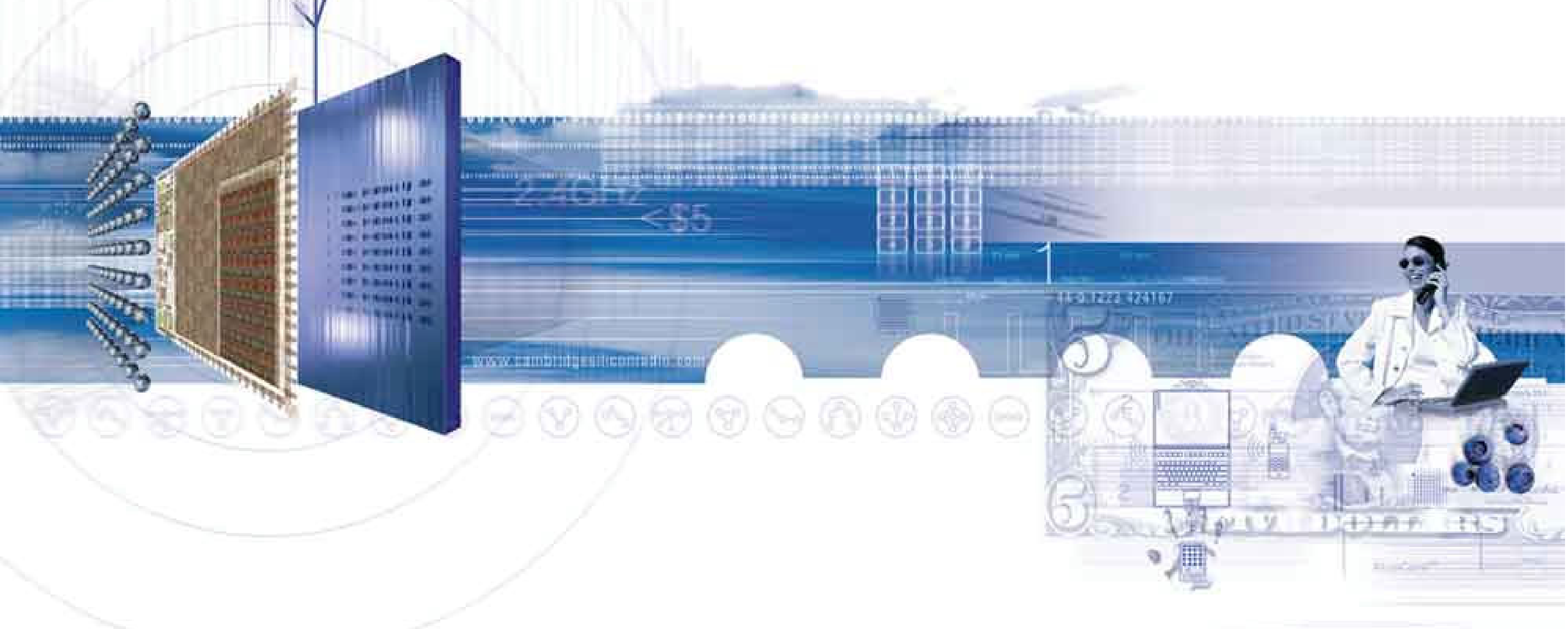
BlueCore2-External

Power Up Sequence

Application Note

May 2002



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1 Introduction

BlueCore™2-External has seven separate power supply inputs, each powering separate sections of the device. With this arrangement, the radio, parallel input/output (PIO), host interface and flash memory interface can be run at different I/O voltages. The coupling of noise from digital to analogue supply rails is also minimised.

As with any integrated circuit that utilises multiple supply rails, the sequence in which power is applied to these rails is important if one is to avoid malfunction. This application note describes the sequence.

