65463 - Zynq UltraScale+ MPSoC - What devices are supported for configuration?

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TITLE

65463 - Zynq UltraScale+ MPSoC - What devices are supported for configuration?

DESCRIPTION

When choosing a flash device to incorporate with Zynq UltraScale+ MPSoC devices, it is important to consider the following logistical criteria:

- Is the device supported for the Xilinx tools?
- Will the device work with the Zynq device BootROM?
- Is the device supported with software like U-Boot and Linux?

In addition, there are design considerations which include:

- How many pins are required for a configuration method?
- How much flash memory is required?
- How fast can the Zynq device be configured?
- How difficult is it to manage the flash device?

Based on the logistical criteria, there are four categories of flash devices:

Xilinx Tested and Supported Flash Devices (See UG908 for Supported Flash Memory Devices)

These devices meet the logistical criteria listed above.
These devices receive regression testing with Xilinx tools and their use is fully supported by Xilinx Technical Support.

Known to Work Flash Devices

These devices are not explicitly supported in the Xilinx tools, but have been known to work with Zynq UltraScale+ MPSoC devices.
Many of these devices are programmed using U-Boot as an alternate programming method, but source changes to U-Boot might have to be made by users in order to configure that specific device.

Unverified Flash Devices

These devices have not been tested in any way by Xilinx with Zynq UltraScale+ MPSoC devices.
There are NO known issues (but possible limitations) for these devices.
The user will be responsible for validating the flash on Zynq UltraScale+ MPSoC, making necessary changes to U-Boot and configuring the device.

Incompatible Flash Devices

These devices will not work on Zynq UltraScale+ MPSoC.

Note: Xilinx Technical Support will not be able to provide assistance with designs using "Known to Work" or "Unverified" flash devices.

Xilinx can only provide assistance for the devices listed as 'Xilinx Tested and Supported'.

SOLUTION

QSPI

Benefits of QSPI:

- High performance - QSPI is the fastest configuration solution.
- Low Pin count - QSPI has the lowest pin count of the configuration solution options besides SD.
- Easy management - QSPI can be accessed as linear memory in Zynq devices. In addition, NO bad blocks management is required.
- XIP - QSPI is the only mode that supports execute-in-place

Downsides of QSPI:

- Low memory density

Vendors. See UG908 for official list.

Vendor	QSPI Flash Families
Micron	MT25, N25Q
Infineon (formerly known as Spansion)	S25FL,S70FL
Macronix	MX25, MX66
ISSI	IS25

Configuration and Specifications

There are two distinct boot modes relative to QSPI:

- QSPI24: 24-bit addressing
- QSPI32: 32-bit addressing

NOTE: Flash Devices larger than 16MB (128Mb) are only tested booting in QSPI32.

The QSPI boot image search limit are listed below.

Memory Configuration	MIO Pins	Boot Image Search Limit
QSPI24 - Single Memory	7	16 MB
QSPI24 - Dual Stack Memory	8*	16 MB
QSPI24 - Dual Parallel Memory	13	32 MB
QSPI32 - Single Memory	7	256 MB
QSPI32 - Dual Stack Memory	8*	256 MB
QSPI32 - Dual Parallel Memory	13	512 MB

NOTE(*): In case of Dual Stack Memory, Zynq UltraScale+ MPSoC only boots from the "lower" QSPI (Same as "Single Memory").

See UG908 for Xilinx Supported Flash Memory Devices

Here a list of devices that might require special attention. See Notes.

Flash Device	Mode	Vendor	Flash Density	Voltage	Support Category	Vivado/SDK Flash Programmer	U-Boot	Notes
S25FL064L	Quad Mode - Single - Dual Parallel and Stacked	Infineon	64 Mb		**Known to Work**		2017.4	
S70FL01GS	Quad Mode - Stacked	Infineon	1024 Mb		**Xilinx Supported**	See (UG908).	2016.3	This part is two 512 Mb dies in a single package (Dual Stacked Only).
S70FS01GS	Quad Mode - Single - Dual Parallel and Stacked	Infineon	1024 Mb		**Incompatible**			The S70FS family does not support Dual Out (0x3B/0x3C) and Quad Out (0x6B/0x6C) read commands.
S25FS128S	Quad Mode - Single - Dual Parallel and Stacked	Infineon	128 Mb		**Incompatible**			The S25FS family does not support Dual Out (0x3B/0x3C) and Quad Out (0x6B/0x6C) read commands.
MX66U1G45G	Quad Mode - Single - Dual Parallel and Stacked	Macronix	1024 Mb	1.8V	**Xilinx Supported**	See (UG908).	2018.1	In 2018.1 a patch is required. See (Xilinx Answer 71042).
MX66[U/L]2G45	Quad Mode - Single - Dual Parallel and Stacked	Macronix	2048 Mb	1.8V/3.3V	**Xilinx Supported**	See (UG908).	2019.1	In 2019.1 a patch is required. See (Xilinx Answer 72430) In 2019.x a patch is required for FSBL. See (Xilinx Answer 73087)
MX25[U/L]51245	Quad Mode - Single - Dual Parallel	Macronix	512 Mb	1.8V/3.3V3.3V	**Xilinx Supported**	See (UG908).	2019.1	In 2019.1 a patch is required. See (Xilinx Answer 72430)

NAND

Benefits of NAND:

- High Memory density - NAND is an inexpensive solution for large density devices.

Downsides of NAND:

- Lower device performance - Maximum bandwidth is less than QSPI.
- High pin count - NAND devices require more pins than QSPI.
- Difficult Management - NAND devices are hard to manage. Bad blocks are a regular concern which require design decisions on how bad blocks will be managed for a particular system setup.

