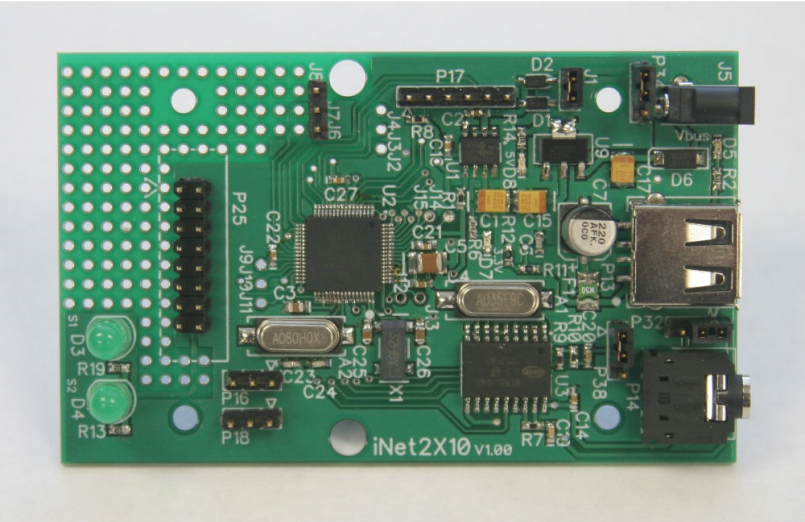
iNet2X10 Developer Guide

Version 1.01



Tri-L Data Systems, Inc.

iNet2X10 Developer Guide

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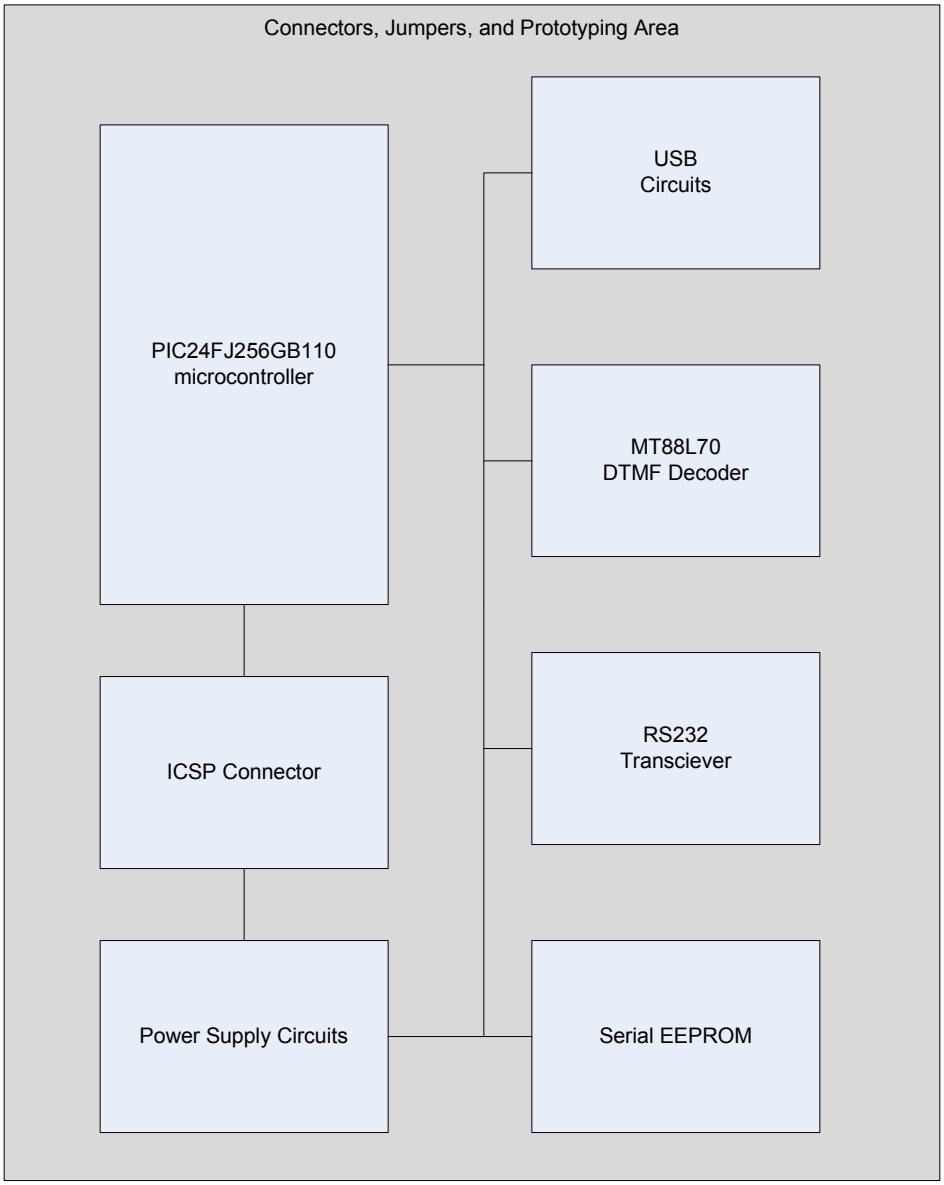
Introduction

