# Storage Capacitor ($V_{CAP}$) Options for Cypress nvSRAM

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**Associated Part Family: CY14xxxxx**
**Software Version: None**
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AN43593 discusses the selection criteria for the storage capacitor ($V_{CAP}$) options for Cypress nvSRAMs. This document also provides a sample list of a few suitable capacitors as guidance.

## Introduction

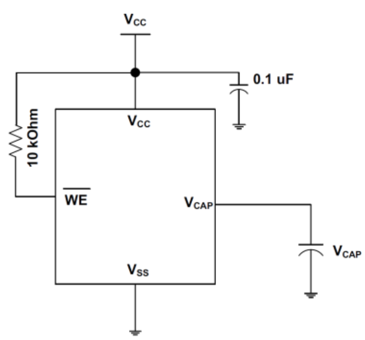
The nvSRAM architecture uses a one-to-one pairing of a nonvolatile bit and a fast SRAM bit in each memory cell. During normal operation, the IC behaves exactly as a standard fast asynchronous SRAM and is easy to interface with the microprocessor or microcontroller. When IC power is disrupted or lost, the event is detected and all the SRAM bits are saved into the nonvolatile part (within 8 ms) using the stored energy in a small capacitor ($V_{CAP}$). This operation is called AutoStore and is described in more detail in the next section. When power is restored, data is automatically recalled from the nonvolatile part to SRAM on power restore and this operation is called Power-Up RECALL (Hardware RECALL).

This application note discusses the various options for selecting a suitable storage capacitor for using as $V_{CAP}$. While we have listed a few capacitor part numbers in this application note as example, it should be noted that this list is only a sample list and does not include all parts from all vendors. Therefore we recommend you to refer to the various vendor catalogs when choosing a suitable capacitor.

## AutoStore Operation

Figure 1 shows the connection of the storage capacitor ($V_{CAP}$) for AutoStore operation.

Figure 1. AutoStore Mode




***Note*** *$\overline{WE}$ pin and the pull-up resistor are applicable to parallel nvSRAMs only.*

During normal operation, the device draws current from $V_{CC}$ to charge a capacitor connected to the $V_{CAP}$ pin. This stored charge is used by the chip to perform a single STORE operation. If the voltage on the $V_{CC}$ pin drops below a minimum threshold ($V_{SWITCH}$), the part automatically disconnects the $V_{CAP}$ pin from $V_{CC}$ and connects it to the internal circuits. A STORE operation is initiated with power provided by the $V_{CAP}$ capacitor. The following sections discuss the required characteristics for the $V_{CAP}$ capacitor.

# Storage Capacitor

## Types

There are different types of capacitors, such as Niobium oxide, tantalum, electrolyte, film, multilayer ceramic capacitors, and polymer aluminum electrolytes. The following four types are selected considering reliability and stability of capacitors over temperature ranges.

- Niobium oxide capacitors
- Tantalum capacitors
- Polymer aluminum electrolyte capacitors
- Multilayer ceramic capacitors (MLCC)

**Note** The above recommendation does not limit the types of capacitors that can be used as $V_{CAP}$. Any type of capacitor that meets the $V_{CAP}$ spec range (value, DC voltage rating) can be used. You have to consider the application operating conditions while selecting the $V_{CAP}$.

## Key Characteristics

The following are capacitor key characteristics. These should be taken into consideration while deciding a suitable $V_{CAP}$ for the nvSRAM.

- Value ($V_{CAP}$ - % Tolerance) ≥ $V_{CAP}$ Minimum
- ($V_{CAP}$ + % Tolerance) ≤ $V_{CAP}$ Maximum

The storage capacitor ($V_{CAP}$), which is charged to $V_{CC}$, must deliver sufficient power required for an AutoStore operation. The time taken to charge must also be reasonably low - it must charge before Power Up RECALL is complete. These requirements decide the minimum and maximum value of the capacitor, respectively. The typical value suggested is the smallest value of $V_{CAP}$ (with 10% tolerance), which will be sufficient for AutoStore to be successful. The performance of the nvSRAM will be the same for any value within the specified range.

