1 Subject

Affected Products	conga-TS67, conga-BS67, conga-BM67, conga-TS77, conga-BS77, conga-BP77, conga-TS87, conga-TC87, conga-TS97, conga-TC97
Subject	Effect of onboard SMBus Hub to carrier board SMBus design
Confidential/Public	Public
Date (yyyy.mm.dd)	2015.05.26
Author	CJR

2 Affected Article Numbers

2.1 Product Data

Affected Number(s)	Product
several	conga-TS67, conga-BS67, conga-BM67, conga-TS77, conga-BS77, conga-BP77, conga-TS87, conga-TC87, conga-TS97, conga-TC97

3 Information

3.1 Why using an SMBus Hub?

The congatec products listed in section 2.1 feature the NXP SMBus hub device PCA9518. This hub device connects the different SMBus segments of the platform. The same hub device is used by Intel on their customer reference boards.

The PCA9518 is a multi-directional translator that requires no external directional control. It is specifically designed to support a multi-master SMBus environment. The hub buffers the SMBus signals from segment to segment and does not respond to any SMB commands.

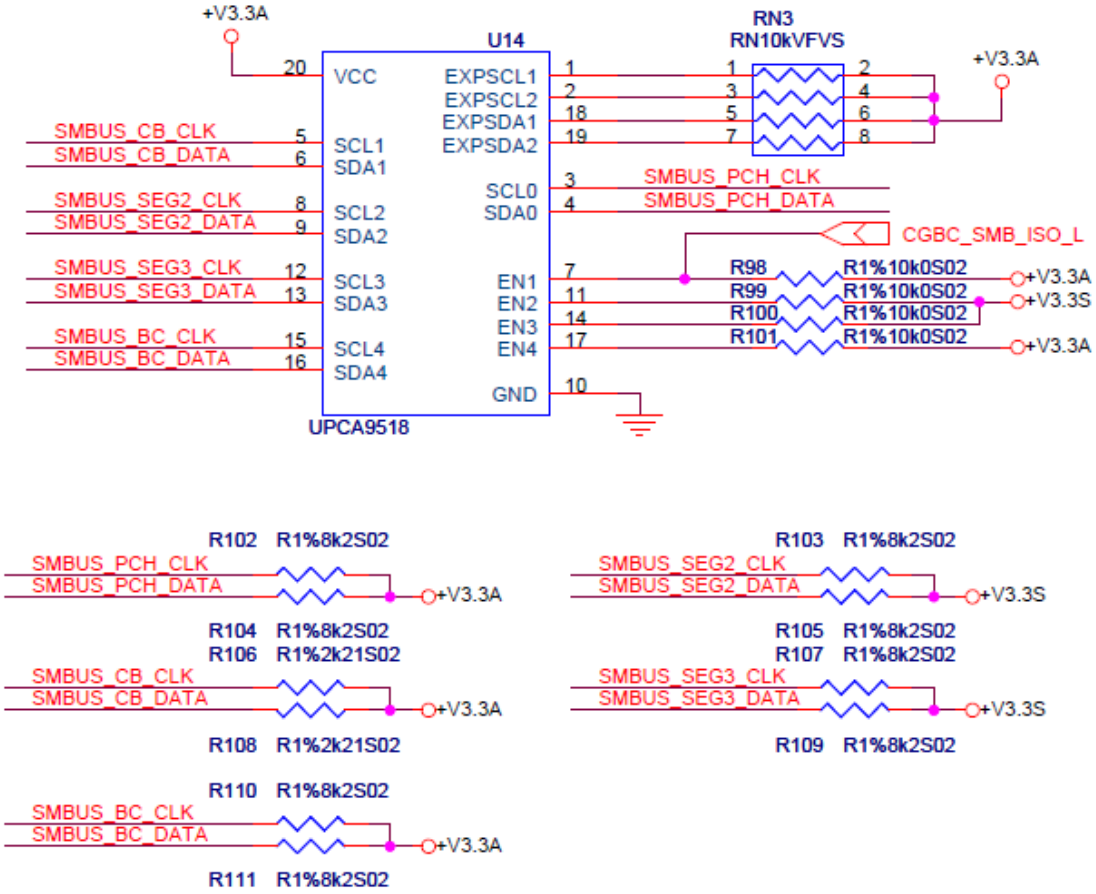

Figure 1: SMBus hub circuitry on congatec products.

