
TA100 24-Pad VQFN Socket Board User Guide

Introduction

The TA100 24-Pad VQFN mikroBUS™-compatible socket board was developed for use with any of Microchip's microcontroller boards that support a MikroElektronika mikroBUS interface. The board's dimensions match the medium-sized add-on board as defined in the mikroBUS specification. Through use of an adapter board, the socket board can also be used with Microchip microcontroller development boards that support an Xplained Pro Interface.

The TA100 secure elements are one-time-programmable devices. Having a socket board allows for a customer to reuse the board with multiple TA100 sample devices for a given application or for multiple different applications. The 24-Pad VQFN socket board and TA100 secure element support both an I²C and SPI Interface.

Figure 1. TA100 24-Pad VQFN Socket Board



Table of Contents

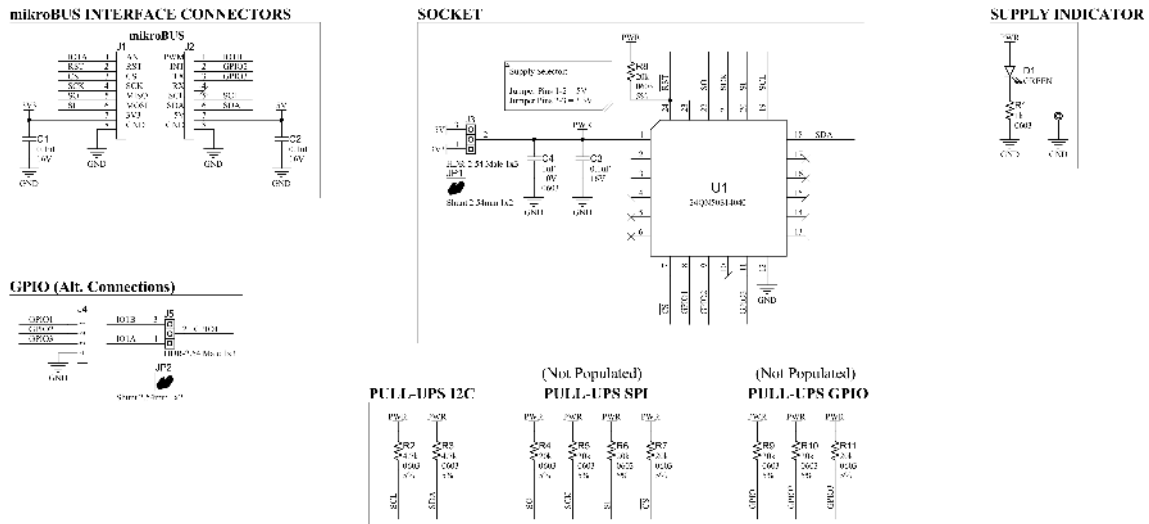
Introduction.....	1
1. Hardware Description.....	3
1.1. Schematic and Key Features.....	3
1.2. Board Configuration.....	3
1.3. Supply Current Measurement.....	4
1.4. Hardware Documentation.....	4
2. Connecting the Board.....	6
2.1. Xplained Pro Connections.....	6
2.2. Microchip Explorer 16/32 Connections.....	7
2.3. Automotive Networking Development Board Connections.....	8
3. Software Tools.....	10
3.1. myMicrochip.....	11
4. Revision History.....	13
The Microchip Website.....	14
Product Change Notification Service.....	14
Customer Support.....	14
Microchip Devices Code Protection Feature.....	14
Legal Notice.....	14
Trademarks.....	15
Quality Management System.....	16
Worldwide Sales and Service.....	17

1. Hardware Description

1.1 Schematic and Key Features

- One 24-Pad VQFN Socket (U1)
- One mikroBUS Connector (J1, J2)
- On-Board 4.7 kΩ I²C Resistors (R2, R3)
- On-Board LED Power Indicator (LD1)
- Power Jumper for selecting 3.3V or 5V power (J3)
- Jumper for selecting which mikroBUS pin is connected to GPIO1 (J5)
- Optional GPIO Header (J4) – Not Populated
- Optional SPI Pull-up resistors R4-R7 – Not Populated
- Optional GPIO Pull-up resistors R9-R11 – Not Populated

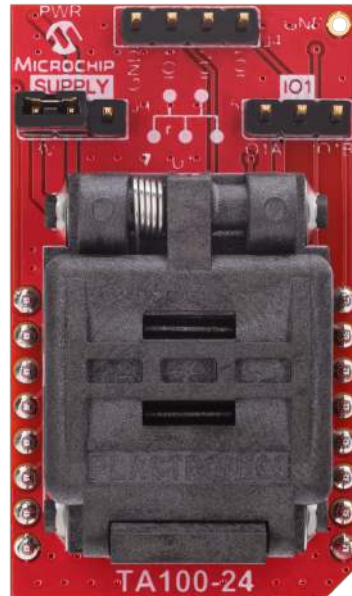
Figure 1-1. TA100 24-Pad VQFN Socket Board Schematic



1.2 Board Configuration

TA100 24-Pad VQFN Socket Board Jumper Configurations

- 3.3V Power: J3 with shunt across 3V3 and PWR positions
- 5.0V Power: J3 with shunt across 5V and PWR positions
- GPIO1 Connected to IO1A: J5 with Shunt across GPIO1 and IO1A
- GPIO1 Connected to IO1B: J5 with Shunt across GPIO1 and IO1B



