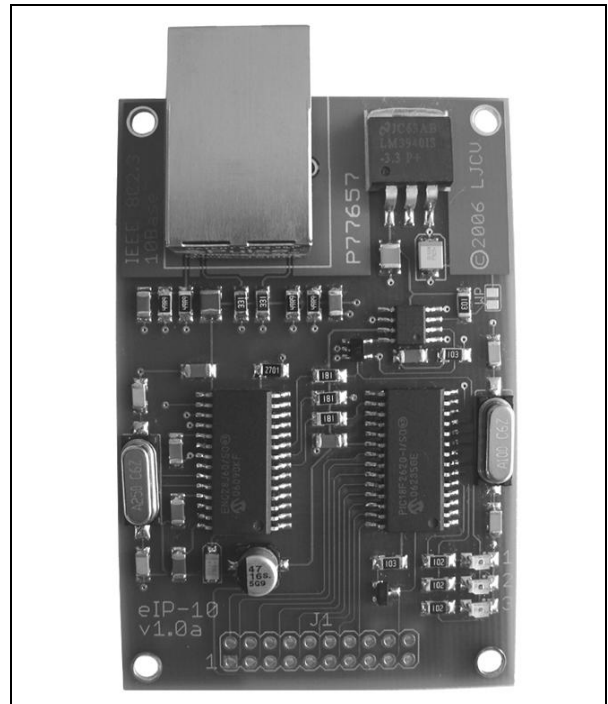


Embedded TCP/IP 10-BaseT Network Module

Features

- 8-bit reprogrammable Microcontroller with Enhanced Flash program memory, EEPROM and Static RAM data memory
- On board 10Mbps Ethernet controller, and RJ45 jack for network connection
- Small 2x3" circuit board footprint
- Single +5VDC supply
- Microchip's TCP/IP protocol stack, with IPv4, UDP, TCP, DHCP, ICMP, FTP, and HTTP support
- Ethernet Boot Loader
- On board Serial Flash EEPROM
- 40MHz CPU clock
- IEEE 802.3 10BaseT compliant
- Fully assembled and tested



Description

The eIP-10/eIP-10+ are small network modules implemented with Microchip Technology PIC18F2620/PIC18F2685 8-bit Microcontroller and ENC28J60 Ethernet Network Controller.

The circuit board includes all required components for both controllers, plus a serial 256Kbit/1Mbit EEPROM for storage of board configuration, basic HTML pages and graphic files, three LEDs for health and board activity, and a RJ-45 jack with integrated magnetics and built-in Link and Activity LEDs for connection to an Ethernet Local Area Network.

Microcontroller SPI™ bus signals, USART Tx and Rx, ICSP™ interface, and unused I/O pins are all routed to the board interface connector.

Applications

- Remote control and monitoring
- Data capture and logging
- Industrial Automation
- Building Automation
- Appliance remote management
- Robotics
- Internet of Things
- Microcontroller Research and Development
- TCP/IP Research and Development
- Serial interface (RS-232/RS-485) to Ethernet bridge

General Description

The eIP-10/eIP-10+ boards combine the flexibility and features of a small package PIC18F2620/PIC18F2685^{[B1][B2]} 8-bit microcontroller (MCU) from Microchip Technology and their ENC28J60^[B3] IEEE 802.3 Stand-Alone Ethernet controller with integrated SPI bus interface, MAC and 10BASE-T PHY (ENC).

The board includes all support components for both controllers plus a 256Kbit/1Mbit serial EEPROM for application and user data storage.

Communication between both controllers is implemented using the standard SPI (Serial Peripheral Interface) signals SCK (clock), SDI (serial data input) and SDO (serial data output). The RC0 I/O port of the MCU is used to drive the CS (chip select) signal of the ENC.

The SPI bus is also shared with the serial EEPROM, in this case the RC1 I/O port of the MCU is used to drive the CS signal of the EEPROM. The board includes next to the EEPROM chip a small solder jumper labeled WP, normally this jumper is open enabling the modification of the EEPROM STATUS register (refer to the 25LC256/25LC1024^{[B4][B5]} Data Sheets for additional information about data protection).

