IEEE 1451 compliant coremicro® Reconfigurable Embedded Smart Sensor Node (CRE-SSN)

Description

This ultra low power, miniaturized (down to 1.7"x1.7"x 1.1"), and multi-functional Smart Sensor provides high performance functions with (i) robust data acquisition, (ii) IEEE 1451 software stack (standard communication protocol, fault detection awareness, and TEDS management); (iii) flexible on-board communications (I2C, UART, IrDA, SPI, and RS232); and (iv) wireless communications (Zigbee). Main features and smart node characteristics are listed in Table 1. Building on the baseline features, the CRE-SSN can be customized (*optional*) for hosting embedded intelligent functions such as:

Figure 1: Modular and Small Form Factor (Baseline Enclosure)

- Health monitoring by processing signals from the attached transducers (single unit or suites) and feeding pattern recognition software
- Valid data generation by sensor self-diagnostics
- Calibration
- Self-identification

The CRE-SSN is a low cost product that can be used as a smart sensor testing node with advanced & embedded processing, flexible communication modules, and low power consumption. Sensor suites are customizable for containing up to 5 different types of sensors per module (two examples are illustrated in Figure 4).

Within the IEEE 1451 framework, the Zigbee baseline communication module can be replaced for other types, including IEEE 802.11.x and Bluetooth (under request).

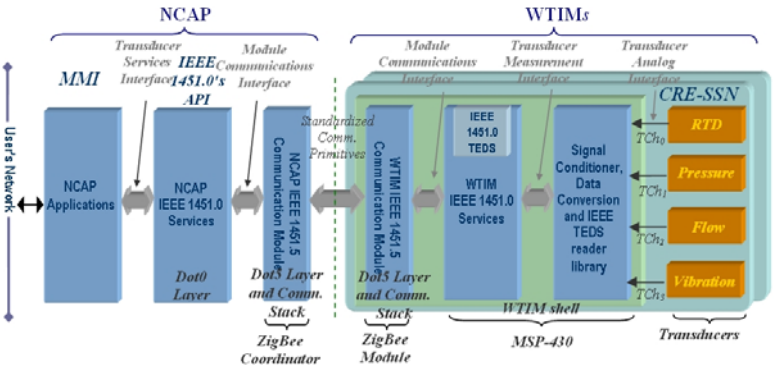

Figure 2: Designed for Operating Within the IEEE 1451 standard

Table 1: CRE-SSN - Main Specifications

Feature	Specification
CPU	RISC (16 bits) with *Hardware Multiplier*
Immunity to power voltage changes	Internal modules are designed to operate properly within an input voltage ranging from 1.8 to 3.6v
Clock	4 MHz (up to 16)
Program Memory	116 KB + 256B Flash Memory
RAM	8 KB
Timers	2, three outputs available for PWM control and event period measurement
DMA	Three-Channel
Standard Ports	JTAG and RS-232 (2 row connector)
Powering	3 configurable sources: (a) AC/DC (12v); (b) battery; and (c) customizable source
ADC	Up to 200 Ksps, 7 channels, programmable S&H timing, and 4 core configurable sampling modes
Dimensions	1.7 x 1.7 x 1.1 " (approximately w/o casing)
Available in the Expansion Connector and Expansion Board	
Digital Input/Output	16 interfacing signals (GPIO, ADC-channels, timer, communications)
ADC	12-bit (up to 7 external channels)
DAC	2
Standard Communications	USC1 allows UART, IrDA, and SPI communications. UCB0 for I2C interface

