BX-35
Hardware Reference

Preliminary

2.01K

Contents

Getting started

This document illustrates how to get started with a BasicX-35 system. System requirements are summarized, and hardware/software setups are explained. A pre-loaded test procedure is run, followed by a simple "Hello World" program that you compile yourself. Help information and procedures are outlined, as well as contact information.

The Basic Express BXDS-35 Development Station includes the following items:

1) BXDS BasicX System Board
2) BX35-PD BasicX-35 PDIP chip on board
3) 32 KB EEPROM chip on board
4) BasicX software and documentation CD
5) 16 jumper wires
6) Serial download cable
7) Plug-in wall transformer

PC System Requirements

Although BasicX is a stand-alone processor, software development requires a PC that meets the following minimum requirements:

1) MS Windows 95/98/ME/2000/NT/XP
2) Pentium or higher processor, 400 MHz mimimum clock speed
3) 32 MB RAM, 64 MB recommended
4) 20 MB free hard disk space
5) High density 3.5" floppy disk drive
6) CD-ROM drive
7) Available COM port

Hardware Setup

Here the COM port on BasicX should be set to COM1 by default:

1) Connect DB-9 cable to unused PC COM port
2) Connect DB-9 cable to BX-35 COM port
3) Connect the wall transformer to the BX-35
4) The factory-loaded program should start blinking LEDs on the BX-35

Software Setup

This step installs the BasicX Downloader and Editor/Compiler on your computer. It is important to close all open programs before running Setup. If sharing violations still occur, press Ignore and continue Setup. Setup will prompt you to replace system files before continuing the installation. Examples assume D: as CD-ROM drive -- substitute appropriate drive letter for your system.

1) Close all running Windows programs
2) Remove any previous BasicX Installations (Start, Settings,
   Control Panel, Add/Remove Programs, BasicX, Add/Remove)
3) Insert BasicX CD into CD-ROM Drive (D: for example)
4) BasicX CD_SETUP screen automatically appears if autorun enabled
   a) If not, Run CD_SETUP.EXE: Start, Run, D:\CD_SETUP.EXE, OK
5) Choose "Install BasicX Development Software" from menu
6) Choose "Install BasicX"

7) Follow prompts for Installing BasicX to computer
   a) If prompted, replace some system files and restart Windows
      i) After restart, proceed from Step 1 again
   b) If prompted, keep newer files and replace older files
   c) If prompted, Ignore sharing violations and continue setup

Test Setup

The Test program is pre-loaded on the SPI EEPROM chip at the factory. It will work until another program gets downloaded to the chip. Therefore, we recommend that you **DO NOT PRESS THE DOWNLOAD BUTTON OR "COMPILE AND RUN"** until after you have run this test. Otherwise, we will be unable to provide phone support.

Test procedure:

1) Start BasicX Program: Start, Programs, BasicX, Basic Express...

2) Processor menu, click on BX-35 if not already checked.

3) I/O Ports -- Download Port menu, open the appropriate serial port if not already open. Note that the baud rate is fixed.

4) I/O Ports -- Monitor Port menu and select the same serial port as you used for the Download port in step (3). Configure the port to 19200 baud, no parity, 8 data bits, 1 stop bit.

5) A test message from the BX-35 should appear. If not, press the Execute button (green stoplight icon).

6) If all is working properly, a BasicX test message will print on screen until stopped by reset button

   a) If not working, verify connections and port addresses and retry

   b) If still not working, confirm that the power supply is working and supplying between 5 VDC to 15 VDC power

After passing this test, the Hello World program can be used as an additional test.

Hello, world

HelloWorld is a simple BasicX program that uses built-in serial port functions to write to the BasicX Status Window. The program simply enters a loop in which the string "Hello, world" is transmitted repeatedly, followed by carriage return/linefeed. A call to the built-in Delay procedure inserts a one second delay after each string.