1.3 Supply Current Measurement

The current consumption of the TA100 device can be measured by using the EV39Y17A 24-Pad VQFN socket board. The only devices on the board that will consume power are the TA100 socketed device, the Power LED and the I²C pull-up resistors. Follow these steps to measure the current:

1. Modify the board to remove the resistor, R1, which is in series with the LED. This will remove the current through the LED from the total measured current.⁽¹⁾
2. Install the TA100 device into the socket.
3. Install the socket board into the host system with the appropriate power settings.
4. Select either 3.3V or 5V power for the measurement.⁽²⁾
5. Connect the high side of the ammeter to the 3.3V or 5V supply.
6. Connect the low side of the ammeter to the common PWR signal of the header.
7. Current measurements can now be taken by running various TA100 commands and measuring the current. ⁽³⁾

Notes:

1. For lower accuracy current measurements, this resistor may be kept in the circuit. It is recommended that a separate measurement of the current through just the LED path be made prior to measuring the TA100 device currents. This value can, then, be subtracted from the total current measured.
2. The host board provides power to the mikroBUS extension board, so whichever supply is selected must match the capabilities and setting used on the host board.
3. When measuring the current of I²C devices, the measurement will include the I²C pull-up currents used to pull up the bus. For SPI signals, the pull-ups are internal to the device and will also factor into the total current consumed.

1.4 Hardware Documentation

Additional documentation for the kit can be found on the Microchip website for the [EV39Y17A](#).

This includes:

- Board Design Documentation including Schematics and 3D Views
- Gerber Files

- [TA100 24-Pad VQFN Socket Board User Guide \(EV39Y17A\)](#)

For other kits referenced in this document, check the website information associated with those kits. This includes:

- [ATSAMV71-XULT](#) SAMV71 Xplained Ultra Evaluation Kit
- [ATMBUSADAPTER-XPRO](#) XPRO to mikroBUS Adapter
- [Explorer 16/32 Development Kit \(DM240001-2\)](#)
- [dsPIC33CK](#) 16-Bit PIC[®] Microcontroller

Related Hardware Kits

Microchip also offers related socket kits for the other packages that the TA100 device is provided in. These include:

- The [AC164166](#) 14-Pin SOIC Socket Kit for the TA100 – This developer's kit supports a 14-pin SOIC TA100 device with both an SPI and I²C Interface
- The [AC164167](#) 8-Pin SOIC Socket Kit for the TA100 – This developer's kit supports an 8-pin SOIC TA100 device with either an SPI or I²C Interface

2. Connecting the Board

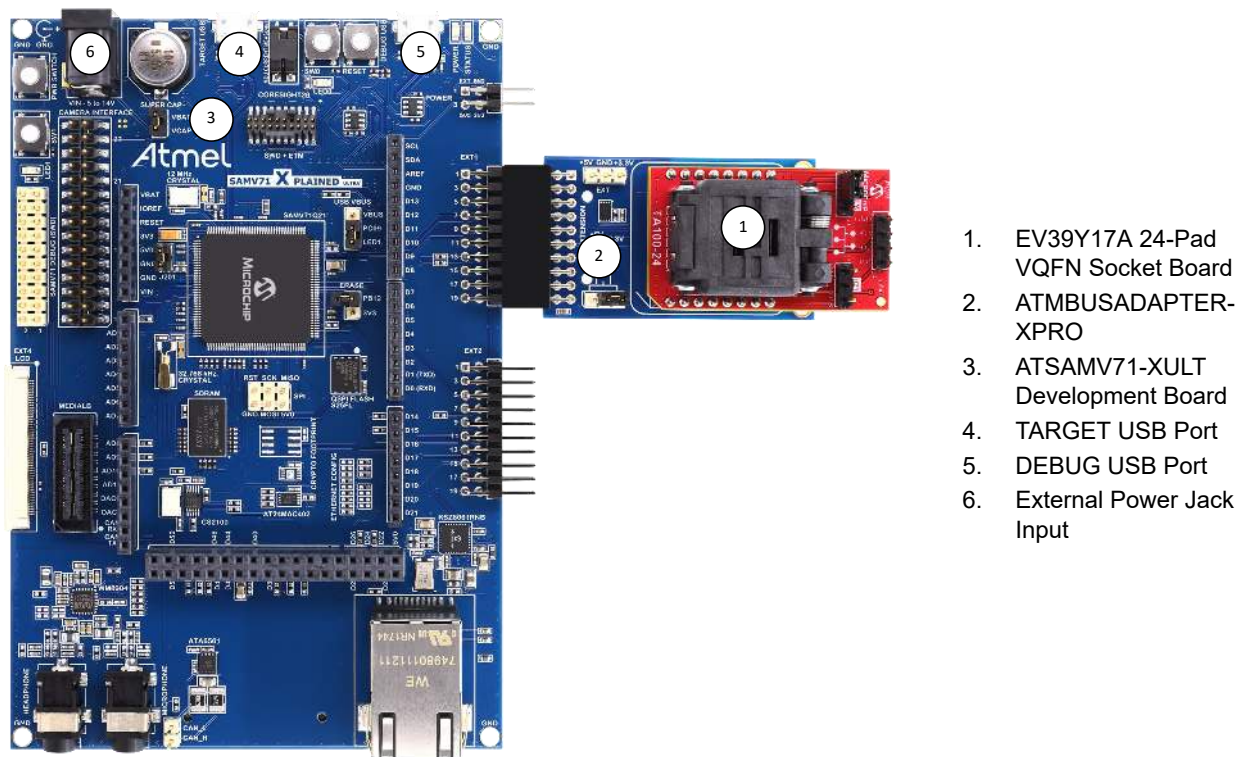
The form factor of the EV39Y17A development board was chosen because Microchip has heavily adopted the use of the mikroBUS connector on host boards. Many of Microchip's development platforms will support one or more mikroBUS interfaces. These include:

