
ATWINC15x0 Software Release Notes

Release Overview

This document describes the ATWINC15x0 version 19.6.1 release package. The release package contains all the necessary components (binaries and tools) required for the latest features including tools, and firmware binaries.

Software Release Details

The following table provides the software release details.

Table 1. Software Version Information

Parameter	Description
Software Name	WINC15x0 Firmware
WINC Firmware Version	19.6.1
Host Driver Version	19.6.1
Minimum Driver Version	19.3.0

Release Impact

The newly added features in ATWINC15x0 v19.6.1 release are:

- Extend support for Enterprise security
- Host File Download
- Simple Roaming support
- Customizable NTP Servers
- Multiple gain table support
- Encrypted AP credentials storage in ATWINC15x0 flash

Note: For more information, refer to Wi-Fi Network Controller Software Design Guide (DS00002389).

Related Information

- Ordering Information
 - Customers who would like to order ATWINC15x0 with Firmware 19.6.1, contact Microchip marketing representative.
- Firmware Upgrade
 - Firmware 19.6.1 is supported in ASF starting from version 3.42 and later. This is available for customers to update the ATWINC15x0-MR210xB module and supporting demo and evaluation boards. Download the latest firmware package from <https://gallery.microchip.com/packages/4CE20911-D794-4550-8B94-6C66A93228B8/3.42.0.1279>.

Note: The references to the ATWINC15x0-MR210xB module include the module devices listed in the following:

- ATWINC1500-MR210PB
- ATWINC1500-MR210UB
- ATWINC1510-MR210PB
- ATWINC1510-MR210UB
- Refer to the reference documents.

Note: For more information, refer to Microchip product webpage:
<https://www.microchip.com/wwwproducts/en/ATWINC1500>.

Table of Contents

Release Overview.....	1
1. Release Details.....	4
1.1. Changes in Version 19.6.1, with respect to Version 19.5.4.....	4
1.2. Changes in Version 19.5.4, with respect to Version 19.5.3.....	7
1.3. Changes in Version 19.5.3, with respect to Version 19.5.2.....	9
1.4. Changes in Version 19.5.2, with respect to Version 19.4.4.....	12
1.5. Version 19.4.4, Initial Release.....	15
2. Known Problems and Solutions.....	16
The Microchip Web Site.....	18
Customer Change Notification Service.....	18
Customer Support.....	18
Microchip Devices Code Protection Feature.....	18
Legal Notice.....	19
Trademarks.....	19
Quality Management System Certified by DNV.....	20
Worldwide Sales and Service.....	21

1. Release Details

1.1 Changes in Version 19.6.1, with respect to Version 19.5.4

The following table compares the features of 19.5.4 to 19.6.1 release.

Table 1-1. Comparison of Features between 19.5.4 and 19.6.1 Release

Features in 19.5.4	Changes in 19.6.1
Wi-Fi STA	
<ul style="list-style-type: none"> IEEE802.11 b/g/n OPEN, WEP security WPA Personal Security (WPA1/WPA2) WPA Enterprise Security (WPA1/WPA2) supporting EAP-TTLSv0/MSCHAPv2 authentication with RADIUS server 	<p>Same features along with the following:</p> <ul style="list-style-type: none"> WPA/WPA2 Enterprise new methods: <ul style="list-style-type: none"> EAP-PEAPv0/MSCHAPv2 EAP-PEAPv1/MSCHAPv2 EAP-PEAPv0/TLS EAP-PEAPv1/TLS EAP-TLS WPA/WPA2 Enterprise other new features <ul style="list-style-type: none"> Phase 1 TLS session caching Option to specify domain Option to send actual identity in phase 1 Simple Roaming support Improved connection API, allowing connection via BSSID as well as SSID Option to encrypt connection credentials that are stored in ATWINC15x0 flash
Wi-Fi Hotspot	
<ul style="list-style-type: none"> Only ONE associated station is supported. After a connection is established with a station, further connections are rejected OPEN and WEP, WPA2 security modes The device cannot work as a station in this mode (STA/AP concurrency is not supported) 	No change
Wi-Fi Direct	
Wi-Fi direct client is not supported	No change
WPS	
The ATWINC15x0 supports the WPS protocol v2.0 for PBC (Push button configuration) and PIN methods	No change