Notes

The SMBus segment going to the carrier board can be isolated by the congatec board controller driving the EN1 input low. This feature can be used as a workaround for non-spec conform SMBus devices on the carrier board.

3.2 Voltage Level Technical Information

The SMBus hub device influences the SMBus signal slightly. The low level of the signals is not 0V anymore; it is around 0.4 to 0.5V.

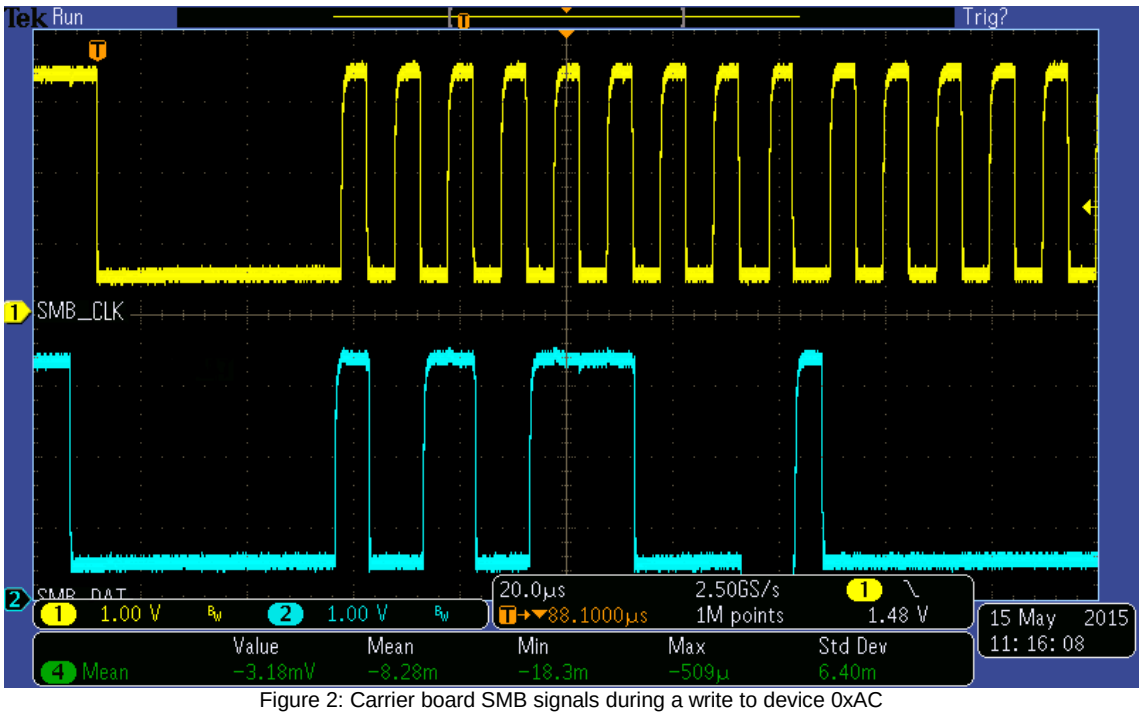

Figure 2: Carrier board SMB signals during a write to device 0xAC

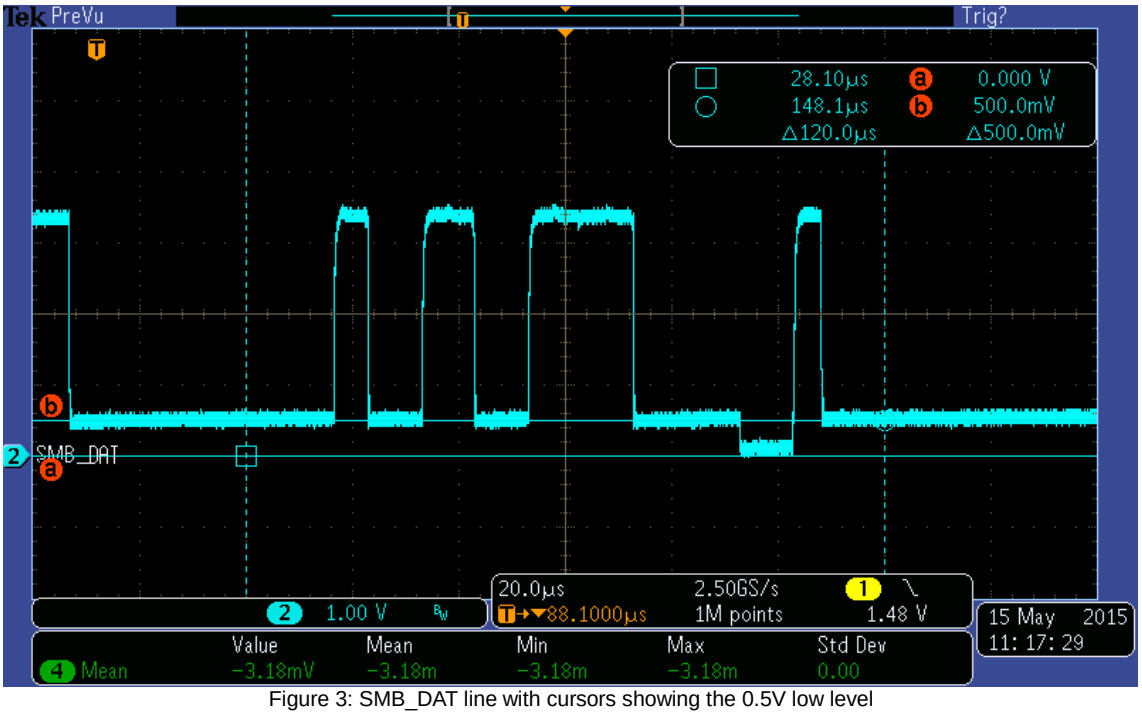

Figure 3: SMB_DAT line with cursors showing the 0.5V low level

In SMBus specification, the maximum low level is defined as 0.3 * Vcc. From this definition, the maximum low level for a 3.3V powered bus is 1V. This implies that the slight low level deviation seen in section 3.2 will not affect the functionality of the SMBus devices. These devices should function as expected because the maximum low level is within the specified range.

For more details about the design constraints of the SMBus hub, refer to figure 7 on page 9 of the NXP application note: **AN255 I²C SMBus REPEATERS, HUBS AND EXPANDERS.pdf**

The AN can be downloaded from this link:
http://www.nxp.com/documents/application_note/AN255.pdf

3.3 Known Incompatibility

The Texas Instrument TCA4311A Hot Swappable 2-Wire Bus Buffer does not work properly when used in combination with the NXP PCA9518 SMBus hub featured on congatec products.