Typical values for a few densities are given below.

- 4 Mbit parallel 68 µF ± 10%
- 8 Mbit parallel 150 µF ±10%
- 16 Mbit parallel 22 µF ± 10%
- 64 Kbit serial 47 µF ± 10%

For minimum and maximum limits, refer to the device datasheet. See Max Limit for the VCAP.

### Tolerance

Tolerance is an important factor to consider when choosing the capacitor. The capacitor value with worst-case tolerance should be within the $V_{CAP}$ minimum and maximum limits.

### Voltage Rating

$V_{CAP}$ is charged to $V_{CC}$ through an internal charging circuit. Hence the $V_{CAP}$ should be rated above the maximum $V_{CC}$ of the part. Some of the newer nvSRAM parts, such as 16 Mbit nvSRAM are designed with an internal charge pump circuitry, which increases the $V_{CAP}$ pin voltage to 5 V, thereby allowing use of lower values of $V_{CAP}$ required for providing the necessary charge for AutoStore. In general, 6.3 V rated capacitors would satisfy the voltage ratings for $V_{CAP}$ for all $V_{CC}$ ranges of nvSRAM parts. Higher voltage ratings are recommended for better capacitor reliability, such as 6.3 V rated capacitors for 2.5 V and 3 V $V_{CC}$ parts, and 10 V rated capacitors for 5 V $V_{CC}$ parts.

### ESR

Effective series resistance (ESR) of the capacitor becomes significant when the capacitor operates under certain conditions, such as high frequency, high current, or temperature extremes. The storage capacitor, unlike coupling and decoupling capacitors, does not operate at high frequencies or current. Therefore, its ESR does not play a major role in the device operation. Though ESR value is not a constraint in capacitor selection, a low ESR of ≤ 1 Ω is preferred. The storage capacitor $V_{CAP}$ supplies the AutoStore current ($I_{CC4}$ in the datasheet) during power down and having lower series resistor provides more operating margin. See Effect of Series Resistor on VCAP Pin.

### Charging Current

The $V_{CAP}$ is charged from the $V_{CC}$ through a charging circuit. Typically the peak charging current is about 70 mA. The peak charging current's orders of magnitude is less than the maximum surge currents, the capacitors are tested by the manufactures. The maximum charging currents in nvSRAM would not exceed 350 mA, across process, voltage, and temperature.

# Capacitor Selection Guide

Table 1 summarizes the smallest value of $V_{CAP}$, which can be used for the various capacitor ranges for the family of nvSRAMs. For instance, for a datasheet $V_{CAP}$ specification of 61 µF (min) to 180 µF (max), the typical is shown as 68 µF, since 68 µF ± 10% is the lowest capacitor value that can be used in the application. It should be noted that any capacitor within the min/max specification limits, namely, 68 µF, 100 µF, or 150 µF would perform the same way as long as the value of the capacitor (net of tolerance) is within the specification limit.

If a system uses two or more nvSRAMs, their $V_{CAP}$ pins can be tied (ganged) together to connect to a single storage capacitor. The value of the storage capacitor must be the sum of the individual storage capacitor value required for the ganged nvSRAMs. See Ganging of VCAP Pins.

