Description

This application note covers both the AVR® and SAM microcontrollers, but not the PIC® microcontrollers.

Microchip AVR and SAM microcontrollers are Flash-based, and the program memory, therefore, needs to be programmed with a firmware image for the end-product to operate as desired. During development, it is recommended to use the combined programming and debugging tools from Microchip, which integrate directly in the Atmel Studio IDE. However, for production programming, it is recommended to use third-party programming tools that are intended for industrial environments. Another option is to order the microcontrollers pre-programmed from Microchip or from a programming house.

Features

- Microchip programming solutions
- Third-party programming solutions
- Programming services
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1. **Microchip Development and Programming Tools**

To identify the correct programming and debugging tool for a microcontroller from Microchip: Go to the microcontroller product page and from the quick access links above the product name, click the Development Tools icon (see the figure below). This will show a list of development tools for the product. The SAM-ICE™ supports programming and debugging of all Microchip SAM microcontrollers. The SAM devices can also be programmed through the SAM-BA® bootloader (various interface options). The Atmel-ICE is a programming and debugging tool that supports all of the Microchip AVR microcontroller products and Microchip SAM microcontrollers. AVR microcontrollers can also be programmed using the AVRISP mkII. However, note that the AVRISP mkII does not support debugging.

**Note:** The above-mentioned programming tools are not recommended for production programming as they are designed for development environments. SAM-BA can be considered as an exception, as it does not depend on a physical tool, but the software only.


**Figure 1-1. Development Tools Icon**
2. **Pre-Programmed Microcontrollers**

Microchip and many Microchip distributors offer pre-programmed microcontrollers. In this case, the binary image is provided to Microchip or the distributor. This solution is obviously less flexible if changes are made frequently to the pre-programmed firmware and does have MOQ implications, but can have advantages related to reduced production time for the end-product.

To request pre-programming of Microchip microcontrollers contact MicrochipDirect, your local Microchip sales office, or your distributor.

MicrochipDirect: [https://www.microchippdirect.com/programming/](https://www.microchippdirect.com/programming/)
3. **Third-Party Programming Tools**

For production programming, and e.g. to perform in-system calibration or parameter customization for the end-product it is recommended to use professional third-party programming tools.

The list of third-party programming tools in the following table includes programming solutions for use in both development and production. Gang programmers in this context refer to single- and multi-site programmers, where devices are inserted into the programming fixture to be programmed. This in contrast to In-system programming where the device to program is mounted on the PCB while being programmed. Both kinds of programmers can thus be used in production environments, while in-system programmers are usually preferred for development purposes.

<table>
<thead>
<tr>
<th>Company Name</th>
<th>ARM® Support</th>
<th>AVR Support</th>
<th>Programmer Intended for</th>
<th>Gang</th>
<th>In-system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advantech Equipment Corp.</td>
<td>Yes</td>
<td>Yes</td>
<td>Production (and development)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Taiwan ROC</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>ASIX s.r.o.</td>
<td>Yes</td>
<td>Yes</td>
<td>Development and production</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Czech Republic</td>
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<tr>
<td><a href="http://tools.asix.net/index.htm">http://tools.asix.net/index.htm</a></td>
<td></td>
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</tr>
<tr>
<td>BPM Microsystems</td>
<td>Information missing: contact vendor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data I/O Corp.</td>
<td>Yes</td>
<td>Yes</td>
<td>Production and development</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>USA</td>
<td></td>
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<tr>
<td><a href="http://dataio.com">http://dataio.com</a></td>
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</tr>
<tr>
<td>Dataman Ltd.</td>
<td>Yes</td>
<td>Yes</td>
<td>Production (and development)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>UK</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><a href="http://www.dataman.com">www.dataman.com</a></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>EETools, Inc.</td>
<td>Information missing: contact vendor</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>USA</td>
<td></td>
<td></td>
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<tr>
<td><a href="http://www.eetools.com">www.eetools.com</a></td>
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<tr>
<td>ELNEC s.r.o.</td>
<td>Yes</td>
<td>Yes</td>
<td>Production (and development)</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Slovak Republic</td>
<td></td>
<td></td>
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<tr>
<td><a href="http://www.elne.com/">http://www.elne.com/</a></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Equinox Technologies</td>
<td>Yes</td>
<td>Yes</td>
<td>Production, field-service, and development</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>United Kingdom</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

