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## PROGRAMMING OPTIONS FOR THE EMBER<sup>®</sup> EM35X PLATFORM

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(Formerly document 120-5073-000)

The Ember EM35x series chips are delivered to customers with only a minimal amount of chip identification data programmed into their embedded flash contents. Before these chips can be used in a ZigBee network, the application and stack software and customer tokens must be programmed into the embedded flash.

This application note describes the various programming options available to Silicon Labs' Ember EM35x series customers. The Ember Debug Adapter (ISA3) can be used for the development, prototype, and both low-volume and high-volume production environments. Other options for the high-volume production environment include gang programmers, in-system programmers (ISPs), and in-circuit test (ICT) programmers.

### New in This Revision

Rebranding for Silicon Labs.

### Contents

1	General Programming Notes .....	2
2	Developer Environment Programming .....	2
3	Prototype and Low Volume Production Programming .....	4
4	High Volume Production Programming .....	5
4.1	Partner Gang Programmer Offerings .....	5
4.1.1	BPM Microsystems.....	5
4.1.2	Data I/O .....	7
4.1.3	System General (SGC) .....	7
4.2	Partner In-System Programmer (ISP) Offerings .....	7
4.2.1	Algocraft .....	7
4.2.2	SMH Technologies .....	8
4.3	Partner In-Circuit Test (ICT) Programming Offerings.....	9
4.3.1	Aeroflex .....	9
4.3.2	I-Test .....	10

## 1 General Programming Notes

Even though the EM35x series embedded flash is fully tested during production test, the flash contents are not set to a known state before shipment. Therefore, the flash contents should be erased before programming an application. During manufacturing test, Silicon Labs recommends erasing the flash contents before test or retest of a device under test (DUT) to ensure that any previously stored calibration data is erased and proper channel calibration is executed before testing the device.

## 2 Developer Environment Programming

The Ember Debug Adapter (ISA3) is included as part of the Ember EM35x Development Kit to allow for debugging and programming of Ember EM35x series devices during the development stage. Figure 1 shows an image of the Debug Adapter (ISA3) connected to an Ember module.



**Figure 1. Debug Adapter (ISA3) Connected to Ember Module**

The Debug Adapter (ISA3) interfaces to either the Ember Desktop PC tool or command line executable utilities to program Ember devices. A snapshot of Ember Desktop is shown in Figure 2, while Figure 3 shows a snapshot of the `em3xx_load` command line utility.