Table 1. Capacitor Selection Guide [1]

| Parameter | | Capacitor Types | | | | |
|---|---|---|---|---|---|---|
| | | **Niobium Oxide** | **Tantalum** | | **Polymer Aluminum Electrolytic Capacitors** | **Ceramic Multilayer Capacitors [2]** |
| Voltage rating for nvSRAM $V_{CAP}$ | 3 V part | 6.3 V / 10 V[3] | 6.3 V / 10 V[3] | | 6.3 V / 10 V[3] | 6.3 V / 10 V[3] |
| | 5 V part | 10 V / 16 V[3] | 10 V / 16 V[3] | | 10 V / 16 V[3] | 10 V / 16 V[3] |
| Tolerance | | ±20% | ±10% | ±20% | ±20% | ±20% |
| Smallest nominal capacitor value | For datasheet spec, $V_{CAP}$ = 61 µF to 180 µF (68 µF typical) | 100 µF | 68 µF | 100 µF | 100 µF | 100 µF |
| | For datasheet spec, $V_{CAP}$ = 122 µF to 360 µF (150 µF typical) | 220 µF | 150 µF | 220 µF | 220 µF | 2 x 100 µF[4] |
| | For datasheet spec, $V_{CAP}$ = 42 µF to 180 µF (47 µF typical) | 68 µF | 47 µF | 68 µF | 68 µF | 100 µF |
| | For datasheet spec, $V_{CAP}$ = 19.8 µF to 82 µF (22 µF typical) | 33 µF | 22 µF | 33 µF | 33 µF | 33 µF |

**Notes**

1. Data collected from the manufacturer's website and other related websites.
2. Ceramic capacitors have sensitivity to DC bias – capacitance reduces with DC bias voltage. Hence higher voltage rating or higher value capacitors should be chosen, taking into consideration the DC bias effect on the capacitance. Refer vendor's technical document for DC bias characteristics.
3. Higher voltage rating capacitor can be used for better reliability. For example, a 68 µF / 10 V rated capacitor would provide higher reliability than a 68 µF / 6.3 V rated capacitor in any application.
4. The MLCC provides limited options in high capacitance range; therefore, to meet the high capacitance requirement, capacitors can be connected in parallel to achieve the desired capacitance.

## Recommended Capacitors

Table 2, Table 3, Table 4, and Table 5 provide details of a few capacitors that can be considered when selecting storage capacitor[5] ($V_{CAP}$) for the nvSRAM. This list is not exhaustive and is provided for guidance only. You are recommended to refer to the various vendor catalogs when choosing the appropriate capacitors.

Table 2. Capacitor Options for $V_{CAP}$ = 68 µF typical

| Manufacturer | Manufacturer Part number | Type | Capacitance | Voltage Rating | Tolerance | Footprint |
|---|---|---|---|---|---|---|
| AVX Corporation | TAJB686K006RNJ | Tantalum | 68 µF | 6.3 V | ±10% | 3528-21(EIA) |
| Kemet | T491C686K006AT | Tantalum | 68 µF | 6.3 V | ±10% | 3528-21(EIA) |
| Vishay | TR3C686K6R3C0200 | Tantalum | 68 µF | 6.3 V | ±10% | 6032-28(EIA) |
| Kemet | T491C686K010AT | Tantalum | 68 µF | 10 V | ±10% | 6032-28(EIA) |
| Vishay | TR3B686K010C0900 | Tantalum | 68 µF | 10 V | ±10% | 3528-21(EIA) |
| Vishay | TR3C686K010C0225 | Tantalum | 68 µF | 10 V | ±10% | 6032-28(EIA) |
| Kemet | T491C686K016AT | Tantalum | 68 µF | 16 V | ±10% | 6032-28(EIA) |
| AVX Corporation | TAJC686K016RNJ | Tantalum | 68 µF | 16 V | ±10% | 6032-28(EIA) |
| Kemet | T491C686K016AT | Tantalum | 68 µF | 16 V | ±10% | 6032-28(EIA) |
| AVX Corporation | NOJB107M006RWJ | Niobium Oxide | 100 µF | 6.3 V | ±20% | 3528-21(EIA) |
| AVX Corporation | NOJC107M006RWJ | Niobium Oxide | 100 µF | 6.3 V | ±20% | 6032-28(EIA) |
| AVX Corporation | NOJD107M006RWJ | Niobium Oxide | 100 µF | 6.3 V | ±20% | 7343-31(EIA) |
| AVX Corporation | NOJD107M010RWJ | Niobium Oxide | 100 µF | 10 V | ±20% | 7343-31(EIA) |
| Kemet | T491B686M006AT | Tantalum | 100 µF | 6.3 V | ±20% | 3528-21(EIA) |
| Kemet | T491C107M010AT | Tantalum | 100 µF | 10 V | ±20% | 6032-28(EIA) |
| AVX Corporation | TPSB107M010R0400 | Tantalum | 100 µF | 10 V | ±20% | 3528-21(EIA) |
| AVX Corporation | TPSC107M010R0100 | Tantalum | 100 µF | 10 V | ±20% | 6032-28(EIA) |
| Kemet | A700D107M006ATE018 | Polymer Aluminum Electrolyte | 100 µF | 6.3 V | ±20% | 7343-31(EIA) |
| TDK Corporation | CKG57NX5R1C107M | MLCC | 100 µF | 16 V | ±20% | 6.50 mm x 5.50 mm x 5.50 mm |
| AVX Corporation | TAJC157K006RNJ | Tantalum | 150 µF | 6.3 V | ±10% | 6032-28(EIA) |
| AVX Corporation | TAJC157K010RNJ | Tantalum | 150 µF | 10 V | ±10% | 6032-28(EIA) |
| Kemet | B45197A3157K409 | Tantalum | 150 µF | 16 V | ±10% | 7343-31(EIA) |

