



Product Change Notification - SYST-22MLHR209

Date:

29 May 2019

Product Category:

32-bit Microcontrollers

Affected CPNs:



Notification subject:

ERRATA - SAM 4S Series Family Silicon Errata and Data Sheet Clarification

Notification text:

SYST-22MLHR209

Microchip has released a new DeviceDoc for the SAM 4S Series Family Silicon Errata and Data Sheet Clarification of devices. If you are using one of these read the document located at [SAM 4S Series Family Silicon Errata and Data Sheet Clarification](#).

Notification Status: Final

Description of Change:

- 1) Added Silicon revision EO as primary die source to MRL A
- 2) data sheet clarifications to: 2. Module: Chip ID and 3. Module: Errata.

Impacts to Data Sheet: None

Reason for Change: To Improve Productivity

Change Implementation Status: Complete

Estimated First Ship Date: 24 May 2019

NOTE: Please be advised that after the estimated first ship date customers may receive pre and post change parts.

Markings to Distinguish Revised from Unrevised Devices: Traceability Code

Revision History:

May 24, 2019: Issued Errata Notification

May 29, 2019: Re-issued Errata notification to include EFSD and remove document only note.

Attachment(s):

Please contact your local [Microchip sales office](#) with questions or concerns regarding this notification.

Terms and Conditions:

If you wish to receive Microchip PCNs via email please register for our PCN email service at our [PCN home page](#) select register then fill in the required fields. You will find instructions about registering for Microchips PCN email service in the [PCN FAQ](#) section.

If you wish to change your PCN profile, including opt out, please go to the [PCN home page](#) select login and sign into your myMicrochip account. Select a profile option from the left navigation bar and make the applicable selections.

Affected Catalog Part Numbers (CPN)

ATSAM4SD32CA-CU
ATSAM4SD32CB-CN
ATSAM4SD32CA-CFU
ATSAM4SD32CB-CFN
ATSAM4SD32CA-AU
ATSAM4SD32CB-AN
ATSAM4SD32BA-MU
ATSAM4SD32BB-MN
ATSAM4SD32BA-AU
ATSAM4SD32BB-AN
ATSAM4SD32BA-UUR
ATSAM4SD32BB-UUR
ATSAM4SD16CA-CU
ATSAM4SD16CB-CN
ATSAM4SD16CA-CFU
ATSAM4SD16CB-CFN
ATSAM4SD16CA-AU
ATSAM4SD16CB-AN
ATSAM4SD16BA-MU
ATSAM4SD16BB-MN
ATSAM4SD16BA-AU
ATSAM4SD16BB-AN
ATSAM4SD16BA-UUR
ATSAM4SD16BB-UUR
ATSAM4SA16CA-CU
ATSAM4SA16CB-CN
ATSAM4SA16CA-CFU
ATSAM4SA16CB-CFN
ATSAM4SA16CA-AU
ATSAM4SA16CB-AN
ATSAM4SA16BA-MU
ATSAM4SA16BB-MN
ATSAM4SA16BA-AU
ATSAM4SA16BB-AN
ATSAM4S16CA-CU
ATSAM4S16CB-CN
ATSAM4S16CA-AU
ATSAM4S16CB-AN
ATSAM4S16CA-CFU
ATSAM4S16CB-CFN
ATSAM4S16BA-AU
ATSAM4S16BB-AN
ATSAM4S16BA-MU
ATSAM4S16BB-MN
ATSAM4S16BA-UUR
ATSAM4S16BB-UUR