Procedure:

1) Start BasicX Program: Start, Programs, BasicX, BasicX Express...

2) Processor menu -- verify that BX-35 is checked.

3) I/O Port -- Download Port -- open the COM port.

4) I/O Port -- Monitor Port -- open the same port as step (3)above.

5) Open Editor button -- press.

6) File -- New Project menu -- press. This causes a dialog box to pop up. Use the default project name and module name, hit OK.

   This boilerplate code is automatically created in the editor window:

```
Option Explicit

Public Sub Main()

End Sub
```

7) Project - Chip menu. Verify all boxes in the "IN" columns are checked (this means all input pins are initialized as input-tristate). Click on OK.

8) Type the following code into the Edit Window:

```
Public Sub Main()

    Do
        Debug.Print "Hello, world"
        Call Delay(1.0)
    Loop

End Sub
```

Hello World program

9) Hit F5 to compile and run. Say "Yes" if compiler asks to save changes.

10) "Hello, world" will print on screen until stopped by reset button

   a) If not working, verify connections and port addresses and retry.

   b) If still not working, supply 5 VDC to 12 VDC power directly to BasicX power terminals and retry.

   c) Try the Download Port - Rescue menu choice, then download the program again.

Software updates

BasicX software updates can be downloaded from the following web site:

http://www.basicx.com/transfer

Help Information

Sources of help information:

1) BasicX documentation and examples can be found on the hard disk and CD under the BX35_Docs folder. The *.doc files are in Microsoft Word format. If you don't have Word installed, we provide a free copy of Microsoft Word Viewer program on the BasicX Setup CD under the Word_Viewer folder. You can run the setup.exe file there to install Word Viewer.

We recommend that you set Word or Word Viewer to Page Layout mode in the View menu. Otherwise illustrations may not appear and other formatting may be adversely affected.

2) This is the official BasicX support mailing list:

http://groups.yahoo.com/group/basicx

3) At the BasicX website: http://www.basicx.com/

4) Through e-mail to: support@basicx.com

5) By phone at: (520)544-4567

6) By mail to: NetMedia, Inc.
10940 N. Stallard Pl.
Tucson, AZ 85737

BasicX quick tour

What is BasicX?

BasicX is a complete control system on a chip, combined with a software development environment on an PC-compatible computer running Windows. A BX-35 system combines a BasicX chip with additional devices to make it a standalone compuer:

BX-35 Hardware -- The BX-35 consists of a fast core processor with a ROM to store the BasicX Operating System, 400 bytes of RAM and lots of I/O devices such as timers, UARTs, ADCs, digital I/O pins, SPI peripheral bus, and more. The BX-35 uses an Atmel AT90S8535 as its core processor.

BasicX Operating System (BOS) -- The BasicX Operating System on-chip provides the multitasking environment that make the BasicX chip so powerful. The operating system also contains a high speed BasicX execution engine.

BasicX Development Environment -- BasicX programs are developed on an IBM-PC compatible computer under Windows 95/98/NT. The BasicX Development Environment includes an editor, compiler, various debugging aids, and source code for examples.

What happens when I make a program?

After you create your program, you compile it. The compiler translates the BasicX source code into an intermediate binary language that the BasicX chip understands, and writes the data to a file (*.BXB). The compiler also takes startup preferences such as pin I/O, RAM configuration information and other important startup parameters and puts them in a preferences file (*.PRF)

```
Source Code --> BasicX Binary file (*.BXB) plus
                BasicX Preferences (*.PRF)
```

If you're familiar with the PC programming environment, an EXE file on a PC is equivalent to the combination of BXB and PRF files in BasicX.

Once you have these two files, they are the complete representation of your program. These files can be stored on disk, e-mailed, or given away without releasing any source code. This way you could sell BasicX programs without anyone having access to your source code.

The development environment downloads the program directly into the development system or your own board.

Where does the code go when I download it?

