Technical Note

Power-Up, Power-Down, and Brownout Considerations on MT25Q, MT25T, and MT35X NOR Flash Memory

Introduction

This technical note provides direction on how to properly apply and remove the power supply to a NOR Flash device from the MT25Q, MT25T, and MT35X families.

This technical note provides suggestions on how to operate under marginal V_{CC} circumstances (after a brownout).

This technical note does not provide detailed device information. The standard density specific device data sheet provides a complete description of device functionality, operating modes, and specifications.

Power-Up and Power-Down

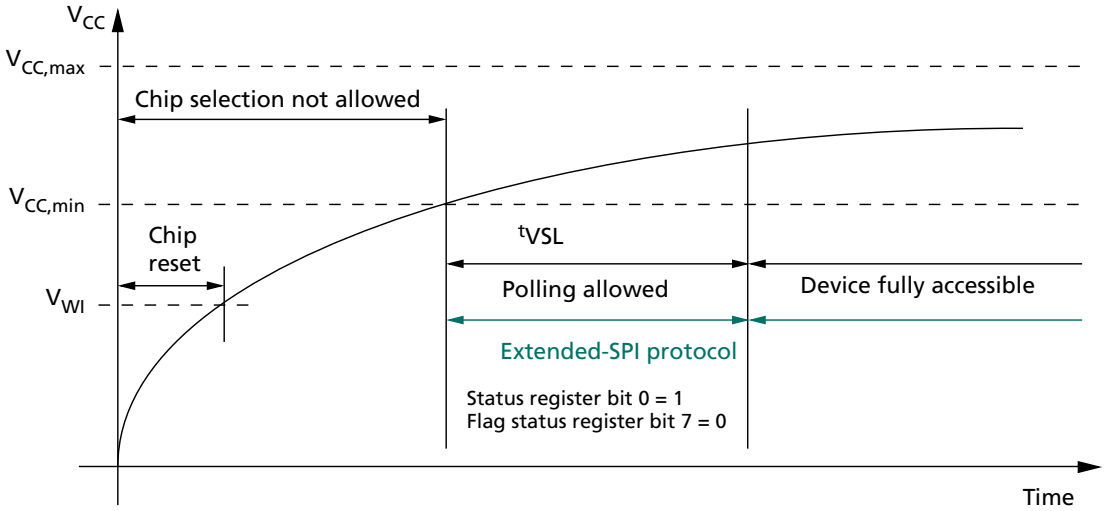
At power-up and power-down, the device must not be selected (that is, chip select must follow the voltage applied on V_{CC}) until V_{CC} reaches the correct value:

- V_{CC}(min) at power-up
- V_{SS} at power-down

To avoid data corruption and inadvertent WRITE operations during power-up, a power-on-reset (POR) circuit is included. The logic inside the device is held reset while V_{CC} is less than the POR threshold voltage -V_{WI}- all operations are disabled, and the device does not respond to any instruction. During the power-up phase the device ignores all the instructions except READ STATUS REGISTER and READ FLAG STATUS REGISTER in extended-SPI mode, SDR mode (they can be used to check the memory internal state (shown below). Alternatively, it is possible to wait t_{VSL}; in this case, polling the status register (or the flag status register) is not required

At power-down, when V_{CC} drops from the operating voltage, to below the POR threshold voltage, V_{WI}, all operations are disabled and the device does not respond to any instruction. The designer must aware that if power-down occurs while a WRITE, PROGRAM, or ERASE cycle is in progress, some data corruption may result.

Figure 1: Power-Up Timing



Notes:
1. tVSL polling has to be in extended-SPI protocol and STR mode.
2. In a system that uses a fast V_{CC} ramp rate, current design requires a minimum 100µs after V_{CC} reaches tVWI, and before the polling is allowed, even though $V_{CC,min}$ is achieved.

Table 1: Power-Up Timing and V_{WI} Threshold

Notes 1 and 2 apply to entire table

Symbol	Parameter	Min	Max	Unit
tVSL	V_{CC},min to device fully accessible	-	300	µs
V_{WI}	Write inhibit voltage – 3V devices	1.5	2.5	V
V_{WI}	Write inhibit voltage – 1.8V devices	1.0	1.5	V

Notes:
1. When V_{CC} reaches $V_{CC,min}$, to determine whether power-up initialization is complete, the host can poll status register bit 0 or flag status register bit 7 only in extended SPI protocol, SDR mode because the device will accept commands only on DQ0 and output data only on DQ1. When the device is ready, the host has full access using the protocol configured in the nonvolatile configuration register. If the host cannot poll the status register in extended SPI protocol, SDR mode, the recommendation is to wait t_{VSL} before accessing the device.
2. Parameters listed are characterized only.

