MitySOM-5CSx System-On-Module (SOM)

Revision History and Errata

Dated

08/17/2017

1 Introduction

This document describes the production revision history and any known design issues or exceptions to the functional specifications for the MitySOM-5CSx developed by Critical Link, LLC. For the purposes of this document, reference to the “module” implies MitySOM-5CSx.

Details regarding the board may be accessed at http://www.criticallink.com/product/mitysom-5csx/, and additional support information is located at the following URL: http://redmine.syr.criticallink.com/redmine/projects/mityarm-5cs/wiki. This document is subject to change without notification, however, the most recent version of this document will be made available at the website mentioned above. The website supports email notification (via the “watch option”) for changes to published documents.

2 Product Marking

The board’s PCA number and serial number may be visually read from a label affixed to the bottom of the module. The Printed Circuit Board (PCB) part number is etched in copper, also visible on the bottom.

The PCA number begins with “80-”. The PCA number can also be determined by the serial number, if necessary. Contact Critical Link for details.

The serial number is of the format “S/NXXXXXX”, where XXXXXX is the serial number.

The PCB part number begins with “90-”.

See Table 1 for products affected.

Table 1: Products Affected

Errata	Model Number	Affected PCA	Resolution
4.1.1 BSEL1 Pull-down Resistor Value	5CSE-L2-3Y8-RC 5CSE-S2-3Y8-RI 5CSE-H4-3YA-RC 5CSE-H4-3YA-RI 5CSX-H5-4YA-RC 5CSX-H5-4YA-RI 5CSX-H6-42A-RC 5CSX-H6-42A-RI 5CSX-H6-4YA-RC 5CSX-H6-4YA-RI 5CSX-H6-53B-RC	80-000705RC-2 80-000729RI-2 80-000713RC-2 80-000713RI-2 80-000714RC-2 80-000714RI-2 80-000642RC-2 80-000642RI-2 80-000772RC-2 80-000772RI-2 80-000646RC-2	Fixed in -3 and newer PCAs. See PCN20150727000 for additional details.
4.2.1 Temperature Sensor Changed From TC74A5 to LM73CIMK-1	5CSE-L2-3Y8-RC 5CSE-S2-3Y8-RI 5CSE-H4-3YA-RC 5CSE-H4-3YA-RI 5CSX-H5-4YA-RC 5CSX-H5-4YA-RI 5CSX-H6-42A-RC 5CSX-H6-42A-RI 5CSX-H6-4YA-RC 5CSX-H6-4YA-RI 5CSX-H6-53B-RC	80-000705RC-1 80-000729RI-1 80-000713RC-1 80-000713RI-1 80-000714RC-1 80-000714RI-1 80-000642RC-1 80-000642RI-1 80-000772RC-1 80-000772RI-1 80-000646RC-1	Fixed in -2 and newer PCAs. See PCN20150626000 for additional details.
4.3.1 DDR Power Current Sinking	5CSE-L2-3Y8-RC 5CSE-S2-3Y8-RI 5CSE-H4-3YA-RC 5CSE-H4-3YA-RI 5CSX-H5-4YA-RC 5CSX-H5-4YA-RI 5CSX-H6-42A-RC 5CSX-H6-42A-RI 5CSX-H6-4YA-RC 5CSX-H6-4YA-RI 5CSX-H6-53B-RC	80-000705RC-2 80-000729RI-2 80-000713RC-2 80-000713RI-2 80-000714RC-2 80-000714RI-2 80-000642RC-2 80-000642RI-2 80-000772RC-2 80-000772RI-2 80-000646RC-2	Fixed in -3 and newer PCAs. See PCN20150727000 for additional details.
4.4.1 ULPI Data Corruption	5CSE-L2-3Y8-RC 5CSE-S2-3Y8-RI 5CSE-H4-3YA-RC 5CSE-H4-3YA-RI 5CSX-H5-4YA-RC 5CSX-H5-4YA-RI 5CSX-H6-42A-RC 5CSX-H6-42A-RI 5CSX-H6-4YA-RC 5CSX-H6-4YA-RI 5CSX-H6-53B-RC	80-000705RC-2,3 80-000729RI-2,3 80-000713RC-2,3 80-000713RI-2,3 80-000714RC-2,3 80-000714RI-2,3 80-000642RC-2,3 80-000642RI-2,3 80-000772RC-2,3 80-000772RI-2,3 80-000646RC-2,3	Fixed in -4 and newer PCAs. See PCN20151019000 for additional details.

