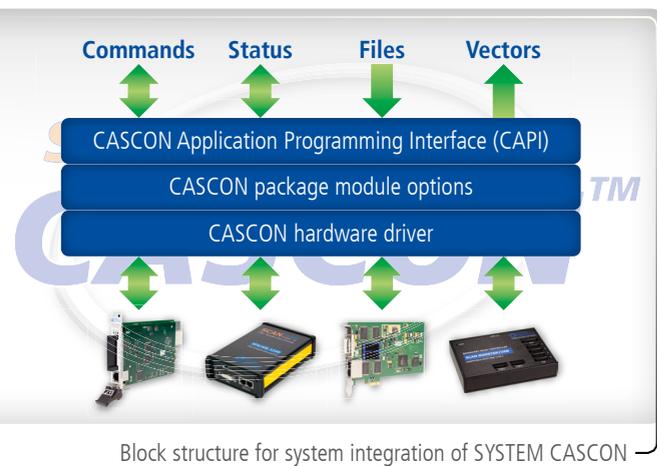
ITAG/Boundary Scan Performance through Perfect Software Integration

Scalable Software Interfaces

In principle, there are **two ways to combine** different test procedures:

- embedded integration (tight or loose coupling)
- vector migration between systems (indirect coupling)

GOEPEL electronic offers **proven solutions for both options**, based on standard products with specially designed, universal software interfaces. Embedded integration uses a common system platform, while indirect coupling is defined by separate execution environments (SW/HW), in which the linking is achieved by merely transferring vectors (remote execution).



Embedded Integration

SYSTEM CASCON offers **CAPI (CASCON API)**, implemented by default for the embedded platform integration option.

This interface has **three different levels** for control and thus offers the highest degree of flexibility and integration depth.

Control Feature	Level 1	Level 2	Level 3
Run time environment setup	✓	✓	✓
Read execution result / report file	✓	✓	✓
Start/stop batch execution	✓	✓	✓
Dynamic control of the test execution	-	✓	✓
Read/write: controller HW, parallel I/O	-	✓	✓
Read/write: vectors, registers, pins	-	-	✓
Read/write: TAP signal bursts	-	-	✓

While **Level 1** only aims at loose integration applications, **Level 2** also enables transparent access to the UUT through parallel I/O and additionally supports non-JTAG compliant targets at the (TAP) interface protocol level. On **Level 3**, the master software also takes over fully independent vector control. This scalability makes it possible to use predefined test programs with dynamically generated vectors, for example, for adaptive fault diagnosis.

Various options are available for system coupling:

- project-specific connection by the user
- system-specific CASCON Link Software (CLS option)

The CLS options are standard products for the integration of SYSTEM CASCON, e.g. contained in various In-Circuit Testers, for which various pre-installed packages are available:

CASCON Module	Run time	Diagnosis	Repair
Executor	✓	✓	✓
Batch sequencer	✓	✓	✓
Pin-failure diagnostics	-	✓	✓
Vector browser	-	✓	✓
Multi-mode debugger	-	-	✓
Layout visualiser	-	-	✓

Vector Migration between Systems

This type of coupling makes use of the **export/import functions** of SYSTEM CASCON to execute test procedures on other systems, such as In-Circuit Testers. In the event of a fault, response vectors will provide feedback, and SYSTEM CASCON will generate the **same fault diagnosis** as if the test were conducted on the **native system**. Migration typically also requires format conversion, which can be provided by GOEPEL electronic in the form of pre-installed solutions.

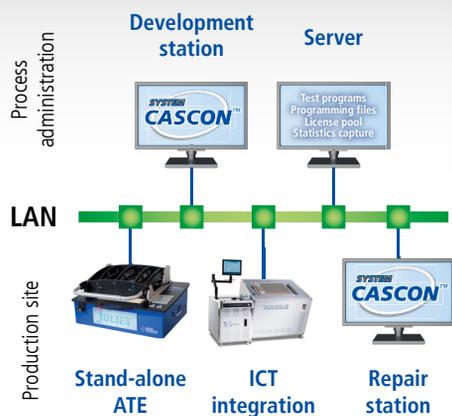


More detailed information and datasheets are available at goepel.com/en/esa/software

JTAG/Boundary Scan Competent In Any Kind of Integration



Desktop ATE and gang tester for production



Example of LAN-based process networking



Examples of customer-specific system integration



System Integration for Production Purposes

GOPEL electronic offers a **broad range of solutions**, including related services, specifically for **automated production testing**. Our portfolio also includes **customer-specific engineering**. The result is a unique combination of products and services for any kind of JTAG/Boundary Scan integration:

- complete desktop tester including adaption (JULIET)
- gang test and gang programming system (SCANFLEX)
- diagnosis and repair systems
- OEM integrations into ICT, MDA, FPT, FCT
- tester for highly accelerated stress screening (HASS)
- optoelectronic test systems
- mechatronic test systems (haptics)
- comprehensive inline test and programming cells
- customer-specific system integrations (PCI/PCIe, PXI/PXIe, LXI)
- customer-specific test program development

Our **global partner program GATE** (GOPEL associated technical experts) provides assistance for the implementation of such integrations.

Process Integration

There is often a need for **integrating stand-alone systems or inline testers** into a specific production environment. Such integrations are typically based on a Local Area Network (LAN) connection or data servers and enable numerous process controls such as:

- dynamic request of software licenses
- download of test programs by means of a look-up table
- dynamic download of programming files
- linking of test and repair stations
- online recording of fault statistics
- server-controlled programming of serial numbers
- remote control of the test system up to vector level.

By default, GOPEL electronic **supports all** listed **process controls** through JTAG/ Boundary Scan systems.

Services for Integration Projects

A broad range of services is available to ensure target-oriented implementation of integration projects. These services include:

- process analyses to determine optimised test strategies
- technology training and system training
- design and realisation of turn-key solutions.

Get the total Coverage!

The **balance** between our **products, features** and **services** enables **full integration**, in line with our corporate philosophy.

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