- Microchip Explorer 16/32 Development Board
- MPLAB® Xpress Evaluation Board
- Automotive Networking Development Board
- PIC® Curiosity Boards
- PIC Curiosity Nano Boards
- AVR® Curiosity Nano Boards
- SAM Xplained-Pro microcontroller development boards when used with an ATMBusAdapter

2.1 Xplained Pro Connections

By using an adapter board, the EV39Y17A development board can still be used with Microchip development boards that only support the Xplained Pro interface. [Figure 2-1](#) shows the full assembly of the , the [ATMBUSADAPTER-XPRO](#) and an [ATSAMV71-XULT](#) Development Board.

Figure 2-1. Connections to an Xplained Pro Development Platform



1. EV39Y17A 24-Pad VQFN Socket Board
2. ATMBUSADAPTER-XPRO
3. ATSAMV71-XULT Development Board
4. TARGET USB Port
5. DEBUG USB Port
6. External Power Jack Input

Powering the SAMV71-XULT Board

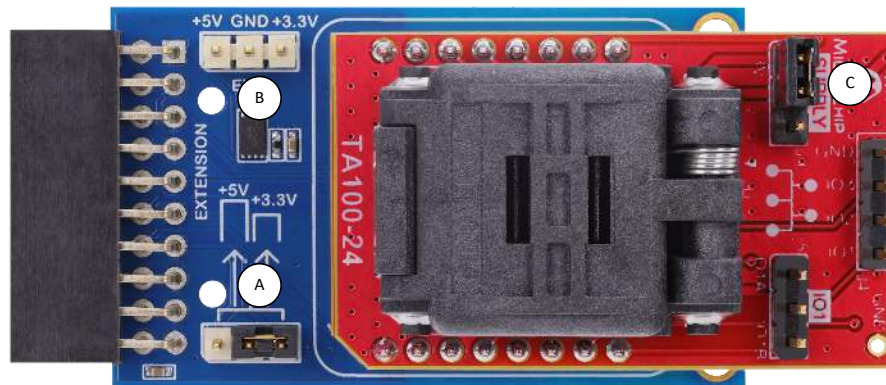
Multiple options exist for powering the SAMV71-XULT Development Board. Depending on the total current requirements, different options are allowed. See the [SAMV71-XULT User Guide](#) for more information.

- External Power Jack Input
 - 2.1 mm barrel connector
 - 5-14V input supply Maximum current of 2.0A
 - 12V 18W Power Adapter Option: Triad Magnetics [WSU120-1500](#)
- Embedded Debugger USB Connection; max. of 500 mA
- Target USB Connection; max. of 500 mA
- External Power Header
 - 2-pin 100 mil Header
 - Direct 5V Supply
 - Max. 2A of current

ATMBUSAdapter Power Settings

The ATMBUSAdapter allows power to be connected to the MikroBus Host adapter either directly through the XPRO interface or by providing external power through the EXT header. It is important that all jumpers are connected correctly before connecting to the SAMV71-XULT or other boards with an XPRO interface to prevent possible damage to the system.

Figure 2-2. ATMBUSAdapter Plus EV39Y17A



1. **Option 1: Direct Power from the XPRO Extension**
 - Determine if the XPRO Board outputs a 3.3V or 5.0V supply voltage.
 - Connect the J3 shunt “C” of the EV39Y17A to the appropriate 3.3V or 5.0V supply.
 - Connect the ATMBUSAdapter power shunt “A” to the same voltage as the XPRO supply.
2. **Option 2: External Power Connected to the ATMBUSAdapter.**
 - Remove the Power Shunt “A” from the ATMBUSAdapter. This disconnects power from the XPRO Header.
 - Connect either 3.3V or 5.0V external power to the Ext Header “B” on the ATMBUSAdapter
 - Make sure the J3 shunt on the EV39Y17A is placed across the correct connections for the External Power Supply chosen.

Additional Resources

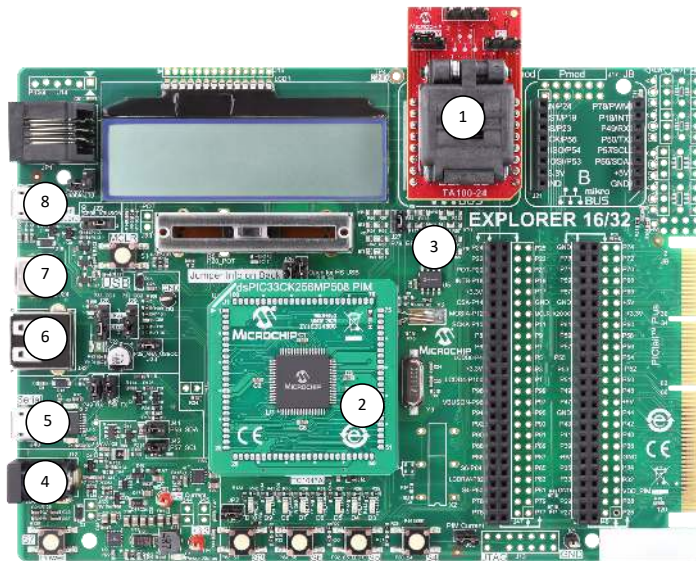
- [SAMV71 Kit Information](#)
- [SAMV71 Xplained Ultra User Guide](#)
- [SAMV71 Microcontroller](#)
- Additional Tools available via [myMicrochip](#)