Table 1 (con't): Products Affected

Errata	Model Number	Affected PCA	Resolution
4.3.2 1.8V Switching Supply Ripple	5CSE-L2-3Y8-RC 5CSE-S2-3Y8-RI 5CSE-H4-3YA-RC 5CSE-H4-3YA-RI 5CSX-H5-4YA-RC 5CSX-H5-4YA-RI 5CSX-H6-42A-RC 5CSX-H6-42A-RI 5CSX-H6-4YA-RC 5CSX-H6-4YA-RI 5CSX-H6-53B-RC	80-000705RC-1,2,3 80-000729RI-1,2,3 80-000713RC-1,2,3 80-000713RI-1,2,3 80-000714RC-1,2,3 80-000714RI-1,2,3 80-000642RC-1,2,3 80-000642RI-1,2,3 80-000772RC-1,2,3 80-000772RI-1,2,3 80-000646RC-1,2,3	Improvements have been identified for future modules.
4.3.3 1.8V Switching Supply Frequency	5CSE-L2-3Y8-RC 5CSE-S2-3Y8-RI 5CSE-H4-3YA-RC 5CSE-H4-3YA-RI 5CSX-H5-4YA-RC 5CSX-H5-4YA-RI 5CSX-H6-42A-RC 5CSX-H6-42A-RI 5CSX-H6-4YA-RC 5CSX-H6-4YA-RI 5CSX-H6-53B-RC	80-000705RC-4 80-000729RI-4 80-000713RC-4 80-000713RI-4 80-000714RC-4 80-000714RI-4 80-000642RC-4 80-000642RI-4 80-000772RC-4 80-000772RI-4 80-000646RC-4	Fixed in -5 and newer PCAs, starting with Lot-Code: 15-12-05 Modules. See PCN20160613000 for additional details.
4.4.2 USB OTG Margin Improvements	5CSE-L2-3Y8-RC 5CSE-S2-3Y8-RI 5CSE-H4-3YA-RC 5CSE-H4-3YA-RI 5CSX-H5-4YA-RC 5CSX-H5-4YA-RI 5CSX-H6-42A-RC 5CSX-H6-42A-RI 5CSX-H6-4YA-RC 5CSX-H6-4YA-RI 5CSX-H6-53B-RC	80-000705RC-1,2,3,4,5 80-000729RI-1,2,3,4,5 80-000713RC-1,2,3,4,5 80-000713RI-1,2,3,4,5 80-000714RC-1,2,3,4,5 80-000714RI-1,2,3,4,5 80-000642RC-1,2,3,4,5 80-000642RI-1,2,3,4,5 80-000772RC-1,2,3,4,5 80-000772RI-1,2,3,4,5 80-000646RC-1,2,3,4,5	Improvements incorporated into -8 and newer modules. See PCN20170801000 for additional details.
4.5.1 Change RTC Crystal to Lower Capacitance Part	5CSE-L2-3Y8-RC 5CSE-S2-3Y8-RI 5CSE-H4-3YA-RC 5CSE-H4-3YA-RI 5CSX-H5-4YA-RC 5CSX-H5-4YA-RI 5CSX-H6-42A-RC 5CSX-H6-42A-RI 5CSX-H6-4YA-RC 5CSX-H6-4YA-RI 5CSX-H6-53B-RC	80-000705RC-1,2,3,4,5,8 80-000729RI-1,2,3,4,5,8 80-000713RC-1,2,3,4,5,8 80-000713RI-1,2,3,4,5,8 80-000714RC-1,2,3,4,5,8 80-000714RI-1,2,3,4,5,8 80-000642RC-1,2,3,4,5,8 80-000642RI-1,2,3,4,5,8 80-000772RC-1,2,3,4,5,8 80-000772RI-1,2,3,4,5,8 80-000646RC-1,2,3,4,5,8	Improvements incorporated into -9 and newer modules. See PCN20170817000 for additional details.

