Table of Contents

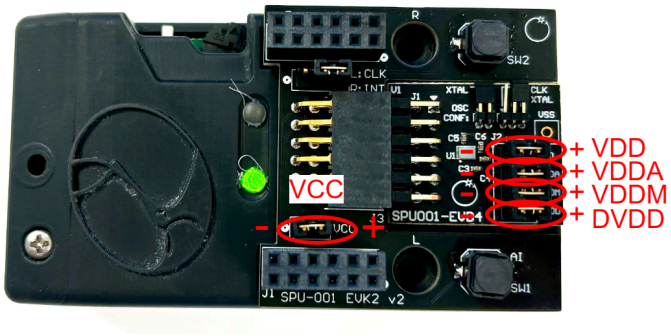
© 2024 Femtosense, Inc. - Confidential

EVK2 and EVK2v2 Power Measurement

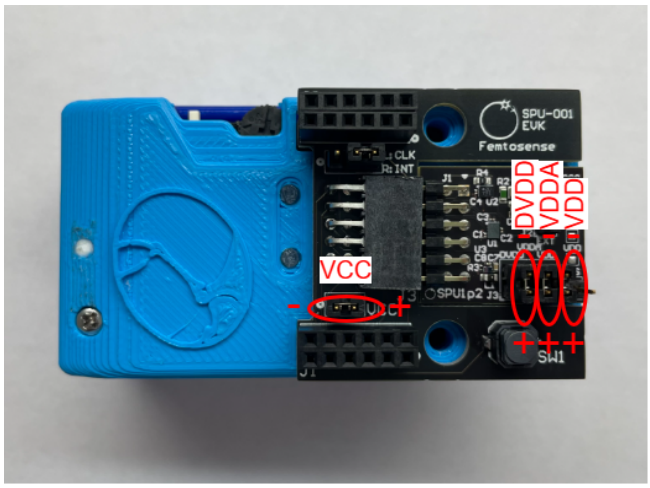
The power consumption of the SPU001 chip can be determined by measuring current on the SPU's individual power supply rails. On the EVK2v2+EVB4 Circuit board, these rails may be broken using the 4x horizontal 2-pin jumpers labeled:

- VDD (0.8V): Main processor power supply
- VDDA (0.8V): PLL power supply
- VDDM (0.8V): Memory power supply
- DVDD (IO Voltage- 1.8V or 3.3V): IO power supply

Additionally, the power input to the entire EVK circuit may be broken using the 1x horizontal 2-pin jumper labeled VCC. Note that this measurement will include the power consumed by the on-board flash memory chip, as well as inefficiencies in the 0.8V switching regulator. The following photo shows the location of each power measurement jumper:



In EVK2+EVB2 shown below, the VDD and VDDM rails are combined together into the single VDD pin:



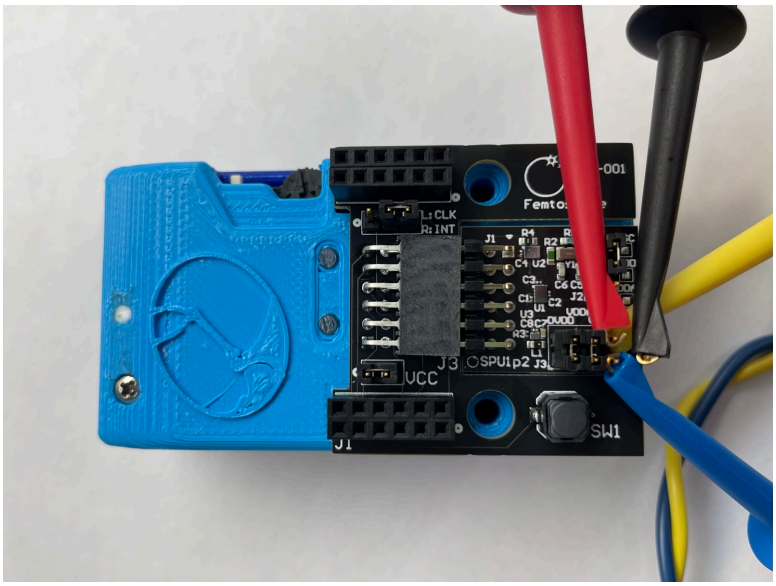
FEMTOSENSE

Application Note 004

At Femtosense, the Joulescope JS220 energy analyzer is used to simultaneously measure voltage and current on the individual power rails. This instrument uses a shunt resistor sampled at 2MSPS, dynamically changing its resistance to minimize its voltage drop (“burden voltage”). It is important that your instrument does not create a significant burden voltage during measurement, particularly on VDD, where the SPU may spike to several milliamps during processing. In our measurements, VDD is maintained within 30mV of 0.8V at all times. The resolution of the Joulescope JS220 is 1.5uA, and its accuracy is +/-0.25% +/-15uA.

We have also produced similar measurements using a shunt resistor across the jumpers (<1 Ohm), amplifying the resistor’s voltage using a discrete amplifier on a breadboard, and measuring the amplified signal with an oscilloscope. Calibration is necessary. If using this approach, be sure to individually measure the true values of the shunt resistor. A sourcemeter could also be used if the measurement sample rate is comparable to the Joulescope (connect across the negative terminal of the jumper and the EVK’s ground labeled VSS or GND).

In order to measure power, connect your current and voltage probes. An example for EVK2 is shown in the following photo. VDD measurement is shown, but the same method can be applied to VDDA, VDDM, DVDD, or VCC.