2.2 Microchip Explorer 16/32 Connections

The EV39Y17A extension board can be connected to any microcontroller board that contains a mikroBUS Host Header. The 24-Pad VQFN socket board contains both the I²C and the SPI interface as shown in [1.2 Board Configuration](#). The diagram below shows a configuration using the [Microchip Explorer 16/32 Development Board](#) and

the [dsPIC33CK](#) 16-bit microcontroller. Note that the Explorer 16/32 board allows for a variety of 100-pin Microchip microcontrollers to be used.

Figure 2-3. Connections to a Microchip Explorer 16/32 Development Board



1. EV39Y17A 24-Pad VQFN Socket Board
2. dsPIC33CK 16-bit Microcontroller
3. Microchip Explorer 16/32 development Board
4. External Power Connection
5. Micro-USB Connection
6. Type-A USB Connection
7. USB Type-C™ Connection
8. PICKit™ On-Board debugger micro-USB Connection

Powering the Board

Multiple options exist for powering the Explorer 16/32 Development board. Depending on the total current requirements, different options are allowed.

- External Power Supply Connection
 - 8-15V Power Supply maximum current 1.3A
 - Universal 9V Supply Adapter: [AC002014](#)
- USB Connections allow up to 400 mA

Additional Resources

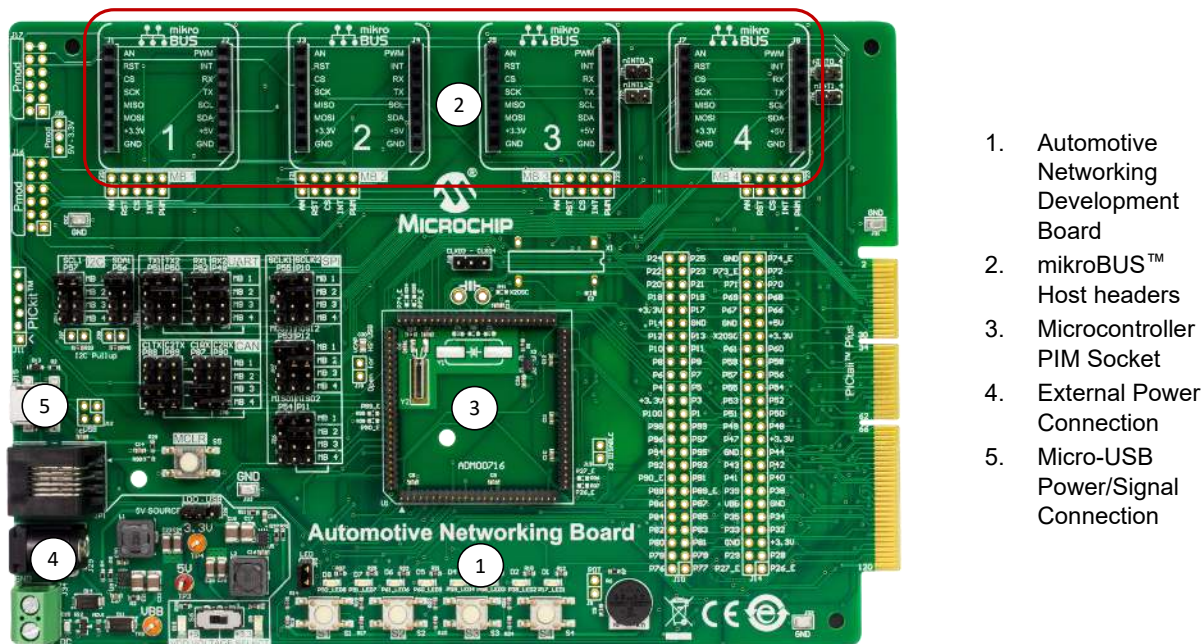
- [Microchip Explorer 16/32 Kit Information](#)
- [Microchip Explore 16/32 User Guide](#)
- [dsPIC33CK](#)
- Additional software tools available via [myMICROCHIP](#)

2.3 Automotive Networking Development Board Connections

The EV39Y17A extension board can be connected to any microcontroller board that contains a mikroBUS Host Header. The 24-Pad VQFN socket board contains both the I²C and the SPI interface as shown in [1.2 Board Configuration](#). The diagram below shows the [Automotive Networking Development Board](#). This board is a low-cost modular development system for Microchip's 8-bit, 16-bit and 32-bit microcontrollers targeting CAN and LIN network-related applications.