Since the SPI bus can be shared with additional devices all SPI signals are present on the board interface connector J1.

Clock source for the Microcontroller is provided by a 10.00MHz parallel cut crystal. To achieve higher performance and recommended clock speeds for the SPI bus the Microcontroller is normally configured with HSPLL enabled for an internal clock speed of 40MHz.

The board also includes three status LEDs (marked 1, 2 and 3) for indication of MCU program status and activity. The LEDs are

connected to RA3, RA4, and RA5 I/O ports of the MCU.

All remaining I/O ports of the MCU (RA0, RA1, RA2, RB0-RB7, and RC2) are present on the board interface connector J1.

The MCU reset logic is implemented with a 10K resistor and a high speed switching diode, the MCU reset or MCLR signal is also present on the J1 board interface connector to complete the MCU ICSP™ (In Circuit Serial Programming) interface.

The board requires a stable +5V DC supply with at least 200 mA (this requirement varies according to the use of available I/O ports).

Complete schematics of the eIP-10 are included in Appendix A (the eIP-10+ has the same PCB layout, only differences are that U1 is a PIC18F2685 and U4 a 25LC1024).

Microcontroller

The PIC18F2620/PIC18F2685 are high performance 8-bit Harvard architecture microcontrollers with a reduced instruction set, that include 64/96Kbytes of enhanced Flash memory (equivalent to 32,768/49,152 single word instructions), 3,986/3,328 bytes of static RAM, 1,024 bytes of data EEPROM, 25 general purpose bidirectional I/O lines, of which up to 10 can be configured as channels for the 10-bit A/D converter, dual analog comparators, a Master Synchronous Serial Port (MSSP) module supporting the 3-wire SPI™ bus, an Enhanced Addressable USART module, and more. The PIC18F2685 also includes an enhanced CAN module.

For a detailed feature description and complete documentation of the Microcontroller, please refer to Microchip's PIC18F2620/PIC18F2685^{[B1][B2]} Data Sheets and the PIC18 Family Reference Manual^[B6].

Ethernet Controller

Microchip's ENC28J60 is an IEEE 802.3 Stand Alone Ethernet controller with integrated MAC and 10BASE-T PHY modules. It has an 8KBytes dual port static RAM buffer with hardware assisted circular receive FIFO and CRC generation.

It supports Unicast, Multicast and Broadcast packets, and programmable receive packet filtering.

The hardware CRC calculation module facilitates the in-buffer checksum generation for various network protocols.

It also includes two programmable LED outputs for LINK, Rx/Tx activity and collision status. These two outputs drive the LEDs present in the eIP-10 RJ-45 jack. By default the yellow LED indicates LINK status and the green LED Rx/Tx activity.

For a detailed feature description and complete documentation of the Ethernet Controller, please refer to Microchip's ENC28J60 Data Sheet^[B3].

Serial EEPROM

The serial EEPROM included in the eIP-10 board is a Microchip 25LC256, and on the eIP-10+ a 25LC1024.

This external 32/128Kbytes memory facilitate the non-volatile storage of configuration information, user data, HTML pages and graphics, etc.