ATSAM4S8CA-CU
ATSAM4S8CB-CN
ATSAM4S8CA-CFU
ATSAM4S8CB-CFN
ATSAM4S8CA-AU
ATSAM4S8CB-AN
ATSAM4S8BA-MU
ATSAM4S8BB-MN
ATSAM4S8BA-UUR
ATSAM4S8BB-UUR
ATSAM4S8BA-AU
ATSAM4S8BB-AN
ATSAM4S4CA-CU
ATSAM4S4CB-CN
ATSAM4S4CA-CFU
ATSAM4S4CB-CFN
ATSAM4S4CA-AU
ATSAM4S4CB-AN
ATSAM4S4BA-MU
ATSAM4S4BB-MN
ATSAM4S4BA-UUR
ATSAM4S4BB-UUR
ATSAM4S4BA-AU
ATSAM4S4BB-AN
ATSAM4S4AA-MU
ATSAM4S4AB-MN
ATSAM4S4AA-AU
ATSAM4S4AB-AN
ATSAM4S2CA-CU
ATSAM4S2CB-CN
ATSAM4S2CA-CFU
ATSAM4S2CB-CFN
ATSAM4S2CA-AU
ATSAM4S2CB-AN
ATSAM4S2BA-MU
ATSAM4S2BB-MN
ATSAM4S2BA-UUR
ATSAM4S2BB-UUR
ATSAM4S2BA-AU
ATSAM4S2BB-AN
ATSAM4S2AA-MU
ATSAM4S2AB-MN
ATSAM4S2AA-AU
ATSAM4S2AB-AN

SAM 4S Series Family Silicon Errata and Data Sheet Clarification

The SAM 4S Series family of devices that you have received conform functionally to the current Device Data Sheet (11100K-ATARM-SAM4S-Datasheet_09-Jun-15), except for the anomalies described in this document.

New Silicon Errata Issues

Note: This document provides information on new errata issues for the SAM 4S Series of devices. Please refer to the current device data sheet for all pre-existing silicon errata issues.

1. Module: Voltage Regulator

The embedded voltage regulator does not work under temperatures below +25°C when VDDIN is supplied below 2.8V.

Work around

VDDIN must be supplied at 2.8V minimum to guarantee embedded voltage regulator start-up down to -40°C.

Affected Silicon Revisions

| A | B | | | | | | |
|---|---|--|--|--|--|--|--|
| X | | | | | | | |

Note: The voltage regulator errata is not applicable to ATSAM4S2 and ATSAM4S4 derivatives.

2. Module: ADC

Using ADC under these conditions: VDDANA < 2.4V or ADVREF < 2.4V, and temperature T° < 0°C, the ADC does not start.

Work around

Use reserved value of IBCTL field in the ADC Analog Control Register (ADC_ACR) IBCTL= 11b to ensure a correct startup of the ADC with a higher bias current (Typically, +50% higher than the standard configuration). This setup can be kept for standard analog conversions. If current consumption is critical, the IBCTL field setting must be kept to 11b at least during 20µs before being changed to its nominal value.

Affected Silicon Revisions

| A | B | | | | | | |
|---|---|--|--|--|--|--|--|
| X | X | | | | | | |

SAM 4S SERIES

Data Sheet Clarifications

1. Module: Ordering Information

In the current device data sheet, the SAM4S Ordering Codes table (Table 47-1) is incorrect. The correct information is provided in the following table.

