

Plug and play

Since its introduction as an industry standard in 1990, boundary-scan (also known as JTAG) has enjoyed growing popularity for board level manufacturing test applications. JTAG (Joint Test Action Group) as defined by the IEEE 1149.1 Standard, is an integrated method for testing interconnects on PCBs that is implemented at IC level. One company that has taken the principles of JTAG a stage further is Cambridge-based XJTAG. EMP's Dave Tudor visited the company to see how an already-established technology could be enhanced even more.

XJTAG's CEO, Simon Payne shines some historical light on the subject: "One of our businesses, Cambridge Technology Consultants, who provide product development, design and technical consultancy services, were seeing an increasing number of BGA chipscale devices coming into its designs. They were seeing new prototype boards coming through but were having problems testing and debugging these boards using conventional functional test, largely due to accessibility problems with the board component connections being underneath the package and the fact that boards were becoming more densely populated with an increasing number of BGA devices."

Today's BGAs are becoming progressively smaller, as chief technology officer, Dominic Plunkett explains: "The technology is rapidly shrinking. The distance between solder connections on the latest devices is as small as 0.35mm and this can lead to probe access problems when it comes to testing."

Cambridge Technology Consultants consequently began investigating possible solutions to solve this problem and XJTAG was spun-out as a result. "Most of the solutions that were available in the marketplace at that time came from a bed-of-nails manufacturing background, making them unsuitable for a design and development environment," continues Simon. "It soon became apparent that nothing was really available in the marketplace that would suit our needs, so we decided to design and develop our own solution which took around three years to develop."

► A new product is born

The XJTAG Development System was born and launched commercially in 2003. "It's worth pointing out that although the JTAG Standard has been around for some years, it's only recently been prevalent on chips and components. JTAG capability needs to be actually designed into the chips themselves by the chip manufacturers and this has only recently started to become commonplace," Dominic explains. "We're now seeing JTAG compliance on more and more chips, including those at the low-end of the market. In order for JTAG testing to work there needs to be a minimum of one JTAG-enabled device on the board and connectivity to other JTAG-compliant devices is achieved via four pins. Through this connection, the interconnects of the other devices on the board can be checked and the whole circuit can be tested."

The XJTAG Development System is compact in size and prices range from £3,500 to £9,000. Designed specifically for ease-of-use at all levels within an organisation, the system includes a demo board, software CD and XJLink (USB2 - JTAG connector) in a small, portable carrying case. The software contains user-friendly tutorials explaining how to use XJTAG and software upgrades for the first year are incorporated in the cost price. After the first year has elapsed, upgrades are subsequently chargeable. The software also



enables users to write their own test programs although the company offers this service also, and XJTAG is offering a 30-day, no obligation, free evaluation of the software to potential customers so that they can use the system in their own environment. Additionally, the software licence provided allows the software to be installed on as many computers as is required.

To operate the system, a laptop or desktop computer running Windows XP/2000 is required and XJTAG claims that the system offers several advantages over conventional flying probe and X-Ray systems as Dominic enthuses: "In comparison, flying probe machines are very large, expensive, time-consuming to set-up and have high maintenance requirements due to the mechanical methods used to move the probes around with high accuracy. In addition to this, if you have components on both sides of the board, additional probes will be needed to for testing. Finally due to their sheer size, you won't find too many flying probe machines installed in a design and development lab. X-Ray machines do enable under-chip inspection but again these are relatively large and expensive and they don't always show up hard-to-find defects such as micro-fractures and they won't tell you if you have good electrical connectivity or not. We're not saying that XJTAG is the only testing equipment you'll ever need, but it definitely can play an important part in the test equipment arena at all levels and this will become apparent as awareness of the technology increases."

► Non-JTAG devices

So what about testing devices on the board that are not JTAG-compliant? Dominic explains: "We've taken the original JTAG Standard and enhanced it so that the majority of non-JTAG devices can be accessed. Because we have control of all the I/O pins on the JTAG devices, we can send patterns of data out and receive patterns of data back and check those patterns against known values relating to how we would expect the chip to behave. In this way we are able to test most non-JTAG devices via data pattern comparison, and although

XJTAG is essentially a digital system, it can test a wide range of analogue devices also."

According to XJTAG, the system enables circuit designers to cut the cost and shorten the development cycle and prototyping process by facilitating early test development, early design validation of CAD netlists and fast generation of functional tests. The XJTAG Development System can migrate seamlessly through the product life cycle from early design to field support and repair and can test a high proportion of the circuit (both JTAG and non-JTAG devices) including BGA and chip scale devices, SDRAMs, ethernet controllers, video interfaces, flash memories, FPGAs and microprocessors. XJTAG also enables in-system programming of FPGAs, CPLDs (complex programmable logic devices) and flash memories and test scripts are re-usable and portable across different boards due to the 'device-centric' approach that the designers have adopted.

Simon comments: "Sales to date have been very encouraging with board developers in market leading companies such as ARM, Barric, Cambridge Broadband, Hansatech, nCipher, Pandora International, Prism Electronics, Thales UK and TTPCom choosing the XJTAG system due to its competitive price and the reusability and portability of test scripts. The business benefits provided by the XJTAG system are simple - designers and developers of printed circuits are able to test and debug their designs in days, as opposed to weeks with many other comparable boundary scan systems."

"XJTAG's strategy has been to price the system competitively to encourage multiple sales per company," continues Simon. To facilitate this, we have signed a distributor agreement with Diagnosys, providing a sales channel into North America and continental Europe."

► The proof is in the eating

Cambridge Broadband has signed a multiple licence agreement to make the XJTAG Development System available in key global locations. The system will also be used by its contract manufacturing partner, Benchmark Electronics, for testing production boards.

"We assessed the solutions from several leading boundary scan test suppliers and opted for the XJTAG Development System because of its price, reusability of scripts and its unbeatable speed of test development," said Alistair Massarella, co-founder and head of product integration at Cambridge Broadband. "Using XJTAG we can now test and debug our boards in days as opposed to weeks. Our designers are now JTAG aware and we are getting our boards into the field far more quickly than before."

nCipher has licensed the XJTAG boundary scan development system for use by its engineering team at its headquarters in Cambridge, where its range of hardware security modules (HSMs) are designed and developed. The XJTAG System will also be used by nCipher's contract manufacturing partner, Hansatech, for testing production boards.

"We opted for the XJTAG Development System as it offered us a best practice solution for testing our boards. XJTAG was also half the price of the nearest alternative, while still offering all the features we required," said Colin Domoney, digital hardware design engineer at nCipher. "With XJTAG, we have a modern, flexible solution that can test a high proportion of the circuit including JTAG and non-JTAG devices. It enables us to test and debug our boards in days as opposed to weeks, run connection tests and port device-centric test scripts across different products - saving valuable development time. XJTAG also allows us to test and program flash chips in a fraction of the time it took us previously."

► XJTAG
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XJTAG's Dominic Plunkett with Alistair Massarella of Cambridge Broadband