Due to the modular nature of the Automotive Networking Development Board, only a generic photo of the board is shown below. There are multiple LIN and CAN Controllers that can be connected through the mikroBUS connectors along with the EV39Y17A socket security board. Each of these devices can be connected via any of the mikroBUS headers. A 100-pin plug-in microcontroller module (PIM) is also required for complete system operation. Microchip has a variety of PIM modules that can be used with this development board. Examples of mikroBUS click boards and PIM modules are shown in the [Additional Resources](#) section.

Figure 2-4. Connections to the Automotive Networking Development Board



1. Automotive Networking Development Board
2. mikroBUS™ Host headers
3. Microcontroller PIM Socket
4. External Power Connection
5. Micro-USB Power/Signal Connection

Powering the Board

Multiple options exist for powering the Automotive Networking Development Board.

- External Power Supply Connection (7-30V)
 - 9V external power supply adapter: ([AC002014](#)) 1.3A current
 - 5 mm output jack with center-positive connection
 - Place jumper across pins 2-3 of header J28 to enable
- USB Connections
 - Micro-USB connection
 - Place jumper across pins 1-2 of header J28 to enable

Additional Resources

The following list provides examples of different resources available and is not exhaustive. To identify additional PIM or mikroBUS modules that may work with the Automotive Networking Development Board, go to www.microchip.com.

- [Automotive Networking Development Board Kit Information](#)
- [Automotive Networking Development Board User's Guide](#)
- [MCP2003B click for LIN systems](#)
- [MCP25625 click with Microchip CAN controller](#)
- [ATA6563 click with Microchip CAN controller](#)
- [PIC18F66K80 100-pin PIM](#)
- Additional software tools available via [myMicrochip](#)

3. Software Tools

The TA100 is supported by a suite of software tools. These tools are only available under NDA. Contact Microchip to obtain an NDA and request access to the tools. Once an NDA is signed, these tools are made available in the My Secure Software section of the customer's myMicrochip account. Enhancements, upgrades and additional tools are automatically made available to any customer that is enabled for the TA100 support.

Table 3-1. TA100 Software Tools

Item #	Tool Name	Description
1	TA100 Configurator GUI and TA100 Library	The TA100 Configurator GUI provides the ability to configure and pseudo-provision TA100 devices, and to illustrate how the TA100 can be used for various applications such as Secure Boot, Device Authentication and CAN-MAC. These applications perform many cryptographic operations using the TA100 library.
2	CryptoAuthLib	A flexible library implemented with a Hardware Abstraction Layer (HAL) that allows the TA100 to be readily ported to other microcontrollers. The library provides commands support for the TA100 and other Microchip CryptoAuthentication™ devices significantly speeding up application development.
3	AUTOSAR™ 4.3.1 CRYPTO driver ⁽¹⁾	CRYPTO driver specifications provide an abstraction layer to integrate an external cryptographic device, such as the TA100, into the AUTOSAR™ stack. This allows for code to be portable between various applications that use different microcontrollers.



Important:

1. For projects that use the AUTOSAR Driver, the AUTOSAR™ Reference Stack is also needed. AUTOSAR™ is an open and standardized automotive software architecture. The TA100 is integrated into 3rd party AUTOSAR™ software stacks to aid customers in the implementation of automotive applications. Contact Microchip for a list of 3rd Party AUTOSAR™ stack vendors that support the TA100.

Use Case Examples

Use Case examples use the TA100 Configurator GUI to demonstrate various sample applications that can be implemented using the TA100 and SAM V71 microcontroller. These sample applications come with the necessary microcontroller firmware, detailed application user guide and other documentation describing the use case in more detail. [Table 3-2](#) provides some of the use case examples that are available from the myMicrochip website. Upgrades to these use case examples and additional use case examples will be provided over time via the same path.

Table 3-2. Use Case Examples

Item #	Use Case Examples ⁽¹⁾	Description
1	Device Authentication	Provides device authentication by verifying the chain of trust using Signer and Device Certificates and a Random Challenge. Upon successful authentication, a known string is encrypted and written to a data element or read and decrypted from a data element inside the TA100.
2	Full Stored Secure Boot with Pre-Boot	Secure Boot use case that, upon initial boot, calculates the digest of the firmware code and, then, stores it for faster subsequent secure boots.
3	CAN Bootloader	Secure Boot use case that allows for a secure firmware upgrade via the CAN Bus using the SAMV71 microcontroller, K2L MOCCA-FD tool and PC-based GUI.

.....continued

Item #	Use Case Examples ⁽¹⁾	Description
4	CAN-MAC Authentication	This use case demonstrates a mechanism to add an AES C-MAC to authenticate CAN-FD messages. This mechanism can be used to ensure data integrity and authenticity of the transmit node. TA-configurator GUI will import a CAN-database file to populate the CAN-MAC tab of the GUI. The user can use the TA-configurator GUI to select which messages need authentication, assign C-MAC keys and to configure message payload structure.