See MitySOM-5CSx Design Guide for migration options across the MitySOM-5CSx family.

3 PCA Product History

The PCA product errata for all MitySOM-5CSX and MitySOM-5CSE is listed in Table 1. Details for Product Change Notifications (PCNs) may be downloaded from the link below. Table 1 highlights the PCA product history for the MitySOM-5CSx:
http://support.criticallink.com/redmine/projects/mityarm-5cs/wiki/Errata_and_Module_Product_Change_Notifications

Table 2 PCA product history

Model Family	PCA Revision (for 80- PCA#)	Description of Changes	PCN Document
MitySOM-5CSX	-1	• Initial production release	
MitySOM-5CSX MitySOM-5CSE	-2	• Updated Temperature Sensor • Updated USB PHY Clocking • RTC Updated • Alternate VBAT Power Connection Added • LEDs Updated for Improved Assemblies • Added QSPI_CLK Series Resistor • HPS GPI ID • Thermal Performance Slightly Improved • Updated Labeling • Add Expanded I/O support • Add support for additional HPS DDR3 memory	PCN20150626000
MitySOM-5CSX MitySOM-5CSE	-3	• Reduced Switching Speed on the DDR Power Supplies • Reduced BSEL1 Resistor Value	PCN20150727000
MitySOM-5CSX MitySOM-5CSE	-4	• Reduced Switching Supply Ripple on the 1.8V Power Supply	PCN20151019000
MitySOM-5CSX MitySOM-5CSE	-5	• Faster Switching Frequency on the 1.8V and 2.5V Power Supplies	PCN20160613000
MitySOM-5CSX MitySOM-5CSE	-8	• Improve USB OTG Margin	PCN20170801000
MitySOM-5CSX MitySOM-5CSE	[Evaluating]	• Silkscreen Improvements • Internal Power Rail Test Access • Thermal Spreading Improvements	PCN20160929000
MitySOM-5CSX MitySOM-5CSE	-9	• Lower RTC Crystal Capacitance	PCN20170817000

4 Known Design Exceptions and Usage Notes

This section outlines the design exceptions to MitySOM-5CSX and MitySOM-5CSE.

4.1 Cyclone V

4.1.1 BSEL1 Pull-down Resistor Value

Issue Description

Altera has updated the pin connection guidelines for the MSEL / CSEL / BSEL pull-down resistor, reducing the recommended value from the original. The resistor is included on the MitySOM for BSEL1 and was initially a 10K resistor.

Design Impact

There is a chance that the BSEL1 value registered at reset could be read wrong and the Cyclone V would attempt to boot from a different device than intended.

Planned Resolution

As a preventative measure, this resistor has been reduced to 2.0K. This is addressed by PCN 20150727000 and the fix is included in “Dash 3” and newer modules.

4.2 I^2C Interface

4.2.1 Temperature Sensor Changed From TC74A5 to LM73CIMK-1

Issue Description

The initial TC74A5 temperature sensor is an older device and was experiencing significant production failures. This device was replaced with a LM73CIMK-1 that does not experience the production fallout.

Design Impact

One of the two temperature sensor devices appear on the I^2C0 bus. They are located at different addresses and can be supported by software updates. The newer LM73CIMK-1 appears at address 0x4C instead of 0x4D. Additional details can be found on the MitySOM-5CSX Wiki: https://support.criticallink.com/redmine/projects/mityarm-5cs/wiki/SoM_Temperature_Sensor.

Planned Resolution

This is addressed by PCN 20150626000. Starting with "dash 2" assemblies (part numbers ending in -2 or newer, such as 80-000642RC-2) the temperature sensor is updated to use the LM73CIMK-1 part.