**Note**

5. Data collected from the manufacturer's website and other related websites.

Table 3. Capacitor Options for $V_{CAP}$ = 150 µF typical

| Manufacturer | Manufacturer Part number | Type | Capacitance | Voltage Rating | Tolerance | Footprint |
|---|---|---|---|---|---|---|
| AVX Corporation | TAJC157K006RNJ | Tantalum | 150 µF | 6.3 V | ±10% | 6032-28(EIA) |
| AVX Corporation | TAJC157K010RNJ | Tantalum | 150 µF | 10 V | ±10% | 6032-28(EIA) |
| Kemet | B45197A3157K409 | Tantalum | 150 µF | 16 V | ±10% | 7343-31(EIA) |
| Panasonic - ECG | EEFUE0J181R | Polymer Aluminum Electrolyte | 180 µF | 6.3 V | ±20% | 7343-43(EIA) |
| AVX Corporation | NOSD227M006R0100 | Niobium Oxide | 220 µF | 6.3 V | ±20% | 7343-31(EIA) |
| Kemet | B76006V2279M045 | Tantalum | 220 µF | 6.3 V | ±20% | 7343-20(EIA) |
| Kemet | B45196H2227M409 | Tantalum | 220 µF | 10 V | ±20% | 7343-31(EIA) |
| AVX Corporation | TAJE227M016RNJ | Tantalum | 220 µF | 16 V | ±20% | 7343-43(EIA) |
| Kemet | A700X227M006ATE015 | Polymer Aluminum Electrolyte | 220 µF | 6.3 V | ±20% | 7343-43(EIA) |

