GaGe

APPLICATION NOTE
Network IC testing

Challenge

Home networking has become extremely popular, thanks in part to trends such as telecommuting and independent work from home. With broadband and the convergence of services, even more traffic needs to be handled by wired and wireless routers. Consequently, it is important to find ways to enable home networking, especially for homes that lack a specialized infrastructure.

A customer makes Integrated Circuit chips that are used in home network systems. These systems can communicate with many different electronic devices by using the standard 120 Volt, 60 Hz AC household wiring to transmit signals throughout the house. This eliminates the need for extra wiring.

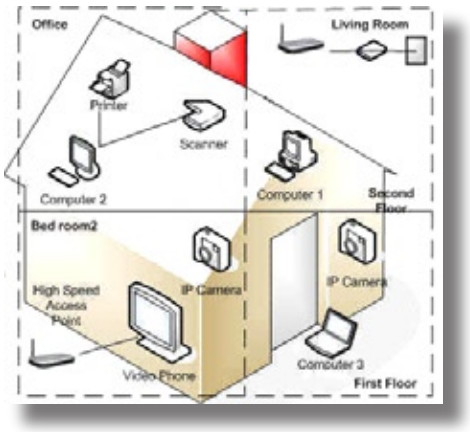
The customer needs to automatically test large lots of IC chips before selling them to the company that builds network systems. They need to verify that the Signal-to-Noise Ratio (SNR) of various analog signals, the bit error rate, the relative timing accuracy of certain digital test point signals, and various other measurements conform to their performance specifications before shipment.

For these manufacturing tests, the customer requires a programmable analog stimulus generator in order to excite circuit elements and a programmable digitizer in order to capture response signals. Most tests within the test suite require only one or two stimulus/response channels. However, some of the more advanced tests require the generation of 4 simultaneous output stimulus waveforms and the acquisition of 4 simultaneous input response signals. Both the generator and digitizer require at least 10-bit vertical resolution in order to characterize small signal features and must work at clocking speeds of up to 50 MHz. Some test points produce noisy but repetitive signals and so the customer was interested in having the ability to perform rapid signal averaging in order to improve signal fidelity.

The ideal solution will be housed in an existing Windows-based PC, equipped with automated IC manipulators and other PC-based devices. The customer would like to quickly develop a C program to control the entire manufacturing test system.

An Integrated Circuit chip manufacturer needs to verify performance of large shipments of IC chips before delivering them to their customer, a company that builds network systems. They need to test the Signal-to-Noise Ratio (SNR), the bit error rate, and other key IC chip performance parameters.

A programmable 4-channel analog stimulus generator is required to excite circuit elements and a programmable 4-channel digitizer is needed to acquire response signals. For this purpose, the customer chose GaGe's CompuGen 4300, analog output (D/A) card and CompuScope 8244 digitizer card and integrated them into a powerful, customized manufacturing test system.



Manufacturing Testing

Solution

GaGe provided both of the PC-based instruments required to test the IC chips: a function generator card and a digitizer card. The CompuGen 4300 is a PCI analog output (D/A) card with 12-bit vertical resolution that is capable of generating 4 simultaneous output signals at a clocking rate of up to 300 MHz. The CompuScope 8244 is a 12-bit PCI digitizer card capable of simultaneously sampling at up to 50 MegaSamples per second on 4 channels. The CS8244 belongs to the CompuScope Octopus multi-channel digitizer family, which includes over 35 models and so allows for cost-effective selection of only the required functionality. With these two PC-based instrument cards, the customer can generate up to 4 stimulus signals and capture up to 4 response signals from the IC chip under test.

The CG4300 is equipped with 1 MegaSample of on-board memory per channel. Using the CG4300's unique LinkN'Loop mode, the customer is able to pre-load the on-board memory with a portfolio of distinct stimulus signals. For instance, the customer could upload 2,000 stimulus signals of 500 points each to CG4300 memory and then rapidly switch among them with no further data upload required.