Brownout

A brownout is when the voltage temporarily drops below the operating voltage level and then recovers. Brownouts can occur for many reasons (decoupling capacitors may help remove short glitches). Battery-powered products can produce longer brownouts, particularly when the batteries are running out.

Normal precautions must be taken for supply line decoupling, to stabilize the V_{CC} supply. Each device in a system should have the V_{CC} line decoupled by an appropriate capacitor close to the package pins. For more information, refer to TN-25-09 for MT25Q/MT25T devices and to TN-25-11 for MT35X devices.

If the voltage level drops too far, then the internal reset circuitry will reset the Flash once the voltage level recovers to the operating level. However, at some voltages the internal reset is not triggered and it can happen that the internal logic and analogic circuitries are not guaranteed to work correctly.

If the V_{CC} power supply voltage drops below $V_{CC,min}$, the following conditions apply:

- If V_{CC} stays above $V_{WI,max}$, then the part will remain initialized and will work correctly when V_{CC} raises again above $V_{CC,min}$
- If V_{CC} drops below $V_{WI,max}$, then it is mandatory that the voltage go below $V_{CC,low}$ for a minimum period of t_{PC} to allow the part to be initialized correctly on next power-up

Figure 2: Brownout Timing

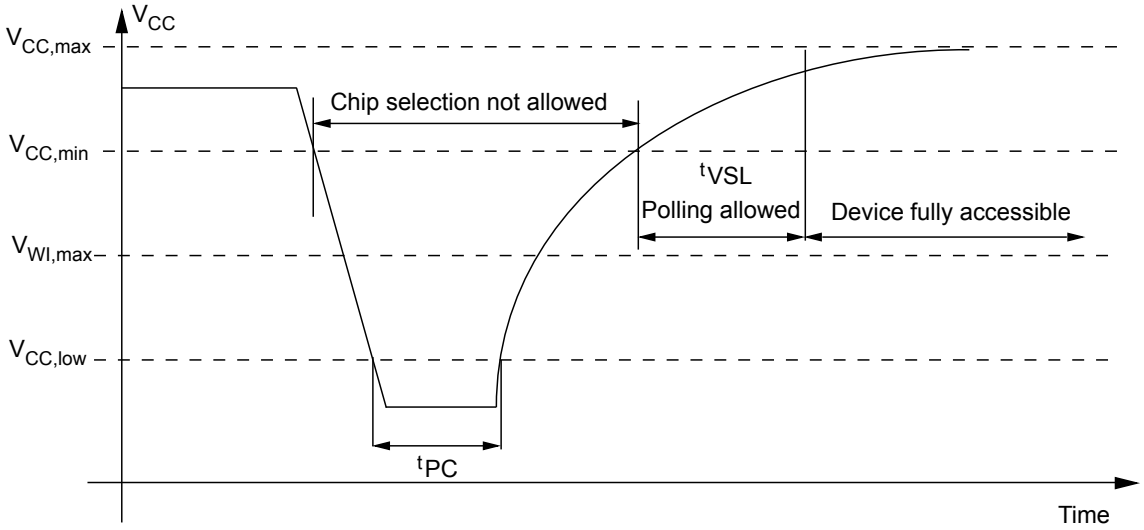


Table 2: Brownout Timing

Note 1 applies to entire table

Symbol	Parameter	Min	Max	Unit
^{t}VSL	$V_{CC,min}$ to device fully accessible	–	300	µs
V_{WI}	Write inhibit voltage (3V devices)	–	2.5	V
V_{WI}	Write inhibit voltage (1.8V devices)	–	1.5	V
$V_{CC,low}$	$V_{cc,low}$ voltage (3V and 1.8V devices)	–	0.7	V
^{t}PC	$V_{cc,low}$ power cycle time (3V and 1.8V devices)	50	–	µs

Note: 1. Parameters listed are characterized only.

Conclusion

Micron NOR Flash devices from the MT25Q, MT25T, and MT35X families are expected to respond correctly at power-up if the correct conditions are applied. Designers should take care to avoid brownouts, which can cause the data bus to have invalid data on it when the voltage returns to the operating voltage level.

Revision History

Rev. A – 12/17

- Initial release

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