Supply Rail	Function Powered	Voltage Range (V)
VDD_RADIO	Radio	1.7 – 1.9
VDD_VCO	VCO and Synthesizer	1.7 – 1.9
VDD_ANA	Analogue	1.7 – 1.9
VDD_CORE	Digital sections and microcontroller	1.7 – 1.9
VDD_PIO	PIO pins. AUX_DAC pin	1.7 – 3.6
VDD_MEM	External flash memory interface. AIO pins	1.7 – 3.6
VDD_PADS	SPI, PCM, UART and USB I/O pins	1.7 – 3.6
TX_A	Transmitter output	1.7 – 1.9
TX_B	Transmitter output	1.7 – 1.9

Table 1.1 Power Supply Rails

Varying the voltage on the VDD_PIO pin will vary the output voltage and input threshold on the PIO pins accordingly.

Varying the voltage on the VDD_MEM pin will vary the output voltage on the flash interface address pins. It will also vary the output voltage and input threshold of the flash interface data pins. The flash memory should be powered from the same voltage as VDD_MEM.

Varying the voltage on the VDD_PADS pin will vary the output voltage and input threshold on the SPI, PCM, UART and USB pins accordingly.

2 BlueCore2-External Power Distribution

2.1 External Flash Memory Supply Sequencing

At power up, Bluecore2-External fetches its first instruction from the external flash memory. It is essential that the flash memory is ready at this point. This means the power pins of the flash memory must be above the flash memory's minimum operating voltage. If the flash is not ready, it may return an invalid op code to BlueCore2-External when read. This can crash the firmware or lead to unpredictable results.

2.1.1 Scenario

A typical application circuit may regulate an external, higher voltage (e.g., 5.0V) down to 3.3V to supply the flash memory and I/O pins of BlueCore-2 External. Figure 2.2 shows this arrangement. The 3.3V is further regulated down to 1.8V to supply the other pins of BlueCore-2 External.

At switch-on, the output of the 3.3V regulator rises in voltage; the output of the 1.8V regulator rises in sympathy, as shown in Figure 2.1:

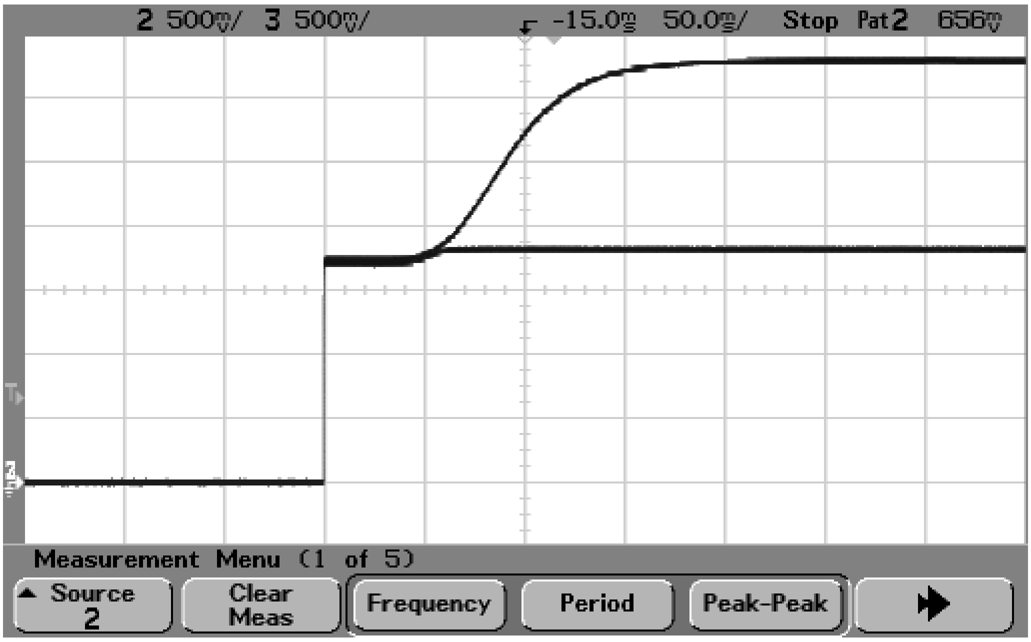


Figure 2.1: BlueCore2-External Power Distribution Diagram

Given that the 1.8V regulator will typically be a low dropout (LDO) type, at some point both the output of the 3.3V regulator and the 1.8V regulator will be near 1.8V. At this point, the processor in BlueCore2-External will start running, but the flash will not be ready.