The iNet2X10 board is based on Microchip™ PIC24FJ256GB110 microcontroller and a Zarlink ™ MT88L70 DTMF receiver. It was designed for prototyping and/or low to medium production volumes of applications requiring a USB interface (host or device). Many I/O ports and other special features of the microcontroller are available and easily accessible via connectors or plated through holes. Additional components may be added to the board using the prototyping area.

Firmware development is facilitated by using the C programming language and other tools available from Microchip™. In-circuit programming and debugging greatly reduces the development cycle. Many sample applications including hardware and code are available on the Microchip™ web site for download. Also a vast amount of information can be found on the internet for just about any application using PIC microcontrollers. Support forums are helpful and abundant.

For detailed information on the capabilities of the PIC234FJ256GB110 please visit the Microchip™ website. There you will find datasheets, applications notes and many other supporting documents. This document provides information necessary for developing PIC24 applications using the iNet2X10 board. Developers not familiar with the PIC24 and USB should first familiarize themselves with these technologies as well as the Microchip™ development tools.

System Block Diagram



PIC24FJ256GB110 Microcontroller

The PIC24FG256GB 110 has a wide array of features and configurable options available in a 64 pin device. The table below lists all 64 pins and describes how each used on the iNet2X10 board. The PIC and Description columns list each microcontroller pin and its description. The 5v tol column indicates if a pin is 5 volt tolerant or not. The MAP column indicates if a pin is mappalbe and the corresponding map port number (see the Microchip™ datasheets for an explanation of mappable ports). The To and

Pin column corresponds to the printed circuit board part reference and pin number if applicable. The To column also indicates if a pin is a power type. And the iNet2X10 Function column describes pins as it relates to iNet2x10 functionality. Many of these pins are generic and are available for general use. However, a few pins are dedicated to USB, DTMF, LED, programming and other functions.