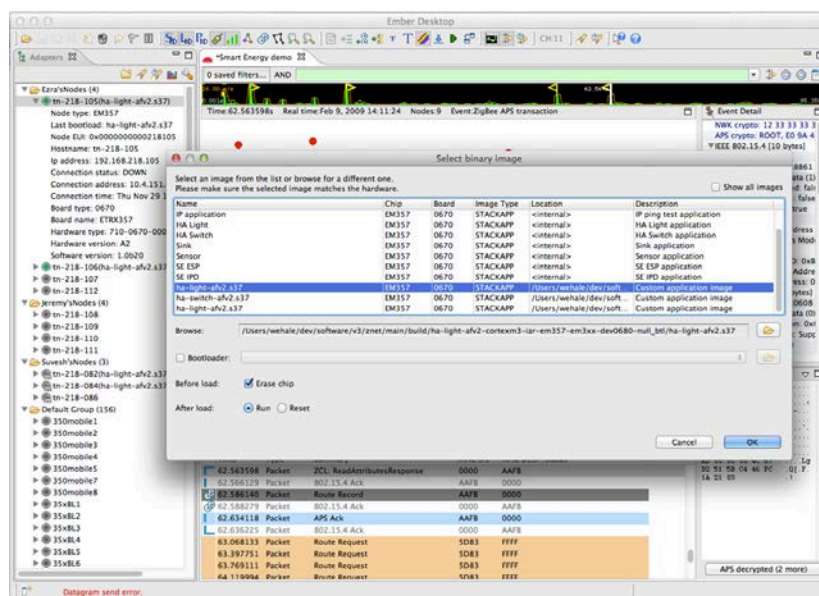


Figure 2. Ember Desktop Screen Capture

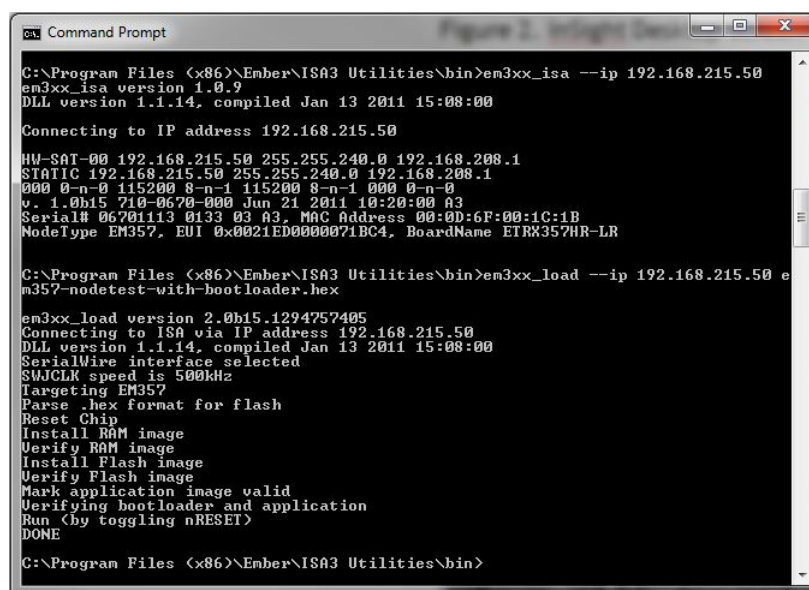


Figure 3. Command Line Utility Screen Capture

The typical programming time when using the Debug Adapter (ISA3) to program an entire EM357 flash image and manufacturing tokens is 10 seconds.

For more information on the Debug Adapter (ISA3), refer to document TS7, *Ember Debug Adapter (ISA3) Technical Specification*. For more information on Ember Desktop, refer to document UG111, *Ember Desktop User's Guide*, in your installed documents. For more information on the command line tools, refer to document UG107, *EM35x Utilities Guide*.

### 3 Prototype and Low Volume Production Programming

The Debug Adapter (ISA3) also can be used for programming Ember EM35x series devices during prototype and low-volume production stages. In a low-volume production environment multiple Debug Adapters (ISA3s) can be used in parallel to program multiple devices at the same time, either using USB or Ethernet.

Connected by USB, up to 4 Debug Adapters (ISA3s) can be addressed on a given PC to program EM35x series ICs at the same time. Follow these steps to change the USB address of a Debug Adapter (ISA3) from its default address of 0:

1. Disconnect all cables from the Debug Adapter (ISA3).
2. Connect the USB cable from PC to the Debug Adapter (ISA3).
3. Install Debug Adapter (ISA3) Utilities version 1.2 build 4 or later. Earlier versions do not support the `usbaddr` admin command.
4. Open a Windows Command Prompt.
5. Enter the command `em3xx_isa --admin "usbaddr set x"`, where x is the desired USB address for this Debug Adapter (ISA3).
6. Unplug the USB cable from the Debug Adapter (ISA3). This is necessary to power cycle the device so the PC re-establishes its USB connection on power-up.
7. Connect the USB cable from PC to the Debug Adapter (ISA3).
8. Enter the command `em3xx_isa --usb x --admin "usbaddr read"`, where x is the USB address set in step 4 above. You should see a response similar to that in Figure 4 below.

```

C:\Program Files (x86)\Ember\ISA3 Utilities\bin>em3xx_isa
em3xx_isa version 1.0.9
DLL version 1.1.21, compiled Oct 24 2011 16:19:00

HW-SAT-00 192.168.215.50 255.255.240.0 192.168.208.1
STATIC 192.168.215.50 255.255.240.0 192.168.208.1
0000 0-n-0 115200 8-n-1 115200 8-n-1 0000 0-n-0
v. 1.0b17 710-0670-000 Oct 24 2011 16:18:00 A3
Serial# 06701113 0133 03 A3, MAC Address 00:0D:6F:00:1C:1B
NodeType NotSet, EUI 0xFFFFFFFFFFFFFFFF, BoardName NotSet

C:\Program Files (x86)\Ember\ISA3 Utilities\bin>em3xx_isa --admin "usbaddr set 3"
em3xx_isa version 1.0.9
DLL version 1.1.21, compiled Oct 24 2011 16:19:00

Success: USB Address: 3 (after reboot, currently it is 0)

C:\Program Files (x86)\Ember\ISA3 Utilities\bin>em3xx_isa --usb 3 --admin "usbaddr read"
em3xx_isa version 1.0.9
DLL version 1.1.21, compiled Oct 24 2011 16:19:00

Connecting to USB address 3
USB Address: 3

C:\Program Files (x86)\Ember\ISA3 Utilities\bin>