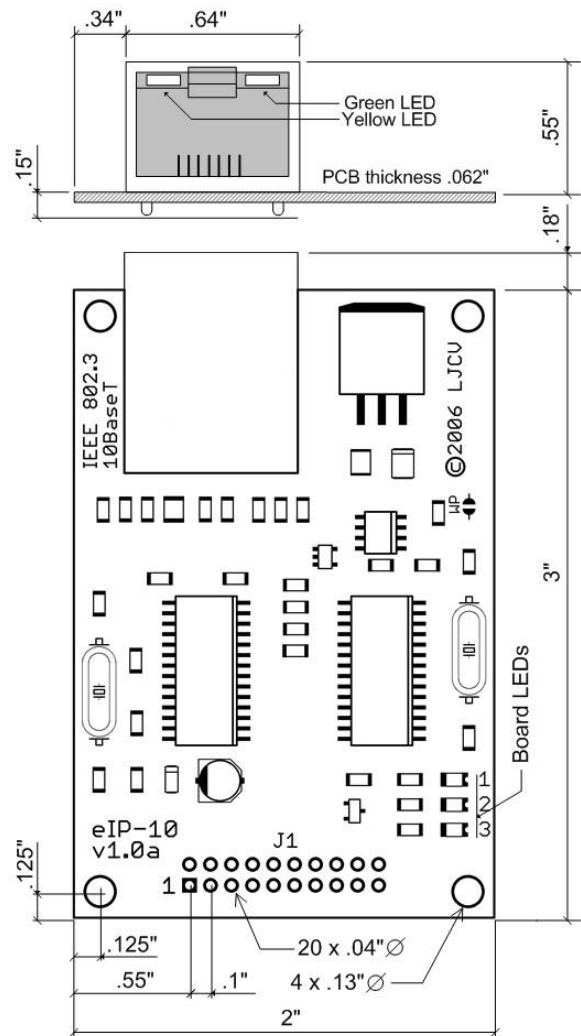
The EEPROM endurance is 1,000,000 read/write cycles with more than 200 years of data retention.

For a detailed feature description and complete documentation of the Serial EEPROM, please refer to Microchip's 25LC256/25LC1024^{[B4][B5]} Data Sheets.

Board Interface (J1)

Connections to the board are performed via the J1 connector interface; it accommodates any standard 20 pin two-row header with .100" pitch.

Physical Dimensions



Note: Drawing not to scale

All dimensions are in inches.

J1 Pin Out

(Shown from component side)

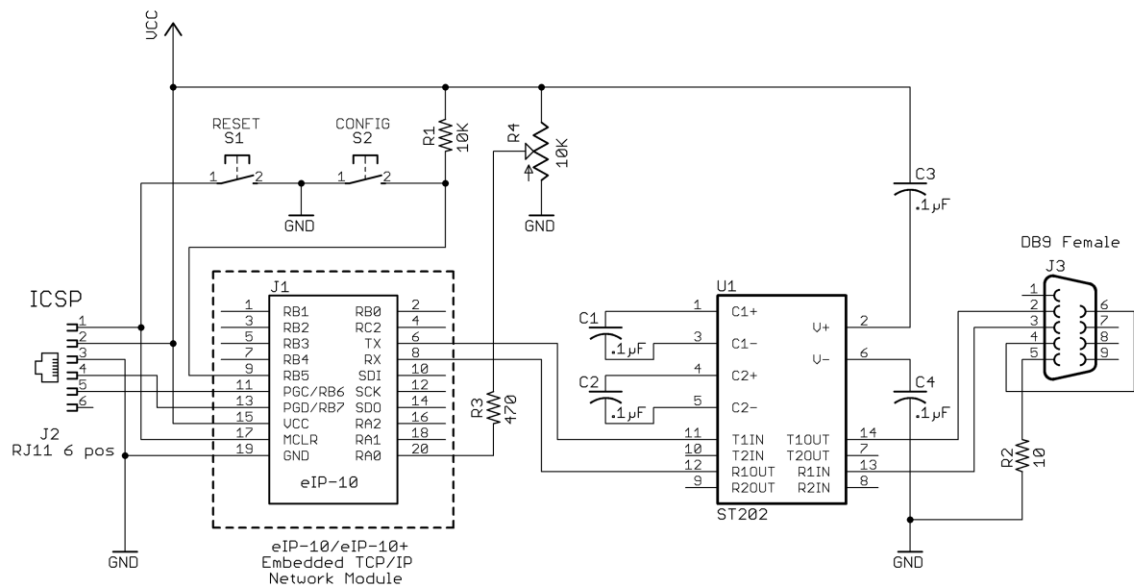
	2	4	6	8	10	12	14	16	18	20
	RB0	RC2	RC6	RC7	RC4	RC3	RC5	RA2	RA1	RA0
	INT	CPP	TX	RX	SDI	SCK	SDO	AN2	AN1	AN0
	RB1	RB2	RB3	RB4	RB5	RB6	RB7	Vcc	~MCLR	GND
					PGM	PGC	PGD	+5VDC	VPP	
	1	3	5	7	9	11	13	15	17	19

