AX110xx Product Introduction

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April 13th, 2016

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Revision History

Revision	Date	Description
1.0	2006/05/26	New release.
1.1	2006/06/09	Rearrange the document structure and update the pictures of AX110xx boards.
1.2	2006/11/09	1. Modify to support AX11025 related information. 2. Update the pictures of AX110xx development boards and reference design boards in Section 6. 3. Add more AX110xx development tools information in Section 7. 4. Add Appendix A "AX110xx Frequently Asked Questions" to provide some basic information about AX110xx applications.
1.3	2006/11/28	1. Add the ordering information in Section 3.
1.4	2007/04/02	1. Add Windows ISP tool information in Section 7-2. 2. Modify Section 7-5 to add information about AX110xx uIP TCP/IP module. 3. Add Chapter 9 "AX110xx Mass Production Solutions". 4. Update the Ordering Information in Section 3. 5. Add AX11025 128-pin Development Kit information into Section 7. 6. Update the AX110xx Software Availability table in Section 10. 7. Update the information of Figure 3 and 4. 8. Add more FAQs in Appendix A.
1.5	2007/12/27	1. Remove AX11015 IP Camera Reference Design Board from Section 3 "Ordering Information". 2. Update AX11025 Development Kit information in Section 7. 3. Add the "UARTH.EXE" utility information in Section 10. 4. Add AX110xx Upper Protocol Modules information in Section 5.
1.6	2009/07/22	1. Removed AX11005 BF related information in Section 2 & 3. 2. Updated the snap shot pictures of Figure 12 & 21. 3. Added more FAQs in Appendix A.
1.7	2009/12/01	1. Corrected some description in Section 7 & 8. 2. Added more FAQs in Appendix A. 3. Modified some descriptions in Section 10.
1.80	2011/06/08	1. Removed AX110xx RS232-to-Ethernet Development Board from Section 3 "Ordering Information". 2. Updated AX110xx RS-232 to Ethernet Reference Design Kit in Section 7. 3. Updated Figure 14. DoCD Hardware Debugger Module. 4. Removed Advantech Equipment Corp.'s AX11001/AX11005 80-pin socket board information. 5. Added ELNEC's Device Programmer information in Section 9-2. 6. Changed the revision number to 3-digit format.
1.90	2016/04/13	Removed AX11025 information.

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1. Introduction

This document provides an overview of AX110xx family and AX110xx Development Kit.

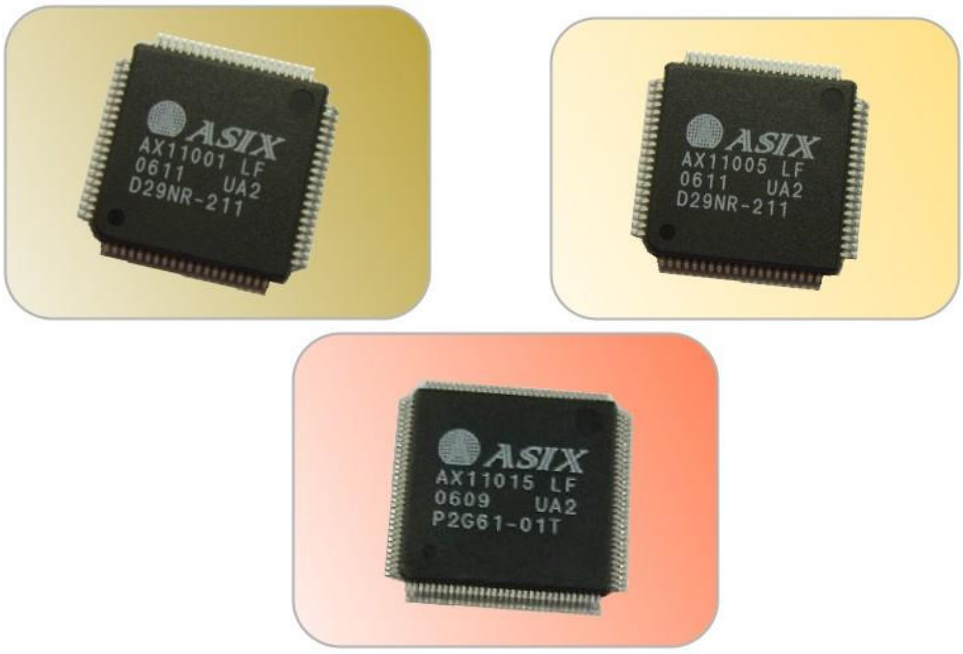

Figure 1. AX110xx Family

AX110xx is a single chip micro-controller with TCP/IP and embedded 10/100M Ethernet MAC/PHY as shown in figure below. The AX110xx also integrates 32K bytes SRAM for Data memory, 128K/512K bytes Flash for Program memory, and several communication interfaces such as UART, I2C, SPI, 1-Wire, PCA, and Local Bus host interface, etc. Please refer to the respective AX110xx product datasheet for detailed descriptions.