Note:

1. The listed use case examples are based on the TA100Lib and TA Configurator GUI.

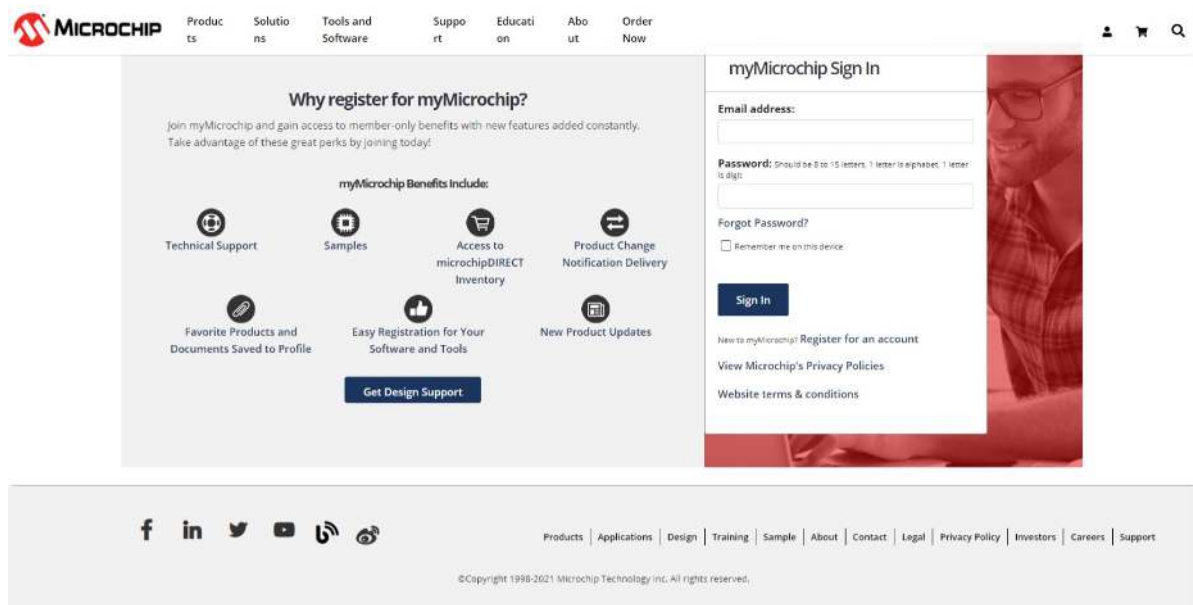
3.1 myMicrochip

Microchip provides the ability to customize your user experience and keep you up to date on key topics that are of the most relevance and importance to you by registering for a myMicrochip account. To have access to many of the TA100 software tools, you must have an account. These tools are accessed by enabling Secure Document Access. Having access will automatically give you access to tool updates and new tools as they are added.

Accessing myMicrochip

1. Go to the myMicrochip website: www.microchip.com/mymicrochip.

Figure 3-1. myMicrochip Login and Registration Page



2. If you do not have an account, click the “Register for an account” link, fill out the information, then save your profile.
3. Once you are fully registered, you can log in through the access page in step 1.
4. After you log in, go to My Preferences and enable Secure Documents Access. You can also set other preferences at this time.

Product, tool and software alerts

If you have a part number for a product, tool or software, you can add an alert by entering the part number below.

Enter Part Number

4TECC605B ATSHA204A TA100

Secure Documents Access

If you would like access Secure documents from Microchip, select the toggle button below. An NDA may be required for some information and you will be informed if an NDA is required and the process.

Subscribe to access Secure Documents

5. After you set your preferences, go to the bottom of the page and make sure you click **Save Preferences**.
6. To gain access to these files, you will need an NDA. If you do not yet have an NDA, work with your Microchip sales representative to obtain an NDA.
7. Once you have the NDA, follow the directions on the website or send an email with the signed version of the NDA along with a request to access the software packages to securefiles@microchip.com. This document will be forwarded to the appropriate administrators of the group. Once your name is added, you will receive an email notifying you of the availability of the software.

Personal myMicrochip Page

Once you log in to your myMicrochip account, your dashboard page will display similar to [Figure 3-2](#). Under the **Products** tab is a listing of all your secure documents, software, etc. Clicking on the various links and setting up your preferences provides you with customized access to everything within Microchip that is relevant to you.

Figure 3-2. myMicrochip Dashboard

myMicrochip Dashboard

REMINDER: These materials are Microchip Proprietary Information and your use of these materials is governed by Microchip's Website Terms and Conditions and by any applicable Non-Disclosure Agreements.

My Products | My Documents | My Tools | Libraries / Firmware | Recent Documents

Product	Product Category		
TA100			
SW-TA100-CAL TA100 CryptoAuthLib		View Secure Documents	
SW-TA100-DEVSUITE TA100 Software Tool Suite		View Secure Documents	
SW-TA100-TCSM		View Secure Documents	
TA100-DS Datasheet		View Secure Documents	
TA100-PS Programming Spec		View Secure Documents	
TA100-SecureBoot App Note		View Secure Documents	
TA100	Crypto Authentication	View Documents	Remove

Secure Documents

- Document Search
- Manage Alerts
- Request access
- JIRA

My PCNs [View All](#)

No Data Available!

Latest News & Events [View All](#)

- 18-Nov-2020 - Microchip Delivers First 8-bit MCU Family for CAN FD networks
- 16-Nov-2020 - World's First Safety Certified Capacitive Touchscreen Controller Family for the Home Appliance Market
- 11-Nov-2020 - First Cryptographic Companion Device Brings Pre-programmed Security to the Automotive Market

Have a question? Please contact our Customer Support.

Products | Applications | Design | Training | Sample | About | Contact | Legal | Privacy Policy | Investors | Careers | Support

©Copyright 1998-2021 Microchip Technology Inc. All rights reserved.