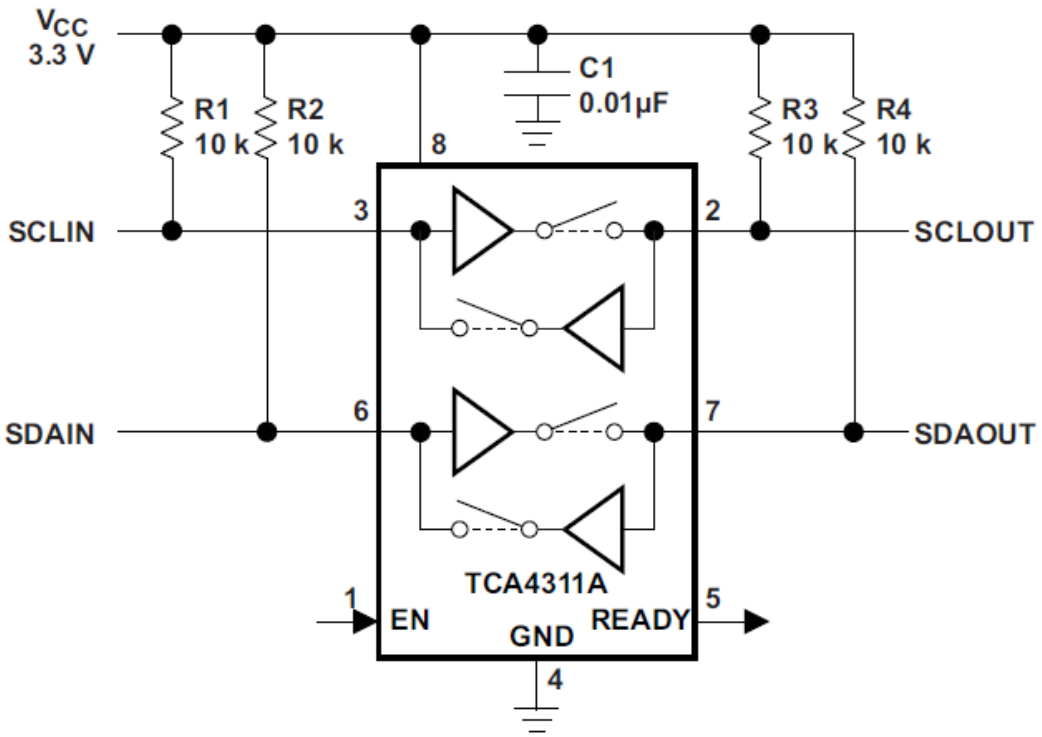

Figure 4: Application Schematics of TCA4311A

Refer to the TCA4311A datasheet which can be downloaded from the Texas Instruments website at www.ti.com.

Below screen shots were captured during write operation to an EEPROM at device address 0xAC. Channel 1 and 2 show the SMBus signal output of the TI4311A buffer. Channel 3 and 4 show the SMB signals from the congatec COM Express module conga-TS77.

