AM08XX/AM18XX Reset and VCC Transient Behavior

1. Introduction

This application note describes the POR (power-on-reset) and counter register data retention behavior of the Ambiq Micro AMX8XX RTC family when the VCC supply is subject to transient voltage drops.

2. Transient Voltage Sources and Prevention

Voltage drops on the VCC supply could potentially come from a variety of sources, such as an instantaneous load on the VCC supply, or an ESD (electro static discharge) event. The magnitude of these voltage drops will be highly dependent upon the design of the hardware system. To minimize or eliminate voltage drops on the VCC supply, the following general guidelines should be followed.

1. All components in the system should have adequate VCC supply bypassing capacitors that are sized according to the transient loading behavior of the particular component. For example, components that have high frequency current surges on the VCC rail should have smaller value, high frequency bypass capacitors placed as close as possible to the component VCC supply pin(s). These high frequency bypass capacitors are also important for minimizing voltage spikes due to an ESD event. Components that have high current, low frequency surges will require larger value bypass capacitors to ensure voltage drops on the VCC supply rail are eliminated.
2. The ESR (equivalent series resistance) of the VCC power source will also impact the ripple and voltage drop susceptibility. The ESR should be well understood so the PCB layout characteristics and supply bypass capacitors can be properly sized and placed to minimize voltage drops.
3. The PCB layout and ground plane routing can also dramatically impact movement (voltage spikes or ringing) of the VCC rail during an ESD event. The PCB should be designed with a low impedance VCC route and solid ground plane under each component, with a high frequency bypass capacitor placed as close as possible to each component (including the AMX8XX).

With these guidelines in mind, VCC transient voltage drops can be minimized, which can prevent system resets and/or data loss or corruption for system components.

For ESD events, transient voltage surges are typically in the range of tens or hundreds of nanoseconds. Figure 1 shows the ESD current waveform with respect to time per IEC61000-4-2 human body model discharge. The path over which ESD travels and how it affects the system components is highly dependent upon the factors stated above as well as the industrial design of the product. However, for ESD events that cause a disturbance to the VCC rail that results in voltage drops that last for nanoseconds, microseconds, and even up to tens of milliseconds, the AMX8XX will be robust in preventing counter register resets or corruption based on the testing results contained in this application note.

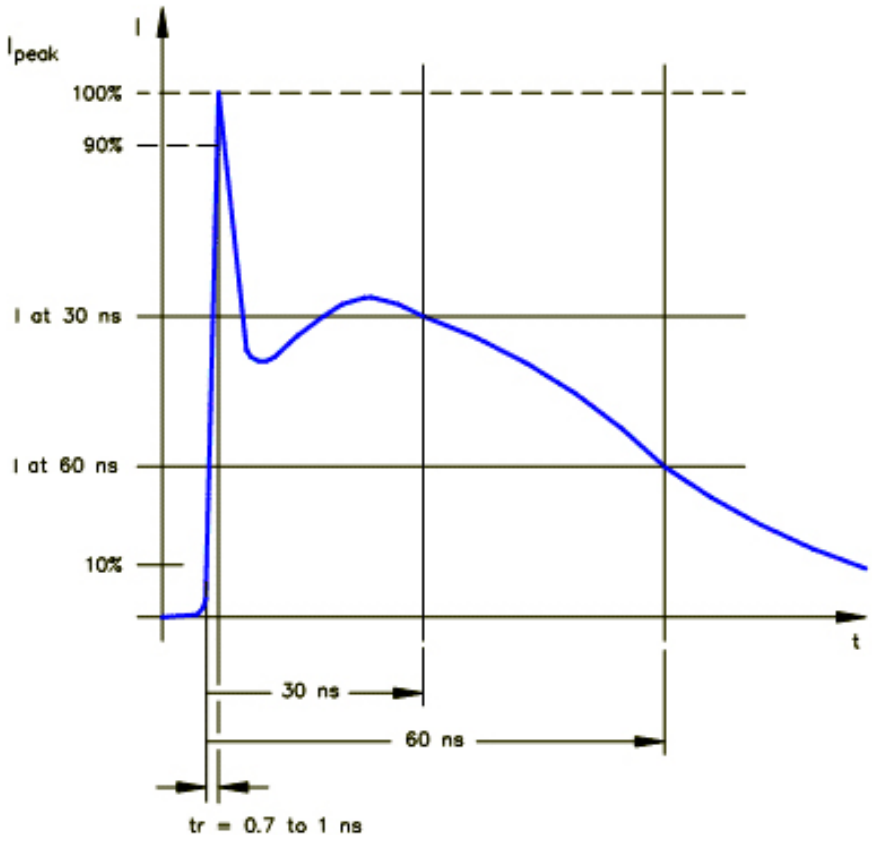

Figure 1 – HBM Current Waveform per IEC61000-4-2

3. AMX8XX Counter Data Retention Test Method

The AMX8XX RTC family is robust in handling VCC transient voltage drops due to many of its internal circuits. This circuitry aids in data retention and requires that a transient voltage drop on VCC be sustained for a period of time before a reset will be asserted. A reset will be asserted when VCC falls below the specified VCC reset voltage (typically 1.3V) for a minimum of one second under typical operating conditions. When reset is asserted, the AMX8XX will reset its registers to their reset values, which includes consistently resetting the counter registers to 0. In addition, as can be seen by the results that follow, the AMX8XX internal ultra-low power and high impedance circuits are capable of retaining counter register and RAM values even if VCC drops to 0V; provided VCC is restored within a short period of time.