```

Figure 4. EM3xx Utility USB Address Change Screen Capture

At this point, this Debug Adapter (ISA3) is now addressable with the `--usb` option of the EM3xx command line utility. Simply use this option to address this Debug Adapter (ISA3).

The Debug Adapter (ISA3) can also be used in parallel in an Ethernet configuration. Each Debug Adapter (ISA3) is addressable with the `--ip` option of the EM3xx command line utility. Silicon Labs has tested 16 Debug Adapter (ISA3)s in parallel and this testing has shown no increased programming times on a per-unit basis when compared to standalone programming times.

## 4 High Volume Production Programming

The Debug Adapter (ISA3) also can be used for programming Ember EM35x series devices during high-volume production stages. In a high-volume production environment multiple Debug Adapters (ISA3s) can be used in parallel to program multiple devices at the same time, either using USB or Ethernet. Please refer to the Prototype and Low Volume Production Programming section for more details.

In addition, Silicon Labs has worked with programming partners to provide gang programming, in-system programming (ISP), and in-circuit test (ICT) programming solutions to customers in high-volume production. The gang programmers allow for EM35x series ICs to be programmed before placement onto boards, while the ISP and ICT programming options allow for integrated programming of the EM35x series ICs on an assembled printed circuit board (PCB) within a test set-up.

**Note:** Gang programmers do not support certificate programming for Smart Energy (SE) ZigBee Application Profile at this time. Please contact Silicon Labs or the programming solutions provider for more information.

### 4.1 Partner Gang Programmer Offerings

Silicon Labs has partnered with BPM Microsystems, Data I/O, and System General to provide gang programming options to Ember EM35x series customers. Each partner offers different options for programming, as discussed in the following sections.

#### 4.1.1 BPM Microsystems

BPM Microsystems offers gang programming options for the EM35x on all of their engineering, manual production, and automated programmers. Table 1 shows an excerpt from [www.bpmicro.com](http://www.bpmicro.com) when searching for EM357 support information (as of October 4, 2011). This outlines socket modules and programmers supported for the EM35x series IC.

**Table 1. BPM Microsystems Device Information for EM357**

Device Parameter	Value
Manufacturer:	Ember (ID=69Ah)
Part Number:	EM357 (ID=962Bh)
Code Revision:	1.0
8-bit Bytes:	134483968
Memory Regions:	134,217,728-134,414,335; 134,481,920-134,483,967
Vcc (program):	3.3
Electrical Erase:	Yes
Packages:	QFN(48)
Socket Modules:	LAP:[FX4ASMR48QFNXC, FX4SMR48QFNXC, ASMR48QFNXC, SMR48QFNXC]
Supported by:	BP-1600 BP-1610 BP-1700 BP-1710 BP-2600 BP-2610 BP-2700M BP-2700 BP-2710M BP-2710 BP-2800

# AN717

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Figure 5, Figure 6, and Figure 7 illustrate examples of BPM Microsystems programmers.



**Figure 5. BPM Microsystems 4710 Multi-Site Automated Programmer**



**Figure 6. BPM Microsystems 4710 Programmer (44 device support)**





**Figure 7. BPM Microsystems 1710 Manual Programmer**

For programming EM357s, the typical time to program 192 kB (Continuity Test, ID Check, Program, and Verify) is 35 seconds, with up to 4 devices in parallel on each socket module. The number of devices that can be programmed at once depends on the number of sites supported by the programmer. BPM Microsystems programmers have between 1 and 11 sites. Therefore, a 1-site programmer will program 4 EM35x ICs per operation, while an 11-site programmer will program 44 EM35x ICs per operation.