TABLE 47-1: SAM4S ORDERING CODES TABLE

| Ordering Code | MRL | Flash (Kbytes) | SRAM (Kbytes) | Package | Carrier Type | Operating Temperature Range |
|------------------|-----|----------------|---------------|----------|--|------------------------------|
| ATSAM4SD32CA-CU | A | 2*1024 | 160 | TFBGA100 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4SD32CB-CN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4SD32CA-CFU | A | 2*1024 | 160 | VFBGA100 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4SD32CB-CFN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4SD32CA-AU | A | 2*1024 | 160 | LQFP100 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4SD32CB-AN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4SD32BA-MU | A | 2*1024 | 160 | QFN64 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4SD32BB-MN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4SD32BA-AU | A | 2*1024 | 160 | LQFP64 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4SD32BB-AN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4SD32BA-UUR | A | 2*1024 | 160 | WLCSP64 | Tape and Reel | Industrial (-40°C to +85°C) |
| ATSAM4SD32BB-UUR | B | | | | | |
| ATSAM4SD16CA-CU | A | 2*1024 | 160 | TFBGA100 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4SD16CB-CN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4SD16CA-CFU | A | 2*512 | 160 | VFBGA100 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4SD16CB-CFN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4SD16CA-AU | A | 2*512 | 160 | LQFP100 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4SD16CB-AN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4SD16BA-MU | A | 2*512 | 160 | QFN64 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4SD16BB-MN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4SD16BA-AU | A | 2*512 | 160 | LQFP64 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4SD16BB-AN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4SD16BA-UUR | A | 2*512 | 160 | WLCSP64 | Tape and Reel | Industrial (-40°C to +85°C) |
| ATSAM4SD16BB-UUR | B | | | | | |
| ATSAM4SA16CA-CU | A | 1024 | 160 | TFBGA100 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4SA16CB-CN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4SA16CA-CFU | A | 1024 | 160 | VFBGA100 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4SA16CB-CFN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4SA16CA-AU | A | 1024 | 160 | LQFP100 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4SA16CB-AN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4SA16BA-MU | A | 1024 | 160 | QFN64 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4SA16BB-MN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4SA16BA-AU | A | 1024 | 160 | LQFP64 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4SA16BB-AN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4S16CA-CU | A | 1024 | 128 | TFBGA100 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4S16CB-CN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4S16CA-AU | A | 1024 | 128 | LQFP100 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4S16CB-AN | B | | | | | Industrial (-40°C to +105°C) |

SAM 4S SERIES

| Ordering Code | MRL | Flash (Kbytes) | SRAM (Kbytes) | Package | Carrier Type | Operating Temperature Range |
|-----------------|-----|----------------|---------------|----------|--|------------------------------|
| ATSAM4S16CA-CFU | A | 1024 | 128 | VFPGA100 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4S16CB-CFN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4S16BA-AU | A | 1024 | 128 | LQFP64 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4S16BB-AN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4S16BA-MU | A | 1024 | 128 | LQFP64 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4S16BB-MN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4S16BA-UUR | A | 1024 | 128 | WLCSP64 | Tape and Reel | Industrial (-40°C to +85°C) |
| ATSAM4S16BB-UUR | B | | | | | |
| ATSAM4S8CA-CU | A | 512 | 128 | TFBGA100 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4S8CB-CN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4S8CA-CFU | A | 1024 | 128 | VFPGA100 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4S8CB-CFN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4S8CA-AU | A | 1024 | 128 | LQFP100 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4S8CB-AN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4S8BA-MU | A | 1024 | 128 | QFN64 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4S8BB-MN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4S8BA-UUR | A | 512 | 128 | WLCSP64 | Tape and Reel | Industrial (-40°C to +85°C) |
| ATSAM4S8BB-UUR | B | | | | | |
| ATSAM4S8BA-AU | A | 512 | 128 | LQFP64 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4S8BB-AN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4S4CA-CU | A | 256 | 64 | TFBGA100 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4S4CB-CN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4S4CA-CFU | A | 256 | 64 | VFPGA100 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4S4CB-CFN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4S4CA-AU | A | 256 | 64 | LQFP100 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4S4CB-AN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4S4BA-MU | A | 256 | 64 | QFN64 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4S4BB-MN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4S4BA-UUR | A | 256 | 64 | WLCSP64 | Tape and Reel | Industrial (-40°C to +85°C) |
| ATSAM4S4BB-UUR | B | | | | | |
| ATSAM4S4BA-AU | A | 256 | 64 | LQFP64 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4S4BB-AN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4S4AA-MU | A | 256 | 64 | QFN64 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4S4AB-MN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4S4AA-AU | A | 256 | 64 | LQFP48 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4S4AB-AN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4S2CA-CU | A | 256 | 64 | TFBGA100 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4S2CB-CN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4S2CA-CFU | A | 256 | 64 | VFPGA100 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4S2CB-CFN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4S2CA-AU | A | 256 | 64 | LQFP100 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4S2CB-AN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4S2BA-MU | A | 256 | 64 | QFN64 | Tray, Tape and Reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4S2BB-MN | B | | | | | Industrial (-40°C to +105°C) |