Such a power-up hazard occurs when the flash memory is powered from a different supply rail to VDD_CORE. For example, the flash may be run from the output of a 3.3V regulator, while VDD_CORE runs from a 1.8V regulator.

Note:

VDD_MEM must be stable before or at the same time as VDD_CORE is powered up.

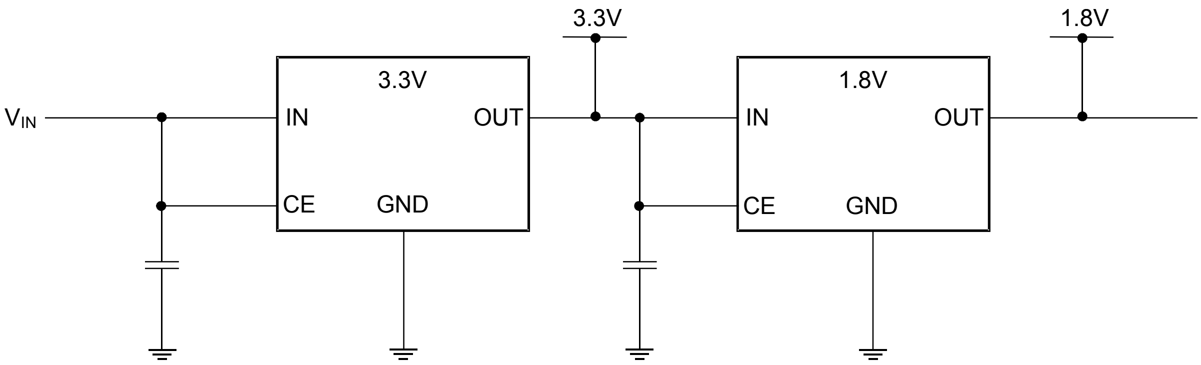
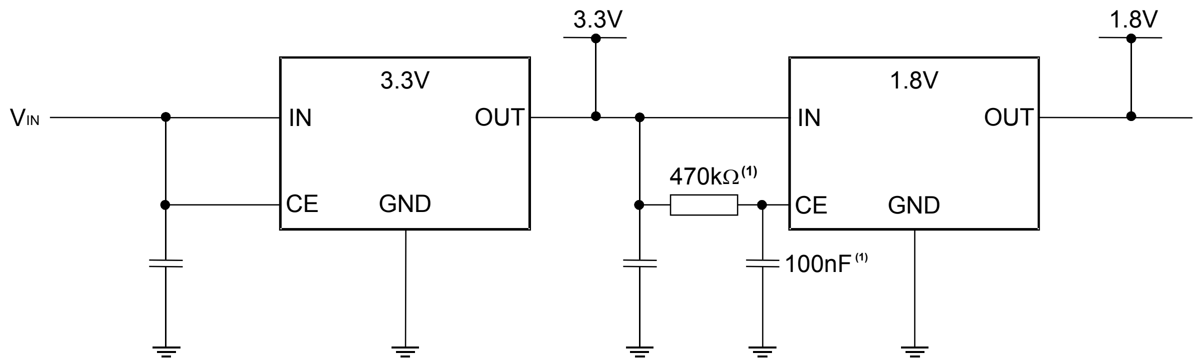


Figure 2.2: Regulation from 3.3V to 1.8V

2.1.2 Solutions

- Delay the turn on of the 1.8V regulator until the 3.3V rail is stable. This can be accomplished by adding an RC circuit to the CE enable pin of the regulator, as shown in Figure 2.3. The time-constant should be established from observing the time taken for the 3.3V rail to become stable. This depends on the type of regulator and the values of decoupling capacitors used.
- Place an RC circuit on the RESET pin of BlueCore2-External. This should be arranged such that the device is held in reset mode until the VDD_MEM power rail is stable. When choosing values for R and C, keep in mind that BlueCore2-External has an internal pull-down resistor on the RESET pin. This sinks up to 5μA.

