VW8000 Wireless Power Controller

Voltraware's VW8000 Wireless Power Controller based on the BCD process of STMicroelectronics, provides a cost-effective platform, and simplifies the design-critical areas for a high performance, smart and safe wireless power transfer system

Background

VW8000, A 68 pin eQFN, is the result of consolidating WiTricity's wireless charging technology IP blocks with STMicroelectronics' essential IP blocks into an ASIC that serves as an Analog Front End on the Tx side with over 200 built-in registers for programming and non-volatile memories for calibration

General Description

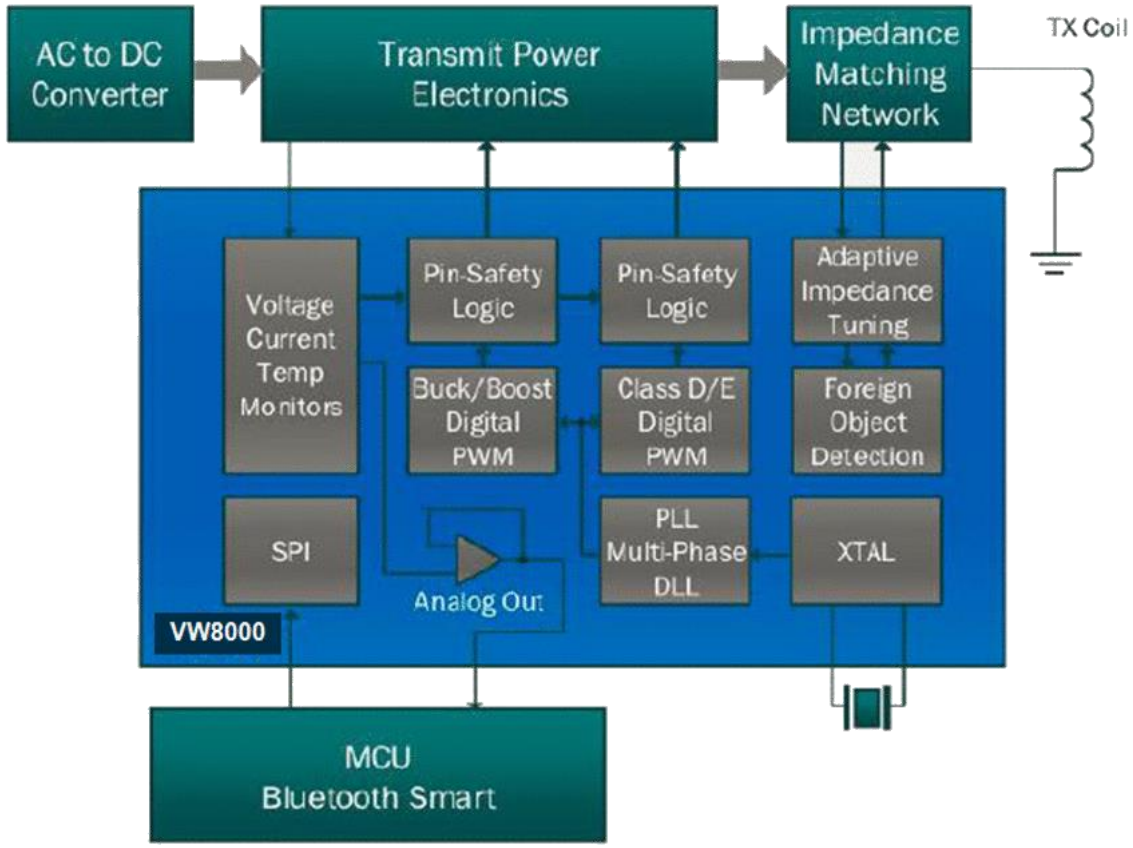
The majority of power delivery electronics today work in switch-mode, and they all share a basic principle that power being delivered needs to be managed with some clever sequencing of on and off cycles of the transistors to make it suitable for a load. Furthermore, for efficient power transmission to a specific load condition, high-precision impedance measurement and matching part of the work must be performed as well. To address this, VW8000's design is basically an 8 input 16 channel analog signal acquisition and conditioning system together with built-in (2 high resolution and 4 standard resolution) PWM signal generators. When paired with an MCU and an ADC (BLE optional), VW8000 provides key system analog signals to ADC for digital signal processing by the MCU. When the various system operating parameters are known to the MCU, MCU can then manage the whole power delivery system with optimized performance and safety.

VW8000 can be deployed to support all A4WP classes. Compatible VW8000 systems can be built to support A4WP and Qi. System based on the VW8000 ASIC can meet or surpass the most aggressive stretch design goals delivering previously unknown high levels of performance at affordable costs.