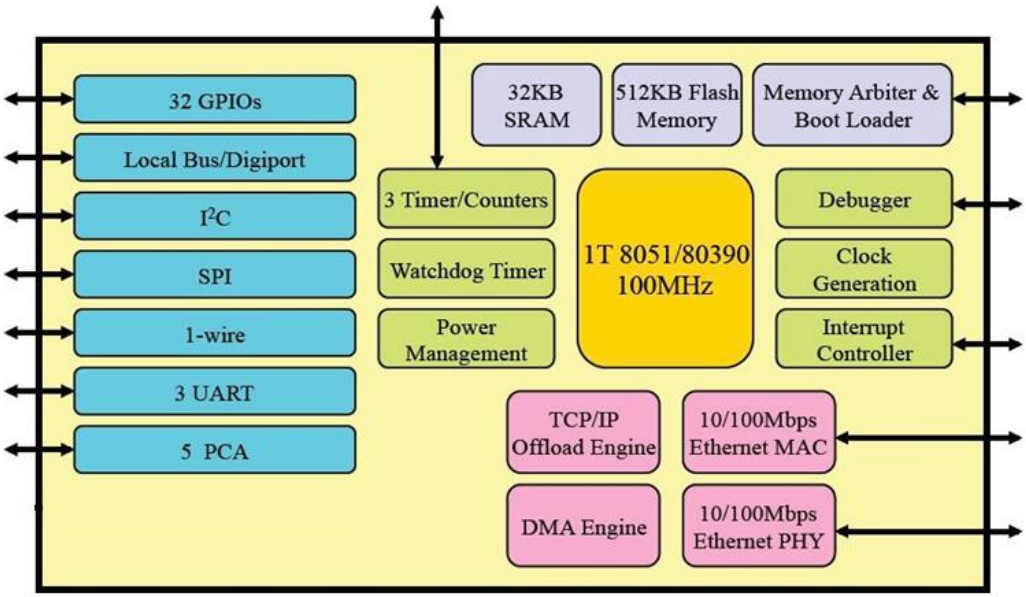

Figure 2. AX110xx Block Diagram

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2. AX110xx Selection Guide

AX110xx family currently consists of 3 variations targeted for different application requirements, as listed below.

Part Number	Embedded Flash (Bytes)	Embedded SRAM (Bytes)	Ethernet MAC 10/100M	Ethernet PHY 10/100M, HP Auto-MDIX	Wake-on-LAN	TCP/IP Accelerator	IP/TCP/UDP Checksum	Programmable Counter Array	16-bit Timer /Counters	Watchdog Timer
AX11001	128K	32K	v	v	v	v	v	5	3	1
AX11005	512K	32K	v	v	v	v	v	5	3	1
AX11015	512K	32K	v	v	v	v	v	5	3	1

Part Number	UART	I²C	SPI	1-Wire	CAN	External Memory Interface	Local Bus	MII	GPIOs	Package	Temperature Range(°C)
AX11001	3	1	v	1	-	-	-	-	16	LQFP-80	0 ~ +70 /-40 ~ +85
AX11005	3	1	v	1	-	-	-	-	16	LQFP-80	0 ~ +70 /-40 ~ +85
AX11015	3	1	v	1	-	v	1	1	32	LQFP-128	0 ~ +70 /-40 ~ +85

Figure 3. AX110xx Features Comparison Table

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3. Ordering Information

The following is the ordering information of AX110xx family chips and AX110xx development boards. Please contact ASIX's Sales (sales@asix.com.tw) for details.

Part Number	Description
AX11001 LF	128K bytes Flash memory, 80-pin LQFP Lead free package, Commercial temperature range, 0 to 70˚C
AX11005 LF	512K bytes Flash memory, 80-pin LQFP Lead free package, Commercial temperature range, 0 to 70˚C
AX11015 LF	512K bytes Flash memory, 128-pin LQFP Lead free package, Commercial temperature range, 0 to 70˚C
AX11001 LI	128K bytes Flash memory, 80-pin LQFP Lead free package, Industrial temperature range, -40 to 85˚C
AX11005 LI	512K bytes Flash memory, 80-pin LQFP Lead free package, Industrial temperature range, -40 to 85˚C
AX11015 LI	512K bytes Flash memory, 128-pin LQFP Lead free package, Industrial temperature range, -40 to 85˚C

AX110xx Development Boards	Description
AX11005 80-pin Development Board	This is a general-purpose development board for AX11005
AX11015 128-pin Development Board	This is a general-purpose development board for AX11015 with local bus interface, external memory interface and 32 GPIOs

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4. AX110xx Target Applications

AX110xx family, with on-chip high performance RISC CPU, built-in TCP/IP protocol suite, and rich communication peripherals supported, provides a very low cost yet very high performance SoC solution to enable easy and simple LAN or Internet access capability to almost every application needs in the Internet era. AX110xx family is targeted for home appliances, factory/building automation, industrial equipments, security systems, remote control/monitoring/ management, and streaming media applications such as network camera/remote surveillance, hardware TCP/IP offload engine, audio over Internet, automatic meter reading, vending system/POS, environment monitoring or network sensor, networked UPS, serial to Ethernet adaptor, and ZigBee to Ethernet gateway, etc.