© 2017 Microchip Technology Inc.
<table>
<thead>
<tr>
<th>Company Name</th>
<th>ARM® Support</th>
<th>AVR Support</th>
<th>Programmer Intended for</th>
<th>Gang</th>
<th>In-system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hi-Lo System Research Co. Ltd.</td>
<td>Yes</td>
<td>Yes</td>
<td>Production (and development)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Taiwan ROC</td>
<td><a href="http://www.hilosystems.com.tw/">http://www.hilosystems.com.tw/</a></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Leap Electronic Co., Ltd.</td>
<td>Yes</td>
<td>Yes</td>
<td>Production (and development)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Taiwan ROC</td>
<td><a href="http://www.leap.com.tw/">http://www.leap.com.tw/</a></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MikroElektronika</td>
<td>No</td>
<td>Yes</td>
<td>Development</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Serbia</td>
<td><a href="http://www.mikroe.com/">http://www.mikroe.com/</a></td>
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</tr>
<tr>
<td>Opteeq Technologies</td>
<td>Yes</td>
<td>Yes</td>
<td>Production (and development)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Phyton, Inc.</td>
<td>Yes</td>
<td>Yes</td>
<td>Production and development</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>USA</td>
<td><a href="http://www.phyton.com">http://www.phyton.com</a></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ronetix GmbH</td>
<td>Yes</td>
<td>Yes</td>
<td>Production and development</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Austria</td>
<td><a href="http://www.ronetix.at/">http://www.ronetix.at/</a></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RPM Systems Corporation</td>
<td>Yes</td>
<td>Yes</td>
<td>Production and development</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>USA</td>
<td><a href="http://www.rpmsys.com/">http://www.rpmsys.com/</a></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>SMH Technologies</td>
<td>Yes</td>
<td>Yes</td>
<td>Production and development</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Italy</td>
<td><a href="http://www.smh-tech.com">http://www.smh-tech.com</a></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>System General Corporation</td>
<td>Yes</td>
<td>Yes</td>
<td>Production (and development)</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>Taiwan ROC</td>
<td><a href="http://www.sg.com.tw">http://www.sg.com.tw</a></td>
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<tr>
<td>Xeltek Inc.</td>
<td>Yes</td>
<td>Yes</td>
<td>Production and development</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>USA</td>
<td><a href="http://www.xeltek.com/">http://www.xeltek.com/</a></td>
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</tbody>
</table>
A general list of third-party vendors for Microchip products can be found at the pages below (not limited to programming tools). It is recommended to refer to this list for the most recent information about third-party tools.
4. **Introduction of Listed Third-Party Programming Offerings**

   The descriptions below are provided by the third-party vendors listed in the previous section’s table and contain additional information related to the programming products and the services these vendors offer. The third-party vendors are listed in alphabetic order.

   **Note:** The descriptions below do not reflect any recommendations by Microchip.

4.1 **Advantech Equipment**

   The **Labtool-48UXP** is a universal programmer for development and low volume production. It supports most of the Microchip AVR 8-bit MCUs, up to 64 pins, in various packages including PLCC, SOIC, TSSOP, SOT23, TQFP, QFN, and QFP. In addition, through adapters with up to 64 pins, it also supports the Microchip ARM7TDMI MCU in 64/48 pins in TQFP package, as well as the complete line of Microchip 8951-C1 and 51-C12 MCU.

   The **Labtool-848XP** is a production gang programmer for high density NOR Flash and Flash-based MCU’s with EEPROM. It supports parts of the AVR 8-bit family as well as the 89C51-1C and -2C MCU from Microchip. The **Labtool-848UXP** can also be customized with additional chip support upon customer request. In addition, if the default chip support is not sufficient, Advantech Equipment can be contacted to add the chip support with custom software.


4.2 **ASIX**

   ASIX s.r.o. founded in 1991 has entered the development tools business in the mid-90s. Since 2004 ASIX has been offering an In-System USB programmer, **PRESTO**, which supports many Microchip devices including AVR, '51, and ARM7TDMI MCUs, as well as serial EEPROM and Flash memories. In 2012, ASIX introduced a **FORTE** programmer, which offers more features and higher speed. Both programmers are primarily intended for development and service purposes, but many of them are also used for small and medium volume production (up to a couple of thousand units/day), typically with multiple programmers working in production lines. User-friendly and highly configurable software, called **UP**, supports production programming (serial number generator, remote control from command-line, Windows® messages, DLL library, etc.). Updates of **UP** and other software tools for **PRESTO** and **FORTE** are freely available. ASIX offers fast and effective technical support including new device implementation by a customer’s request.

   **Company web page**: [http://www.asix.net/](http://www.asix.net/)

4.3 **BP Microsystems**

   No description available.