The customer can use the CS8244's powerful Multiple Record mode in order to rapidly acquire repetitive waveforms for signal averaging. The CS8244 comes with 128 MegaSamples of on-board memory, which may be shared equally among the 4 input channels. The customer could then, for instance, rapidly acquire 32,000 waveforms of 1,000 points each on all 4 channels and then download them to PC RAM very rapidly through the PCI bus. Within PC RAM, the waveforms may be quickly summed together in order to produce a single signal-averaged waveform with a dramatically-reduced noise level.

In order to improve signal averaging performance even further, the customer may elect to obtain the GaGe eXpert™ Signal Averaging on-board processing firmware option which allows extremely rapid signal averaging to be performed on-board the CS8244 digitizer. The eXpert Signal Averaging option may be implemented either at the factory prior to shipment or remotely at the customer site. This way the customer may evaluate the signal averaging performance provided by the CS8244's Multiple Recording mode before deciding if the faster signal averaging of the eXpert option is required for their IC tests.

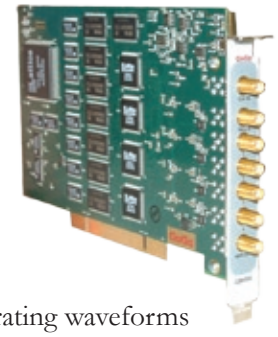
Results

The customer is able to prepare a prototype system using only GaGe's powerful free standalone software without having to write a single line of computer code. Using CGTest, the customer can load stimulus signals from pre-prepared ASCII files and generate them on all 4 channels. Using GageScope Lite, the customer can completely control the CS8244 and store resultant waveforms to data files that may then be analyzed to provide performance specification measurements.

The customer can use both GaGe's CompuGen and CompuScope Software Development Kits to construct a fully-automated Windows software application, written in C, that controls all GaGe hardware, along with the customer's IC manipulators and supporting electronics. The CompuScope C/C# SDK provides multiple powerful sample programs that illustrate the usage of CompuScope hardware in various operating modes. These sample programs serve as ideal starting points for the customer's software application. From the waveform data acquired by the CS8244, the application

CompuGen 4300

Arbitrary waveforms are generated by creating a digital representation of the waveform in the memory on-board the CompuGen 4300. This digital pattern is then converted into an analog signal using a high-speed Digital-to-Analog Converter (DAC) and 50 Ω drive output amplifiers.



CompuGen 4300 Features

- 4 simultaneous output channels
- 12-bit resolution
- 300 million conversions per second
- 4 MegaSamples of on-board memory
- 30 dB software-selectable output attenuators
- Free CGTest software for importing and generating waveforms
- Free Software Development Kits for C/C++, MATLAB & LabVIEW

CompuScope 8244

The CompuScope 8244 is part of the Octopus family of multi-channel digitizers. The Octopus family offers up to 8 channels, 10 to 125 MS/s sampling rates and up to 4 GB on-board acquisition memory, all on a single-slot PCI card. The CS8244 samples analog signals at speeds up to 50 MS/s with 12-bit resolution and stores the data in on-board memory.

Octopus Family Features

- 2, 4, or 8 digitizing channels
- 10, 25, 50, 65, 100, or 125 MS/s sampling per channel
- 12 or 14-bit vertical resolution
- 128 MS to 2 GS on-board memory
- More than 100 MHz input bandwidth
- Full-featured front-end, with software control over input ranges, coupling, impedances and filtering
- Advanced timing features such as Trigger In/Out, External or Reference Clock In/Out and TimeStamping
- Programming-free operation with GageScope® oscilloscope software
- Software Development Kits available for LabVIEW, MATLAB, C/C# and other programming environments

will automatically calculate and display values of the SNR and the other required performance parameters for the current IC chip under test. These values are automatically compared against the required specifications. A Pass/Fail criteria then automatically determines whether the IC chip is accepted. In this way, the manufacturing test system guarantees that all IC chips provided to the home network system manufacturer are within the agreed-upon specifications.

GaGe is able to provide a complete PC-based instrumentation solution to the manufacturing test requirement, including a multi-channel waveform generator, a multi-channel waveform digitizer, and a powerful suite of controlling software. Using these powerful, high-performance tools the customer is able to quickly construct a working prototype, with no programming required. Subsequently, the customer is able to easily integrate the GaGe PC-based instrumentation into a complete manufacturing test system that is tailored to their needs.

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