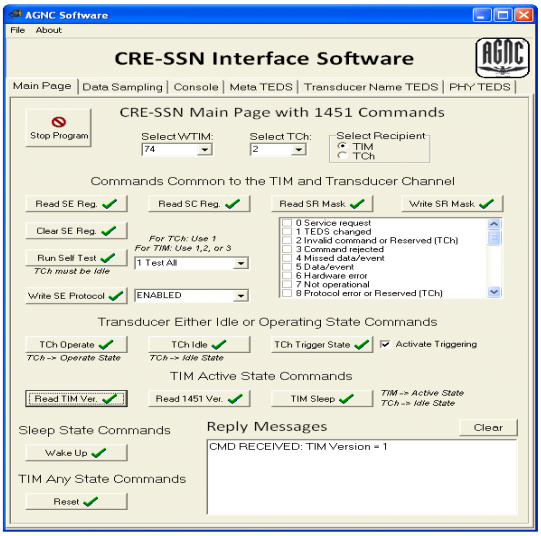

Figure 3: Man Machine Interface (Hosted in the PC Base Station)

Table 2: CRE-SSN Hardware Advantages

Feature	Description
Hardware Multiplier	To enable efficient computation of embedded algorithms
Support for Power Management	Already available input channel to monitor the power level to the MCU
Power Voltage Change Robustness	Internal modules are designed to operate properly within an input voltage ranging from 1.8v to 3.6v
High Performance Data Acquisition	200 ksps, with DMA, timers, and buffers, programmable S&H timing, and four core configurable operational modes
Ultra Low Power	Standby 0.5 μA and 5 low power operation modes
Form Factor (option)	Size of 1.7 x 1.7 x 1.1" (minimal size as an *option*)

Systems can be deployed in a modular way (rail mounting) by stacking several modules along with a power module (that serves several nodes). For distributed configurations, each CRE-SSN requires a complementary power module for standalone operation

The CRE-SSN enables customization and flexibility to configure the module with required sensor suites (selected according to the application when placing the order). An MMI (shown in Figure 3) provides a fast way to set up networks of CRE-SSNs, but also an available Application Programming Interface (API) allows custom software design (with execution of the command set listed in Table 3)

Table 3: Supported IEEE 1451 Commands

WTIM or TCh State	Dot0 Command
WTIM active TCh in any state	Query TEDS
	Read TEDS segment
	Write TEDS segment
	Update TEDS
	Run Self-Test
	Write Service request mask
	Read Service request mask
	Read Status-event register
	Read Status-condition register
	Clear status-event register
	Write status-event protocol state
TCh in Idle State	AddressGroup definition
	Sampling Mode
	Calibrate Transducer Channel
TCh in Operating State	Read TransducerChannel data-set segment
	Write TransducerChannel data-set segment
	Trigger command
TCh either Idle or Operating state	TransducerChannel Operate
	TransducerChannel Idle
	Write TransducerChannel Trigger State
WTIM Sleep	Wake-up
WTIM Active State	Read TIM version
	WTIM Sleep
	Read Dot0 version
Any State	Reset

(a) Pressure and (b) Flow Rate
Figure 4: Sensor Option Examples (Customizable)

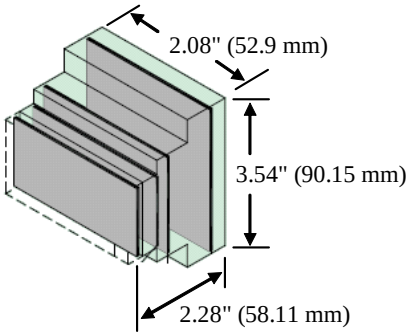

Figure 5: Baseline Module Dimensions

Systems Health-Monitoring Design Services

Network of CRE-SSNs enable distributed hardware platforms, which can be complemented with AGNC's software toolsets for a fully intelligent system suitable in high performance *health monitoring applications*. Advanced analysis tools include: Optimized Neuro Genetic Fast Estimator (*ONGFE*) for designing Artificial Neural Networks; Real-Time Kernels for feature extraction (time and frequency domain as well as wavelet analysis); and custom GUIs for complete system visualization and analysis. This full set of capabilities has been demonstrated successfully in NASA and DoD applications.

American GNC Corporation
888 Easy Street, Simi Valley, CA 93065
Tel: (805) 582-0582 Fax: (805) 582-0098
Website: www.americangnc.com