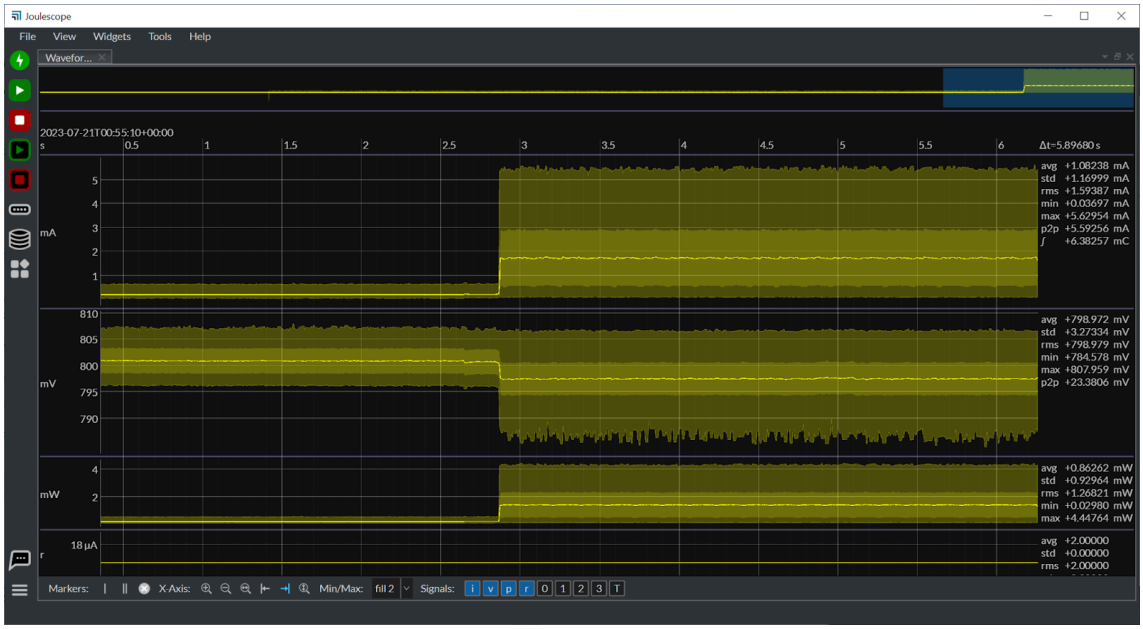


In the photo, the current and voltage probes measure power on the VDD power rail.

RED: Voltage (+)
BLACK: Voltage (-)
BLUE: Current (+)
YELLOW: Current (-)

© 2024 Femtosense, Inc. - Confidential

The screenshot below shows Current (first row), Voltage (second row), and Power (third row) for VDD. Around t=2.8s, SPU001 starts processing, which can be seen as an increase in Current activity.



In order to measure average power consumption, take a long average, or zoom into the Current trace and select several periods of activity with your cursor. In this example, the period is 4ms, and we select 5 periods with the green cursor. The average power in this case (third trace) is u=1.39038mW on VDD. A similar procedure can be used to measure the average power on VDDA and DVDD in order to obtain the total SPU001 consumption.

An example of the average total power consumed on the 8ms AI Noise Reduction algorithm (AINRGP_16khz_4hop_8algo_v3) running on EVK2 (SPU001 TC2) shown above is:

```
1395uW VDD
  34uW VDDA
  36uW DVDD (@3.3V, expect ~⅓ power @1.8V)
_____________
```

1.465mW Total (Model On)

You can also measure the power when the model is turned off, but the chip is still powered. An example of this measurement is:

```
  153uW VDD
    2uW VDDA
    9uW DVDD (@3.3V, expect ~⅓ power @1.8V)
_____________
```

0.164mW Total (Model Off)

An example of the average total power consumed on the WWD algorithm (WWDSNIPS_8khz_16ms_v2) running on EVK2 (SPU001 TC2) is:

```
176uW VDD
  21uW VDDA
  11uW DVDD (@3.3V, expect ~⅓ power @1.8V)
_____________
```

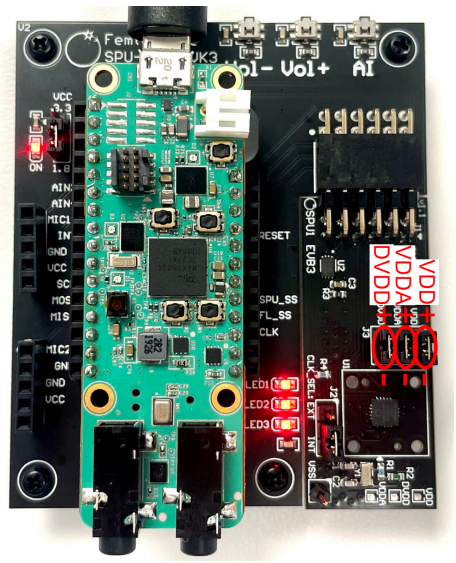
0.208mW Total

© 2024 Femtosense, Inc. - Confidential

EVK3 Power Measurement

Power consumption can also be measured on EVK3. However, note that the VCC header on EVK3 also includes power consumed by the microphone headers, button pull-up resistors. See below the photo indicating the location and polarity of the power measurement jumpers.

Note that in EVK2 and EVK2v2, several power optimizations are controlled by the firmware. These include clock frequency, memory mode, and core power gating optimizations. However, as of EVK3 firmware release v1.1, these optimizations are not available on EVK3. Therefore, all power optimized models should be measured on EVK2 or EVK2v2 instead of EVK3.



The photo shows the power measurement jumpers for EVK3 (with EVB3)

© 2024 Femtosense, Inc. - Confidential

Change Log

Version	Release Date	Description
1.0	2023-05-10	Initial release
1.1	2023-06-14	Added info about VCC
1.2	2023-07-23	Updated with new models and WWD measurement examples
1.3	2023-12-15	Add reference to EVK3
1.4	2024-03-18	Add reference to EVK2v2

© 2024 Femtosense, Inc. - Confidential