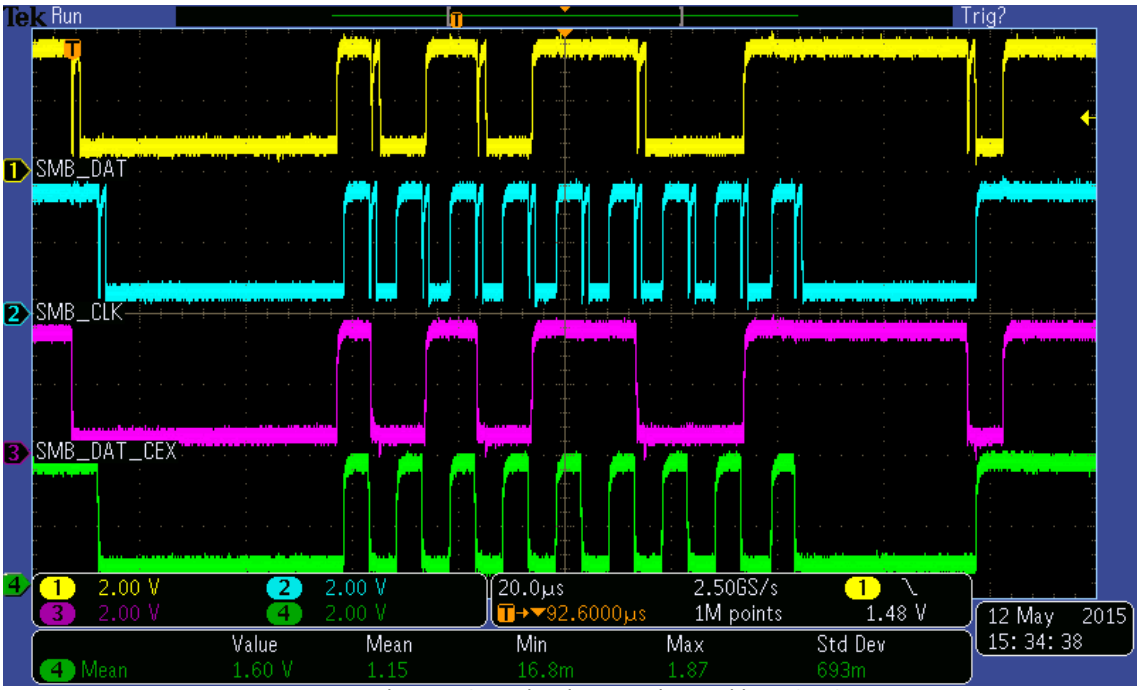

Figure 5: SMB signals on a write to address 0xAC

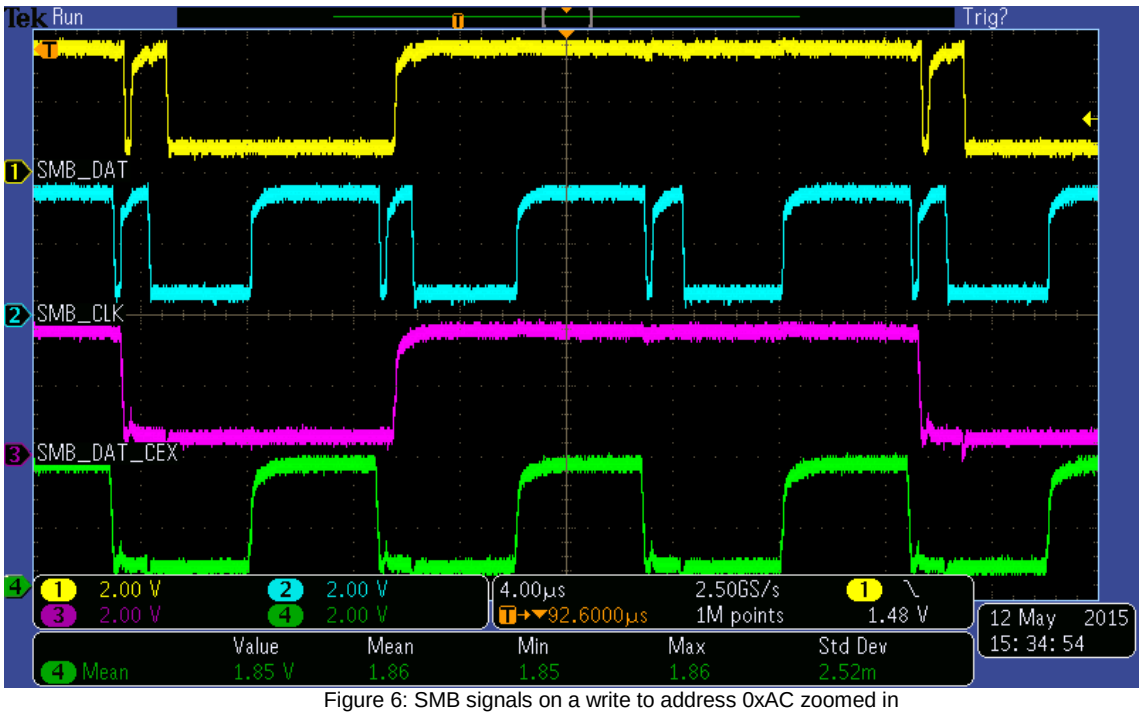

Figure 6: SMB signals on a write to address 0xAC zoomed in

From the screen shot, it can be seen that there are signal errors on the SMBus output segment of the TI4311A buffer. The communication to an SMB device connected on the output segment of the buffer does not work. The test has been performed with two different devices - an EEPROM and a SMART battery. Both devices showed the same signal errors.

3.4 Solution

The assumption is that the signal errors above are caused by the rise time acceleration (RTA) feature of the TI4311A buffer. NXP offers a pin compatible buffer device PCA9512 that allows the disabling of the rise time acceleration. congatec successfully tested this buffer device in combination with the PCA9518 hub on the module.