Features in 19.5.4	Changes in 19.6.1
TCP/IP Stack	
<p>The ATWINC15x0 has a TCP/IP Stack running in firmware side. It supports TCP and UDP full socket operations (client/server). The maximum number of supported sockets is currently configured to 11 divided as:</p> <ul style="list-style-type: none"> • 7 TCP sockets (client or server) • 4 UDP sockets (client or server) 	No change
Transport Layer Security	
<ul style="list-style-type: none"> • Support TLS v1.2 • Client and server modes • Mutual authentication • Custom scheme for X509 certificate revocation • X509 certificate support including SHA1, SHA256, SHA384 and SHA512 • Integration with ATECC508 (adds support for ECDSA/ECHE) • Supported cipher suites are: <ul style="list-style-type: none"> TLS_RSA_WITH_AES_128_CBC_SHA TLS_RSA_WITH_AES_128_CBC_SHA256 TLS_RSA_WITH_AES_256_CBC_SHA TLS_RSA_WITH_AES_256_CBC_SHA256 TLS_DHE_RSA_WITH_AES_128_CBC_SHA TLS_DHE_RSA_WITH_AES_128_CBC_SHA256 TLS_DHE_RSA_WITH_AES_256_CBC_SHA TLS_DHE_RSA_WITH_AES_256_CBC_SHA256 TLS_RSA_WITH_AES_128_GCM_SHA256 TLS_DHE_RSA_WITH_AES_128_GCM_SHA256 TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 (requires ATECC508) TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA256 (requires ATECC508) TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256 (requires ATECC508) 	No change
Networking Protocols	

Features in 19.5.4	Changes in 19.6.1
DHCPv4 (client/server) DNS Resolver IGMPv1, v2 SNTP	SNTP servers are fully customizable
Power saving Modes	
<ul style="list-style-type: none"> M2M_PS_MANUAL M2M_PS_AUTOMATIC M2M_PS_H_AUTOMATIC M2M_PS_DEEP_AUTOMATIC 	No change
Device Over-The-Air (OTA) upgrade	
<ul style="list-style-type: none"> Built-in OTA upgrade available Backwards compatible as far as 19.4.4, with the exception of: <ul style="list-style-type: none"> Wi-Fi Direct (removed in 19.5.3) Monitor mode (removed in 19.5.2) 	No change
Wi-Fi credentials provisioning via built-in HTTP server	
Built-in HTTP/HTTPS (TLS server mode) provisioning using AP mode (Open, WEP or WPA2 secured)	<ul style="list-style-type: none"> Improved provisioning user experience Default gateway and subnet mask can now be customized when in AP mode
Ethernet Mode (TCP/IP Bypass)	
Allow ATWINC15x0 to in WLAN MAC only mode and let the host to send/receive Ethernet frames	No change
ATE Test Mode	
Embedded ATE test mode for production line testing driven from the host MCU	No change
Miscellaneous Features	
	<ul style="list-style-type: none"> Addition of host file download capability, allowing the host MCU to download and retrieve files from the ATWINC1510 flash Multiple Gain Table support - Support upto 4 gain tables Simple Roaming feature Encrypted credential storage in ATWINC15x0 flash

1.2 Changes in Version 19.5.4, with respect to Version 19.5.3

The following table compares the features of 19.5.3 to 19.5.4 release.