In applications where the external I/O runs at 3.3V, the second of the above two solutions is preferable.



(1) Dependent on start-up time of 1.8V regulator and ramp time of 3.3V rail

Figure 2.3: 1.8V Regulator Enabled with Delay

2.2 Brown-Out Detection

A ‘brown-out’ is where the supply voltage drops temporarily to a lower voltage. This is most common in equipment powered from mains electricity supplies or from a car battery. Bluecore2-External has an integrated power-on-reset (POR) circuit. This resets the device when the supply voltage on the VDD_CORE pin drops to 1.5V (typical).

A hazard exists in the case where the supply voltage has dropped to a level such that BlueCore2-External *can* operate correctly, but the external flash memory can not. The problem can be partitioned into two cases: that for 1.8V flash memory, and that for 3.3V flash memory.

2.2.1 1.8V Flash memory

Typically, 1.8V flash memory is run from the same regulator as that supplying the other 1.8V rails of BlueCore2-External.

Some 1.8V flash memory devices on the market are actually rated at 2.0V +/-0.2V. In these cases, one may operate the VDD_MEM and flash supply at 1.85V +/-2%. However, if the 1.85V supply were to drop to 1.75V (as a result of a brown-out), then the flash memory may fail to operate correctly, crashing the BlueCore2-External firmware.

The problem does not exist with flash memory that has a minimum operating voltage below that of the lower threshold voltage of the POR detector within BlueCore2-External.

2.2.2 3.0V or 3.3V Flash Memory

3.0V or 3.3V flash memory is typically supplied from the input of the 1.8V regulator on the Bluetooth™ system.

A drop in supply voltage prior to the 3.3V regulator to 2.0V (for example) may leave the 1.8V supply at 1.8V, but drop the 3.3V supply to 2.0V. 3.3V flash memory will malfunction at this voltage and the BlueCore2-External firmware will crash as a result. The POR circuit within BlueCore2-External looks at the 1.8V rail, and will not cause a reset in this situation.

For critical applications, a voltage detector on the 3.3V power rail should be connected to the RESET pin of BlueCore2-External or to the enable pin of the 1.8V regulator. In either case, the end result should be that BlueCore2-External is reset or powered down when there is not enough potential on the VDD_MEM supply rail to operate the flash memory. The threshold of the voltage detector should be determined from the flash memory manufacturer's datasheet. 3.0V is a typical value.

Note:

> The RESET pin should not be driven to more than 0.4V above the VDD_PADS supply rail. The RESET pin of BlueCore2-External is active high.

2.3 I/O Pin Power Supply Sequencing

The I/O pins (PIO, UART, USB and SPI) will enter an undefined state if their respective VDD pin is powered when VDD_CORE is not powered. This is commonplace in devices that have separate Core and I/O ring supply rails.

If this is objectionable, ensure that the VDD_CORE supply is ready before or at the same time as the I/O supply pins.

If the VDD rail supplying the I/O pins is powered down while the software is running, then the software may read spurious values from the I/O pins. It may also wake the device from Deep Sleep mode (depending on the software configuration).

2.4 RESET Signal Slew Rate

The RESET pin of BlueCore2-External has a schmitt-trigger input; thus the slew rate of the RESET signal is not important.

Acronyms and Definitions

AIO	Analogue Input/Output
BlueCore	CSR's range of Bluetooth chips
Bluetooth	A set of technologies providing audio and data transfer over short-range radio connections
DAC	Digital to Analogue Converter
LDO	Low Drop Out
PIO	Parallel Input/Output
PCM	Pulse Code Modulation; refers to digital voice data
PCMCIA	Personal Computer Memory Card International Association
RC	Resistor-Capacitor
RF	Radio Frequency
SPI	Serial Peripheral Interface
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus

Record of Changes

Date:	Revision	Reason for Change:
02 MAY 02	a	Original publication of this document (CSR reference: bc2x-an-001Pa)

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