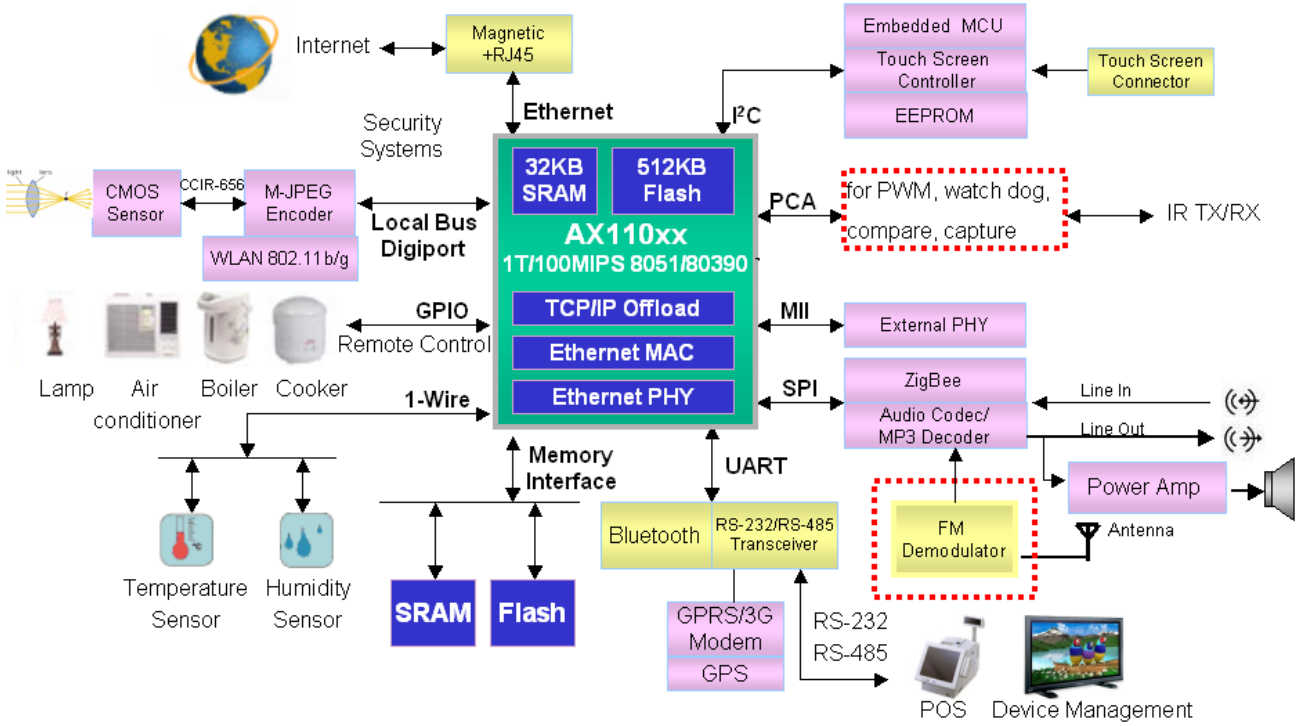

Figure 4. Examples of AX110xx Application

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5. AX110xx Software Modules Introduction

5-1. Driver Modules

ASIX Electronics provides customers with several software modules and its application notes for developing with AX110xx hardware platform. As shown in figure below, the AX110xx software modules include CPU, Ethernet, S/W DMA, MS Timer, Local Bus, I2C, SPI, 1-Wire, UART2, PCA and TCP/IP stack, namely, uIP. All these modules are developed on Keil C development environment. Most modules, except for the CPU core module, are optional and configurable depending on user's application needs.

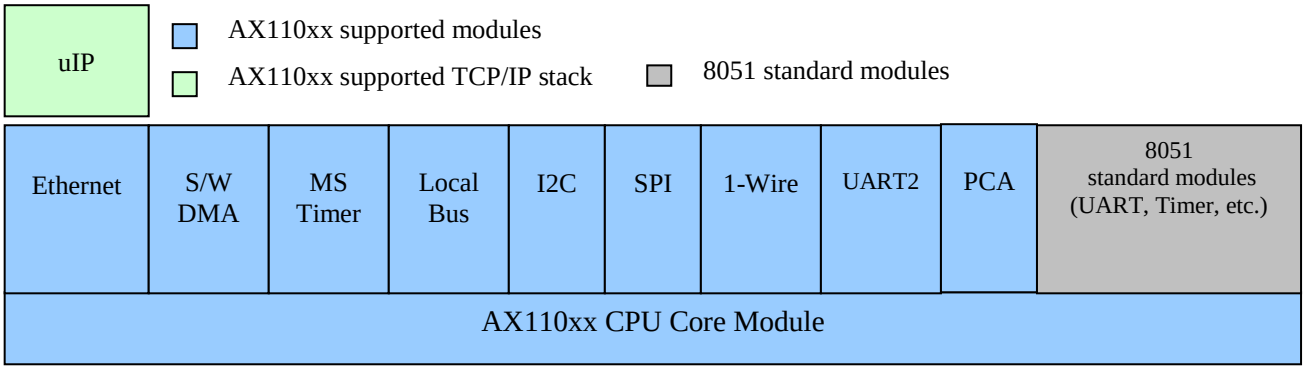

Figure 5. AX110xx Software Modules Block Diagram

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5-2. Upper Protocol Modules

There are some protocol modules provided for AX110xx software developers to develop applications. The AX110xx protocol modules consist of eight application protocol modules and three network protocol modules. All modules are developed based on the AX110xx software driver modules. Please refer to "**AX110xx Software User Guide**" and "**AX110xx Upper Protocol Developer's Guide**" for details. Below diagram shows the architecture of AX110xx software protocol modules.