Connecting the eIP-10/eIP-10+

The eIP-10/eIP-10+ boards are shipped fully assembled and tested. The Microcontroller program memory is pre-loaded with a customized version of Microchip's TCP/IP Stack^[B7], and the external serial EEPROM with some sample pages.

The only connections required to get the board up and running are $V_{CC} = 5V$, GND and a 10BASE-T cable to your local area network or PC (be aware that if you connect the 10BASE-T cable directly to a PC Network Interface Card a crossover cable is needed).

The schematic below shows a basic circuit with the eIP-10/eIP-10+ that includes two pushbutton switches, S1 to force a hardware RESET of the Microcontroller, and S2 connected to the RB5 I/O Port to restore the factory configuration. The schematic also shows a RJ-11 6 position jack for the ICSP™ (In Circuit Serial Programming) interface to the Microcontroller, which enables tools such as Microchip's In-Circuit Debugger/Programmer MPLAB® ICD2/ICD3 to access and program the MCU.



Note: ST202 and additional components not included on eIP-10/eIP-10+ board

eIP-10/eIP-10+ Demo Firmware

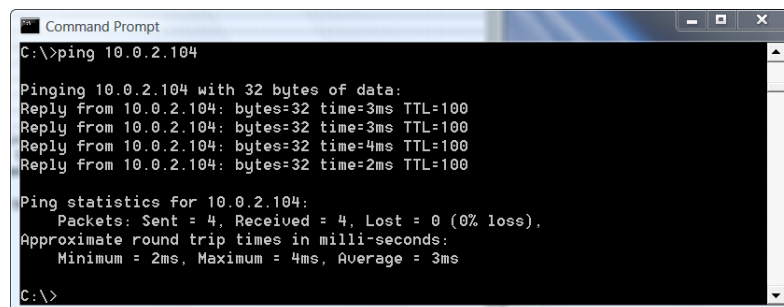
The demo firmware pre programmed on the eIP-10/eIP-10+ boards is based on the original distribution of the Microchip TCP/IP Stack^[B7] as part of the Microchip Application Libraries^[B8].

The demo application by default includes the basic transport layers of the TCP/IP Protocol Suite (IP, UDP, and TCP) and has enabled the ICMP (for echo requests or ping responses), SNTP, DHCP and DNS clients, the NetBIOS Name Service and Microchip Announce modules, and the HTTP server (Microchip Version 2 using MPFS Version 2.1).

After you apply power to the eIP-10 board and connect it to a live Ethernet network port, the application will try to obtain the network configuration parameters (IP Address, Netmask, Gateway and DNS server IP addresses) via DHCP, if you have connected a terminal or terminal emulator to the serial interface (speed is 19,200 bps, 8 bits, no parity, one stop bit, no flow control) you should see a series of messages like this:

```
EIP10 Hardware Initialized, HW Config Ver.1.0a
MPFS Initialized, Ver.2.1
EIP10 Config loaded
Microchip TCP/IP Stack Ver.v5.25
MAC Address = 00:04:A3:00:00:10, IP Address = 169.254.1.1
EIP10 Ready, FW Ver.2.0, Built Jul 09 2010-20:13:16
New IP Address = 169.254.1.1
New IP Address = 10.0.2.104
```

Once the eIP-10 board has obtained an IP address for your network (in this example 10.0.2.104), you can try to send an ICMP Echo Request using the ping command as shown below:



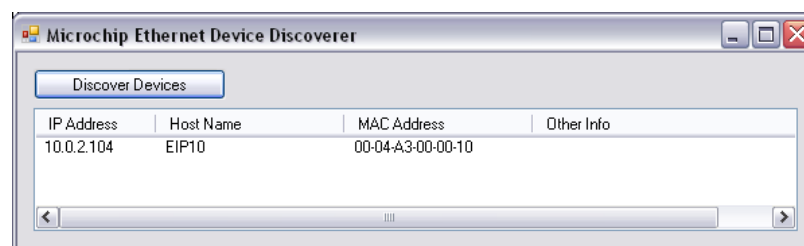
```
Command Prompt
C:\>ping 10.0.2.104

Pinging 10.0.2.104 with 32 bytes of data:
Reply from 10.0.2.104: bytes=32 time=3ms TTL=100
Reply from 10.0.2.104: bytes=32 time=3ms TTL=100
Reply from 10.0.2.104: bytes=32 time=4ms TTL=100
Reply from 10.0.2.104: bytes=32 time=2ms TTL=100

Ping statistics for 10.0.2.104:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 4ms, Average = 3ms

C:\>
```

From the Microchip Application Libraries on the "Microchip\TCPIP Stack\Utilities" directory you can run the "Microchip Ethernet Discoverer.exe" program, it will show a window with a list of devices running the Microchip TCP/IP Stack and their MAC and IP addresses and NetBIOS name.



Then you can access the HTTP Server on the eIP-10 board pointing your browser to the URL <http://10.0.2.104/> (the IP address assigned via DHCP to the board) or if your computer supports name resolution via the NetBIOS Name Service (NBNS) you can also use the URL <http://EIP10/>, your browser will show a page like this:

LJC Electronics **eIP10/eIP10+ Demo**

Home [Hardware](#) [Firmware](#) [Show Config](#)

Introduction

This demo page is being served by a simple HTTP server running on a [LJC Electronics](#) eIP10 or eIP10+ Embedded TCP/IP prototype board.

Both boards feature a 8-bit Microchip microcontroller, a [PIC18F2620](#) on the eIP10 and a [PIC18F2685](#) on the eIP10+, both boards use Microchip's [ENC28J60](#) standalone ethernet controller. In addition an external serial EEPROM memory is included for storage of configuration information and web pages, for the eIP10 this part is a Microchip [25LC256](#) and a [25LC1024](#) for the eIP10+.

The demo application has been developed using Microchip's License Free [TCP/IP Stack](#) distributed as part of the Microchip's Application Libraries. Complete source code and additional information for the Microchip TCP/IP Stack is available at [Microchip's Website](#).

This technology and architecture may not be suitable for applications that require to transfer massive amounts of data or a complete TCP/IP suite protocol stack implementation, but it is good enough for low or medium complexity applications such as remote sensing and data logging, remote appliances control, as an interface to provide TCP/IP connectivity to other devices, etc.

The right section of this page demonstrates the ability to handle real-time control functions and how to generate pages with dynamic content. On the **General Information** section, several variables show the current running version of the demo firmware and TCP/IP Stack along with other parameters such as the current IP and MAC addresses assign to the board.

The **Actions** section demonstrates one of the mechanisms to send commands to the board via HTTP, the status of two of the on board LEDs can be toggled by clicking on the LED2 and LED3 buttons.

And the **Status** section shows the status of several variables such as the status of the on board LEDs, few digital inputs and the current value of the AN0 analog input. The actual value for these variables refreshes with board information periodically using a series of JavaScript functions developed by Microchip to demonstrate the ability of the TCP/IP Stack to handle dynamic and real-time contents.

For more information about the eIP10 and eIP10+ prototype boards and how we may be able to assist you using this type of technologies, please visit www.ljcv.net, and for additional information about the Microchip TCP/IP Stack www.microchip.com.

Note: The show configuration page is protected with HTTP Basic Authentication, to be able to access that page use admin as username and microchip as password.