4.3 Power

4.3.1 DDR Power Current Sinking

Issue Description

A limit was observed in the current sinking capacity of the termination rail power supply used by the DDR memory. Due to this limited ability to sink current, some modules experienced a start-up issue where the MitySOM remains stuck in reset.

Design Impact

When the MitySOM experiences this issue, it fails to boot with the power-on reset (POR) held active (low) by the Cyclone V itself. If this condition occurs, the unit must be powered off and wait for about one minute before powering the unit back on.

Planned Resolution

The switching supplies generating the voltage rails for the DDR memory going forward are set to run at a slightly reduced frequency. The initial design ran the DDR memory power supplies at a nominal frequency of 2.25MHz. This has been reduced to a nominal frequency of 1.9MHz by changing the value of a single resistor. Reducing the switching frequency slightly has a large impact on the current sinking capability of the power supply. With this change, there is more margin in the design and the modules no longer experience the reset issue.

This is addressed by PCN 20150727000 and the fix is included in "Dash 3" and newer modules.

4.3.2 1.8V Switching Supply Ripple

Issue Description

The 1.8V VIO supply provided from the MitySOM to the baseboard for the RGMII I/O power has higher ripple than intended. If this supply is used on the baseboard to power the oscillator for the Ethernet PHY, there may be too much jitter on the clock to meet the PHY's clock input requirements.

Design Impact

MitySOM-5CSx Baseboard designs should avoid using the provided 1.8V supply to power the PHY reference oscillator. Designs that use a crystal oscillator for the Ethernet PHY reference clock are not affected.

Workaround

Revision -4 and newer MitySOM-5CSx modules have slightly lower power supply ripple. The -4 modules reduce the ripple as described above for the USB PHY clocking fix.

If the baseboard design powers the oscillator from the provided 1.8V supply, additional filtering or a different supply should be used. Adding a ferrite bead before the bypass cap for the oscillator is expected to clean up the clock jitter. Alternatively, the oscillator can be powered from a 2.5V supply on the baseboard and use a resistor divider to adjust the clock signal's level back down to 1.8V levels.

Resolution

The -6 and newer revision modules will incorporate layout updates to reduce the 1.8V switching power supply to the desired levels. Once these changes have been incorporated into the module and qualified, there will be a PCN document posted to the Wiki describing the change and when the updated MitySOM modules will be available.

4.3.3 1.8V Switching Supply Frequency

Issue Description

Starting with Lot-Code 12-23-15 MitySOM-5CSx modules, the 1.8V power supply was not stable over time and temperature. After running for 15 to 20 minutes, many of the modules experienced larger voltage ripple on the 1.8V supply. Some modules had voltage ripple that would continue to grow until it resulted in power-good on the supply declaring the voltage out of regulation and causing a reset. In many of these cases, the module would then continue to cycle between short periods of running and reset.

Design Impact

The issue was attributed to process variation on the power supply device. MitySOMs with a “Dash 4” revision and with Lot-Code 15-12-05 need a resistor modification on the module to have sufficient process variation margin.

Workaround

Please contact Critical Link if you have any of the modules from Lot-Code 15-12-03 with a -4 revision.

Resolution

This is addressed in PCN 20160613000. The 1.8V switching frequency is increased to improve the power supply margin. The frequency increases from the original 800kHz to 1.9MHz. With the faster switching frequency, the modules maintain regulation and the change has been tested over the full temperature range.

4.4 USB PHY

4.4.1 ULPI Data Corruption

Issue Description

During stress tests of the latest production run, some USB errors were observed on the ULPI bus to the USB. These errors were observed under conditions of continuous use the of the USB interface. The errors were traced back to ULPI_CLK ripple when extra ripple on the 1.8V supply is experienced by the oscillator.

Design Impact

When a corrupt packet is seen across the ULPI bus between the Cyclone V and the USB PHY, the driver or device can get into a bad state. There are a few instances where the software does not handle bad transactions and the interface can hang. This was observed with some format tests of a USB flash drive. Testing with updated kernel code and an RNDIS connection to a PC could experience minor soft failures where the software was able to recover.