Table 4. Capacitor Options for $V_{CAP}$ = 47 µF typical

| Manufacturer | Manufacturer Part number | Type | Capacitance | Voltage Rating | Tolerance | Footprint |
|---|---|---|---|---|---|---|
| AVX Corporation | TAJB476K006RNJ | Tantalum | 47 µF | 6.3 V | ±10% | 3528-21(EIA) |
| Vishay | TR3B476K6R3C0550 | | | | | |
| AVX Corporation | TAJB686M006RNJ | Tantalum | 68 µF | 6.3 V | ±20% | 6032-28(EIA) |
| Vishay | TR3B686M6R3C0650 | | | | | |
| AVX Corporation | NOJC686M006RWJ | Niobium Oxide | 68 µF | 6.3 V | ±20% | 6032-28(EIA) |
| AVX Corporation | NOJC686M010RWJ | Niobium Oxide | 68 µF | 10 V | ±20% | 6032-28(EIA) |
| Vishay | TR3B686M010C1500 | Tantalum | 68 µF | 10 V | ±20% | 3528-21(EIA) |
| Kemet | A700V686M006ATE028 | Polymer Aluminum Electrolyte | 68 µF | 6.3 V | ±20% | 7343-20(EIA) |
| AVX Corporation | 12106D107KAT2A | MLCC | 100 µF | 6.3 V | ±10% | 3225-12 |
| Murata | GRM31CR60J107ME39 | MLCC | 100 µF | 6.3 V | ±20% | 3216-16 |
| Kemet | C1210C107M9PAC | MLCC | 100 µF | 6.3 V | ±20% | 3225-21 |
| TDK Corporation | C3225X5R0J107MT | MLCC | 100 µF | 6.3 V | ±20% | 3225-25 |
| Taiyo Yuden | JMK325ABJ107MM<br>JMK325BJ107MY | MLCC | 100 µF | 6.3 V | ±20% | 3225-25<br>3225-20 |
| Taiyo Yuden | LMK325ABJ107MM | MLCC | 100 µF | 10 V | ±20% | 3225-25 |

Table 5. Capacitor Options for $V_{CAP}$ = 22 µF typical

| Manufacturer | Manufacturer Part number | Type | Capacitance | Voltage Rating | Tolerance | Footprint |
|---|---|---|---|---|---|---|
| Kemet | T494C226K010AT | Tantalum | 22 µF | 10 V | ±10% | 6032-28(EIA) |
| Vishay | TR3C226K010C0400 | | | | | |
| AVX Corporation | NOJC336M006RWJ | Niobium Oxide | 33 µF | 6.3 V | ±20% | 6032-28(EIA) |
| AVX Corporation | NOJC336M010RWJ | Niobium Oxide | 33 µF | 10 V | ±20% | 6032-28(EIA) |
| Kemet | T494C336M010AT | Tantalum | 33 µF | 10 V | ±20% | 6032-28(EIA) |
| Vishay | TR3C336M010C0375 | | | | | |
| Kemet | A700V336M006ATE028 | Polymer Aluminum Electrolyte | 33 µF | 6.3 V | ±20% | 7343-20(EIA) |
| Murata | GRM31CR60J476ME19L | MLCC | 47 µF | 6.3 V | ±20% | 3216 metric |
| Murata | GRM31CR61A476ME15L | MLCC | 47 µF | 10 V | ±20% | 3216 metric |
| Murata | GRM32ER61A476ME20L | MLCC | 47 µF | 10 V | ±20% | 3225 metric |
| TDK Corporation | C3225X5R1A476M | MLCC | 47 µF | 10 V | ±20% | 3225-25 |
| Kemet | C1206C476M8PAC | MLCC | 47 µF | 10 V | ±20% | 3225 metric |

## Summary

The Cypress nvSRAM is the most reliable nonvolatile SRAM solution and it requires a small external capacitor ($V_{CAP}$) for its nonvolatile operation. This application note provides the electrical requirements of the capacitor and lists a few capacitor types and values. The list of capacitors is not exhaustive and is intended as a guideline for selection of $V_{CAP}$. There is a wide range of options available other than the capacitors listed here. You can choose an appropriate $V_{CAP}$ capacitor depending on the desired size, cost, reliability, and other conditions, which the system is subject to. The nvSRAM device operation is independent of these characteristics.