4.4 **Data I/O**

   Data I/O is the world’s leading provider of manual and automated device programming systems for Flash, Microcontroller, and Logic devices. They serve electronics manufacturers around the world including
OEM, ODM, EMS, and programming centers. Programming systems and value-added software solutions enable our customers to:

- Streamline programming - with their production processes
- Meet their specific quality requirements
- Ensure that the devices are programmed at maximum speed and with the highest quality

Data I/O creates best-in-class production solutions including:

**PSV7000** Automated high-speed automated handler: [www.dataio.com/PSV7000](http://www.dataio.com/PSV7000)

**RoadRunner3** Inline automated just-in-time programmer: [http://www.dataio.com/Solutions/RoadRunner-Family](http://www.dataio.com/Solutions/RoadRunner-Family)

**FlashPAK III** manual programmer: [http://www.dataio.com/Solutions/FlashPAK-Family](http://www.dataio.com/Solutions/FlashPAK-Family)

### 4.5 Dataman

With over 30 years of experience, Dataman is a world-leading provider of device programmers.

Dataman designs and sells products that stand out from the crowd and continue to provide market-leading solutions. Dataman offers a comprehensive range of programming solutions suitable for every requirement from design and development to large-scale production.

Dataman currently supports over 80,000 devices (Nov. 2013), with updates every 3 - 4 weeks adding 200 - 300 new chips. Support can be added for missing devices quickly and typically free of charge. Their universal programmers come as standard with a 3-year warranty, free life-time technical support, and software updates.

### 4.6 EE Tools, Inc.

In 1992, EE Tools, Inc. started manufacturing a line of low-cost device programmers with an emphasis on MOS programming. EE Tools later developed a series of bipolar memory and logic programmers to complement the earlier products, and have since then grown to become one of the most well-known universal device programmer manufacturers worldwide. From their headquarter in San Jose, through a network of distributors around the globe, they are able to stay on top of the expanding device programmer market and provide customers with the best performance products and support. All products are backed with full technical support and free software updates for the product’s lifetime.

Stand-alone and Production Programmer: **MultiMax-8G+**

PC-driven Production Programmer via USB Interface: **ProMax-4G**

PC-driven Development Programmer via USB Interface: **TopMax2, ChipMax2**

EPROM Eraser: **Model 10, Chip-20**

EPROM Emulator via USB Interface: **EEROM-8U**

### 4.7 Elnec

Elnec is a leading provider of solutions for programming memories, microcontrollers, and other programmable devices in Europe. Elnec is committed to set a new standard in the industry by providing universal, highly reliable, and cost-effective programming solutions for devices in any package, whether
programmed in a socket or through ISP on a circuit board. El nec offers programming adapters; more than 800 models of universal, specialized, and BGA adapters.

Their product range includes support for Microchip AVR 8-bit, AVR 32-bit, ARM-based, and 8051 microcontroller: Production programmers with multi-site concurrent programming for high volume manufacturers, and Universal programmers with single-site programming for developers and low volume manufacturers.

Production programmers: http://www.el nec.com/products/production-programmers/
Universal programmers: http://www.el nec.com/products/universal-programmers/
Programming adapters: http://www.el nec.com/products/programming-adapters/

4.8 Equinox Technologies

Equinox Technologies offers a comprehensive range of development, field-service, and production programming tools, which support In-System Programming (ISP) of Microchip AVR and ARM microcontrollers. The EPSILON5-MK4 and FS2009USB portable programmers operate in standalone mode and are therefore ideally suited to low-throughput production programming and field-service applications. The ISPnano - Series 3/Series 4 GANG and MUX families of ISP programmers offer scalable, high-speed production programming solutions from 1 to 32 channels (gang mode) and 2 - 256 channels (multiplexed mode). All programmers offer comprehensive ESD and over-voltage protection.


4.9 Hi-Lo Systems

HI-LO has been devoted to providing device programmers and programming/testing solutions, with reliable quality at a reasonable price for over 30 years. Their product range covers engineering, production programmers, automated device programming systems, and 3D lead/marking inspection systems. HI-LO is one of the market leaders regarding to Device Programming Equipment and Programming services in Pan Asia. (Hong Kong, Taiwan, China, Japan, etc.)