Happy Networking
LJC Electronics
San Antonio, Texas

General Information

Firmware Version	2.0
TCP/IP Version	v5.25
Build date	Jul 09 2010 20:13:17
IP Address	10.0.2.104
MAC Address	00:04:A3:00:00:10

Actions

Toggle LEDs

Status

LEDS	1	2	3
Digital Inputs	RB5		
Analog Input	AN0		
	10176		

The demo application will show on the main page served by the HTTP server some general information about the firmware version and network configuration, the status of the three LEDs on board, the status of the RB5 digital input and the current analog value of the AN0 input, and using the two buttons labeled LED2 and LED3 you will be able to toggle the state of the LED2 and LED3 on board LEDs, LED1 will be blinking every second to show the active status of the TCP/IP demo application.

For additional information about the Demo Application for the eIP-10 and eIP-10+, and latest updates about how to build this application, please visit the product page at www.ljcv.net/eip10.

Note: LJC Electronics **does not** distribute the source code of the Microchip TCP/IP Stack. To build the demo application using the TCP/IP stack you **MUST** download, install and accept the terms and conditions of the Software License Agreement of your own copy of the Microchip Application Libraries.

You can download the distribution file directly from Microchip at www.microchip.com/mal

Electrical Characteristics

Absolute Maximum Ratings

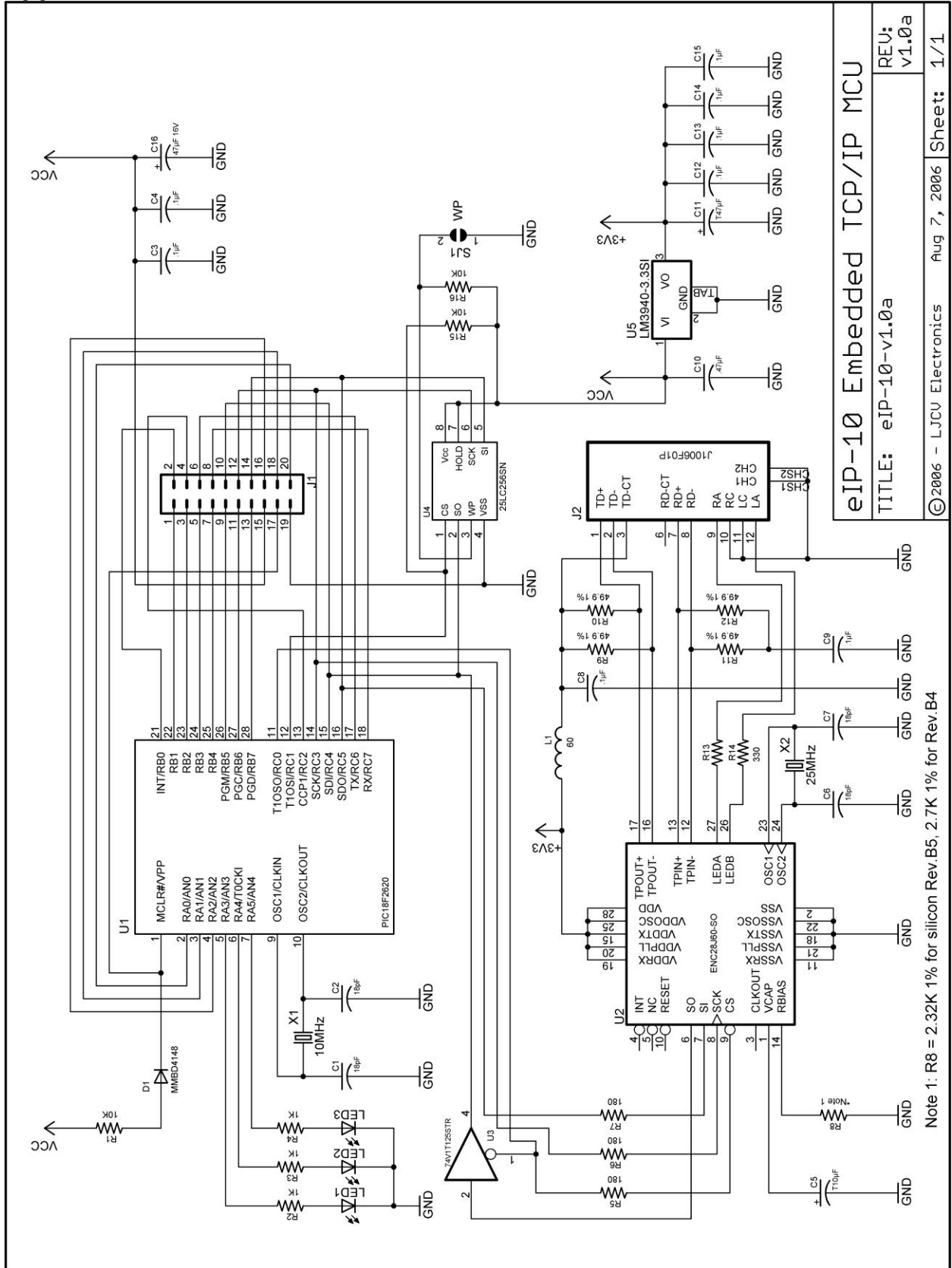
Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	-0.3 to +6.5	V
I_{SUP}	Supply Current (@ $V_{CC}=5.0V$)	200	mA
T_{OP}	Operating Temperature	0 to +70	°C
T_{STO}	Storage Temperature	-50 to +150	°C