Table 1-2. Comparison of Features between 19.5.3 and 19.5.4 Release

Features in 19.5.3	Changes in 19.5.4
Wi-Fi STA	
<ul style="list-style-type: none"> IEEE802.11 b/g/n OPEN, WEP security WPA Personal Security (WPA1/WPA2) WPA Enterprise Security (WPA1/WPA2) supporting EAP-TTLS/MS-Chapv2.0 authentication with RADIUS server 	<ul style="list-style-type: none"> Protect against key re-installation attacks forcing NONCE re-use Fix <code>m2m_wifi_set_tx_power()</code> to work in all cases Fix interoperability issues with ARRIS TG862G/CT (Xfinity) access point
Wi-Fi Hotspot	
<ul style="list-style-type: none"> Only ONE associated station is supported. After a connection is established with a station, further connections are rejected OPEN and WEP, WPA2 security modes The device cannot work as a station in this mode (STA/AP concurrency is not supported) 	No change
Wi-Fi Direct	
Wi-Fi direct client is not supported	No change
WPS	
The ATWINC15x0 supports the WPS protocol v2.0 for PBC (Push button configuration) and PIN methods	No change
TCP/IP Stack	
<p>The ATWINC15x0 has a TCP/IP Stack running in firmware side. It supports TCP and UDP full socket operations (client/server). The maximum number of supported sockets is currently configured to 11 divided as:</p> <ul style="list-style-type: none"> 7 TCP sockets (client or server) 4 UDP sockets (client or server) 	No change
Transport Layer Security	

Features in 19.5.3	Changes in 19.5.4
<ul style="list-style-type: none"> • Support TLS v1.2 • Client and server modes • Mutual authentication • X509 certificate revocation scheme • Add SHA384 and SHA512 support in X509 certificates processing • Integration with ATECC508 (add ECDSA/ECHE support) • Certificate revocation check API • Disable Support of DH groups larger than 2048 bits • Supported cipher suites are: TLS_RSA_WITH_AES_128_CBC_SHA TLS_RSA_WITH_AES_128_CBC_SHA256 TLS_RSA_WITH_AES_256_CBC_SHA TLS_RSA_WITH_AES_256_CBC_SHA256 TLS_DHE_RSA_WITH_AES_128_CBC_SHA TLS_DHE_RSA_WITH_AES_128_CBC_SHA256 TLS_DHE_RSA_WITH_AES_256_CBC_SHA TLS_DHE_RSA_WITH_AES_256_CBC_SHA256 TLS_RSA_WITH_AES_128_GCM_SHA256 TLS_DHE_RSA_WITH_AES_128_GCM_SHA256 TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 (requires ATECC508) TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256 (requires ATECC508) 	No change
Networking Protocols	
DHCPv4 (client/server) DNS Resolver IGMPv1, v2 SNTP	Use NTP server pools instead of specific servers
Power saving Modes	
<ul style="list-style-type: none"> • M2M_PS_MANUAL • M2M_PS_AUTOMATIC • M2M_PS_H_AUTOMATIC • M2M_PS_DEEP_AUTOMATIC 	No change
Device Over-The-Air (OTA) upgrade	

Features in 19.5.3	Changes in 19.5.4
<ul style="list-style-type: none"> Built-in OTA upgrade available Backwards compatible as far as 19.4.4, with the exception of: <ul style="list-style-type: none"> Wi-Fi Direct (removed in 19.5.3) Monitor mode (removed in 19.5.2) 	No change
Wi-Fi credentials provisioning via built-in HTTP server	
Built-in HTTP/HTTPS (TLS server mode) provisioning using AP mode (Open, WEP or WPA2 secured)	No change
Ethernet Mode (TCP/IP Bypass)	
Allow ATWINC15x0 to in WLAN MAC only mode and let the host to send/receive Ethernet frames	No change
ATE Test Mode	
Embedded ATE test mode for production line testing driven from the host MCU	No change

1.3 Changes in Version 19.5.3, with respect to Version 19.5.2

The following table compares the features of 19.5.2 to 19.5.3 release.