SAM 4S SERIES

| Ordering Code | MRL | Flash (Kbytes) | SRAM (Kbytes) | Package | Carrier Type | Operating Temperature Range |
|----------------|-----|----------------|---------------|---------|--|------------------------------|
| ATSAM4S2BA-UUR | A | 128 | 64 | WLCSP64 | Tape and Reel | Industrial (-40°C to +85°C) |
| ATSAM4S2BB-UUR | B | | | | | |
| ATSAM4S2BA-AU | A | 128 | 64 | LQFP64 | Tray, Tape and reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4S2BB-AN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4S2AA-MU | A | 256 | 64 | QFN48 | Tray, Tape and reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4S2AB-MN | B | | | | | Industrial (-40°C to +105°C) |
| ATSAM4S2AA-AU | A | 256 | 64 | LQFP48 | Tray, Tape and reel (add R to ordering code) | Industrial (-40°C to +85°C) |
| ATSAM4S2AB-AN | B | | | | | Industrial (-40°C to +105°C) |

2. Module: CHIP ID

Table 30-1. “SAM 4S Chip ID Registers” is updated with Chip ID information. The newly added information is shown in **BOLD**.

TABLE 30-1: SAM 4S CHIP ID REGISTERS

| Chip Name | CHIPID_CIDR | CHIPID_EXID |
|-------------------|---------------------------------|-------------|
| SAM4SD32C (Rev A) | 0x29A7_0EE0 | 0x0 |
| SAM4SD32C (Rev B) | 0x29A7_0EE1 | 0x0 |
| SAM4SD32B (Rev A) | 0x2997_0EE0 | 0x0 |
| SAM4SD32B (Rev B) | 0x2997_0EE1 | 0x0 |
| SAM4SD16C (Rev A) | 0x29A7_0CE0 | 0x0 |
| SAM4SD16C (Rev B) | 0x29A7_0CE1 | 0x0 |
| SAM4SD16B (Rev A) | 0x2997_0CE0 | 0x0 |
| SAM4SD16B (Rev B) | 0x2997_0CE1 | 0x0 |
| SAM4SA16C (Rev A) | 0x28A7_0CE0 | 0x0 |
| SAM4SA16C (Rev B) | 0x28A7_0CE1 | 0x0 |
| SAM4SA16B (Rev A) | 0x2897_0CE0 | 0x0 |
| SAM4SA16B (Rev B) | 0x2897_0CE1 | 0x0 |
| SAM4S16B (Rev A) | 0x289C_0CE0 | 0x0 |
| SAM4S16B (Rev B) | 0x289C_0CE1 | 0x0 |
| SAM4S16C (Rev A) | 0x28AC_0CE0 | 0x0 |
| SAM4S16C (Rev B) | 0x28AC_0CE1 | 0x0 |
| SAM4S8B (Rev A) | 0x289C_0AE0 | 0x0 |
| SAM4S8B (Rev B) | 0x289C_0AE1 | 0x0 |
| SAM4S8C (Rev A) | 0x28AC_0AE0 | 0x0 |
| SAM4S8C (Rev B) | 0x28AC_0AE1 | 0x0 |
| SAM4S4C (Rev A) | 0x28AB_09E0/ 0x28AB_09E1 | 0x0 |
| SAM4S4C (Rev B) | 0x28AB_09E1 | 0x0 |