Critical Link has made an effort to pull USB patches into the MitySOM-5CSx git[1] repository to fix many of the USB driver issues. However; this is open source software and Critical Link does not maintain the driver code. There is a good chance that the patches have not been back ported to all Linux kernel versions listed in the repository.

Resolution

This is addressed by PCN 20151019000. ULPI_CLK is changed to be filtered by a PLL inside the USB PHY. The second change adjusts the feedback loop on the 1.8V power supply, adding a feed-forward capacitor to the feedback resistor divider and cutting off a path for PGND return current around the feedback resistors.

4.4.2 USB OTG Margin Improvements

Issue Description

During volume production, a certain set of modules would fail USB tests. The production process was to separate these units for further investigation. Once enough units had failed, the mode of failure could be investigated to determine the root cause.

The USB test fallout was investigated and the root cause was determined. In this case, the root cause of USB failures was traced to a pull-down resistor on the baseboard design. There is a USB_PSW output on the MitySOM's TUSB1211 PHY that is called USB1_PS_ON on the edge connector. This net cannot reliably drive a pull-down, at high temperatures, with a value less than 5k. The production test setup included a 2.2k pull-down. Changing the baseboard to use a 10k alleviated this temperature-dependent, USB PHY component variation failure mode.

In the course of investigating the production fallout, two details were identified where components are outside the recommended range of values. The datasheet recommends PSW [USB1_PS_ON] pull-down with a typical value of 100k. Unfortunately, the MitySOM design initially included a 102k pull-up resistor on that net, which prevents using the typical pull-down value specified in the datasheet. Removing the MitySOM's PSW [USB1_PS_ON] pull-up resistor allows designs in the future to use the typical value.

The second design vs. datasheet difference identified was the bypass capacitor values used on the USB PHY's LDO power rails. The MitySOM has bypass capacitors below the recommended range of values. These capacitors are updated to larger values in the recommended range specified in the USB PHY datasheet.

Design Impact

Many baseboard designs that use USB OTG power switching control include a 10k pull-down. For these designs, the 5CSx module is expected to operate the USB port and the failure should not be experienced. Likewise, baseboard designs that omit the pull-down resistor, because they do not make use of the USB port power switching feature, also do not experience the failure.

[1] Critical Link's MitySOM-5CSx Linux Kernel Repository: http://support.criticallink.com/gitweb/?p=linux-socfpga.git;a=summary

The baseboard designs that include a pull-down resistor less than 10k on the PSW [USB1_PS_ON] net could still experience the failure at high temperatures. In fact, if it is a heavy pull-down, the range of temperatures experiencing the error will likely grow. In all cases, please ensure the baseboard has a pull-down resistor of 10k or higher when the USB1_PSW [USB1_PS_ON] power control net is used in the design as an open-source output.

Design Impact

This is addressed in PCN 20170801000.

4.5 RTC

4.5.1 Change RTC Crystal to Lower Capacitance Part

Issue Description

The RTC uses a 32 kHz tuning fork crystal with capacitance (12.5 pF) higher than manufacturer recommended (6pF or lower).

Design Impact

Abracon has indicated that the RTC will have more stable drift with the lower capacitance crystal.

Abracon has also noted a potential stall of the RTC crystal with the original crystal that included a 12.5pF parasitic capacitance. Critical Link has not identified a case of a stalled crystal, nor has there been reports of this failure mode from fielded MitySOM units.

Resolution

This is addressed in PCN 20170818000. To ensure product reliability and provide additional stability on the RTC's crystal clock source, the MitySOM will be updated to use a crystal with 6pF capacitance.

5 Errata Revision History

Date	Version	Change Description
05-Nov-2015	1.0	Initial Release
13-Jun-2016	2.0	Added 1.8V Switching Frequency Errata
01-Aug-2017	3.0	Improve USB Margin
18-Aug-2017	4.0	Lower RTC Crystal Capacitance