Application Report
SPRAAZ5A–July 2010

Power Consumption for Common TMS320DM355 Application Usage Scenarios

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ABSTRACT

This document discusses the power consumption for common system application usage scenarios for the TMS320DM355 digital media system-on-chip (DMSoC) processor. Power consumption is highly dependent on the individual user's application; however, this document focuses on providing several DM355 application-usage case scenarios and the environment settings that were used to perform such power measurements.

For additional details about the DM355 processor, see the *TMS320DM355 Digital Media System-on-Chip (DMSoC) Data Manual* (SPRS463).

Contents

1 DM355 Power Consumption for Separate Application Cases

The following section details power measurements taken on a DM355 platform for typical use case applications. These measurements have been performed on an internal test evaluation reference system [2] and not on the DM355 evaluation module (EVM).

The software being used is a Digital Still Camera Program Development Kit (DSCPDK) [3]; it is using a real-time operating system (OS) that has less memory access requirements than Linux™. Linux requires more memory access so faster DDR clock speed could be required than the numbers in this application report.

NOTE: Static power or leakage current consumption varies across manufacturing process, temperature and voltage. All of the readings shown here are taken at room temperature (25°C).

NOTE: Power for IO18 and IO33 includes the analog as well as digital power rail.

1.1 Live Preview Application

In this scenario, video from an image sensor is processed and resized by the video port front end (VPFE) and displayed to an LCD through the video port back end (VPBE). In this mode, there is no video codec running and the frame rate and format is VGA 30 fps with a CMOS sensor input and an LCD output.

The results below were gathered for an image preview application using the DM355 product.

1.1.1 System Setup Details

The hardware and software configuration used for these measurements was done on an internal reference system.

1.1.1.1 ARM CPU and DDR2 Frequency

Because the video codec is not running, a high clock rate is not required for this application mode. Power consumption can be reduced by setting a lower clock frequency. The clock setting below is a reasonable clock setting to achieve normal performance of live preview and low power consumption.

- ARM CPU running @ 108 MHz
- DDR2 running @ 79.5 MHz

1.1.2 Power Consumption per DM355 Power Supply Rail Breakdown

Power Supply Rail	Live Preview (mW)
1.3 V CPU core	140
System PLL	7
1.8 V I/O	10
3.3 V I/O	24
DDR2 DLL	9
DDR2 DRAM power	42
Total without DDR2 DRAM power	190
Total including DDR2 DRAM power	232

1.2 Still Image Processing Application

In this scenario, a JPEG encoder is running to make the JPEG file. An 8 Mega pixel CMOS image sensor is used and 8 Mega pixels of full resolution are converted to JPEG format by the JPEG encoder.

The results below were gathered for a still image processing application using the DM355 product.

1.2.1 System Setup Details

The hardware and software configuration used for these measurements was done on an internal reference system.

1.2.1.1 ARM CPU and DDR2 Frequency

The ARM CPU running at 135 MHz shows sufficient performance to handle JPEG encoding but, of course, a faster CPU speed shows better performance at a higher power consumption cost.

- ARM CPU running @ 135 MHz
- DDR2 running @ 133 MHz

1.2.2 Power Consumption per DM355 Power Supply Rail Breakdown

Power Supply Rail	Still Image Processing (mW)
1.3 V CPU core	176
System PLL	7
1.8 V I/O	12
3.3 V I/O	31
DDR2 DLL	18
DDR2 DRAM power	45
Total without DDR2 DRAM power	244
Total including DDR2 DRAM power	289

1.3 VGA Movie Record Application

In this scenario, a CMOS sensor generates VGA 30 fps images and the MPEG4 encoder encodes the video stream at a 30 fps VGA speed. Also, an AIC12 gathers audio data from mic and the ARM runs a G711 audio encoder. The ARM also generates a MOV format movie file with encoded video and audio stream and saves it to an secure digital (SD) card through the SDIO interface.

The results below were gathered for a VGA movie record application using the DM355 product.

1.3.1 System Setup Details

The hardware and software configuration used for these measurements was done on an internal reference system.

1.3.1.1 ARM CPU and DDR2 Frequency

For a VGA 30fps MPEG4 encoding, the clock setting below is good enough. If 720p MPEG4 encoding is needed, then an ARM speed of 216 MHz and DDR speed of 171 MHz is recommended.

- ARM CPU running @ 135 MHz
- DDR2 running @ 133 MHz

1.3.2 Power Consumption per DM355 Power Supply Rail Breakdown

Power Supply Rail	VGA Movie Record (mW)
1.3 V CPU core	165
System PLL	7
1.8 V I/O	10
3.3 V I/O	32
DDR2 DLL	15
DDR2 DRAM power	75
Total without DDR2 DRAM power	229
Total including DDR2 DRAM power	304

1.4 VGA Movie Playback Application

In this scenario, an MOV file is read from the SD card through the SDIO interface by the ARM and the video and audio streams are de-multiplexed from the file by the ARM as well. The video stream is decoded by the MJCP MPEG4 decoder and the audio stream is decoded by the ARM G711 decoder. The decoded video stream is displayed on an LCD through the VPBE and the audio stream goes out to the AIC12. The results below were gathered for a VGA movie playback application using the DM355 product.