Using the 4710 line of programmers, for example, throughput capacity is as high as 1250 to 1350 EM35x devices per hour.

For more information on these programmers and support for the EM35x series devices, please see BPM Microsystems' web site at [www.bpmicro.com](http://www.bpmicro.com), or contact Technical Support by phone at 1-800-225-2102 (US only) or 713-688-4600, or by email at [tech@bpmicro.com](mailto:tech@bpmicro.com).

#### **4.1.2 Data I/O**

Data I/O plans to offer gang programming support for the EM35x series IC. No further information is available at this time.

For more information on EM35x series support, please see Data I/O's support page (<http://www.dataio.com/Support/DeviceSupport/DeviceSupportSearchorig.aspx>) or contact Data I/O technical support using the web form at <http://dataio.com/ContactUs/TechnicalSupport.aspx>.

#### **4.1.3 System General (SGC)**

System General plans to offer gang programming support for the EM35x series IC. No further information is available at this time.

For more information on EM35x series support, please see System General's support page ([http://www.sg.com.tw/instruGP/support\\_E.asp](http://www.sg.com.tw/instruGP/support_E.asp)).

### **4.2 Partner In-System Programmer (ISP) Offerings**

Silicon Labs has partnered with Algocraft and SMH Technologies to provide in-system programming (ISP) options. ISP differs from gang programming in that ISP is done when the EM35x series IC is already installed on an assembled board. Each partner offers different options for programming, as discussed in the following sections.

#### **4.2.1 Algocraft**

Algocraft provides support for the EM35x series IC on all of their WriteNow! Series single and parallel in-system programmers. Four models are available: WN-PRG01A (programs 1 device at a time), WN-PRG02A (programs 2 devices in parallel), WN-PRG04A (programs 4 devices in parallel), and WN-PRG08A (programs 8 devices in parallel). Figure 8 and Figure 9 illustrate examples of these programmers.



**Figure 8. AlgocraftWriteNow! Series ISP Options**



**Figure 9. AlgocraftWriteNow! Series Programmer (WN-PRG08A)**

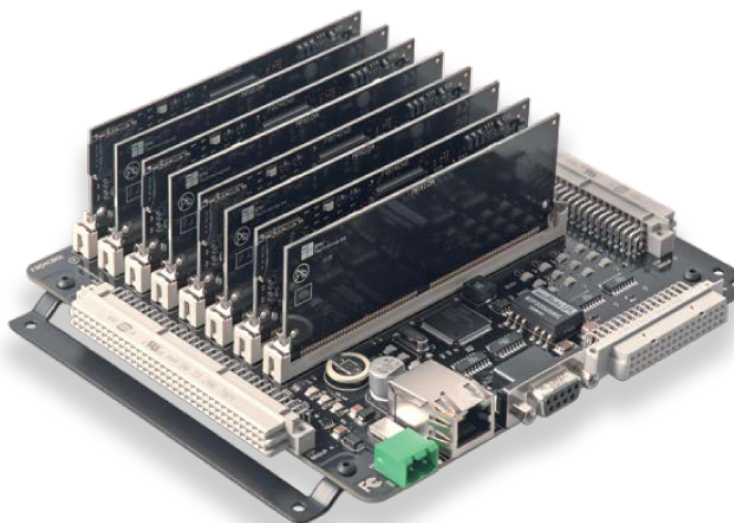
For programming EM351 devices, the typical time is 8.5 seconds, with up to 8 devices in parallel using the WN-PRG08A programmer. For programming EM357 devices, the typical time is 12 seconds. With an optional demultiplexer module (WN-DM series), Algocraft can program up to 32 devices at once.

For more information on these programmers and support for the EM35x series devices, please see Algocraft's web site at [www.algocraft.com](http://www.algocraft.com), or email Algocraft's technical support at [support@algocraft.com](mailto:support@algocraft.com).

#### 4.2.2 SMH Technologies

SMH Technologies offers ISP support for the EM35x series IC on their FlashRunner Series Programmers. The Quattro Series offers three models: FR04A04 (4 true parallel ISP channels, no demultiplexing), FR04A08 (8 ISP channels on 4 parallel channels, each demultiplexable to 2 channels), and FR04A16 (16 ISP channels on 4 parallel channels, each demultiplexable to 4 channels). Figure 10 illustrates an example of this programmer.