PIC	Description	5V tol	MAP	To	Pin	iNet2X10 Function
1	RE5/PMD5	X		P25	10	PIO_D5
2	RE6/PMD6/SCL3	X		P25	11	PIO_D6
3	RE7/PMD7/SDA3	X		P25	12	PIO_D7
4	RG6/PMA5/RP21		21	U5	5	SDI1, EE_SI
5	RG7/PMA4/RP26		26	U5	6	SCK1, EE_SCK
6	RG8/PMA3/RP19		19	J2		GPIO
7	MCLR			P17	1	ICSP, 10K
8	RG9/PMA2/RP27		27	U5	3	EE_WP
9	Vss			GND		
10	Vdd			V3.3		
11	RB5/Vbuson//RP18		18	J3		GPIO
12	RB4/USBOEN/RP28		28	J4		GPIO
13	RB3/AN3			U5	1	EE_CS
14	RB2/AN2//RP13		13	U5	2	SDO1, EE_SO
15	RB1/PGEC1/RP1		1	P17	5	ICSP,PGC
16	RB0/PGED1/RP0		0	P17	4	ICSP, PGD
17	RB6/AN6/RP6		6	J6		GPIO,SS1
18	RB7/AN7/RP7		7	R12		Vchk
19	AVdd			V3.3		
20	Avss			GND		
21	RB8/AN8/RP8		8	D3	1	LED1
22	RB9/PMA7/RP9		9	D4	1	LED2
23	RB10/PMA13/TMS			J7		GPIO,TMS
24	RB11/PMA12/TDO			J8		GPIO,TDO
25	Vss			GND		
26	Vdd			V3.3		
27	RB12/PMA11/TCK			J9		GPIO,TCK
28	RB13/PMA10/TDI			J10		GPIO,TDI
29	RB14/PMA1/RP14		14	U4	10	R2OUT, UART
30	RB15/PMA0/RP29		29	P25	15	PIO_A0
31	RF4/PMA9/RP10	X	10	U4	15	R1OUT, UART
32	RF5/PMA8/RP17	X	17	U3	14	DTMF_D4
33	RF3/USBID/RP16	X	16	J11		GPIO
34	Vbus			Vbus		
35	Vusb			V3.3		
36	RG3/D-			P13	2	USB Con
37	RG2/D+			P13	3	USB Con
38	Vdd	X		V3.3		
39	RC12/OSCI			A2	2	8MHZ XTAL
40	RC15/OSCO			A2	1	8MHz XTAL
41	Vss			GND		
42	RD8/RTCC/RP2	X	2	U3	13	DTMF_D3
43	RD9/SDA1/RP4	X	4	U3	12	DTMF_D2
44	RD10/SCL1/RP3	X	3	U3	11	DTMF_D1
45	RD11/PMCS1/RP12	X	12	P25	16	PIO_CS
46	RD0/INT0/RP11	X	11	U3	15	DTMF RDY
47	RC13/SOSCI			X1	1	32KHz XTAL

48	RC14/SOSCO/RPI37		37(in)	X1	4	32KHz XTAL
49	RD1/Vcpcon/RP24	X	24	U4	12	T2IN, UART
50	RD2/DPH/RP23	X	23	P25	3	PIO_RST
51	RD3/PMBE/RP22	X	22	U4	13	T1IN, UART
52	RD4/PMWR/RP25	X	25	P25	14	PIO_WR
53	RD5/PMRD/RP20	X	20	P25	13	PIO_RD
54	RD6			J12		GPIO
55	RD7			J13		GPIO
56	Vcap/VddCore			C4	1	
57	ENVREG			V3.3		Tied high, enabled
58	RF0			J14		GPIO
59	RF1	X		J15		GPIO
60	RE0/PMD0	X		P25	5	PIO_D0
61	RE1/PMD1	X		P25	6	PIO_D1
62	RE2/PMD2	X		P25	7	PIO_D2
63	RE3/PMD3	X		P25	8	PIO_D3
64	RE4/PMD4	X		P25	9	PIO_D4

BLUE = P25, I/O port, parallel configurable

RED = mappable ports

X = 5v tolerant

Power Supply Circuits

Power may be supplied to the board either through the power jack or from the USB connector. The board operates on 3.3 volts. Power from the jack is regulated with a linear 5 volt regulator which is then further regulated to 3.3 volts for the board. Power from the USB connector routes to the same 3.3V regulator via jumper J1. Install jumper J1 to power the board from the USB connector. Remove J1 if the board to power the board from the power jack.