DC Normal Operating Characteristics

Symbol	Parameter	Value			Unit
		Min	Typ	Max	
V_{CC}	Supply Voltage	4.2	5.0	5.5	V
I_{SUP}	Supply Current (@ $V_{CC}=4.75V$)	140	170	190	mA
V_{IL}	Input Low Voltage (I/O ports)	-	-	0.8	V
V_{IH}	Input High Voltage (I/O ports)	2.0	5.0	V_{CC}	V
V_{OL}	Output Low Voltage (I/O ports)	-	0.6	0.6	V
V_{OH}	Output High Voltage (I/O ports)	$V_{CC}-0.7$	-	-	V

For complete AC and DC operating characteristics please refer to Microchip's PIC18F2620/PIC18F2685 Data Sheets^{[B1][B2]}.

Appendix A – eIP-10 Schematics



eIP-10 Embedded TCP/IP MCU	
TITLE: eIP-10-v1.0a	REV: v1.0a
© 2006 - LJCVC Electronics	Aug 7, 2006
Sheet: 1/1	

Note 1: R8 = 2.32K 1% for silicon Rev.B5, 2.7K 1% for Rev.B4

Appendix B – Technical References

- [B1] PIC18F2620 Enhanced Flash 8-bit Microcontroller Data Sheet, Microchip Technology Inc., 2008, Document Number DS39626E.
- [B2] PIC18F2685 Enhanced Flash 8-bit Microcontroller Data Sheet, Microchip Technology Inc., 2009, Document Number DS39761C.
- [B3] ENC28J60 Stand-Alone Ethernet Controller Data Sheet, Microchip Technology Inc., 2008, Document Number DS39662C.
- [B4] 25LC256 256K SPI™ Bus Serial EEPROM Data Sheet, Microchip Technology Inc., 2007, Document Number DS21822F.
- [B5] 25LC1024 1 Mbit SPI™ Bus Serial EEPROM Data Sheet, Microchip Technology Inc., 2010, Document Number DS22064D.
- [B6] PICmicro® 18C MCU Family Reference Manual, Microchip Technology Inc., 2000, Document Number DS39500A.
- [B7] Microchip TCP/IP Protocol Stack, available at www.microchip.com/tcpip.
- [B8] Microchip Application Libraries, available at www.microchip.com/mal.

Revision History:

September 2006, Original data sheet document for eIP-10.

March 2010, Updated references to Microchip TCP/IP Stack.

July 2010, Updated to include information for eIP-10+ and Demo Application Firmware.

Notes:

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