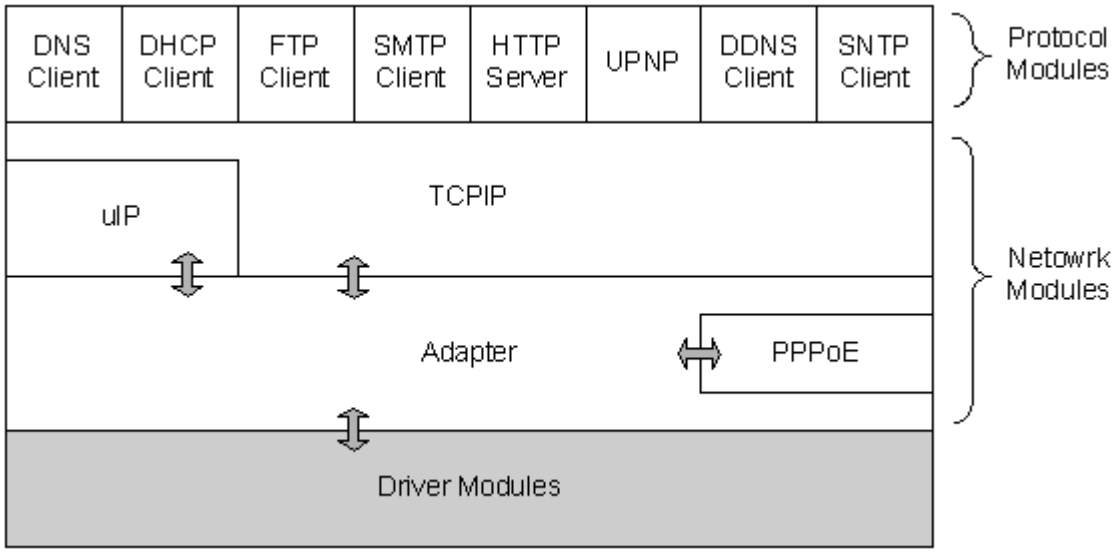

Figure 6. AX110xx Upper Protocol Modules Block Diagram

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6. AX110xx Development Kit and Reference Designs

For customer evaluation purpose, ASIX Electronics currently can provide two kinds of "**AX110xx Development Kit**". ASIX Electronics will provide more reference designs for AX110xx family later, for most up-to-date information, please contact ASIX's Sales (sales@asix.com.tw).

The AX110xx Development Kit allows customers to evaluate the AX110xx hardware platform and to develop software on AX110xx platform for their application needs. The Kit includes some user guide documentations and the software codes, which include Flash programming utilities, Boot Loader module, AX110xx RS232 to Ethernet Reference Design Demo Firmware and peripheral software modules. The following sections describe some introduction about the Kit.

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7. AX110xx Development Kit Introduction

ASIX Electronics provides three kinds of AX110xx development kits for customers' reference. AX1100x 80-pin development kit is for users to evaluate AX11001/AX11005 products; AX11015 128-pin development kit for users to evaluate AX11015 product. If you need to purchase the AX110xx development boards, please contact ASIX's Sales (sales@asix.com.tw) for details.

AX1100x 80-pin development kit consists of five components:

- AX1100x 80-pin development board with a 1-Wire temperature sensor,
- AX110xx Development Kit CD,
- 1 RS-232 cable with a Null modem converter,
- 1 RJ-45 Ethernet cable,
- 1 5V/3A AC/DC power adapter

AX11015 128-pin development kit consists of five components:

- AX11015 128-pin development board with a 1-Wire temperature sensor,
- AX110xx Development Kit CD,
- 1 RS-232 cable with a Null modem converter,
- 1 RJ-45 Ethernet cable,
- 1 5V/3A AC/DC power adapter

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7-1. Development Board/Reference Designs