USB Supporting Circuits

USB hardware consists of two functional types, a host or a device. A USB device connects to a host giving it added hardware capabilities. Examples of devices are mice, flash drives, printers, cameras, and other peripherals. The host is typically a personal computer or a USB hub that connects to a personal computer. Some USB designs allow the hardware to programmatically switch between a host and a device. The iNet2X10 is jumper configurable as a host or a device. Install J1 if the iNet2X10 will be an USB device. Remove J1 if the iNet2X10 board is to function as a host. Other support circuits include over current protection, filter capacitors, and USB type A connector.

MT88L70 DTMF Decoder

Firmware DTMF decoders are available for PIC devices. However, since there was ample board space and to reduce firmware complexity, a hardware solution is used on the iNet2X10 board. The DTMF decoder consists of a Zarlink™ MT88L70 DTMF receiver.

Serial EEPROM (optional)

Many of the devices in the PIC 24 family have the ability to read and write data into internal flash program memory and additional may not be needed. However, a Microchip™ 25LC010A, 1K bit, serial EEPROM is available on the iNet2X10 board for additional nonvolatile memory storage.

RS232 Transceivers (optional)

The PIC24Fj256GB110 has 4 internal UARTs I/O pin mappable ports. The iNet2X10 board uses a Maxim™MAX13234 RS232 transceiver to provide two RS232 compatible ports without hardware handshaking. If only one RS232 port is needed then the other pins may be used for hardware handshaking.

Connectors

iNet2X10 connectors are described below.

Connector	Type	Description
J5	Power Jack, 3.5 mm	6 – 9 V DC, Uses 1.3mm I.D. x 3.5mm O.D. x 9.5mm Female plug
P17	PIC ICSP Header	Standard PIC ICSP Header 1 – MCLR 2 – VDD (3.3V) 3 – GND 4 – PGD 5 – PGC 6 – LVP (not used)
J2 – J15	Generic I/O ports, PCB plated through holes	See the PIC24FJ256GB110 pin assignments table for jumper port definitions
P13	USB Connector	Standard USB Type A, 2.0 connector 1 – Vbus 2 – D- 3 – D+ 4 - GND
P16	RS232 Port, IDC 1X3	RS232 Port 1 – XMIT (out) 2 – RCVR (in) 3 - GND
P18	RS232 Port, IDC 1X3	RS232 Port 1 – XMIT (out) 2 – RCVR (in) 3 - GND

<table>
<tr>
<td>P25</td>
<td>Expansion Port, IDC 2X8</td>
<td>The I/O pins may be defined individually or programmed as a parallel port.
<table>
<tr><th>Description</th><th>PIN</th><th>PIN</th><th>Description</th></tr>
<tr><td>V5/Vbus</td><td>1</td><td>2</td><td>V3.3</td></tr>
<tr><td>PMRST</td><td>3</td><td>4</td><td>GND</td></tr>
<tr><td>PMD0</td><td>5</td><td>6</td><td>PMD1</td></tr>
<tr><td>PMD2</td><td>7</td><td>8</td><td>PMD3</td></tr>
<tr><td>PMD4</td><td>9</td><td>10</td><td>PMD5</td></tr>
<tr><td>PMD6</td><td>11</td><td>12</td><td>PMD7</td></tr>
<tr><td>PMRD</td><td>13</td><td>14</td><td>PMWR</td></tr>
<tr><td>PMA0</td><td>15</td><td>16</td><td>PMCS1</td></tr>
</table>
</td>
</tr>
</table>

Jumpers

Jumpers on the iNet2X10 board are used to configure hardware options. The table below describes jumper options.