Table 1-3. Comparison of Features between 19.5.2 and 19.5.3 Release

Features in 19.5.2	Changes in 19.5.3
Wi-Fi STA	
<ul style="list-style-type: none"> IEEE802.11 b/g/n OPEN, WEP security WPA Personal Security (WPA1/WPA2) WPA Enterprise Security (WPA1/WPA2) supporting EAP-TTLS/MS-Chapv2.0 authentication with RADIUS server 	Same features along with the following: <ul style="list-style-type: none"> Improved automatic rate selection algorithm for optimized TCP upload experience Supports SAMW55 module Firmware does not print WLAN passcode in the WINC firmware log
Wi-Fi Hotspot	
<ul style="list-style-type: none"> Only ONE associated station is supported. After a connection is established with a station, further connections are rejected OPEN and WEP, WPA2 security modes The device cannot work as a station in this mode (STA/AP concurrency is not supported) 	No change
Wi-Fi Direct	

Features in 19.5.2	Changes in 19.5.3
<ul style="list-style-type: none">The device can operate only as a Wi-Fi Direct client (group owner function is not supported)The device could not work as a station in this mode (STA/P2P concurrency is not supported)	Wi-Fi direct client is not supported
WPS	
The ATWINC15x0 supports the WPS protocol v2.0 for PBC (Push button configuration) and PIN methods	No change
TCP/IP Stack	
The ATWINC15x0 has a TCP/IP Stack running in firmware side. It supports TCP and UDP full socket operations (client/server). The maximum number of supported sockets is currently configured to 11 divided as: <ul style="list-style-type: none">7 TCP sockets (client or server)4 UDP sockets (client or server)	Implement fast TCP re-transmission for improved TCP upload in busy radio environments
Transport Layer Security	

Features in 19.5.2	Changes in 19.5.3
<ul style="list-style-type: none"> • Support TLS v1.2 • Client and server modes • Mutual authentication • X509 certificate revocation scheme • Add SHA384 and SHA512 support in X509 certificates processing • Integration with ATECC508 (add ECDSA/ECHE support) • Certificate revocation check API • Disable Support of DH groups larger than 2048 bits • Supported cipher suites are: TLS_RSA_WITH_AES_128_CBC_SHA TLS_RSA_WITH_AES_128_CBC_SHA256 TLS_RSA_WITH_AES_256_CBC_SHA TLS_RSA_WITH_AES_256_CBC_SHA256 TLS_DHE_RSA_WITH_AES_128_CBC_SHA TLS_DHE_RSA_WITH_AES_128_CBC_SHA256 TLS_DHE_RSA_WITH_AES_256_CBC_SHA TLS_DHE_RSA_WITH_AES_256_CBC_SHA256 TLS_RSA_WITH_AES_128_GCM_SHA256 TLS_DHE_RSA_WITH_AES_128_GCM_SHA256 TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 (requires ATECC508) TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256 (requires ATECC508) 	Fix an issue where SHA384 and SHA512 are not present in the list supported signature algorithms in the ClientHello message
Networking Protocols	
DHCPv4 (client/server) DNS Resolver IGMPv1, v2	<ul style="list-style-type: none"> • Fix DHCP client renew never timeout issue • Add client identifier to DHCP request • Various DHCP client improvements to confirm to RFC 2131
Power saving Modes	
<ul style="list-style-type: none"> • M2M_PS_MANUAL • M2M_PS_AUTOMATIC • M2M_PS_H_AUTOMATIC • M2M_PS_DEEP_AUTOMATIC 	Improved initialization time (reduced by about 70 ms)
Device Over-The-Air (OTA) upgrade	

Features in 19.5.2	Changes in 19.5.3
	Improve WINC HTTPS client to allow it to work with HTTP servers which do not provide "content-length" HTTP header field (e.g. openssl s_server)
Wi-Fi credentials provisioning via built-in HTTP server	
Built-in HTTP/HTTPS (TLS server mode) provisioning using AP mode (Open, WEP or WPA2 secured)	No change
Ethernet Mode (TCP/IP Bypass)	
Allow ATWINC15x0 to in WLAN MAC only mode and let the host to send/receive Ethernet frames	No change
ATE Test Mode	
Embedded ATE test mode for production line testing driven from the host MCU	No change

1.4 Changes in Version 19.5.2, with respect to Version 19.4.4

The following table compares the features of 19.4.4 to 19.5.2 release.