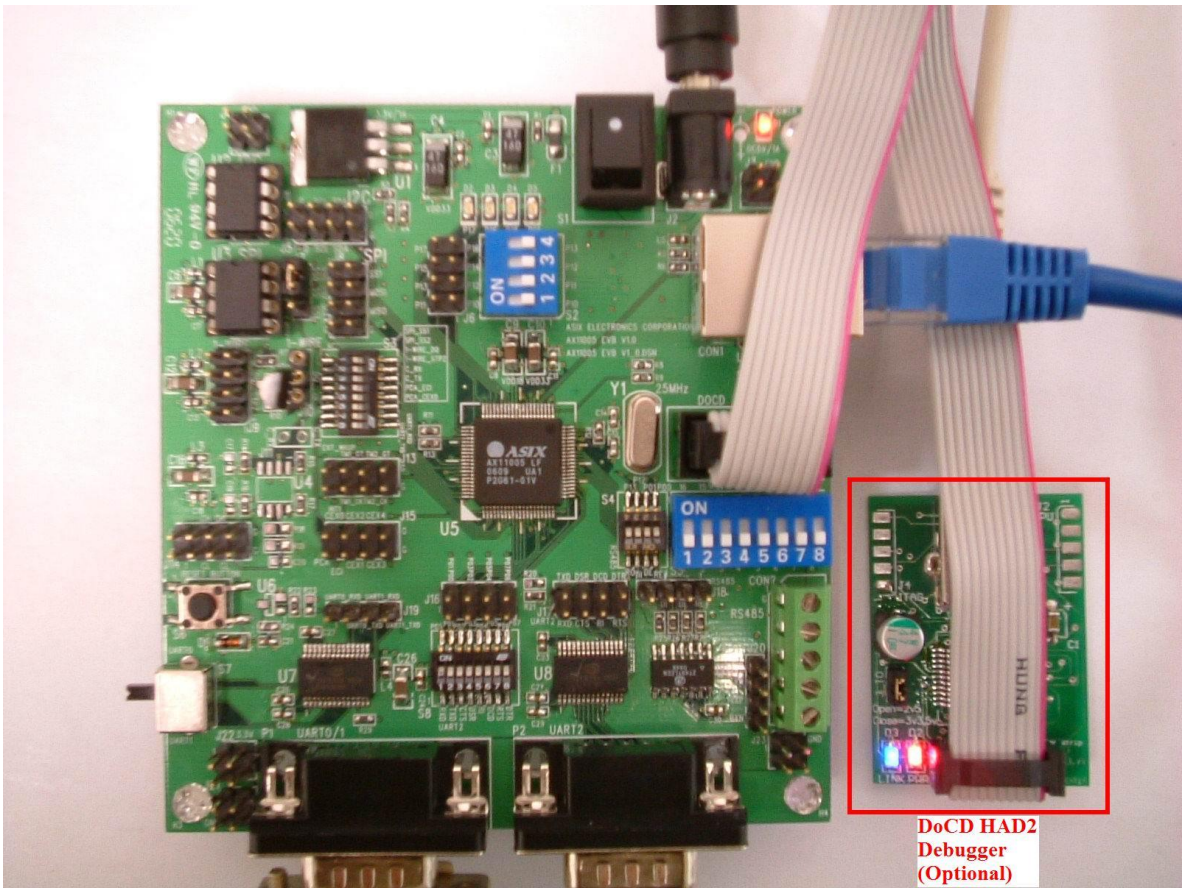

Figure 7. AX1100x 80-pin Development Board

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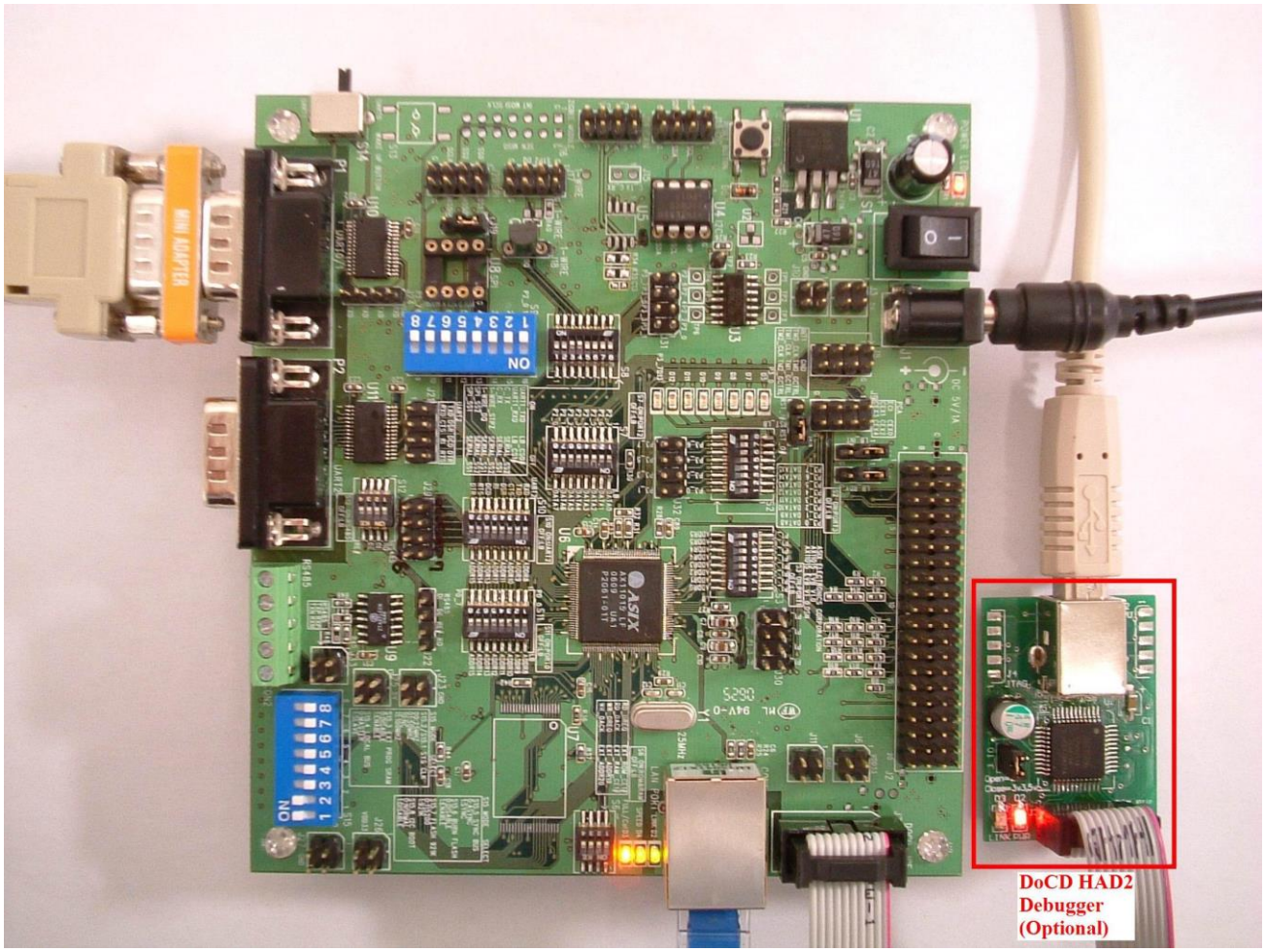

Figure 8. AX11015 128-pin Development Board

Note: The DoCD HAD Debugger is optional for users and can be purchased from Digital Core Design's web site (http://www.dcd.pl/).

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7-2. UART Flash Programming Utilities

AX110xx supports a couple of UART Flash programming solutions; one is Windows ISP tools (AX110xx_ISP.EXE for Windows 32-bit systems and AX110xx_ISP_64.EXE for Windows 64-bit systems); another one is DOS UART Flash Programming utilities (UARTL.EXE and UARTH.EXE).

The Windows ISP tools are a Windows dialog-based software program that can be run on Windows 32-bit or 64-bit systems. The ISP program supports baud rates 921600 bps and 115200 bps. The baud rate 921600 bps is provided for high speed UART interface.