Jumper	Description	Option 1	Option 2
J1	USB Power	Jumper ON - Board powered from USB Connector (P13), USB Device	Jumper OFF - Board powered from power Jack (J5), USB Host
P38	DTMF Signal	Jumper ON 1-2, audio input from P14, pin 2	Jumper ON 2 – 3, audio input from P14, pin 3
P32	MT88L70 Power	Jumper ON 1-2, 3.3V power (MT88L70, 3.3V device installed) usually factory installed	Jumper ON 2-3, Vbus (5V) power (MT8870,5V device installed) usually factory installed
P34	P25 Power	Jumper ON 1-2, supply 5V to expansion port P25	Jumper ON 2-3, supply Vbus to expansion port P25

Prototyping Area

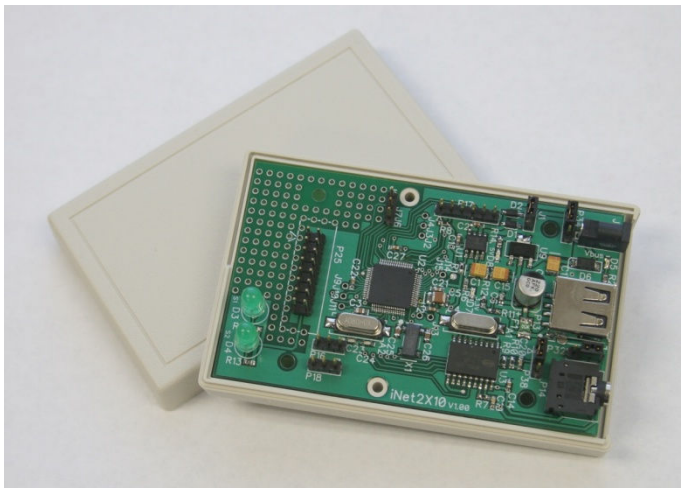
A small prototyping area is available to added hardware directly to the board. It consists of plated through holes organized in a 0.1” matrix. P25 is located adjacent to the prototyping area to allow easy access to the microcontroller ports.

LEDs

Two standard T1-3/4 5mm LEDs (PCB ref D3 and D4) are provide for general use. Both are connected directly to ports on the microcontroller and under program control. Two surface mount LEDs are provided to indicate power status. One indicates the 5V from the power jack and the other indicates 3.3V on board power supplied either from the power jack or the USB connector.

Enclosure and Mounting

A significant amount of time development time is often allocated to designing and fabricating an enclosure. The iNet2X10 board was designed to fit into a PacTec HM enclosure with minimal modifications. The board has six mounting holes. Two holes are sized and positioned to accommodate the PacTec ™ enclosure. The other four mounting holes are generic and may be used if the board is not mounted in a PacTec™ enclosure. Access to the power jack, USB connector and DTMF audio input are through the side panel of the enclosure. Two holes are required on the top cover if the status LEDs are needed. The pictures below show examples of iNet2X10 boards in a PacTec™ enclosure. The first picture has no cut outs and does not use the side panel. The second picture is an iNet2X10 board used in a product where the PacTec enclosure has cut outs and an overlay.



iNet2X10 board and a generic PacTec™ enclosure

iNet2X10 board in a PacTec™ enclosure customized for a specific application

Application Development and Programming

Hardware Development

The iNet2X10 board may be suitable for many applications as is, either as a USB device or USB Host. However, when additional hardware is needed a prototyping area consisting of plated through holes is available. Also available for expansion is P25, an IDC 2x8 connector with power and generic I/O ports. Many reference designs are available for a myriad of applications.

Firmware Development

Microchip™ as well as others offers an excellent array of programming tools for the PIC24 family of microcontrollers. Compilers, linkers, editors, programmers, in-circuit debuggers, and a vast amount of sample code and libraries are available for download. Also available for download are demo apps using the iNet2X10 board. Starting any development with sample code can greatly reduce your development time.

For the latest and complete documentation on iNet2X10 development please visit the Tri-L web site for current downloads.

