Product Description

The C210_B Power Component is a customizable voltage-mode PWM synchronous buck regulator to track another voltage rail and produce half its output voltage while both sourcing or sinking currents. These two rails are typically the DDR memory VDDQ and VTT respectively. The C210_B is powered from a voltage reference, the output of a C200_B, or a C220_B (High Current) synchronous buck regulator located in the same AmP device, to enable accurate DC and dynamic tracking.

Features

- PWM, voltage-mode, point-of-load (POL) regulator
- Input voltage, PV_{IN}: 0.8 to 11V, V_{OUT}: 0.4V to 5.5V
- Integrated MOSFETs, $R_{DS(on)}$: 30mΩ
- 1% typical accuracy
- Efficiency up to 90%
- Internal Compensation
- Adjustable bandwidth, gain and phase margin
- Adjustable switching frequency
- Frequency synchronization with selectable phase shift: adjustable up to 1 MHz
- Adjustable protection: Ouput Undervoltage Lockout, (VoUVLO), Overcurrent (OCP), Overvoltage (OVP)
- Over Temperature Protection (OTP)
- Short-circuit protection (SCP)
- Power-good flag output and Enable input
- Pre-bias startup
- Uses two of the available power MOSFETs

Applications

DDR memory VTT power rail

Figure 1: C210_B application schematic
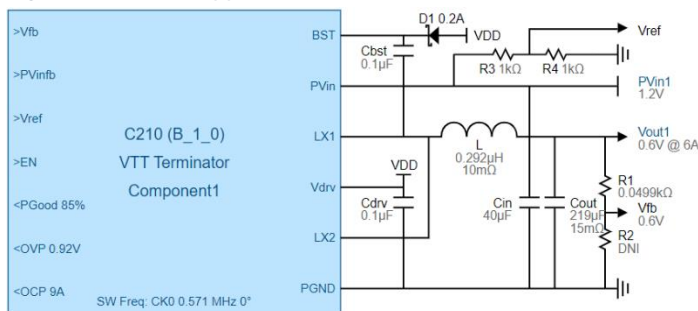
Product Details

The C210_B synchronous buck regulator includes integrated MOSFETs, customizable PWM controller and various protection circuits.

The integrated low-Rdson MOSFETs provide up to 6A output current. A digital feedback loop subtracts the output voltage from a divide-by-two resistor voltage divider on the power rail (VDDQ) that it is tracking. The C210_B will track the VDDQ rail and produce half the voltage, as the latter starts up, shuts down, or is perturbed by a load transient. The VDDQ is typically provided by a C200 synchronous buck or a C220 high-current synchronous buck regulator power component.

Pulse-width modulated (PWM), voltage-mode control is implemented using digital PID compensation. The switching frequency is generated internally via an oscillator with selectable frequencies and phase angles relative to other power components on the device.

The output voltage is specified by the power engineer during customization using AnDAPT's cloud-based WebAmP development software. The C210_B component has customizable control and status pins including enable input, an optional power-good output, and optional output flags to signal when the system triggers an overvoltage (OVP), or overcurrent (OCP) condition. The threshold values are specified using the WebAmP tool.

Product Brief — 06/09/2022

Theory of Operation

The C210_B synchronous buck regulator with integrated MOSFETs operates in PWM voltage mode. It subtracts the digitized Vref input which is connected to a voltage divider which halves the PVin/VDDQ voltage, from the digitized V_{OUT} voltage. The resulting digital error voltage feeds a PID controller whose output determines the MOSFETs' duty cycle. The C210_B output thus produces half the VDDQ/Vref voltage, tracking even rapid voltage perturbations on the VDDQ due to load transients on it. See Figure 2

The C210_B always runs in CCM (Continuous Conduction Mode). When the PWM driver goes high, it turns the Hi-side switch "ON" to provide VDDQ to the LX side of an inductor, L, where $V_L = V_{LX} - V_{OUT}$, causing its current to ramp up. When the PWM driver goes low, the Hi-side switch turns "OFF", and after a short shoot-through-prevention delay time, the Low-side switch turns "ON" providing a path for the inductor current to decrease with voltage $V_L = -V_{OUT}$, until the next PWM turns back "ON". At low load currents this inductor current can reverse polarity. As this cycle repeats, the PID algorithm regulates V_{OUT} by updating the PWM duty cycle at every cycle to maintain regulation, with fast transient response to changing load conditions.

Figure 2: Functional Block Diagram