Note:

- To use On-Die ECC with MPSoC, the flash MUST be a MICRON and MUST support bit 3 (Enable/Disable ECC) in Feature Address 90h. The bootROM try to set bit-3 during initialization and reads it back to confirm the ECC scheme to use:
  - "0" = HW-ECC or SW-ECC
  - "1" = "On-DIE ECC

Please, let me know if you need anything else.

Vendors. See UG908 for official list.

Vendor	NAND Flash Families
Micron	MT29F
SkyHigh Memory	S34ML

Configuration and Specifications

Memory Configuration	MIO Pins	Boot Image Search Limit
NAND - x8	17	128 MB

See UG908 for Xilinx Supported Flash Memory Devices
The table below highlights few characteristics.

Flash Device	Mode	Vendor	Flash Density	Classification	Technology	ECC	Voltage	Support Category	Vivado/SDK Flash Programmer	U-Boot	Notes
MT29F2G08AB	x8	Micron	2 Gb	1 Die, 1 CE#, 1 RB#	SLC	onDIE ECC	3.3 V	**Xilinx Supported**	See (UG908).	2018.1	
MT29F8G08AD	x8	Micron	8 Gb	2 Die, 1 CE#, 1 RB#	SLC	onDIE ECC	3.3 V	**Unverified Flash**			
MT29F8G08AB	x8	Micron	8 Gb	1 Die, 1 CE#, 1 RB#	SLC	8-bit HWECC	3.3 V	**Xilinx Supported**	See (UG908).	2019.1	
MT29F16G08AB	x8	Micron	16 Gb	1 Die, 1 CE#, 1 RB#	SLC	8-bit HWECC	3.3 V	**Xilinx Supported**	See (UG908).	2019.1	
MT29F32G08AB	x8	Micron	32 Gb	1 Die, 1 CE#, 1 RB#	SLC	8-bit HWECC	3.3 V	**Xilinx Supported**	See (UG908).	2015.4	
MT29F64G08AE	x8	Micron	64 Gb	2 Die, 2 CE#, 2 RB#	SLC	8-bit HWECC	1.8 V	**Xilinx Supported**	See (UG908).	2016.1	
S34ML01G1	x8	SkyHigh Memory	1 Gb	1 Die, 1 CE#, 1 RB#	SLC	1-bit HWECC	3.3 V	**Xilinx Supported**	See (UG908).	2017.1	
S34ML02G1	x8	SkyHigh Memory	2 Gb	1 Die, 1 CE#, 1 RB#	SLC	1-bit HWECC	3.3 V	**Xilinx Supported**	See (UG908).	2016.3	
S34ML08G101TFI200	x8	SkyHigh Memory	8 Gb	2 Die, 2 CE#, 2 RB#	SLC	1-bit HWECC	3.3 V	**Unverified Flash**			

SD

Benefits of SD:

- High density - SD has densities comparable to NAND.
- Easy Management - Device is generally managed as a file system. Bad blocks do not need to be managed in the user design.

Downsides of SD:

- Slow performance - SD is slower than QSPI
- Mechanical considerations - SD cards require a connector.

Configuration and Specifications

Memory Configuration	MIO Pins	Boot Image Search Limit
SD Card (4-bit data)	6	8,192 files

Consult (Xilinx Answer 66779) for the list of SD cards currently tested on Zynq UltraScale+ MPSoC.

Xilinx Supported Devices

Any compliant card. See the SD/SDIO Controller Chapter of (UG1085).

eMMC

Benefits of eMMC:

- High density - eMMC has densities comparable to NAND.
- Easy Management - Device is generally managed as a file system. Bad blocks do not need to be managed in the user design.

Downsides of eMMC:

- Slow performance - eMMC is slower than QSPI

Configuration and Specifications

Memory Configuration	MIO Pins	Boot Image Search Limit
eMMC (8-bit data)	12	8,192 files

Xilinx Supported Devices:

NOTE (*): (UG908) reports the "Device Alias" as the JEDEC version and density of the flash (i.e. "jedec4.51-16gb").

There is no need to specify the "Manufacturer" in the tools.

Flash Device	Vendor	Flash Density	JEDEC Version	Support Category	Vivado/SDK Flash Programmer (*)	U-Boot	Notes
MTFC4GMVEA-4M IT	Micron	4 GB	4.41	**Known to Work**		2017.1	
MTFC8GLVEA-1M WT	Micron	8 GB	4.41	**Known to Work**	See (UG908).	2016.1	
MTFC8GAKAJCN-1M IT	Micron	8 GB	5.0	**Xilinx Supported**	See (UG908).	2017.1	
MTFC32GJDED-4M IT	Micron	32 GB	4.41	**Known to Work**		2016.3	
MTFC32GAZAQHD	Micron	32 GB	5.1	**Xilinx Supported**			
MTFC64GJDDN-4M IT	Micron	64 GB	4.41	**Known to Work**		2016.3	
MTFC64GAKAEEY-4M IT	Micron	64 GB	5.0	**Known to Work**		2017.3	
THGBMFG6C1LBAIL	Toshiba	8 GB	5.1	**Xilinx Supported**	See (UG908).	2016.1	
EMMC16G-IB29-PE90	Kingston	16 GB	5.1	**Known to Work**			
EMMC64G-W525	Kingston	64 GB	5.1	**Known to Work**		2017.1	
KLM8G1GENS-B041	Samsung	8 GB	4.5	**Xilinx Supported**	See (UG908).	2017.3	
KLM8G1GEME-B041	Samsung	8 GB	4.5	**Xilinx Supported**	See (UG908).	2017.3	
SDINBDG4-8G-1225	Sandisk	8 GB	4.5	**Xilinx Supported**	See (UG908).	2017.3	
MX52LM08A11XVI	Macronix	8 GB	5.1	**Xilinx Supported**			Firmware Version PRV 08 or later.

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