ATI ACCURATE TECHNOLOGIES

Pi Innovo™

MATLAB Enabled

MathWorks Partner

OpenECU M670-FPGA In-Cylinder Pressue

Calculating Burn Rate with M670 equipped with FPGA

In-Cylinder Pressure

Heat release curve crank degree vs. burn percentages

- Crank angle of combustion for different percentages such as CA10, CA20, CA50 and CA90

Max pressure rise rate and location

- Provided in crank degrees

Peak pressure value and location

- Provided in crank degrees

MATLAB, Simulink and Stateflow compatibility using HDL Coder and Intel Quantus II

High Performance

- **Fast Processing** – 100MHz clock (up to 450 MHz capable)
- **Highly Parallel** – Execute complex calculation in parallel with MCU and other calculations
- **Fasts Multipliers** – 18x18 bit 1 clock multipliers
- **Instant On FPGA** – No lag between power up and operation
- Provides 50k logic elements for calculations
- **Co-Processor** – Nios II soft core processor

Benefits

- Adds fast execution of complex calculation in parallel with MCU and other calculations
- Massively parallel processing
- Digital Signal processing
- Custom real-time calculation

OPEN ECU® By Pi Innovo

Pi Innovo™

Capabilities

HIGHLIGHTS	
Processor	Altera/Intel Max 10 10M50DAF256I7 FPGA
Clock Rate	100 MHz (up to 450 MHz)
Logic Elements	Up to 50 K
DSP Blocks	Up to 144 integrated 18x18 bit multipliers
PLL Clock Units	4
FPGA ROM Space	Up to 736 KB
External ROM Space RAM Space	Up to 64 MB Up to 1,638 KB
External RAM space	Up to 64 MB DDR2 RAM
Digital Inputs	2 external channels (12 internal channels)
Analog Inputs	10 channels
ADC	Dual 12-bit 1MS/s ADCs
Communication interface to MCU	6MHz Serial Peripheral Interface (SPI)
Required Tools	Mathworks: MATLAB Simulink

REAL TIME COMBUSTION CONFIGURATION HIGHLIGHTS	
Burn rate resolution	0.1 degree
Burn percentage angle reported	At 16 configurable heat release percentages per firing
Max rate of rise	1
Cylinders	Up to 8
Maximum Engine Speed	8,000 RPM
Acquisition to result time	125 microsecond (<6 degrees at 8,000 RPM)
Calculated Values (per cylinder firing)	Maximum Pressure Maximum Pressure Crank Angle Maximum Pressure Rise Rate Maximum Pressure Rise Rate Crank Angle Net Heat Release
Digital Filtering	Configurable low pass cutoff
Device Utilization	60% remaining space available for additional processing

Overview

Because accurate measurements of cylinder pressure and crank angle are crucial factors when developing combustion engines, Pi Innovo now offers the M670 FPGA option is designed to support complex high-speed calculations in parallel with the M670 MCU. Calculation offered in the FPGA option is real time combustion analysis based on in-cylinder pressure. This real time combustion feedback to the M670 microprocessor allows adaption of the control strategy to provide optimal combustion of fuel in an engine. This feedback method has been shown to provide high efficiency and smoother power.

This provides real time results that can be used for advanced control of the most demanding applications.

M670 takes advantage of the daughter board expansion of the FPGA option to add advanced high- speed processing capabilities to allow in-cylinder pressure using MATLAB and Simulink API.

By taking advantage of connector pins reserved for the internal expansion board the FPGA option provides all functionality of the M670 along with the additional functionality provided by the FPGA system.

Calculation implemented in the FPGA option is real time combustion analysis based on in-cylinder pressure. This real time combustion feedback to the M670 microprocessor allows adaption of the control strategy to provide optimal combustion of fuel in an engine. This feedback method has been shown to improve high efficiency and peak output.

Other Potential Application Areas

Depending on FPGA experience and complexity of the application, other applications could be developed. These applications could include:

- Ionization Current monitoring and feedback allowing ignition and combustion quality feedback
- Fast Fourier Transform Knock Analysis allowing discrimination of knock from engine noise
- Custom Communication protocols
- Custom high speed or high-performance algorithms

Note: Currently only In-Cylinder Pressure is available. For more functionality contact us at info@pi-innovo.com

ATI ACCURATE TECHNOLOGIES
sales@accuratetechnologies.com
www.accuratetechnologies.com

OPEN ECU By Pi Innovo Pi Innovo