

## Manufacturing Test System for MPEG2 DVB Digital Broadcast Decoders

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**The Challenge:** Developing an end-of-line automated functional tester to ensure the functionality and parametric quality of complex digital receivers used to decode video, audio and private data for terrestrial, cable and satellite broadcast systems.

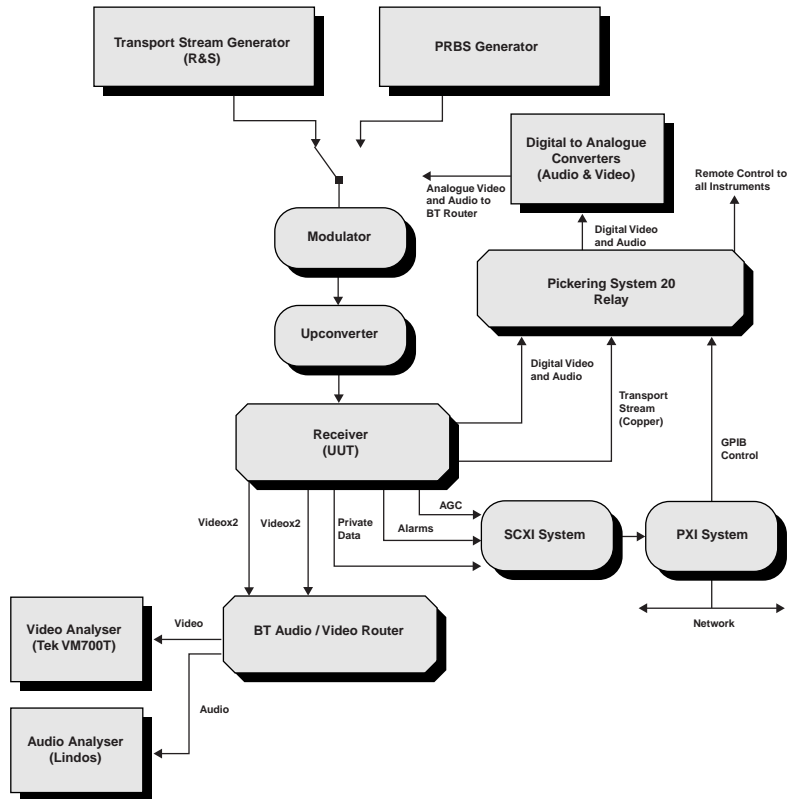
**The Solution:** Building a machine using a PC-based system of RS-232, GPIB, PXI, SCXI and LabVIEW.

### Introduction

NDS Ltd of Southampton UK, is the world's leading supplier of MPEG2 DVB digital compression systems, that allow broadcasters to encode and distribute sound, vision, and data to other providers or consumers using a much-reduced bandwidth. As an example, digital video in a studio environment has a data rate of 270 Mb/s, in contrast, an MPEG-2 compressed video stream varies between 0.5 and 50 Mb/s, depending on the desired quality. A VHS quality compressed video stream requires a bit rate of approximately 2 Mb/s. Transmission is via satellite, terrestrial, or cable links, either between broadcaster and service provider or service provider and subscriber. A good example is the 1998 football World Cup Tournament, in which

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NDS was responsible for providing all the compression equipment to the European Broadcasting Union (EBU) EuroVision Network, from which the transmissions were beamed throughout the world via terrestrial and satellite uplinks. As a manufacturer, NDS has the difficult task of testing these complex devices as part



*A Block Diagram of the Test System*

of the manufacturing process. When looking for solutions to end-of-line test, they approached a National Instruments Alliance Member, Advanced Test Methods of Camberley, UK, for help. ATM recommended their System 2000, an off-the-shelf functional test platform based on LabVIEW and the Test Executive.