On a BX-35 computer, once you have a BasicX binary file and preferences file, the code is downloaded into an external 32 KB EEPROM. When the BasicX chip starts (after reset), it goes out and begins executing instructions from the EEPROM. Since the EEPROM is non-volatile, it is safe from power outages. If the power goes out, the code is still retained in the EEPROM. Of course any RAM data that the BasicX chip was working on would be lost.

Why Basic and not C or C++ or assembler?

Typical microcontroller applications use C or assembly language. That is why they are also typically expensive to produce and maintain.

With BasicX, NetMedia did the hard stuff for you, such as building a multitasking network operating system, language processor, and compiler. You get the benefit of all this power which is not available on most microcontrollers at any price.

With this power you can write structured programs in a simple, straightforward language. In fact BasicX's language was modeled after the language used in Microsoft's Visual Basic® development system, which is the most popular programming language in existance.

What is BasicX's relationship with Visual Basic?

You do not need Visual Basic to use BasicX. The BasicX language is subset-compatible with the Visual Basic language, and it is possible to write code that will run in both PC and BasicX environments, as long as you use a common subset.

Obviously you must accommodate differences between operating systems as well as hardware, but if you choose, you can develop and debug your algorithms in Visual Basic and make use of the same code in BasicX.

NetMedia also provides source code for Visual Basic applications that lets you communicate with with the PC from a BasicX application.

Using a Visual Basic deveopment system on the PC side and BasicX as the controller makes a powerful combination. NetMedia recommends that you get Visual Basic 6.0 or higher if you are codeveloping PC applications and BasicX applications.

BX-35 system

BX-35 processor

The BX-35 processor consists of an Atmel AT90S8535 chip. This custom-programmed 40 pin chip reads and executes the program stored in an external 32 KB EEPROM chip.

The BX-35 has 25 general purpose I/O lines that are TTL and CMOS compatible. When used for digital I/O, each line can be set to 1 of 4 states -- output high, output low, input tristate (hi-Z) and input with pullup. Up to 8 of the 25 lines can be used alternatively as 10-bit analog to digital converters (ADCs) for sensing analog voltages.

SPI EEPROM chip

When you write a program, the SPI (Serial Peripheral Interface) EEPROM chip is where the program is stored. When the BasicX processor is executing, it fetches instructions from this chip. The 32 KByte EEPROM (AT25656) can store approximately 8000 lines of BasicX code, depending on the complexity of the program.

Serial port

A high speed 5 volt serial port is provided for connection to modems, PCs, terminals or other controllers. The maximum communication speed is 460 800 baud.

The serial port uses 3 wires -- RxData, TxData and DTR. The DTR line is used only for downloading programs. The BasicX Development Environment on the PC has a built-in window that allows 2-way communication with the BasicX serial port.

Analog to digital converter

The BX-35 includes an 8 channel, 10-bit analog to digital converter (ADC). The ADC channels are tied to pins 13 to 20, and is an integral part of the processor. All 8 channels can be used either as analog or digital inputs.

The ADC inputs are 0 V to 5 V level and will not tolerate either higher or negative voltages. For reliable ADC conversions it is recommended that pins 30 to 32 (AVCC, AGND and AREF) be connected properly. See Atmel documentation (AT90S_8535.PDF, included in the distribution) for more information.

Memory map

RAM -- stored inside the processor chip. Use RAMpeek, RAMpoke to access directly.

Start address:	207
End address:	607
Size:	401 bytes

Persistent memory -- stored inside the processor chip. Use PersistentPeek, PersistentPoke to access directly.

Start address:	32
End address:	511
Size:	480 bytes

EEPROM memory -- stored in a separate SPI EEPROM chip. Use GetEEPROM, PutEEPROM to access directly. Note that the program code is stored here.

Start address:	0
End address:	32767
Size:	32768 bytes

You can also refer to the MPP map file to see where and how much memory is allocated for a specific program. The MPP file is created whenever you compile a BasicX program.