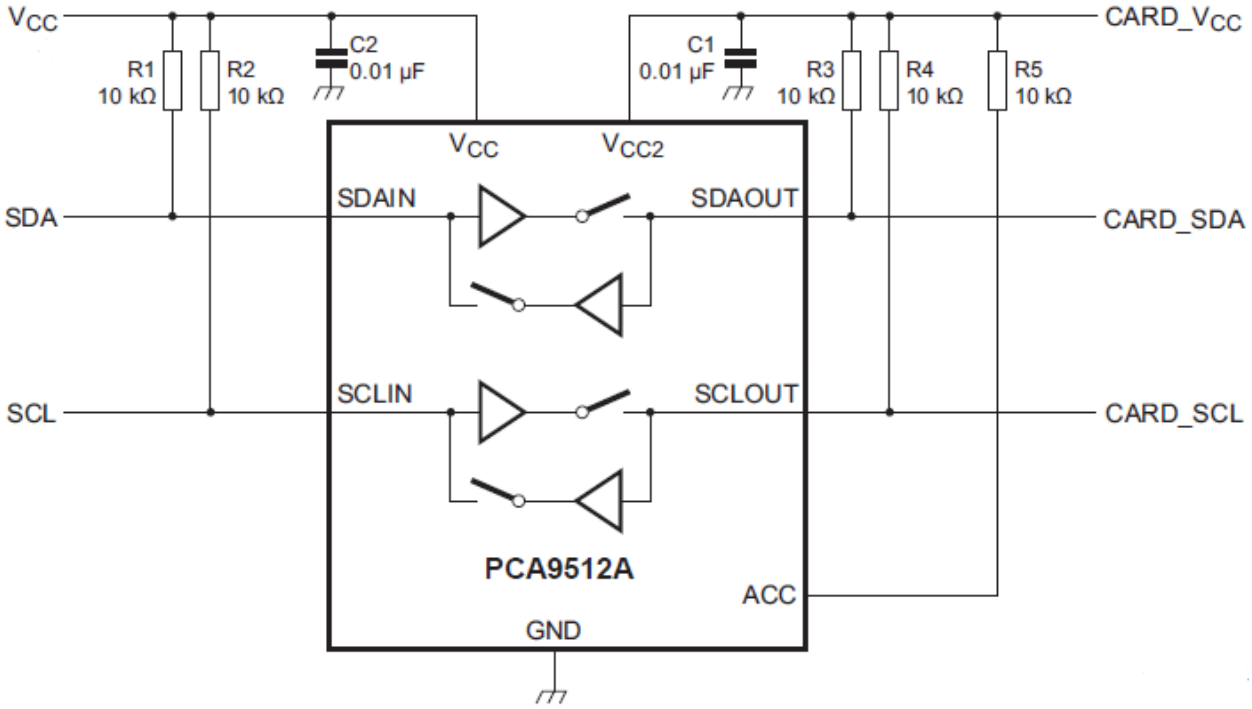

Figure 7: Typical PCA9512 application circuit

When using the PCA9512 buffer device on a carrier board, the following design changes must be applied to the above NXP reference schematics:

- Do not pull-up the SDAIN and SCLIN signals with R1 and R2 because these signals are already pulled to 3.3Vstb on the module.
- Vcc and Vcc2 can be tied together if the output bus of the buffer is also powered by a 3.3V power rail.
- The pull-up resistors R3 and R4 on the output bus must be implemented. The value of the resistors depends on the system design. Typical pull-ups are 2.2k to 10k.
- With the ACC input being connected to Vcc via R5, the buffers rise time acceleration is enabled. Connecting ACC to GND disables the rise time acceleration.

For further technical information please refer to the PCA9512 datasheet which can be downloaded from the NXP website at www.nxp.com.

The screen shots below show that the SMB output signals of the PCA9512 buffer do not show the errors seen with the TI4311A buffer.