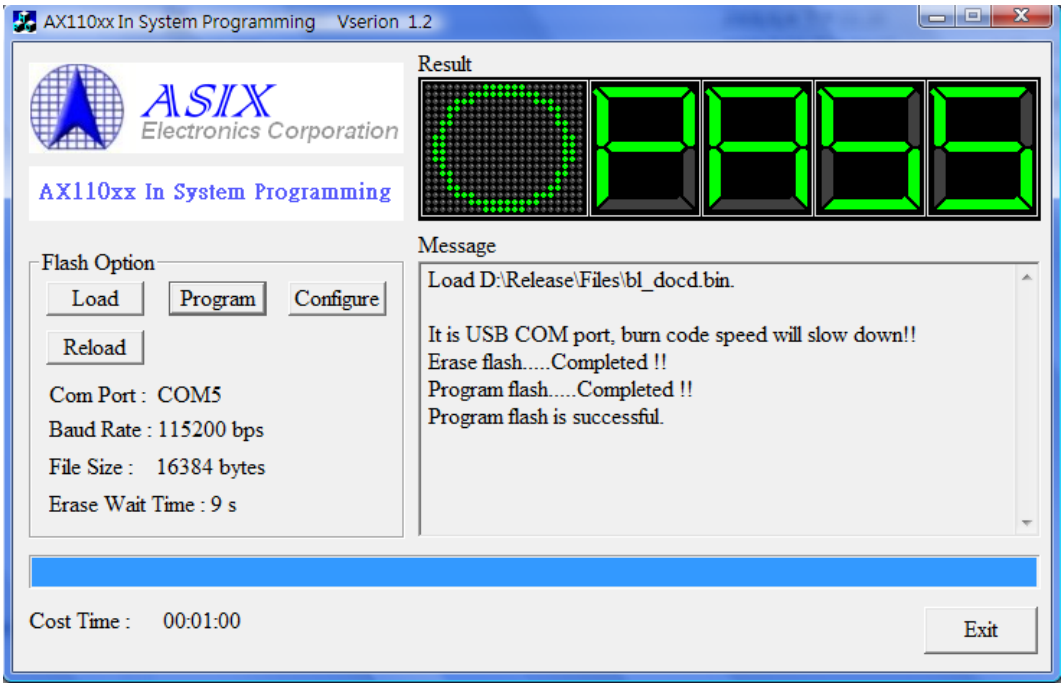

Figure 9. AX110xx Windows ISP Tool

ASIX Electronics provides two DOS UART Flash programming utilities "UARTH.EXE" for High Speed UART interface (921Kbps) and "UARTL.EXE" for UART interface (115200bps).

The Flash memory of AX110xx development board is programmed through the UART 0 interface; the Flash memory of AX110xx IP Camera reference design is programmed through the UART module, and the Flash memory of AX110xx RS232 to Ethernet reference design is programmed through the COM Port interface. Please refer to the Flash Programming section of **"AX110xx Development Kit User Guide"** or **"AX110xx RS232 to Ethernet Reference Design User Guide"** for details.

Note: The High Speed UART Flash programming utility (UARTH.EXE) can only be run with the PC machine that supports the high speed UART mode (i.e. the baud rate up to 921Kbps). If your machine only supports the standard UART mode (i.e. the baud rate up to 115200bps), you should run the "UARTL.EXE" utility to program the AX110xx Flash.

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Figure 10. AX1100x 80-pin Development Board UART 0

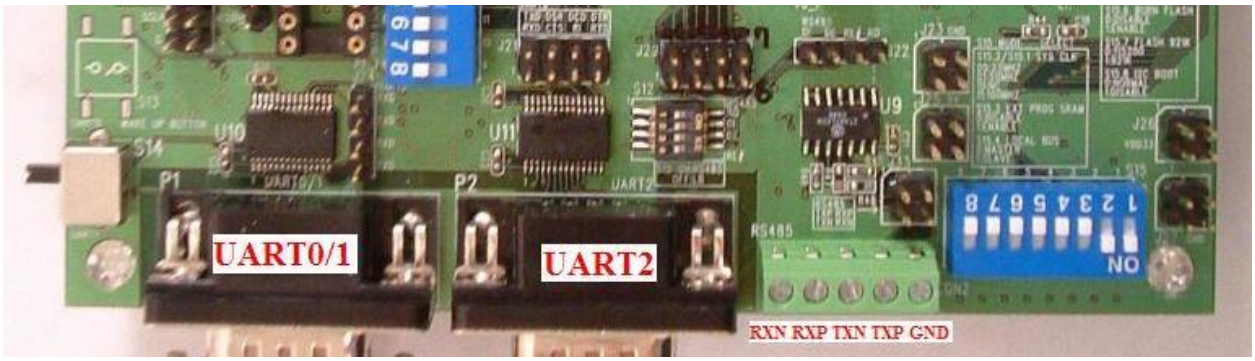

Figure 11. AX11015 128-pin Development Board UART 0

7-3. Ethernet Boot Loader

In addition to the UART 0 Flash programming method, AX110xx also supports a faster way to program the Flash memory of AX110xx development board by AX110xx Ethernet Boot Loader. To do so, the Ethernet Boot Loader code should be first programmed into the Flash memory of AX110xx development board via UART interface before using the Ethernet Boot Loader Flash programming method. Users need to setup the DHCP and TFTP servers to provide the firmware code download function and select the "3 Download new runtime code via Ethernet" or "4 Download new boot loader code via Ethernet" function from AX110xx UART 0 console to start programming AX110xx Run Time code or Ethernet Boot Loader code to the Flash memory of AX110xx board. Please refer to the Ethernet Boot Loader section of **"AX110xx Development Kit User Guide"** for details.

7-4. Peripheral Software Modules

ASIX Electronics provides the AX110xx software modules like CPU, Ethernet, S/W DMA, MS Timer, Local Bus, I2C, SPI, 1-Wire, PCA, UART2, and 8051 standard modules (like UART, Timer). Please refer to the software module sections of **"AX110xx Software User Guide"** for details.

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7-5. TCP/IP Stacks

AX110xx Development Kit provides uIP TCP/IP Stacks sample codes, it is a TCP/IP Stack for 8-bit and 16-bit microcontrollers with very small code footprint and RAM requirements. The uIP is an open source software that are originally developed by Adam Dunkels and are ported for Keil C51 by Murray R. Van Luyn.