4. Revision History

Revision	Date	Description
A	10/2021	Initial release of this document

The Microchip Website

Microchip provides online support via our website at www.microchip.com/. This website is used to make files and information easily available to customers. Some of the content available includes:

- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip design partner program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

Product Change Notification Service

Microchip's product change notification service helps keep customers current on Microchip products. Subscribers will receive email notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, go to www.microchip.com/pcn and follow the registration instructions.

Customer Support

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Embedded Solutions Engineer (ESE)
- Technical Support

Customers should contact their distributor, representative or ESE for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in this document.

Technical support is available through the website at: www.microchip.com/support

Microchip Devices Code Protection Feature

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

- Microchip products meet the specifications contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is secure when used in the intended manner, within operating specifications, and under normal conditions.
- Microchip values and aggressively protects its intellectual property rights. Attempts to breach the code protection features of Microchip product is strictly prohibited and may violate the Digital Millennium Copyright Act.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of its code. Code protection does not mean that we are guaranteeing the product is "unbreakable". Code protection is constantly evolving. Microchip is committed to continuously improving the code protection features of our products.

Legal Notice

This publication and the information herein may be used only with Microchip products, including to design, test, and integrate Microchip products with your application. Use of this information in any other manner violates these terms. Information regarding device applications 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. Contact your local Microchip sales office for additional support or, obtain additional support at www.microchip.com/en-us/support/design-help/client-support-services.

THIS INFORMATION IS PROVIDED BY MICROCHIP "AS IS". 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 ANY IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE, OR WARRANTIES RELATED TO ITS CONDITION, QUALITY, OR PERFORMANCE.

IN NO EVENT WILL MICROCHIP BE LIABLE FOR ANY INDIRECT, SPECIAL, PUNITIVE, INCIDENTAL, OR CONSEQUENTIAL LOSS, DAMAGE, COST, OR EXPENSE OF ANY KIND WHATSOEVER RELATED TO THE INFORMATION OR ITS USE, HOWEVER CAUSED, EVEN IF MICROCHIP HAS BEEN ADVISED OF THE POSSIBILITY OR THE DAMAGES ARE FORESEEABLE. TO THE FULLEST EXTENT ALLOWED BY LAW, MICROCHIP'S TOTAL LIABILITY ON ALL CLAIMS IN ANY WAY RELATED TO THE INFORMATION OR ITS USE WILL NOT EXCEED THE AMOUNT OF FEES, IF ANY, THAT YOU HAVE PAID DIRECTLY TO MICROCHIP FOR THE INFORMATION.

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.

Trademarks

The Microchip name and logo, the Microchip logo, Adaptec, AnyRate, AVR, AVR logo, AVR Freaks, BesTime, BitCloud, CryptoMemory, CryptoRF, dsPIC, flexPWR, HELDO, IGLOO, JukeBlox, KeeLoq, Klear, LANCheck, LinkMD, maXStylus, maXTouch, MediaLB, megaAVR, Microsemi, Microsemi logo, MOST, MOST logo, MPLAB, OptoLyzer, PIC, picoPower, PICSTART, PIC32 logo, PolarFire, Prochip Designer, QTouch, SAM-BA, SenGenuity, SpyNIC, SST, SST Logo, SuperFlash, Symmetricom, SyncServer, Tachyon, TimeSource, tinyAVR, UNI/O, Vectron, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

AgileSwitch, APT, ClockWorks, The Embedded Control Solutions Company, EtherSynch, Flashtec, Hyper Speed Control, HyperLight Load, IntellIMOS, Libero, motorBench, mTouch, Powermite 3, Precision Edge, ProASIC, ProASIC Plus, ProASIC Plus logo, Quiet- Wire, SmartFusion, SyncWorld, Temux, TimeCesium, TimeHub, TimePictra, TimeProvider, TrueTime, WinPath, and ZL 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, Augmented Switching, BlueSky, BodyCom, CodeGuard, CryptoAuthentication, CryptoAutomotive, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, Espresso T1S, EtherGREEN, GridTime, IdealBridge, In-Circuit Serial Programming, ICSP, INICnet, Intelligent Paralleling, Inter-Chip Connectivity, JitterBlocker, Knob-on-Display, maxCrypto, maxView, memBrain, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, NVM Express, NVMe, Omniscient Code Generation, PICDEM, PICDEM.net, PICkit, PICtail, PowerSmart, PureSilicon, QMatrix, REAL ICE, Ripple Blocker, RTAX, RTG4, SAM-ICE, Serial Quad I/O, simpleMAP, SimpliPHY, SmartBuffer, SmartHLS, SMART-I.S., storClad, SQL, SuperSwitcher, SuperSwitcher II, Switchtec, SynchroPHY, Total Endurance, TSHARC, USBCheck, VariSense, VectorBlox, VeriPHY, ViewSpan, WiperLock, XpressConnect, 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.

The Adaptec logo, Frequency on Demand, Silicon Storage Technology, Symmcom, and Trusted Time are registered trademarks 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.

© 2021, Microchip Technology Incorporated and its subsidiaries. All Rights Reserved.

ISBN: 978-1-5224-8647-3

Quality Management System

For information regarding Microchip's Quality Management Systems, please visit www.microchip.com/quality.