Table 1-4. Comparison of Features between 19.4.4 and 19.5.2 Release

Features in 19.4.4	Changes in 19.5.2
Wi-Fi STA	
<ul style="list-style-type: none"> IEEE802.11 b/g/n OPEN, WEP security WPA Personal Security (WPA1/WPA2) WPA Enterprise Security (WPA1/WPA2) supporting EAP-TTLS/MS-Chapv2.0 authentication with RADIUS server 	No change
Wi-Fi Hotspot	
<ul style="list-style-type: none"> Only ONE associated station is supported. After a connection is established with a station, further connections are rejected OPEN and WEP security modes The device cannot work as a station in this mode (STA/AP concurrency is not supported) 	Added WPA/WPA2 security mode
WPS	
The ATWINC15x0 supports the WPS protocol v2.0 for PBC (Push button configuration) and PIN methods	No change
TCP/IP Stack	

Features in 19.4.4	Changes in 19.5.2
<p>The ATWINC15x0 has a TCP/IP Stack running in firmware side. It supports TCP and UDP full socket operations (client/server). The maximum number of supported sockets is currently configured to 11 divided as:</p> <ul style="list-style-type: none">• 7 TCP sockets (client or server)• 4 UDP sockets (client or server)	No change
Transport Layer Security	

Features in 19.4.4	Changes in 19.5.2
<ul style="list-style-type: none"> • TLS protocol version 1.0 TLSv1.0 • TLS v1.2 Client operation only • RSA is the only supported Public Key Algorithm with AES and is the only supported Encryption technique • Supported cipher suites are: TLS_RSA_WITH_AES_128_CBC_SHA TLS_RSA_WITH_AES_256_CBC_SHA TLS_RSA_WITH_AES_128_CBC_SHA256 TLS_RSA_WITH_AES_256_CBC_SHA256 	<ul style="list-style-type: none"> • Support TLS v1.2 • Client and server modes • Mutual authentication • X509 certificate revocation scheme • Add SHA384 and SHA512 support in X509 certificates processing • Integration with ATECC508 (add ECDSA/ECHE support) • Certificate revocation check API • Disable Support of DH groups larger than 2048 bits • Supported cipher suites are: TLS_RSA_WITH_AES_128_CBC_SHA TLS_RSA_WITH_AES_128_CBC_SHA256 TLS_RSA_WITH_AES_256_CBC_SHA TLS_RSA_WITH_AES_256_CBC_SHA256 TLS_DHE_RSA_WITH_AES_128_CBC_SHA TLS_DHE_RSA_WITH_AES_128_CBC_SHA256 TLS_DHE_RSA_WITH_AES_256_CBC_SHA TLS_DHE_RSA_WITH_AES_256_CBC_SHA256 TLS_RSA_WITH_AES_128_GCM_SHA256 TLS_DHE_RSA_WITH_AES_128_GCM_SHA256 TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 (requires ATECC508) TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256 (requires ATECC508)
Networking Protocols	
DHCPv4 (client/server) DNS Resolver IGMPv1, v2	Add device name feature in DHCP requests
Power saving Modes	

Features in 19.4.4	Changes in 19.5.2
<ul style="list-style-type: none"> M2M_PS_MANUAL M2M_PS_AUTOMATIC M2M_PS_H_AUTOMATIC M2M_PS_DEEP_AUTOMATIC 	Same list of power saving modes. Optimized power saving state machine which reduced power consumption during: <ul style="list-style-type: none"> Idle disconnected Beacon monitoring Intermittent traffic
Device Over-The-Air (OTA) upgrade	
Wi-Fi credentials provisioning via built-in HTTP server	
Built-in HTTP provisioning using AP mode	HTTPS support (needs TLS server) on WPA2 secured AP mode
Ethernet Mode (TCP/IP Bypass)	
Allow ATWINC15x0 to in WLAN MAC only mode and let the host to send/receive Ethernet frames	No change
ATE Test Mode	
Embedded ATE test mode for production line testing driven from the host MCU	No change

1.5 Version 19.4.4, Initial Release

Initial release of version 19.4.4 to public.

2. Known Problems and Solutions

The following table provides the list of known problems and solutions.