The AX110xx uIP TCP/IP module has been modified slightly by ASIX Electronics for supporting functions of UDP packets, keep alive, don't fragment, PPPoE packets, and so on. In addition, although uIP itself supports the feature of IP fragment reassembly, it is not supported in the AX110xx uIP TCP/IP module.

We strongly suggest users to implement AX110xx firmware based on AX110xx development board demo firmware source codes with AX110xx TCP/IP module source code since the AX110xx TCP/IP module source code has been optimized and much more stable than the original uIP TCP/IP Stack source code.

Below table shows the original uIP and AX110xx uIP TCP/IP module.

Feature	Original uIP	AX110xx uIP TCP/IP Module
IP and TCP checksums	YES	Support with hardware accelerator
IP fragment reassembly	YES	NO
IP options	NO	NO
Multiple interfaces	NO	YES
UDP	NO	YES
Multiple TCP connections	YES	YES
TCP options	YES	YES
Variable TCP MSS	YES	YES
RTT estimation	YES	YES
TCP flow control	YES	YES
Sliding TCP window	NO	NO
TCP congestion control	No needed	No needed
Out-of-sequence TCP data	NO	NO
TCP urgent data	YES	YES
Data buffered for re-transmission	NO	YES
TCP keep alive timer	NO	YES

Figure 12. Original uIP and AX110xx uIP TCP/IP modules

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8. AX110xx Software Development Tools

8-1. Software Compiler Tool

All software modules for AX110xx family are developed in C language under Keil IDE development environment. Users can purchase the Keil IDE Development Environment from Keil's web site (http://www.keil.com/c51/selector.asp). In general, users need to purchase the PK51 development tool for C-language compiler, debugger and simulator. In case if user just needs the compiler function and program code size less than 64K bytes, you can purchase the CA51 package. Users can also download the Keil C51 evaluation software from Keil's web site for free, but the evaluation software can only compile the sample codes with less than 2K bytes binary code. Please refer to the "How to compile AX110xx development board demo firmware" section of **"AX110xx Development Kit User Guide"** for detailed procedures about how to compile AX110xx sample codes.

8-2. Software Debugger Tool

AX110xx currently provides two debug tool solutions, one is the UART console debugging; another is the Digital Core Design (DCD)'s DoCD HAD debugger. All AX110xx S/W modules support the basic UART console debugging function by default. If user needs more powerful debugging tool like source level debugging, AX110xx development board supports the DCD's DoCD Hardware Debugger – the HAD module. Through the HAD module, the software running on AX110xx development board can be real-time debugged. The user may consider purchasing the HAD module from DCD and download the debugger software from DCD's web site (http://www.dcd.pl/). Please refer to the "How to setup DoCD HAD Debugger Environment" section of **"AX110xx Development Kit User Guide"** for detailed procedures about how to setup the DoCD HAD debugger environment.

Figure 13. DoCD Hardware Debugger Module

Note: The DoCD HAD Debugger is optional for users and can be purchased from Digital Core Design's web site (http://www.dcd.pl/). If users don't want to purchase the DoCD HAD Debugger, you can debug AX110xx software via UART console debug method.

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➢ DoCD Hardware Debugger Key Features:

AX110xx execution control
R/W all contents of AX110xx
Real-time hardware watch-points and breakpoints
Source Level debugging
Software watch-points and breakpoints
AX110xx Flash programming
Supports Keil, IAR and others
Source code tracing

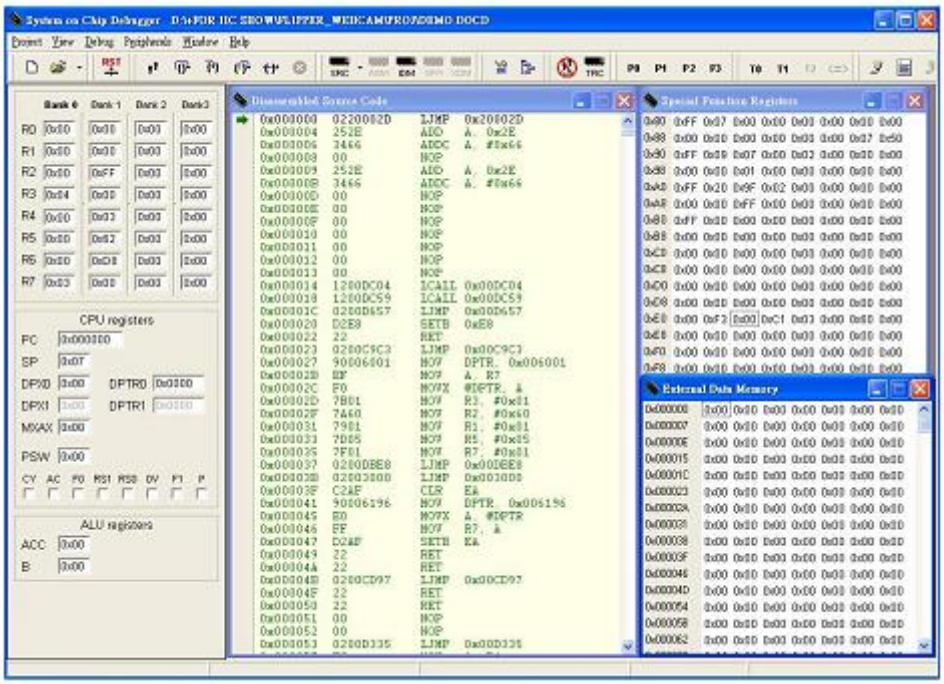

Figure 14. DoCD Debugger Software Interface

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9. AX110xx Mass Production Solutions

To support the mass production for those products using AX110xx chips. ASIX Electronics provides 3rd Party Universal Programmer and AX110xx Manufacture Program solutions for AX110xx customers. This chapter provides a brief introduction for both solutions. Please refer to "**AX110xx Mass Production Application Note**" for details.