1.4.1 System setup details

The hardware and software configuration used for these measurements was done on an internal reference system.

1.4.1.1 ARM CPU and DDR2 Frequency

Again, for VGA 30fps MPEG4 decoding the clock frequency setting below is good enough.

- ARM CPU running @ 135 MHz
- DDR2 running @ 133 MHz

1.4.2 Power Consumption per DM355 Power Supply Rail Breakdown

Power Supply Rail	VGA Movie Playback (mW)
1.3 V CPU core	154
System PLL	7
1.8 V I/O	12
3.3 V I/O	32
DDR2 DLL	15
DDR2 DRAM power	75
Total without DDR2 DRAM power	220
Total including DDR2 DRAM power	295

1.5 720p Movie Record and Playback Application

For this scenario, all of the dataflow is the same as the above VGA movie record and playback cases, but the video resolution was changed from VGA to 720p. The results below, gathered for both 720p movie encode application and 720p movie decode application, were the same using the DM355 product.

NOTE: The scenario for this section is for either application. They are not both running at the same time.

1.5.1 System Setup Details

The hardware and software configuration used for these measurements was done on an internal reference system.

1.5.1.1 ARM CPU and DDR2 Frequency

The typical recommended DDR speed is 171 MHz, but to obtain lower power consumption for this scenario a lower DDR speed can be used as mentioned below. The appropriate DDR speed needs to be determined depending on the complete system application, since it depends on the memory access requirement of the operating system and the application program.

- ARM CPU running @ 216 MHz
- DDR2 running @ 162 MHz

1.5.2 Power Consumption per DM355 Power Supply Rail Breakdown

Power Supply Rail	720p Movie Record and Playback (mW)
1.3 V CPU core	340
System PLL	7
1.8 V I/O	8
3.3 V I/O	36
DDR2 DLL	15
DDR2 DRAM power	150
Total without DDR2 DRAM power	406
Total including DDR2 DRAM power	556

1.6 MP3 Decoder Application

In this scenario, the MP3 file in the SD card is read through SDIO interface and the ARM decodes the music; the decoded music then goes out to the AIC12 via the audio serial port (ASP).

The results below were gathered for the MP3 decoder application using the DM355 product. The scope was to run the CPU at the lowest frequency to be able to perform the MP3 decoding application for measuring lower power consumption.

1.6.1 System Setup Details

The hardware and software configuration used for these measurements was done on an internal reference system.

1.6.1.1 ARM CPU and DDR2 Frequency

The MP3 playback does not require the highest ARM and DDR clock speed settings and the speeds below are good enough for this particular application.

- ARM CPU running @ 69 MHz
- DDR2 running @ 80 MHz
- Modules enabled: enhanced direct memory access (EDMA), ASP1, DDR2, multimedia card/secure data (MMCSD0), inter-integrated circuit (I2C), TIMER0, TIMER3, System module.
- MP3 source code pre-loaded to DDR2 memory.

1.6.2 Power Consumption per DM355 Power Supply Rail Breakdown

Power Supply Rail	MP3 Decoder (mW)
1.3 V CPU core	49.4
System PLL	6.64
1.8 V I/O	9.62
3.3 V I/O	6.6
DDR2 PLL	9.24
Total without DDR2 DRAM power	78.5

1.7 Deep Sleep Power-Down Mode Measurement

DM355 is in deep sleep mode and DDR memory is in self-refresh mode in this scenario, and all other external components (like the LCD) were turned off.

The results below were gathered for the DM355 during deep sleep power mode that stops all device clocks and power down internal oscillators to reduce active power to a minimum, in which state registers and memory are preserved.

1.7.1 System Setup Details

The hardware and software configuration used for these measurements was done on an internal reference system, optimized for I/O power consumption as detailed in the following I/O power consumption optimization guidelines for this device. Additionally, the JTAG emulation has been disconnected when performing these measurements.

Guidelines for Reducing I/O Power Consumption:

http://processors.wiki.ti.com/index.php/Guidelines_for_Reducing_I/O_Power_Consumption_on_DM355_and_DM335

1.7.2 Power Consumption per DM355 Power Supply Rail Breakdown

Power Supply Rail	Deep Sleep Power-Down Mode (mW)
1.3 V CPU Core	1.77
USB 1.3 V	0
1.3 V System PLL	0
1.8 V I/O	0.88
3.3 V I/O	0.52
3.3 V DDR2 DLL	0.04
Total without DDR2 DRAM Power	3.21

2 References

1. *TMS320DM355 Digital Media System-on-Chip (DMSoC) Data Manual* (SPRS463)
2. Reference hardware board used to make the digital still camera (http://www.appropho.com/NewWeb/Product_DM350.htm). This was selected because software on top of the board has more realistic use case scenarios than the DM355 EVM. This board is known as a Software Development Board (SDB).
3. DSCPDK is designed for digital still camera reference software.
4. Guidelines for Reducing I/O Power Consumption: http://processors.wiki.ti.com/index.php/Guidelines_for_Reducing_I/O_Power_Consumption_on_DM355_and_DM335

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