## About the Author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# Appendix A

## Max Limit for the $V_{CAP}$

While it is easy to understand the minimum limit for $V_{CAP}$, the restriction on the maximum value can be difficult to comprehend. This restriction is because the nvSRAMs are specified to be ready for access in $t_{HRECALL}$ time (which is 20 ms in most parts). $t_{HRECALL}$ is the time nvSRAM takes to complete its boot-up sequence followed by the Power Up RECALL and be ready for access. This Power Up RECALL specification guarantees that the $V_{CAP}$ would charge to a sufficient voltage (and charge) to ensure that the part will complete a STORE operation, should the power fail immediately after the $t_{HRECALL}$ time from power up. If a capacitor of value exceeding the $V_{CAP}$ spec is used, it is possible that the $V_{CAP}$ would not have charged to sufficient voltage within the $t_{HRECALL}$ duration. In case customers prefer using larger value capacitor exceeding the max value, they should ensure that the nvSRAM first access after power-up is delayed longer than the $t_{HRECALL}$ spec to allow capacitor to be sufficiently charged. As a rule of thumb, for every 10% increase in value over the maximum specified $V_{CAP}$, add an additional 1 x $t_{HRECALL}$ duration before beginning access to the nvSRAM.

For example, if nvSRAM device is rated for $V_{CAP}$ = 180 µF and if you have decided to use 220 µF capacitor instead of 180 µF, which is 22% higher than max value, in this case nvSRAM first access should be after 3.2 x $t_{HRECALL}$ ($t_{HRECALL}$ + 2.2 x $t_{HRECALL}$). Since $V_{CAP}$ (min) to $V_{CAP}$ (max) range is about 3x, exceeding the max $V_{CAP}$ spec is not considered necessary in any application.

## Effect of Series Resistor on $V_{CAP}$ Pin

A series resistor reduces the voltage to the STORE circuit, which is powered by the $V_{CAP}$ voltage during AutoStore. For instance, in the 1 Mbit nvSRAM that has $I_{CC4}$ = 5 mA, a 10 Ω series resistor would reduce the voltage from $V_{CAP}$ pin by 50 mV. This reduction could be significant for the following reason. The AutoStore operation starts below a threshold level ($V_{SWITCH}$); let us assume it starts at 2.4 V. The charge stored in the capacitor supplies the 5 mA ($I_{CC4}$) current required for the STORE operation.

As the STORE operation progresses, the voltage on the $V_{CAP}$ pin would be decreasing. The STORE operation takes 8 ms ($t_{STORE}$) time. During this 8 ms, the voltage on the $V_{CAP}$ pin should not go below the minimum voltage required for proper STORE operation. If we assume the minimum voltage for proper circuit operation is 1.9 V, then the STORE operation should finish within the 500 mV drop (2.4 V minus 1.9 V) on the $V_{CAP}$ pin.

In case we put a series resistor on the $V_{CAP}$ pin, then because of the drop at $V_{CAP}$ pin due to series resistor it would mean that AutoStore circuit starts at a lower voltage and the circuit has power for a shorter time. In this example, the 500 mV operating range is reduced by the 50 mV to 450 mV due to drop in the 10 Ω resistor. A 1 Ω resistor affects the available voltage range by only 5 mV.

Note that these levels vary across process, voltage, and temperature (PVT) conditions and are not datasheet specs. The illustrative values are shown only to help understand the device operation better.

## Ganging of $V_{CAP}$ Pins

nvSRAM allows ganging of its storage capacitor ($V_{CAP}$) pin when using more than one nvSRAM in a system. The individual $V_{CAP}$ pin of two or more nvSRAMs can be tied (ganged) together to connect to a single storage capacitor, rather than using individual storage capacitors for the $V_{CAP}$ pin of each nvSRAM. This ganging scheme saves the board space and the bill of materials (BOM) cost. When ganging nvSRAM $V_{CAP}$ pins, the minimum and maximum size of the storage capacitor for the ganged $V_{CAP}$ pins is determined by adding the respective minimum and the maximum rated $V_{CAP}$ size of the individual nvSRAM.