### System Design

The test system has evolved over several years; previous versions were based on desktop PCs running Windows, data acquisition (DAQ), custom SCXI, RS-232, and GPIB-controlled instruments. The instruments used reflect the specialised nature of the tests required. The test system incorporates a core set of instruments with switching to provide a flexible base from which to test different products or different variants of the same product.

The software is based on LabVIEW and the Test Executive, which has been extended by Advanced Test Methods to form the

System 2000 functional Tester. A typical test set for a decoder involves 200-250 steps within 5-6 sequences and the tester has been designed to test several different variants. The unit under test (UUT) is a professional integrated receiver decoder (IRD) unit. This unit receives QPSK modulated data from satellite downlinks, demodulates and decodes this data into baseband video, audio, and private serial data. One of the main functions of the IRD is as a system watchdog, for monitoring of signal quality and alerting the operator to any problems.

### System Details

A diagram of the test system is shown in the figure. Two MPEG2 transport streams are generated, one by a Rohde & Schwarz DVG and the other by a NDS proprietary PRBS transport stream generator. The required transport stream is switched to an EF Data Digital Satellite Modulator where it is QPSK modulated and then fed to the

up converter. The up converter output is fed to the UUT where it is demodulated and decoded. The UUT has a number of video and audio outputs in both analogue (PAL and NTSC) and digital (625 and 525) formats as well as private serial data (RS-232 and RS-422) and alarm/ monitor outputs. The digital video and audio outputs are routed to the digital to analogue converters via a Pickering System 20 router using an 8x SPDT-relay module and a 4x RF-relay module. All analogue video and audio signals are routed to the measurement instruments via a broadcast technology router. RS-232 remote control of all instruments is achieved from COM port 0 by the use of a 15x3 multiplexer module situated in the Pickering System 20. The UUT also has serial transport stream outputs in both copper and fibre-optic formats. The copper format at 270 Mb/s is routed to the measurement system again by the Pickering System 20. The alarm/ monitor outputs are fed to the DAQ system and the RS-232 private data is fed

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back to the controller via the multiplexer module in the Pickering. The RS-422 private serial data stream is checked by a custom built SCXI module and the pass/fail result is fed to the data acquisition system. The extensive use made of the Pickering System 20 switcher means that GPIB also plays an important part in the test system because this is the controlling mechanism of the Pickering System 20. A second custom SCXI module is included so the UUT can be controlled by either RS-232 or RS-485 data formats.

The heart of the test system is a PXI-1000 chassis containing a PXI-6070E MIO module, which is cabled to the SCXI system to read analogue values from the UUT such as the AGC signal. Finally the UUT is interfaced to the test system via a Virginia Panel TAC connector, so different test harnesses can be added as the tester is applied to new products.

The software for the tester is based on Advanced Test Methods Systems 2000. This is a combination of LabVIEW, a Test Executive, and databasing tools, designed for rapid development of test modules and the storage and retrieval of previous and current test data. The whole suite consists of 200-250 individual tests and around 160 LabVIEW VI's developed for this application. A full system test takes 8-10 minutes, well inside the required production target of 12 minutes per unit.

#### The Benefits

The system is based around industry standards, and as such can be modified and supported for many years. Earlier systems were based on desktop PCs, that in a production environment were found to be unreliable. To overcome this problem, we used the PXI modular system, which is

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designed from the ground-up to be rugged, reliable, and easy to expand and repair. Nick Storton highlighted the speed, robustness, and connectivity of PXI as the major advantages, and cited the fact that "They are built to run 24 hours a day, unlike office PCs." As an added benefit, on a shop floor the PXI system is easy to secure and has the look and feel of a truly industrial tool, it comes with all the interfaces necessary to link to the network and other equipment via RS-232 and GPIB.

#### The Future

Future developments will include the upgrade of the existing four test systems and the engineering development system to a PXI-based system with Virginia Panel TAC connectors to increase the production throughput of the products tested on those systems. Custom SCXI will also play an important part in the continuing enhancement and improvement of these test systems as will off-the-shelf SCXI modules. ▶

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