**Figure 10. SMH Technologies FR04 FlashRunner Quattro Series Programmer**

Using the FR04A04, 4 EM351 devices can be programmed (Erase, Blank Check, Program, and Verify for 128k) in 53 seconds. For a single EM351, a breakdown of various programming sequences is as follows:

- 12.32 seconds for erase, program, verify readout
- 8.73 seconds for erase, program, verify checksum
- 6.17 seconds for program only

For more information on support for the EM35x series devices, please see SMH Technologies' web site at [www.smh-tech.com](http://www.smh-tech.com), or contact SMH Technologies technical support at [support@smh-tech.com](mailto:support@smh-tech.com).

### **4.3 Partner In-Circuit Test (ICT) Programming Offerings**

Silicon Labs has partnered with Aeroflex and I-Test to provide in-circuit test (ICT) programming options. ICT programming is similar to ISP programming in that the EM35x series IC is already installed on an assembled board. ICT typically includes unpowered tests of passive components, as well as powered tests for digital circuits and voltage nets. Programming is typically done at the end of an ICT routine.

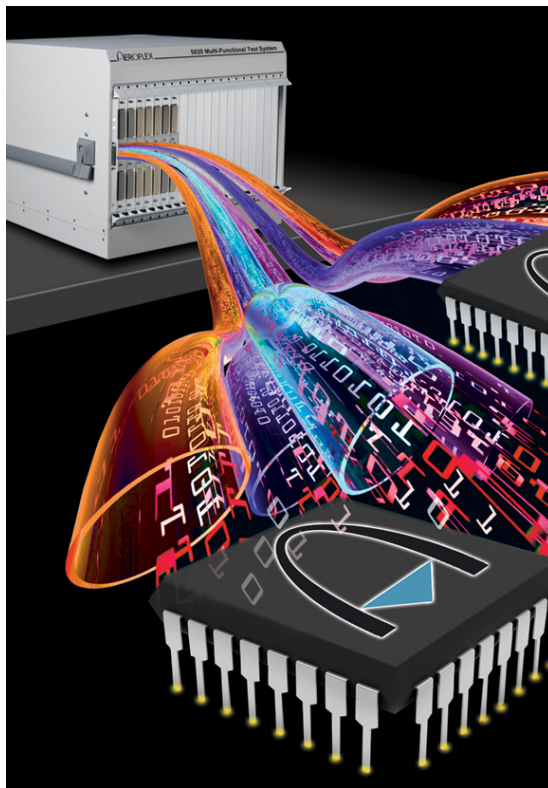
#### **4.3.1 Aeroflex**

Aeroflex offers ISP options for the EM35x on their AX520 and 5800 Series Testers, which include parallel programming capabilities. More information on these programmers can be found at the following URLs:

[http://www.aeroflex.com/ats/products/category/Semiconductor\\_Test.html](http://www.aeroflex.com/ats/products/category/Semiconductor_Test.html)

[http://www.aeroflex.com/ats/products/category/ATE/Test\\_Systems/Analog\\_In-Circuit/5800\\_Series.html](http://www.aeroflex.com/ats/products/category/ATE/Test_Systems/Analog_In-Circuit/5800_Series.html)

Figure 11 illustrates an example of the 5800 Series tester.



**Figure 11. Aeroflex 5800 Series Tester**

Using the 5800 Series tester, for example, a panel of 20-40 boards with EM35x devices can be programmed in less than a minute.

For more information on these programmers and support for the EM35x series devices, please see Aeroflex's web site at [www.aeroflex.com](http://www.aeroflex.com), or contact Aeroflex technical support at [support@eroflex.com](mailto:support@eroflex.com).

### **4.3.2 I-Test**

I-Test plans to offer ICT programming support for the EM35x series IC. No further information is available at this time.

For more information on support for the EM35x series devices, please see I-Test's web site at [www.i-test.ca](http://www.i-test.ca), or contact I-Test technical support at [support@i-test.ca](mailto:support@i-test.ca).

**NOTES:**

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