Worldwide Sales and Service

AMERICAS	ASIA/PACIFIC	ASIA/PACIFIC	EUROPE
<p>Corporate Office 2355 West Chandler Blvd. Chandler, AZ 85224-6199 Tel: 480-792-7200 Tel: 480-792-7277 Technical Support: www.microchip.com/support Web Address: www.microchip.com</p> <p>Atlanta Duluth, GA Tel: 678-957-9614 Fax: 678-957-1455</p> <p>Austin, TX Tel: 512-257-3370</p> <p>Boston Westborough, MA Tel: 774-760-0087 Fax: 774-760-0088</p> <p>Chicago Itasca, IL Tel: 630-285-0071 Fax: 630-285-0075</p> <p>Dallas Addison, TX Tel: 972-818-7423 Fax: 972-818-2924</p> <p>Detroit Novi, MI Tel: 248-848-4000</p> <p>Houston, TX Tel: 281-894-5983</p> <p>Indianapolis Noblesville, IN Tel: 317-773-8323 Fax: 317-773-5453 Tel: 317-536-2380</p> <p>Los Angeles Mission Viejo, CA Tel: 949-462-9523 Fax: 949-462-9608 Tel: 951-273-7800</p> <p>Raleigh, NC Tel: 919-844-7510</p> <p>New York, NY Tel: 631-435-6000</p> <p>San Jose, CA Tel: 408-735-9110 Tel: 408-436-4270</p> <p>Canada - Toronto Tel: 905-695-1980 Fax: 905-695-2078</p>	<p>Australia - Sydney Tel: 61-2-9868-6733</p> <p>China - Beijing Tel: 86-10-8569-7000</p> <p>China - Chengdu Tel: 86-28-8665-5511</p> <p>China - Chongqing Tel: 86-23-8980-9588</p> <p>China - Dongguan Tel: 86-769-8702-9880</p> <p>China - Guangzhou Tel: 86-20-8755-8029</p> <p>China - Hangzhou Tel: 86-571-8792-8115</p> <p>China - Hong Kong SAR Tel: 852-2943-5100</p> <p>China - Nanjing Tel: 86-25-8473-2460</p> <p>China - Qingdao Tel: 86-532-8502-7355</p> <p>China - Shanghai Tel: 86-21-3326-8000</p> <p>China - Shenyang Tel: 86-24-2334-2829</p> <p>China - Shenzhen Tel: 86-755-8864-2200</p> <p>China - Suzhou Tel: 86-186-6233-1526</p> <p>China - Wuhan Tel: 86-27-5980-5300</p> <p>China - Xian Tel: 86-29-8833-7252</p> <p>China - Xiamen Tel: 86-592-2388138</p> <p>China - Zhuhai Tel: 86-756-3210040</p>	<p>India - Bangalore Tel: 91-80-3090-4444</p> <p>India - New Delhi Tel: 91-11-4160-8631</p> <p>India - Pune Tel: 91-20-4121-0141</p> <p>Japan - Osaka Tel: 81-6-6152-7160</p> <p>Japan - Tokyo Tel: 81-3-6880-3770</p> <p>Korea - Daegu Tel: 82-53-744-4301</p> <p>Korea - Seoul Tel: 82-2-554-7200</p> <p>Malaysia - Kuala Lumpur Tel: 60-3-7651-7906</p> <p>Malaysia - Penang Tel: 60-4-227-8870</p> <p>Philippines - Manila Tel: 63-2-634-9065</p> <p>Singapore Tel: 65-6334-8870</p> <p>Taiwan - Hsin Chu Tel: 886-3-577-8366</p> <p>Taiwan - Kaohsiung Tel: 886-7-213-7830</p> <p>Taiwan - Taipei Tel: 886-2-2508-8600</p> <p>Thailand - Bangkok Tel: 66-2-694-1351</p> <p>Vietnam - Ho Chi Minh Tel: 84-28-5448-2100</p>	<p>Austria - Wels Tel: 43-7242-2244-39 Fax: 43-7242-2244-393</p> <p>Denmark - Copenhagen Tel: 45-4485-5910 Fax: 45-4485-2829</p> <p>Finland - Espoo Tel: 358-9-4520-820</p> <p>France - Paris Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79</p> <p>Germany - Garching Tel: 49-8931-9700</p> <p>Germany - Haan Tel: 49-2129-3766400</p> <p>Germany - Heilbronn Tel: 49-7131-72400</p> <p>Germany - Karlsruhe Tel: 49-721-625370</p> <p>Germany - Munich Tel: 49-89-627-144-0 Fax: 49-89-627-144-44</p> <p>Germany - Rosenheim Tel: 49-8031-354-560</p> <p>Israel - Ra'anana Tel: 972-9-744-7705</p> <p>Italy - Milan Tel: 39-0331-742611 Fax: 39-0331-466781</p> <p>Italy - Padova Tel: 39-049-7625286</p> <p>Netherlands - Drunen Tel: 31-416-690399 Fax: 31-416-690340</p> <p>Norway - Trondheim Tel: 47-72884388</p> <p>Poland - Warsaw Tel: 48-22-3325737</p> <p>Romania - Bucharest Tel: 40-21-407-87-50</p> <p>Spain - Madrid Tel: 34-91-708-08-90 Fax: 34-91-708-08-91</p> <p>Sweden - Gothenberg Tel: 46-31-704-60-40</p> <p>Sweden - Stockholm Tel: 46-8-5090-4654</p> <p>UK - Wokingham Tel: 44-118-921-5800 Fax: 44-118-921-5820</p>