4.10 Leap Electronic Co., Ltd.

Leap Electronic is deeply involved in the field of IC testing and programming equipment, supplying many series of products such as programmers, automation systems, and logic analyzers. The range of programmers varies from universal to gang programmers, all of which can support both AVR and ARM. Moreover, Leap Electronic also has the capability of providing programming services. Four branches are established in China, in order to provide customers well-organized and professional services. Email: overseas1@leap.com.tw.
4.11 MikroElektronika

mikroProg™ for AVR is a fast USB programmer supporting numerous AVR microcontrollers. It is supported with mikroC, mikroBasic, and mikroPascal compilers for AVR, but may also be used as a standalone programming tool. Outstanding performance, easy operation, and low price are its top features. Elegant minimalistic design, clean matte white plastic finish, and color indicator LEDs make mikroProg for AVR the first of its kind.

mikroProg for AVR web page: http://www.mikroe.com/mikroprog/avr/
mikroElektronika AVR compilers: https://www.mikroe.com/compilers/compilers-avr

4.12 Opteeq Technologies

Opteeq S-Series is an ultra-fast, industrial grade, in-system programmer. It universally supports different types of programming interfaces and silicon architectures. Thanks to its compact size and software library, S-Series can be easily integrated into other production equipment, e.g., functional or circuit testing machines, testing fixtures, etc. Additionally, S-Series can also be used as a desk-top programmer. To satisfy various output volumes, S-Series offers models with 1, 4, or 8 physical programming channels. Its capability to work stable and protection of target circuit makes the S-Series an excellent choice for mass production of automotive, industrial, and consumer electronics.


4.13 Phyton, Inc.

Phyton ChipProg line of device programmers for both development and production include single-site, gang parallel, and in-system programmers. They provide extremely fast flash programming for Microchip SAM D20, SAM3, SAM4, AVR, C51, and AT89LP microcontrollers, memory devices, and PLDs. Multiple Phyton programmers can be controlled from one computer for concurrent programming, from a friendly GUI, remotely from ATE via DLL, or in command line mode. The ChipProg software features script language and other tools for programming automation, allowing the writing of serial numbers and signatures into the chips. Adapters are available (BGA, QFN, QFP, TSOP, SOIC, PLCC, etc.).

ChipProg-ISP web page: http://phyton.com/categories/product/chipprog-isp
ChipProg-G41 web page: http://phyton.com/categories/product/chipprog-g41
ChipProg-481 web page: http://phyton.com/categories/product/chipprog-481
Device Finder web page: http://phyton.com/device-search
4.14 Ronetix

Ronetix is an Austrian manufacturer of high-quality software tool-kits, debug probes, and programmers for wide-range CPUs and cores. Ronetix's JTAG Flash programmer PEEDI is a production and development solution for high-speed programming onboard and on-chip Flash devices on all ARM and AVR based MCUs.

- Programming of over 1000 NOR flash chips, NAND Flash, OneNAND Flash
- Programming of Data Flash, SPI Flash devices
- Programming of a JFFS2 image to a NAND Flash
- Working in standalone mode in the production line (with an MMC/SD card)
- Multi-core programming; upgrade to PEEDI JTAG Emulator

For more information, see: http://www.ronetix.at/flash-programmer.html

4.15 RPM Systems

RPM System Corporation with MPQ Four-port In-circuit Gang Programmers provide programming support with:

- One image on up to four devices in parallel
- Up to 16 MPQ’s can be interconnected to provide programming of up to 64 devices in parallel
- Up to four separate program images can be stored on the programmer, allowing optional standalone operation, and making programming fast and efficient
- Stand-alone, ATE-controlled, or PC-controlled operation
- Device Serialization feature allows automatic serialization of programmed devices
- Secure Image Management feature provides code security and allows restrictions on the number of parts programmed from each image
- Support for Microchip AVR, AVR32, and ARM devices
- Support for SPI, PDI, TPI, JTAG, and SWD Microchip programming interfaces

4.16 SMH Technologies

SMH Technologies is a global, independent, high-tech company leader in Silicon Device In-System Programming and related services for the electronic boards manufacturing industry. FlashRunner series, the company's professional Silicon Device In-System Programming platform, is the result of the decennial experience in micro-code encoding for 8-, 16-, and 32-bit processors. FlashRunner helps customers enhance quality, save time, and optimize manufacturing cycles. SMH continuously improve their offer by releasing new programming algorithms weekly. Thanks to FlashRunner flexible and modular design, the same algorithms are to be used on all of the models.

FlashRunner I series: A range of high-performance In-System Programmers for Flash-based microcontrollers and serial memories. Targets production environments and works in full standalone mode or controlled by a host system.