The AMX8XX was tested for counter register data retention using the following test method to simulate a transient voltage drop on VCC.

1. VCC was supplied with an initial voltage, V_{HIGH}.
2. VCC was then pulsed to a lower voltage, V_{LOW}, for a time duration, t_{LOW} (pulse width), with VCC subsequently returning to the initial starting voltage, V_{HIGH}.
3. After applying the VCC pulse low, the counter registers were checked for data retention as well as continued counting operation after restoration of VCC.
4. Steps 1 -3 were repeated to find the maximum pulse width, $t_{LOW,MAX}$, that could be applied and the AMX8XX RTC still retain its counter register values.

Figure 2 shows the waveform applied to VCC using the test method described above.

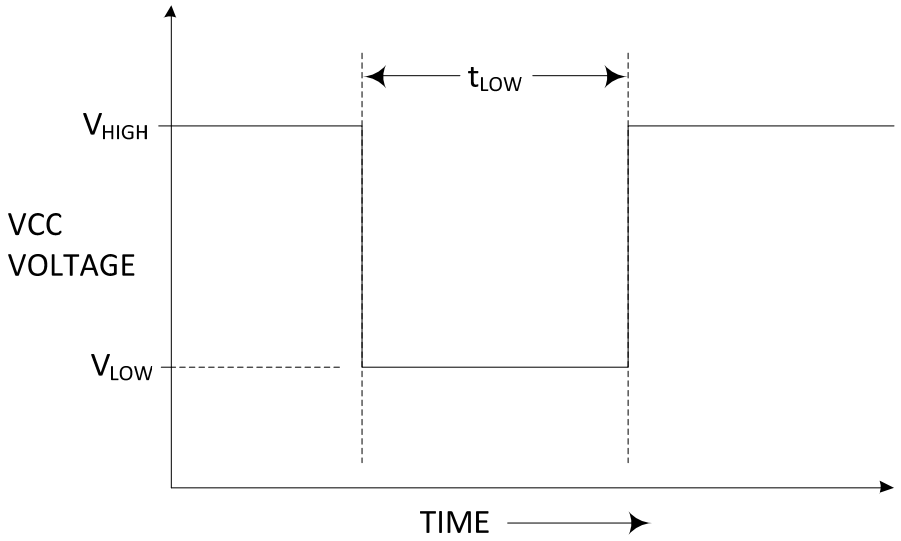

Figure 2 – VCC Pulsed Low

4. Test Results

Typical test results at 25ºC are shown in Table 1. For all test results, the AMX8XX RTC counter clocks were running after VCC returned to the V_{HIGH} voltage and it was verified that the counter clocks retained their values.

V_{HIGH} (V)	V_{LOW} (V)	$t_{LOW,MAX}$ (ms)
3.0	0	59
3.0	0.3	69
3.0	0.9	880
1.8	0	3.7
1.8	0.3	20
1.8	0.9	790

Table 1 – AMX8XX Test Results

As can be seen in Table 1, VCC can be typically driven all the way down to 0V for up to 59ms with an initial VCC voltage of 3.0V and up to 3.7ms with an initial VCC voltage of 1.8V and still retain the counter register values. A voltage drop to 0.9V would be more realistic, although still rather extreme. In this case, the AMX8XX can typically sustain a VCC voltage drop for a much longer time period; up to 880ms with an initial VCC voltage of 3.0V and up to 790ms with an initial VCC voltage of 1.8V.

5. Summary

The board hardware system must be designed carefully including consideration of component selection and placement, PCB layout, and industrial design in order to achieve a system that is robust against ESD and other transient voltage sources. Should a voltage drop on VCC occur due to a transient event, the AMX8XX will be robust in preventing counter register resets or corruption, even from large VCC voltage drops that last for nanoseconds, microseconds, and even up to hundreds of milliseconds due to an ESD event or supply loading.

AM08XX/AM18XX Reset and VCC Transient Behavior

Document Revision History

Rev #	Description
0.02	Initial release

Contact Information

Address:

Ambiq Micro, Inc.
303 Camp Craft Road
Westlake Hills, TX 78746

(512)-485-7790

Website:

www.ambiqmicro.com

General Information:

info@ambiqmicro.com

Sales:

sales@ambiqmicro.com

Technical Support:

support@ambiqmicro.com