Features

- Single ended and differential signal conditioning and multiplexing circuits with programmable Finite State Machine to provide selected analog signals to the MCU ADC (0-3.3V) with reduced MCU overhead.
- 2 high resolution (12ns steps with additional 17x700ps steps for fine tune) and 4 standard resolution PWM engines for RF inversion, DC/DC conversion, fan, and LED control, etc.
- 4-pin slave-addressable serial peripheral interface (SPI) for VW8000 IC control and status
- Digital static control to MCU (3.3V) including interrupts and synchronization inputs
- LDO to power MCU (3.3V).
- 16 x 5V GPIO interface, controlled via SPI bus for external mixed-signal peripherals
- 4 x 3.3V GPIO interface, controlled via SPI bus (not 5V compatible)
- DC current shunt monitor
  - External load resistor (inexpensive, 0.01Ω)
- Two DC voltage sense amplifiers (VPOW and VBUS)
- Peak detectors for loop current sensing
- Isolated loop current detection amplifiers
  - External Rogowski coil ◦ Current transformers
- Two single ended temperature sensor buffers (voltage mode); ADC and correction in MCU
- 4 quadrature phase mixers for precise impedance and phase measurements
- Low frequency in-band signaling via PWM modulation & power level demodulation
- 8 Programmable comparators including with programmable threshold (7-bit ladder DAC)
- 2 sets of "Pin Safety Logic" that monitor analog and digital inputs to offer auto regulation/protection of power delivery system without the need of MCU intervention
- Internal temperature sensor, +/- 5-degree accuracy
- Integrated LDO/Buck converters for 5.0V (on-chip and off-chip power), 3.3V (external MCU power and on chip MCU interface) and 1.8V (internal digital core power) supplies
- NVM to support ATE based IC trimming and system calibration constants for use in MCU based algorithms.

Walk the system function blocks



External blocks

1. AC to DC Converter
The mains power adaptor converts AC to the desired DC level for Transmit Power Electronics

2. Transmit Power Electronics
Consists of two major components:
- Buck/Boost Converter
- Power Amplifier (PA or RF Inverter)

The Buck/Boost Converter is PWM driven to provide the desired voltage level required by the PA. The PA is also PWM driven to invert DC to AC that drives the Tx coil through Impedance Matching Network

3. Impedance Matching Network
This is where the reactive component networks are used in order to transform the reflected load (as seen by the PA) to optimize transfer efficiency.

4. MCU and Bluetooth Smart
The MCU provide system operational controls and digital signal processing of the desired analog signals to be measured. When out of band communication is required (i.e., A4WP) between Tx and Rx, BLE (Bluetooth Low Energy) with appropriate protocol stack is needed.

Internal blocks

1. Voltage, Current, Temp Monitors

This block acquires and conditions key analog signals from the Transmit Power Electronics and provide to:

- Analog out to MCU for digital signal processing
- Pin Safety Logic where direct comparing of the monitored signals with pre-defined levels in the analog domain is performed (pre-defined levels are digitally defined and converted to analog levels by DAC) to provide the necessary auto protection mechanism

2. SPI

SPI Bus controller where the internal memory-mapped I/O and registers of VW8000 are accessed by MCU and Bluetooth

3. Pin Safety Logic

There are two Pin Safety Logic blocks assigned to 2 respective PWMs

- Buck/Boost Digital PWM
- Class D/E Digital PWM

Pin Safety Logic act as an interface between internal PWMs to the external Buck/Boost and PA to:

- define the polarity of PWM output active state
- provide driver protection of Buck/Boost and PA with pre-defined safe-operating states
- provide driver-inhibit functions and power limiting controls

4. Buck/Boost Digital PWM

A Hi Resolution PWM to provide precise signals for driving the Buck/Boost Convertor through PSL

5. Class D/E Digital PWM

A Hi Resolution PWM to provide precise signals for driving the PA through PSL

6. PLL Multi-Phase DLL + XTAL

- to provide 6.78MHz clock which is the resonant frequency of the AC magnetic field (coil frequency)
- to provide 81.36MHz clock for PWMs and offer available 17 delay taps for the FINE control of the Hi Resolution PWMs

7. Adaptive Impedance Tuning

This block consists of 2 channels of 4 Mixers used for precision impedance and phase measurements of the Impedance Matching Network and the Tx Coil. Adaptive Impedance Tuning can be performed based on the measured data

8. Foreign Object Detection

This block takes the impedance measured by the Mixers to determine if the load is normal or a foreign object

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