FlashRunner Quattro is a high-integration in-system gang programmer, based on the FlashRunner technology, designed for programming multi-PCB panel assemblies.
FlashRunner FRPXIA3 is a PXI module for Gang In System Programming. First in the world programming solution for PXI system, and has full hardware and software ATE integration and multi-target parallel programming channels.

4.17 System General
In response to increasing customer demands for programming IC devices, System General provides total solutions in terms of manual and automated equipment primarily used for mass production. Currently System General supports more than 22,000 IC’s from major IC manufacturers, including the Microchip AVR and ARM-based families. The supported IC list can be found in one of the links below. As for automated solutions, the AP710 is intended for handling small and fragile CSP packages and serves as the universal programming platform, while the AP720 is optimized for high volume production, carrying four nozzles and is able to run with four programmers simultaneously. In addition, programming solutions support eMMC/NAND/NOR/MCU and CPLD devices and software updates are free of charge throughout the product life of the programming equipment!


4.18 Xeltec Inc.
Xeltek Inc. offers professional high-speed programming solutions for in-system production programming of AVR microcontrollers. SuperPro IS01 is intended for small to medium scale production. SuperPro IS03 and SuperPro XPS01 are for large-scale production and multiple SuperPro IS03 units can be set up to program multiple microcontrollers in parallel, to save production time. All programming tools are controlled through the SuperPro software, and some can also be controlled by command line and LabVIEW. The SuperPro software has multilingual support including English, Chinese, German, French, and other languages.

SuperPro IS01 web page: http://www.xeltek.com/isp-programmers/in-system-programmers-superpro-is01/
SuperPro IS03 web page: http://www.xeltek.com/isp-programmers/superpro-is03-in-system-isp-programmer/
SuperPro XPS01 web page: http://www.xeltek.com/isp-programmers/superpro-xps01-isp-production-workstation/
SuperPro software web page: http://www.xeltek.com/SuperPro-Software-Download-Center/
5. **Programming Houses**  
Programming services are also available from distributors. Contact your distributor for more information about programming services.

**Table 5-1. Other Programming Houses in Alphabetic Order (not limited to)**

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Products Supported</th>
<th>Other Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>A&amp;J Programming USA</td>
<td>AVR, ARM</td>
<td>Ink and laser marking, coplanarity check and inspection, dry pack.</td>
</tr>
<tr>
<td>Falcon Denshi K.K. Japan</td>
<td>SAM3, SAM4, SAMA5, SAM9</td>
<td></td>
</tr>
<tr>
<td>Hi-Lo Electronics AB Sweden</td>
<td>AVR, ARM</td>
<td>Laser and ink marking. Repacking according to the customer’s needs.</td>
</tr>
<tr>
<td>Hi-Lo System Research Co. Ltd. Taipei, Taiwan</td>
<td>AVR, ARM</td>
<td>Programming of NAND, Nor flash, etc.</td>
</tr>
<tr>
<td>MINATO HOLDINGS INC. Japan</td>
<td>SAM3, SAM4</td>
<td></td>
</tr>
<tr>
<td>Prochild International Incorporated Korea</td>
<td>AVR, ARM</td>
<td></td>
</tr>
<tr>
<td>Program Automation, Inc. USA</td>
<td>AVR, ARM</td>
<td>Programming of memories and FPGA.</td>
</tr>
<tr>
<td>Xeltek Co., Ltd. China</td>
<td>AT89C51, AVR, SAM7, SAM3, SAM4, SAM D20</td>
<td>Programming of PLD, GAL.</td>
</tr>
</tbody>
</table>
6. **How to Register as a Third-Party Design Partner**

Microchip's Worldwide Design Partner network provides a channel between our authorized Design Partners and customers in need of technical expertise and cost-effective solutions in a timely manner. If you are interested in joining, e.g. registering programming tools for Microchip microcontroller products, send us an email: designpartners@microchip.com. See also our Design Partner Program web page for more information.
## Revision History

<table>
<thead>
<tr>
<th>Doc. Rev.</th>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
</table>
| B        | 12/2017 | 1. In Chapter 1 - "Atmel-ICE for AVR..." is added.  
                     2. Some minor editorial updates                                    |
| A        | 06/2017 | 1. Converted to Microchip format and replaced the Atmel document number  
                     42215.  
                     2. Opteck added.  
                     3. New documentation template.                                     |
| 42215D   | 10/2016 | A complete update with several changes in the application note          |
| 42215C   | 01/2015 | SMH details added                                                        |
| 42215B   | 01/2014 | EE Tools, Dataman, and Segger added                                       |
| 42215A   | 11/2013 | Initial document release                                                 |
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- **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

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