9-1. Advantech Equipment Corporation's Flash Programmer Solution

AX110xx family is supported by Advantech Equipment Corp.'s LABTOOL-848XP Turbo Gang Programmer. The LABTOOL-848XP programmer supports to program up to 8 AX110xx chips at the same time. Please visit Advantech Equipment's website at **www.aec.com.tw** to get the detailed user manual and update the software if necessary.

Users can purchase LABTOOL-848XP Turbo Gang Programmer and AX11015 128-pin socket board (i.e. SDP-AX110-128LQ) from Advantech Equipment Corp. (www.aec.com.tw).

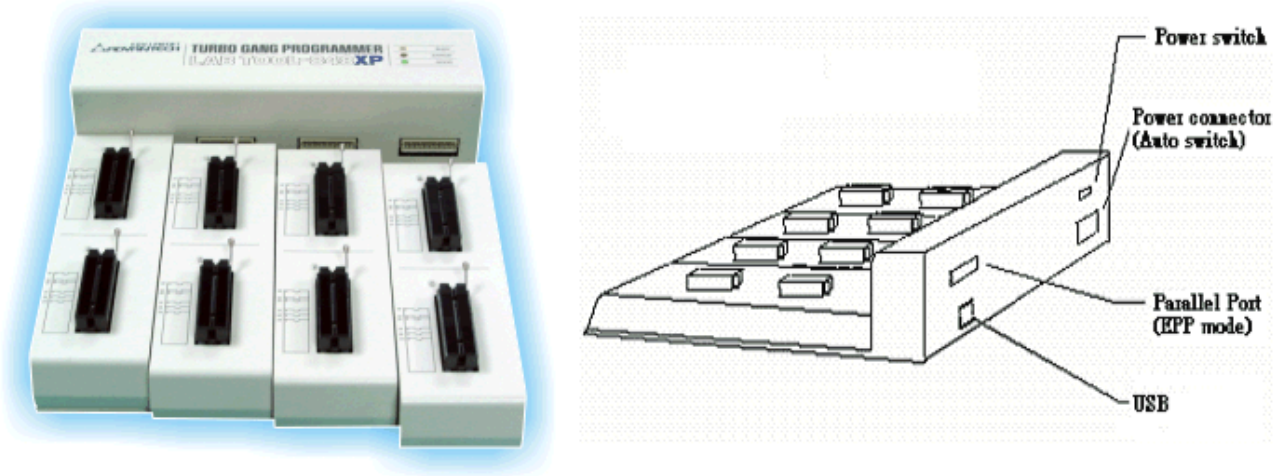

Figure 15. AEC's LABTOOL-848XP Turbo Gang Programmer

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9-2. ELNEC's Flash Programmer Solution

AX110xx family is supported by ELNEC's device programmer series such as BeeHive, and BeeProg, etc. These device programmer series support up to 8 AX110xx chips Flash programming operation at one time. Please visit ELNEC's website at **www.elnec.com** to get the detailed user manual and update the software if necessary.

Users can purchase ELNEC's Device Programmer and AX11001/AX11005 80-pin socket board (i.e. LQFP80) or AX11015 128-pin socket board (i.e. LQFP128) from ELNEC (http://www.elnec.com/sw/dev_html/asix_electronics_dev.htm).

Figure 16. ELNEC's BeeHive 208S and 204 Programmer

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10. AX110xx Software Availability

ASIX Electronics provides the following utilities, software modules and TCP/IP stack sample codes for customers' reference. Please contact ASIX's Sales (sales@asix.com.tw) for detailed information.

AX110xx Software	Source Code Release	Need to sign a NDA
CPU Module	YES	NO
Ethernet Module	YES	NO
S/W DMA Module	YES	NO
MS Timer Module	YES	NO
Local Bus Module	YES	NO
I2C Module	YES	NO
SPI Module	YES	NO
1-Wire Module	YES	NO
UART2 Module	YES	NO
UART Module	YES	NO
PCA Module	YES	NO
Buffer Module	YES	NO
Adapter Module	Available upon request	NO
TCP/IP Module	NO	NO
PPPoE Module	Available upon request	NO
DHCP Client Module	Available upon request	NO
FTP Client Module	Available upon request	NO
HTTP Module	Available upon request	NO
DNS Module	Available upon request	NO
DYNDNS Module	Available upon request	NO
SMTP Module	Available upon request	NO
SNTP Module	Available upon request	NO
UPNP Module	Available upon request	NO
Boot Loader Code	NO	NO
I2C Module Sample Code	YES	NO
SPI Module Sample Code	YES	NO
GPIO Port 3 LED Control Sample Code	YES	NO
AX11001/AX11005 80-pin Development Board Demo Firmware	YES	NO
AX11015 128-pin Development Board Demo Firmware	YES	NO
Manufacture Program	Available upon request	YES
Windows ISP	NO	NO
DOS Flash Programming Utility (UARTL.EXE)	NO	NO
DOS Flash Programming Utility for 921K bps Baud Rate (UARTH.EXE)	Available upon request	NO
Device Finder Utility (DEVICEFINDER.EXE)	NO	NO

Figure 17. AX110xx Software Availability

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Appendix A: AX110xx Frequently Asked Questions

Users can learn some basic information about AX110xx family FAQ via ASIX Electronics web site (http://www.asix.com.tw/faq.php). If you couldn't find the answers to your questions, please feel free to contact ASIX's Support (support@asix.com.tw) for helps.

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