SAM 4S SERIES

TABLE 30-1: SAM 4S CHIP ID REGISTERS

| | | |
|-----------------|---------------------------------|-----|
| SAM4S4B (Rev A) | 0x289B_09E0/ 0x289B_09E1 | 0x0 |
| SAM4S4B (Rev B) | 0x289B_09E1 | 0x0 |
| SAM4S4A (Rev A) | 0x288B_09E0/ 0x288B_09E1 | 0x0 |
| SAM4S4A (Rev B) | 0x288B_09E1 | 0x0 |
| SAM4S2C (Rev A) | 0x28AB_07E0/ 0x28AB_07E1 | 0x0 |
| SAM4S2C (Rev B) | 0x28AB_07E1 | 0x0 |
| SAM4S2B (Rev A) | 0x289B_07E0/ 0x289B_07E1 | 0x0 |
| SAM4S2B (Rev B) | 0x289B_07E1 | 0x0 |
| SAM4S2A (Rev A) | 0x288B_07E0/ 0x288B_07E1 | 0x0 |
| SAM4S2A (Rev B) | 0x288B_07E1 | 0x0 |

3. Module: Errata

Table 48-3. “Errata SAM 4S4/S2 Rev A Parts” is updated with Chip ID information. The newly added information is shown in **BOLD**.

TABLE 48-3: ERRATA SAM 4S4/S2 REV A PARTS

| Device Name | Revision | Chip ID |
|-------------|----------|---------------------------------|
| SAM4S4C | A | 0x28AB_09E0/ 0x28AB_09E1 |
| SAM4S4B | A | 0x289B_09E0/ 0x289B_09E1 |
| SAM4S4A | A | 0x288B_09E0/ 0x288B_09E1 |
| SAM4S2C | A | 0x28AB_07E0/ 0x28AB_07E1 |
| SAM4S2B | A | 0x289B_07E0/ 0x289B_07E1 |
| SAM4S2A | A | 0x288B_07E0/ 0x288B_07E1 |

SAM 4S SERIES

APPENDIX A: REVISION HISTORY

Rev A Document (3/2018)

This is the initial released version of this document.

Rev B Document (5/2019)

The following Data Sheet Clarifications were added:

- **2. Module: "CHIP ID"**
- **3. Module: "Errata"**

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION, INCLUDING BUT NOT LIMITED TO ITS CONDITION, QUALITY, PERFORMANCE, MERCHANTABILITY OR FITNESS FOR PURPOSE. Microchip disclaims all liability arising from this information and its use. Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights unless otherwise stated.

Microchip received ISO/TS-16949:2009 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC[®] MCUs and dsPIC[®] DSCs, KEELOQ[®] code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.

**QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
= ISO/TS 16949 =**

Trademarks

The Microchip name and logo, the Microchip logo, AnyRate, AVR, AVR logo, AVR Freaks, BitCloud, chipKIT, chipKIT logo, CryptoMemory, CryptoRF, dsPIC, FlashFlex, flexPWR, Helder, JukeBlox, KeeLoq, Klear, LANCheck, LINK MD, maXStylus, maXTouch, MediaLB, megaAVR, MOST, MOST logo, MPLAB, OptoLyzer, PIC, picoPower, PICSTART, PIC32 logo, Prochip Designer, QTouch, SAM-BA, SpyNIC, SST, SST Logo, SuperFlash, tinyAVR, UNI/O, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

ClockWorks, The Embedded Control Solutions Company, EtherSynch, Hyper Speed Control, HyperLight Load, IntellIMOS, mTouch, Precision Edge, and Quiet-Wire are registered trademarks of Microchip Technology Incorporated in the U.S.A. Adjacent Key Suppression, AKS, Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, BodyCom, CodeGuard, CryptoAuthentication, CryptoAutomotive, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, EtherGREEN, In-Circuit Serial Programming, ICSP, INICnet, Inter-Chip Connectivity, JitterBlocker, KlearNet, KlearNet logo, memBrain, Mindi, MiWi, motorBench, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICkit, PICtail, PowerSmart, PureSilicon, QMatrix, REAL ICE, Ripple Blocker, SAM-ICE, Serial Quad I/O, SMART-I.S., SQI, SuperSwitcher, SuperSwitcher II, Total Endurance, TSHARC, USBCheck, VariSense, ViewSpan, WiperLock, Wireless DNA, and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

Silicon Storage Technology is a registered trademark of Microchip Technology Inc. in other countries.