Table 2-1. Known Problems and Solutions

Problem	Solution
Occasionally ATWINC15x0 fails to receive an individual UDP broadcast frame when in M2M_PS_DEEP_AUTOMATIC powersave mode.	Use M2M_NO_PS Power Save mode if reliability is preferred for UDP broadcast frames. Otherwise ensure the overlying protocol can handle the odd missing frame.
The ATWINC15x0 cannot handle two simultaneous TLS handshakes, due to memory constraints.	When attempting to open two secure sockets in STA mode, the application should wait to be notified of the first one completing (succeeding or failing) before attempting the second one.
Under high interference and high data throughput (TCP/UDP), the ATWINC15x0 occasionally runs out of memory for receiving data and does not recover. This occurred 4 times during 9 hours of high interference high throughput Rx/bidirectional testing.	Close all sockets then retry the data transfer.
1% of Enterprise conversations fail due to the ATWINC15x0 not sending an EAP response. The response is prepared and ready to send but does not appear on the air. After 10 seconds the firmware times-out the connection attempt and the application is notified of the failure to connect.	Configure the authentication server to retry EAP requests (with interval < 10 seconds). The application should retry the connection request when it is notified of the failure.
Using the <code>m2m_wifi_set_tx_power()</code> API stops the ATWINC15x0 from transmitting.	Avoid using the <code>m2m_wifi_set_tx_power()</code> API.
When connected to certain access points, the ATWINC15x0 sometimes fails to roam when the access point changes channel. The issue is seen with these access points: Linksys E2500, Linksys E4200, Linksys 6500. The failures to roam are due to two issues: <ul style="list-style-type: none"> Sometimes the access point takes a long time to start sending beacons or probe responses on the new channel, so it is not discoverable. Sometimes the access point does not initiate the 4-way handshake (for WPA/WPA2 PSK reconnection). 	On reception of M2M_WIFI_DISCONNECTED event, the application should attempt to discover the access point using <code>m2m_wifi_request_scan()</code> API.

Problem	Solution
When provisioning the ATWINC15x0 using a mobile phone, 5% of provisioning attempts cause an error message “Request Failed” to pop up on the phone, even though the provisioning has succeeded.	Ignore the “Request Failed” message.
When connecting to a TL-WR841N router, data transfer is sometimes unavailable until several seconds after DHCP. Occasionally the data-plane is never established.	If DHCP completes but data transfer fails, disconnect and reconnect to the router.
If an AP uses an 802.11 ACK policy of “No Ack”, then the ATWINC15x0 sometimes fails to receive 802.11b frames.	Avoid using an ACK policy of “No Ack”. If “No Ack” is used, ensure frames are sent at 802.11g or higher rates.
70% of Enterprise connection requests fail with a TP Link Archer D2 access point (TPLink-AC750-D2). The access point does not forward the initial EAP Identity Re-sponse to the authentication server. The issue is bypassed by PMKSA caching (WPA2 only), so reconnection attempts will succeed.	The application should retry the connection request when it is notified of the failure.

The Microchip Web Site

Microchip provides online support via our web site at <http://www.microchip.com/>. This web site is used as a means to make files and information easily available to customers. Accessible by using your favorite Internet browser, the web site contains the following information:

- **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 (FAQ), technical support requests, online discussion groups, Microchip consultant 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

Customer Change Notification Service

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

To register, access the Microchip web site at <http://www.microchip.com/>. Under "Support", click on "Customer Change Notification" and follow the registration instructions.

Customer Support

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

Customers should contact their distributor, representative or Field Application Engineer (FAE) for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the back of this document.

Technical support is available through the web site at: <http://www.microchip.com/support>

Microchip Devices Code Protection Feature

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.

Legal Notice

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.

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, Printed in the U.S.A., All Rights Reserved.

ISBN:

Quality Management System Certified by DNV

ISO/TS 16949

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.

Worldwide Sales and Service

AMERICAS	ASIA/PACIFIC	ASIA/PACIFIC	EUROPE
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	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	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	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: 49-7131-67-3636 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: 47-7289-7561 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