# DIGITAL SYSTEM

#### Technology Overview

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### NORDCO DIGITAL ULTRASONIC PROCESSOR

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**DIGITAL PROCESSING SYSTEM** FOR INDUSTRIAL & TONNE UE SYSTEM





**KEY FEATURES** 

DIGITAL PROCESSING SYSTEM FOR MICRO UE SYSTEM

- channel
- throughput

**Advanced Digital Platform** for addressing precision ultrasonic testing applications

**Simultaneous Processing** of multiple test channels, thereby decreasing system cost per

High-Pulse Densities and Testing Speeds, for enhanced defect detection and

High Signal-to-Noise Ratios and Linear

**Reject** provided through the enhanced **Digital Signal Processing techniques** 

Synthesized ultrasonic calibration standards digitally reproduce RF ultrasonic calibration signals for Automated Calibration Processes

Automatic DAC Curve Generation from Digitally Synthesized Standard Test Frame

Reconstructed High-Resolution Detected Video Display with **Selectable Filtering** 

## **SYSTEM ARCHITECTURE**

- Modular Architecture based on open specifications and standards, allows Nordco to <u>deliver complex systems based on a common set of building blocks</u>
  - PCI Express<sup>®</sup> high-speed serial links for board level interconnect
  - Serial RapidIO<sup>®</sup> for high-speed digital exchange between devices on a single board
  - Compact PCI<sup>®</sup> chassis with 3U and 6U system board form factors
  - Compact PCI<sup>®</sup> modular plug-in chassis power supplies
  - Standard Gigabit Ethernet Switch
- **High-Speed Full-Duplex** digital data connections
  - 10 Gigabit full-duplex digital connection to each Multi-Core DSP Module
  - 5 Gigabit between signal processing elements on each Board
- Combining a **powerful FPGA** (Field Programmable Gate Array) device for implementing high-speed sequential signal processing tasks in real-time, with an advanced six-core Digital Signal Processor (DSP) providing parallel execution of signal processing software algorithms
- All DSP and system board supply **voltages generated locally** from backplane power feeds eliminating power distribution and voltage tolerance problems
- High level of **electronic circuit density** leading to <u>small instrument package</u>; further size reduction possible through high-speed channel multiplexing



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#### SYSTEM DIAGRAM





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# DIGITAL QUAD PULSER / PRE-AMPLIFIER

- Four **independently controlled ultrasonic pulsers** per module
- Capable of addressing a <u>wide range of ultrasonic applications</u>. Each ultrasonic pulser's attributes are software programmable via DSP
  - **Firing Delays**
  - Frequency of transmitted Burst Waveform
  - Number & Phase of transmitted Burst Cycles
  - **Transmission Line Terminations**
  - RF Preamp Gain
- Dedicated active damping circuit to dynamically reduce the Return-to-Zero Recovery Time, enabling small signals to be clearly resolved
- Independent software control of static gain settings and dynamic time time-varied gain functions (i.e. Distance Amplitude Correction). This provides for <u>accurate and reproducible</u> **Channel-by-Channel calibration gains** and DAC functions.





## **MULTI-CORE DIGITAL SIGNAL PROCESSOR**

- Digitally controlled **analog RF Front-End** circuit for each ultrasonic channel with provisions for "soft-limiting" large signal amplitudes, preventing the loss of signal resolution due to RF amplifier saturation
- Independent control of DC offset, positive peak and negative peak signal limiting in the RF amplifiers
- Independent software control of static gain settings and dynamic time time-varied gain functions (i.e. Distance Amplitude Correction). This provides for <u>accurate and</u> <u>reproducible</u> Channel-by-Channel calibration gains and DAC functions.
- Received ultrasonic signal is digitized and pre-processed through digital noise reduction algorithms using Wavelet Transforms. This adaptive signal processing technique provides an increase in signal-to-noise ratio, enabling small signals to be clearly resolved.
- Digital processing of up to 8 inspection gates per channel for the detection and measurement of up to **16 echoes** within each inspection gate enables advanced ultrasonic analysis



### I/O PROCESSOR

- Provides a high-speed interface to system resources
- 32 bit **RISC processer** element
- Dual gigabit **network ports**
- Various optically isolated **external circuit interfaces** 
  - 8 Differential Outputs (EIA-422-B and ITU compliant). These circuits can be configured as 2 sets of 4 Differential Outputs; 1 set of 4 Differential Outputs and 8 Single Ended 5 volt outputs; or 16 Single Ended 5 volt outputs.
  - **16 Differential Inputs** (EIA-422-B and ITU compliant)
  - 6 Analog Inputs capable of a 0 to 5 volt Unipolar, or ± 2.5 volt Bipolar Differential Input Range.
  - 18 Single Ended Inputs capable of detecting minimum transitions of 0 to 5 volts, and maximum transitions of 0 to 24 volts. These inputs have protection clamps that trigger on voltages greater than 24 volts.
  - 6 Solid State Relay Contacts rated for 60 Volts (AC or DC) at 1 Amp



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## **DIGITAL SYSTEM BENEFIT SUMMARY**

- Advanced, digital signal processing high resolution digitizing of RF signals, elimination of noise issues, advanced analysis of ultrasonic signals
- Real-time, parallel processed algorithms faster execution enables higher test-speeds / throughput, pre-processing on the hardware level speeds up windows applications
- Modular, standard based architecture low maintenance costs, ability to upgrade modules or firmware to take advantages of new features

#### • Flexibility, highly configurable

hardware and software can be easily adapted and optimized to various ultrasonic applications, flexible I/O for interfacing with external systems and automation

• State-of-Art, modern digital system solid platform for development of new applications and future innovations (futureproof)