For example, if a system uses two 4 Mbit nvSRAMs with their rated $V_{CAP}$ minimum and maximum size as 61 µF and 180 µF respectively, then the minimum and the maximum size of the storage capacitor for the ganged two $V_{CAP}$ pins should be within 2 x 61 µF (122 µF) and 2 x 180 µF (360 µF). Similarly, if a system uses N numbers of 4 Mbit nvSRAMs, then the minimum and maximum size of the storage capacitor for the ganged N $V_{CAP}$ pins should be within N x 61 µF and N x180 µF.

Ganging of nvSRAM $V_{CAP}$ pins is not allowed in the following cases:

1. If the system uses more than one nvSRAM device and each is connected to different $V_{CC}$ power supplies. In such cases, $V_{CAP}$ ganging is not allowed, because each nvSRAM will try to charge the storage capacitor to different voltage levels according their maximum $V_{VCAP}$ rating, resulting in a conflict in capacitor charging.
2. If two or more nvSRAMs are connected to the same $V_{CC}$ power supply but have different $V_{VCAP}$ (maximum voltage driven on the $V_{CAP}$ pin by the device) specifications, then the $V_{CAP}$ ganging is not allowed. New-generation nvSRAM devices such as CY14x116x have been designed with an on-chip voltage-doubler circuit to reduce the storage capacitor size on the $V_{CAP}$ pin and have the $V_{CAP}$ pin charging to 5 V max while the CY14x104x devices charge to $V_{CC}$ max. Therefore, for CY14B116L and CY14B104LA devices, do not tie $V_{CAP}$ pins together even when both the parts are connected to the same 3 V power supply.

As a rule of thumb, ganging of more than one nvSRAM is allowed only when the ganged nvSRAM $V_{CC}$ is connected to the same power supply and each nvSRAM has the same $V_{VCAP}$ rating.

# Document History

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| Revision | ECN | Orig. of Change | Submission Date | Description of Change |
|---|---|---|---|---|
| ** | 1836148 | UNC | See ECN | New application note |
| *A | 2829379 | MEDU | 12/16/09 | Updated Storage Capacitors sections. Added options to the Recommended Capacitors table |
| *B | 3158192 | MEDU | 01/31/2011 | Updated Table 1 and Table 2.<br>Added Table 3 and Table 4. |
| *C | 3203457 | MEDU | 03/23/2011 | Added $V_{CAP}$ in title, abstract and introduction to enable easier search by users.<br>Added more explanation in Value and ESR sections |
| *D | 3542218 | MEDU | 03/05/2012 | Explanatory notes added in appendix<br>Added $V_{CAP}$ = 19 µF to 120 µF in Table 1<br>Updated the list of recommended capacitors in Tables 2 to 4<br>Added Table 5 for Capacitor Options for $V_{CAP}$ = 22 µF typical<br>Added appendix for explaining the $V_{CAP}$ max spec and the effect of ESR on the $VC_{AP}$<br>Updated template |
| *E | 3887876 | ZSK | 01/30/2013 | Updated in new template. |
| *F | 3933202 | ZSK | 03/14/2013 | Updated Appendix A (Updated Effect of Series Resistor on $V_{CAP}$ Pin (Replaced “600 mV drop” with “500 mV drop”)). |
| *G | 4598353 | ZSK | 12/16/2014 | Update $V_{CAP}$ = 19.8 µF to 82 µF for 22 µF typical in Table 1<br>Added a note in the “Capacitor Selection Guide” section on $V_{CAP}$ ganging when using more than one nvSRAM in a system<br>Removed the following capacitor options for $V_{CAP}$ from the “Recommended Capacitor” table:<br>LKM325BJ107MM-T<br>LKM325ABJ107MM<br>C3216X5R1A107M<br>1216D476MAT2A<br>12066D476MAT2A<br>C3216X5R0J476M<br>C3216X5R1A476M<br>Added “Ganging of $V_{CAP}$ Pins” section in Appendix 1 |
| *H | 5797325 | AESATMP8 | 07/06/2017 | Updated logo and Copyright. |

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