Boot Loader

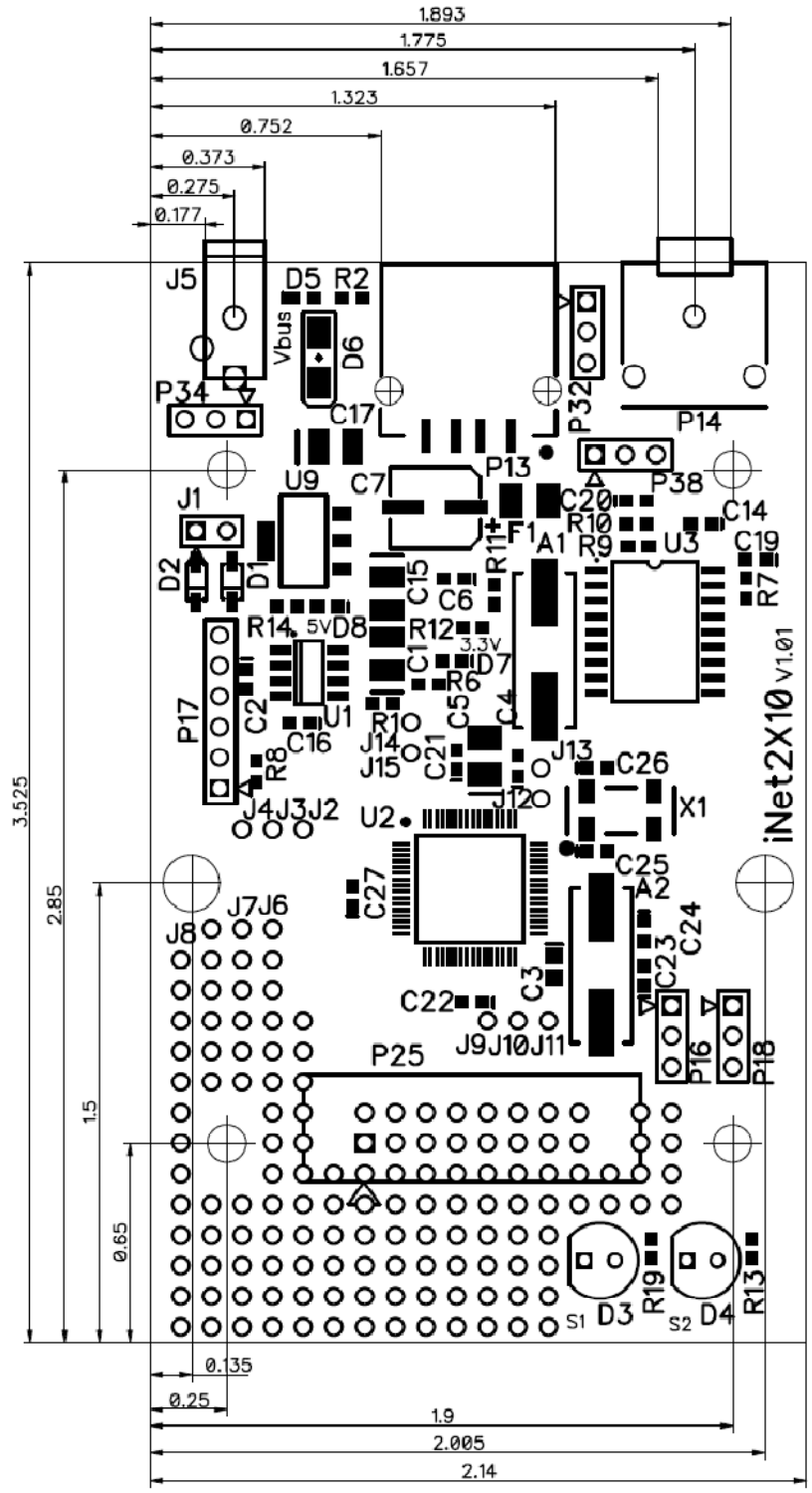
The iNet2X10 is shipped with a USB flash drive boot loader. No additional hardware is necessary to program the unit. The boot loader checks for a USB flash drive on power up. If a flash drive is detected the boot loader then checks the root directory for a code file, “iNet2X10.Hex”. If the code file is found the boot loader programs it into the microcontroller’s nonvolatile memory then executes it. The boot loader checks for previously loaded code to execute if a USB flash drive is not found.