Real time clock

The BX-35 has a built-in real time clock/calendar that ticks at a rate of 512 Hz. Every clock tick increments Register.RTCTick, which is a 32 bit signed integer. The register wraps every 24 hours.

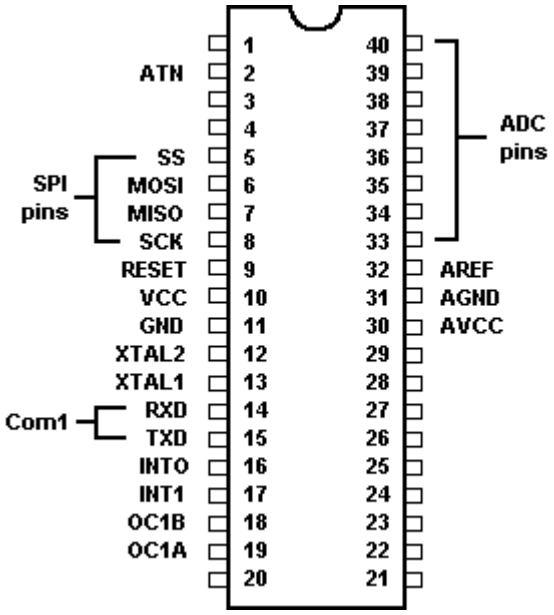
The calendar date is stored as a day number in Register.RTCDay. Day 0 is 1 January 1999 by definition. The register is a 16 bit unsigned integer, which is incremented whenever Register.RTCTick wraps.

BX-35 technical specifications

General

I/O Lines	25 total; 17 digital plus 8 lines that can be ADC or digital
EEPROM for program and data storage	32 KB EEPROM chip required (external) Largest executable user program size is 32 KBytes
RAM	400 bytes
Analog to digital converter	8 channels of 10 bit ADC, can also be used as regular digital (TTL level) I/O
ADC sample rate	6 k samples/s maximum
Program execution speed	60 microseconds per 16 bit integer add/subtract
Serial I/O speed	2400 baud to 460.8 Kbaud on Com1 300 baud to 19 200 baud on any I/O pin (Com3)
Operating voltage range Min/Max	4.0 VDC to 6.0 VDC
Current requirements	TBD mA plus I/O loads, if any
I/O output source current	TBD mA @ 5 V (I/O pin driven high)
I/O output sink current	TBD mA @ 5 V (I/O pin pulled low)
Combined maximum current load allowed across all I/Os	100 mA sink or source
I/O internal pull-up resistors	120 kΩ maximum
Floating point math	Yes
On-chip multitasking	Yes
On-chip clock/calendar	Yes
Built-in SPI interface	Yes
PC programming interface	Parallel or serial downloads
Package type	40 pin PDIP
Environmental specifications Absolute maximum ratings	Operating temperature: 0 °C to +70 °C Storage temperature: -65 °C to +150 °C

BX-35 pin numbering



BX-35 Pin Definitions

Each pin on the BX-35 chip has a primary and alternate function as shown in the table below. The primary function describes how the pin can be configured. The alternate function describes how the pin is configured when BasicX built-in options are selected.