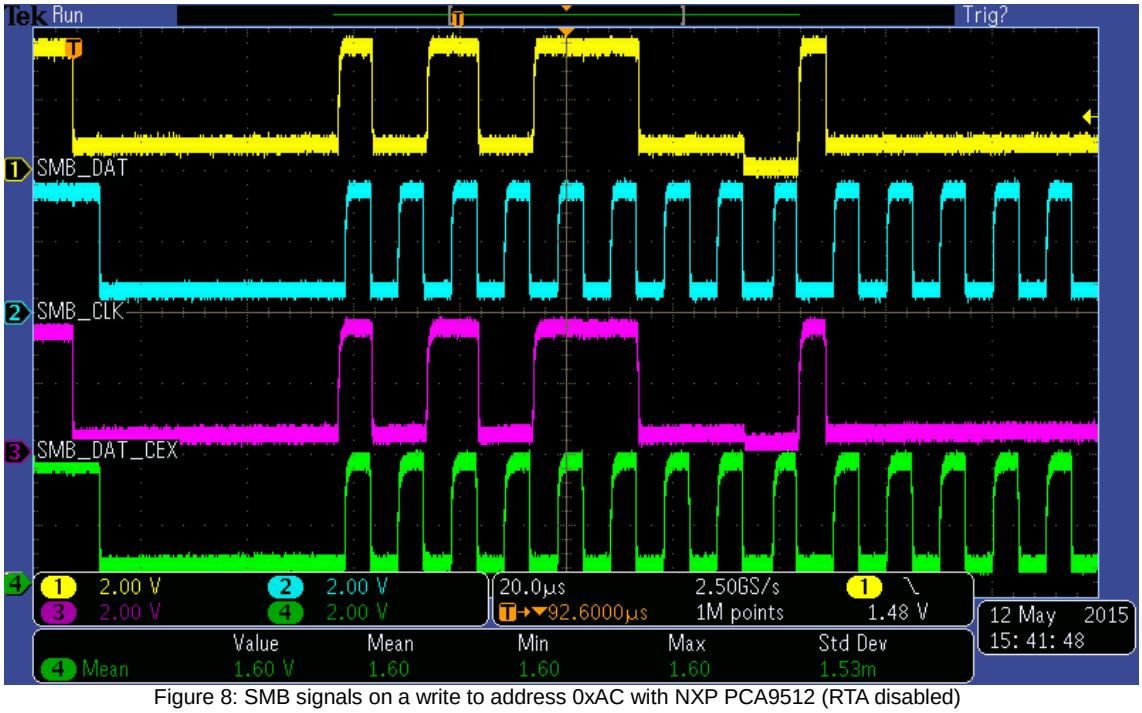

Figure 8: SMB signals on a write to address 0xAC with NXP PCA9512 (RTA disabled)

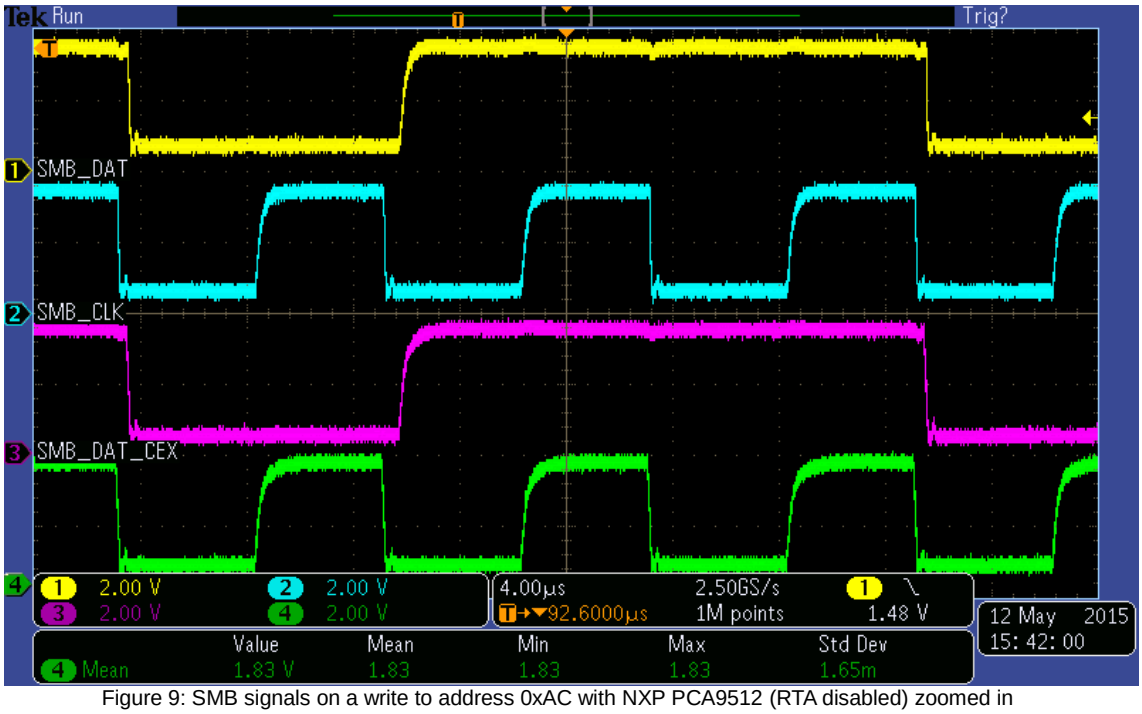

Figure 9: SMB signals on a write to address 0xAC with NXP PCA9512 (RTA disabled) zoomed in

The two screen shots above were captured with rise time acceleration disabled (ACC connected to GND). The screen shot below shows the influence of the rise time acceleration on the SMB signals at the PCA9512 buffer.