GestIC is a registered trademark of Microchip Technology Germany II GmbH & Co. KG, a subsidiary of Microchip Technology Inc., in other countries.

All other trademarks mentioned herein are property of their respective companies.

© 2018, Microchip Technology Incorporated, All Rights Reserved.
ISBN: 978-1-5224-4533-3



MICROCHIP

Worldwide Sales and Service

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
<http://www.microchip.com/support>
Web Address:
www.microchip.com

Atlanta
Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

Austin, TX
Tel: 512-257-3370

Boston
Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Dallas
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit
Novi, MI
Tel: 248-848-4000

Houston, TX
Tel: 281-894-5983

Indianapolis
Noblesville, IN
Tel: 317-773-8323
Fax: 317-773-5453
Tel: 317-536-2380

Los Angeles
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608
Tel: 951-273-7800

Raleigh, NC
Tel: 919-844-7510

New York, NY
Tel: 631-435-6000

San Jose, CA
Tel: 408-735-9110
Tel: 408-436-4270

Canada - Toronto
Tel: 905-695-1980
Fax: 905-695-2078

ASIA/PACIFIC

Australia - Sydney
Tel: 61-2-9868-6733

China - Beijing
Tel: 86-10-8569-7000

China - Chengdu
Tel: 86-28-8665-5511

China - Chongqing
Tel: 86-23-8980-9588

China - Dongguan
Tel: 86-769-8702-9880

China - Guangzhou
Tel: 86-20-8755-8029

China - Hangzhou
Tel: 86-571-8792-8115

China - Hong Kong SAR
Tel: 852-2943-5100

China - Nanjing
Tel: 86-25-8473-2460

China - Qingdao
Tel: 86-532-8502-7355

China - Shanghai
Tel: 86-21-3326-8000

China - Shenyang
Tel: 86-24-2334-2829

China - Shenzhen
Tel: 86-755-8864-2200

China - Suzhou
Tel: 86-186-6233-1526

China - Wuhan
Tel: 86-27-5980-5300

China - Xian
Tel: 86-29-8833-7252

China - Xiamen
Tel: 86-592-2388138

China - Zhuhai
Tel: 86-756-3210040

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-3090-4444

India - New Delhi
Tel: 91-11-4160-8631

India - Pune
Tel: 91-20-4121-0141

Japan - Osaka
Tel: 81-6-6152-7160

Japan - Tokyo
Tel: 81-3-6880-3770

Korea - Daegu
Tel: 82-53-744-4301

Korea - Seoul
Tel: 82-2-554-7200

Malaysia - Kuala Lumpur
Tel: 60-3-7651-7906

Malaysia - Penang
Tel: 60-4-227-8870

Philippines - Manila
Tel: 63-2-634-9065

Singapore
Tel: 65-6334-8870

Taiwan - Hsin Chu
Tel: 886-3-577-8366

Taiwan - Kaohsiung
Tel: 886-7-213-7830

Taiwan - Taipei
Tel: 886-2-2508-8600

Thailand - Bangkok
Tel: 66-2-694-1351

Vietnam - Ho Chi Minh
Tel: 84-28-5448-2100

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4450-2828
Fax: 45-4485-2829

Finland - Espoo
Tel: 358-9-4520-820

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Garching
Tel: 49-8931-9700

Germany - Haan
Tel: 49-2129-3766400

Germany - Heilbronn
Tel: 49-7131-72400

Germany - Karlsruhe
Tel: 49-721-625370

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Germany - Rosenheim
Tel: 49-8031-354-560

Israel - Ra'anana
Tel: 972-9-744-7705

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Italy - Padova
Tel: 39-049-7625286

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Norway - Trondheim
Tel: 47-7288-4388

Poland - Warsaw
Tel: 48-22-3325737

Romania - Bucharest
Tel: 40-21-407-87-50

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

Sweden - Gothenberg
Tel: 46-31-704-60-40

Sweden - Stockholm
Tel: 46-8-5090-4654

UK - Wokingham
Tel: 44-118-921-5800
Fax: 44-118-921-5820