Pins 1 to 20

Pin #	Primary Function	Primary Description	Alternate Function	Alternate Description
1	PortB, Bit 0	General Purpose I/O Port		
2	ATN line	For serial downloading		
3	PortB, Bit 2	General Purpose I/O Port		
4	PortB, Bit 3	General Purpose I/O Port		
5	PortB, Bit 4		SPI-CS EEPROM Chip Select	See SPI EEPROM
6	PortB, Bit 5		SPI-MOSI	See SPI Devices
7	PortB, Bit 6		SPI-MISO	See SPI Devices
8	PortB, Bit 7		SPI-SCK	See SPI Devices
9	Reset	Low Active Reset	Not applicable -- Always reset	Internal Pullup
10	VCC	Power Supply 4.0 VDC to 6.0 VDC	Not applicable -- Always power	See DC Characteristics
11	Ground	Ground	Not applicable – Always ground	See DC Characteristics
12	XTAL 2	Crystal/Resonator		See Oscillator Options
13	XTAL 1	Crystal/Resonator		See Oscillator Options
14	PortD, Bit 0	Com1 Receive Data		See Com Ports
15	PortD, Bit 1	Com1 Transmit Data		See Com Ports
16	PortD, Bit 2	General Purpose I/O Port		
17	PortD, Bit 3	General Purpose I/O Port	Interrupt pin	
18	PortD, Bit 4	General Purpose I/O Port	Output Capture Pin	See OutputCapture
19	PortD, Bit 5	General Purpose I/O Port		
20	PortD, Bit 6	General Purpose I/O Port	Input Capture Pin	See InputCapture

Pins 21 to 40

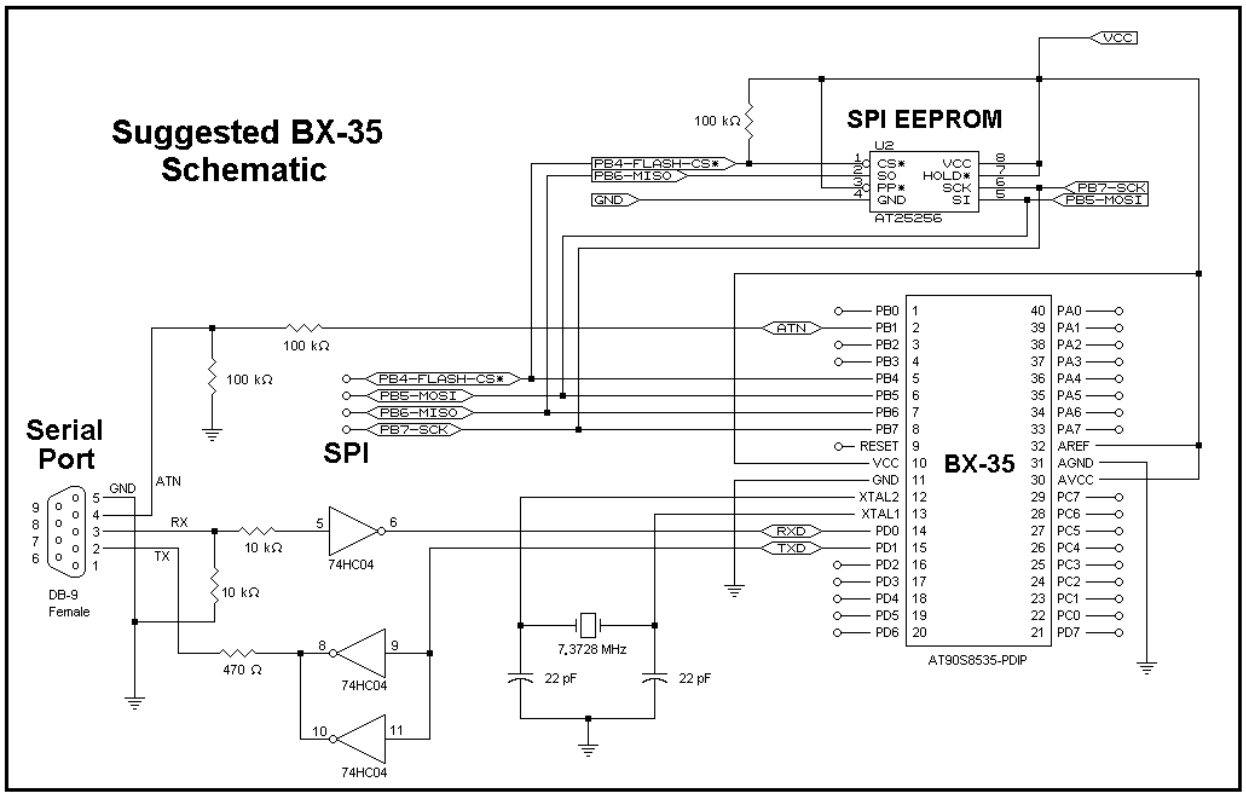
Pin #	Primary Function	Primary Description	Alternate Function	Alternate Description
21	PortD, Bit 7	General Purpose I/O Port		
22	PortC, Bit 0	General Purpose I/O Port		
23	PortC, Bit 1	General Purpose I/O Port		
24	PortC, Bit 2	General Purpose I/O Port		
25	PortC, Bit 3	General Purpose I/O Port		
26	PortC, Bit 4	General Purpose I/O Port		
27	PortC, Bit 5	General Purpose I/O Port		
28	PortC, Bit 6	General Purpose I/O Port		
29	PortC, Bit 7	General Purpose I/O Port		
30	AVCC	ADC supply voltage (see note below)		See DC Characteristics
31	AGND	Analog ground (see note below)		See DC Characteristics
32	AREF	ADC reference input (see note below)		See DC Characteristics
33	PortA, Bit 7	ADC channel 7	General Purpose I/O Port	
34	PortA, Bit 6	ADC channel 6	General Purpose I/O Port	
35	PortA, Bit 5	ADC channel 5	General Purpose I/O Port	
36	PortA, Bit 4	ADC channel 4	General Purpose I/O Port	
37	PortA, Bit 3	ADC channel 3	General Purpose I/O Port	
38	PortA, Bit 2	ADC channel 2	General Purpose I/O Port	
39	PortA, Bit 1	ADC channel 1	General Purpose I/O Port	
40	PortA, Bit 0	ADC channel 0	General Purpose I/O Port	