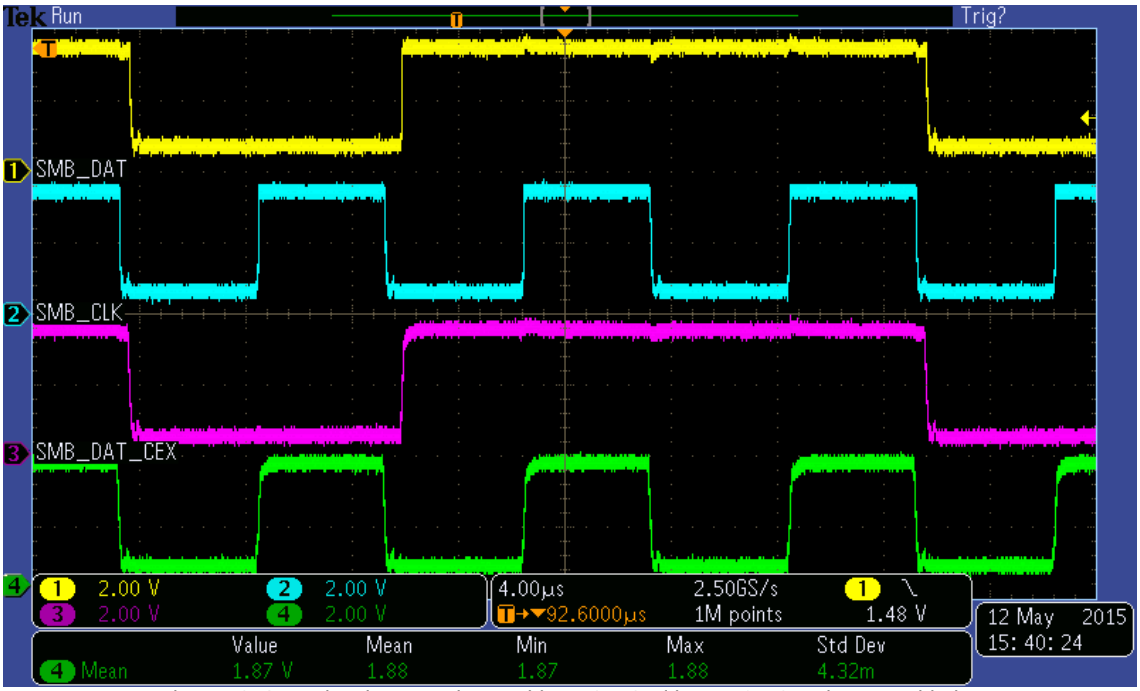

Figure 10: SMB signals on a write to address 0xAC with NXP 9512 and RTA enabled.

As expected, with rise time acceleration enabled, the rise time of the SMB signals is much faster now, even though the same pull-ups were used. With rise time acceleration enabled, it is possible to use weaker pull-up resistors while still meeting the rise time requirements.

If the rise time acceleration is not required, the NXP PCA9510A can be used. This buffer does not support rise time acceleration at all and has exactly the same pin-out as the TCA4311A.

4 Summary

Due to the SMB hub used on some congatec COM Express modules, the SMB_CLK (B13) and SMB_DAT (B14) signals show a low level higher than 0V. Nevertheless, the signals are spec compliant and except for the TI4311A, there is no known SMB/I2C device that fails when connected to the SMBus signals provided by the modules.

For customer carrier board designs using the TI4311A, a simple BOM change can help to solve the compatibility problem. NXPs PCA9510A (no rise time acceleration support) and PCA9512A (rise time acceleration can be disabled) are pin compatible and work in combination with the NXP hub PCA9518 used on the congatec COM Express modules.

5 Revision History

Revision	Date (yyyy-mm-dd)	Author	Changes
0.1	2015-05-26	CJR	Initial release of document