Note – Regarding pins AVCC, AGND and AREF – if these pins are left unconnected, PortA pins (33 to 40) will not function.

BX-35 DC characteristics

Vcc is 4.0 V to 6.0 V (unless otherwise noted)

Parameter	Condition	Min	Typ	Max
Output low voltage	Vcc = 5 V Output current = 20 mA			0.6 V
Output high voltage	Vcc = 5 V Output current = -3 mA	4.2 V		
Output source current	Vcc = 5.0 V Vcc = 2.7 V			TBD mA TBD mA
Output sink current **Maximum total**	Vcc = 5.0 V Vcc = 2.7 V **for all output pins**			TBD mA TBD mA **100 mA**
Reset pullup		100 kΩ		500 kΩ
I/O pin pullup resistor		35 kΩ		120 kΩ
Power supply	Active mode		TBD mA	
	Idle mode		TBD mA	
	Power down, watchdog on		TBD μA	
	Power down, watchdog off		TBD μA	


Suggested BX-35
Schematic
SPI EEPROM
U2
CS*
SO
PP*
GND
VCC
HOLD*
SCK
SI
AT25256
100 kΩ
VCC
PB4-FLASH-CS*
PB6-MISO
PB7-SCK
PB5-MOSI
GND
ATN
100 kΩ
100 kΩ
PB4-FLASH-CS*
PB5-MOSI
PB6-MISO
PB7-SCK
SPI
Serial
Port
GND
ATN
RX
TX
10 kΩ
74HC04
10 kΩ
470 Ω
8
9
74HC04
10
11
74HC04
DB-9
Female
7,3728 MHz
22 pF
22 pF
PB0
PB1
PB2
PB3
PB4
PB5
PB6
PB7
RESET
VCC
GND
XTAL2
XTAL1
PD0
PD1
PD2
PD3
PD4
PD5
PD6
RXD
TXD
BX-35
PA0
PA1
PA2
PA3
PA4
PA5
PA6
PA7
AREF
AGND
AVCC
PC7
PC6
PC5
PC4
PC3
PC2
PC1
PC0
PD7
AT90S8535-PDIP