The iNet2x10 boot loader enables your applications to be field programmable. And along with free downloadable development tools startup costs are essentially reduced to the price of an iNet2X10 board.

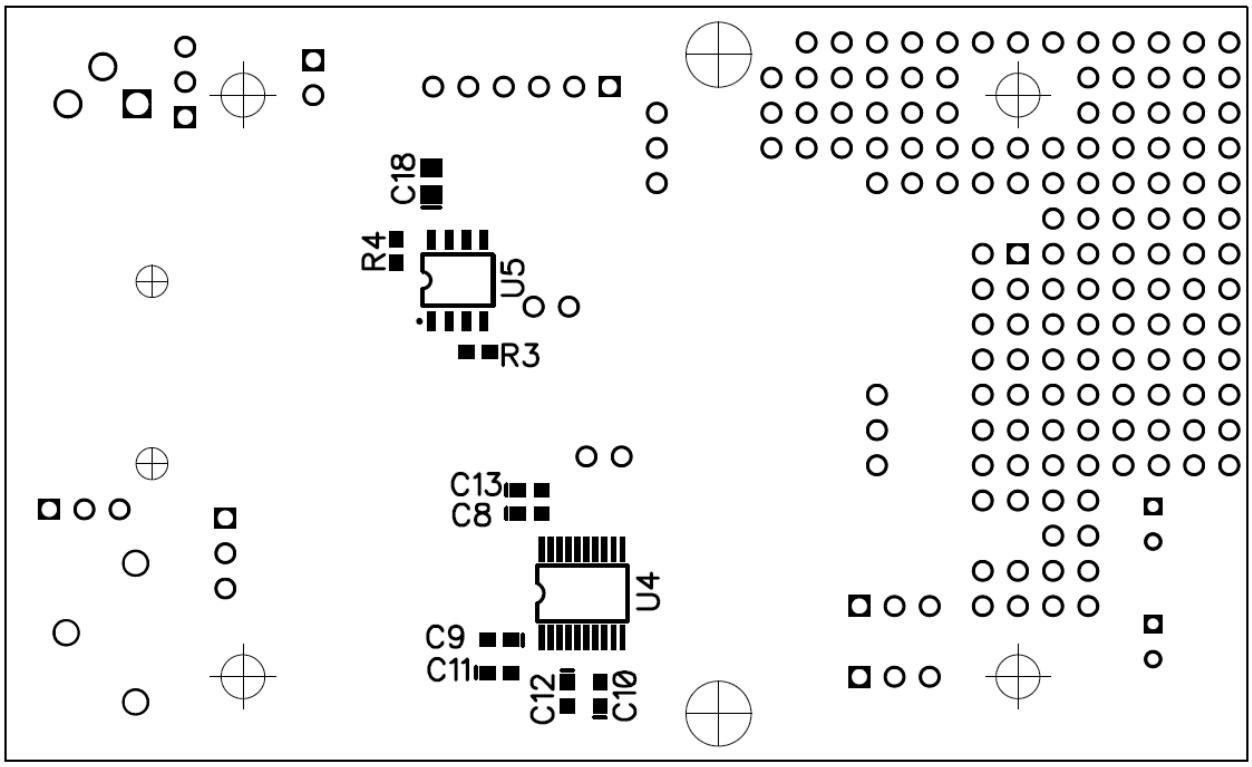
iNet2X10 Sample Code

Sample code specific to the iNet2X10 board will be made available as downloads. We hope for global contributions with a goal of making all your projects effective as well as educational, easy, and fun.

Assembly Drawings

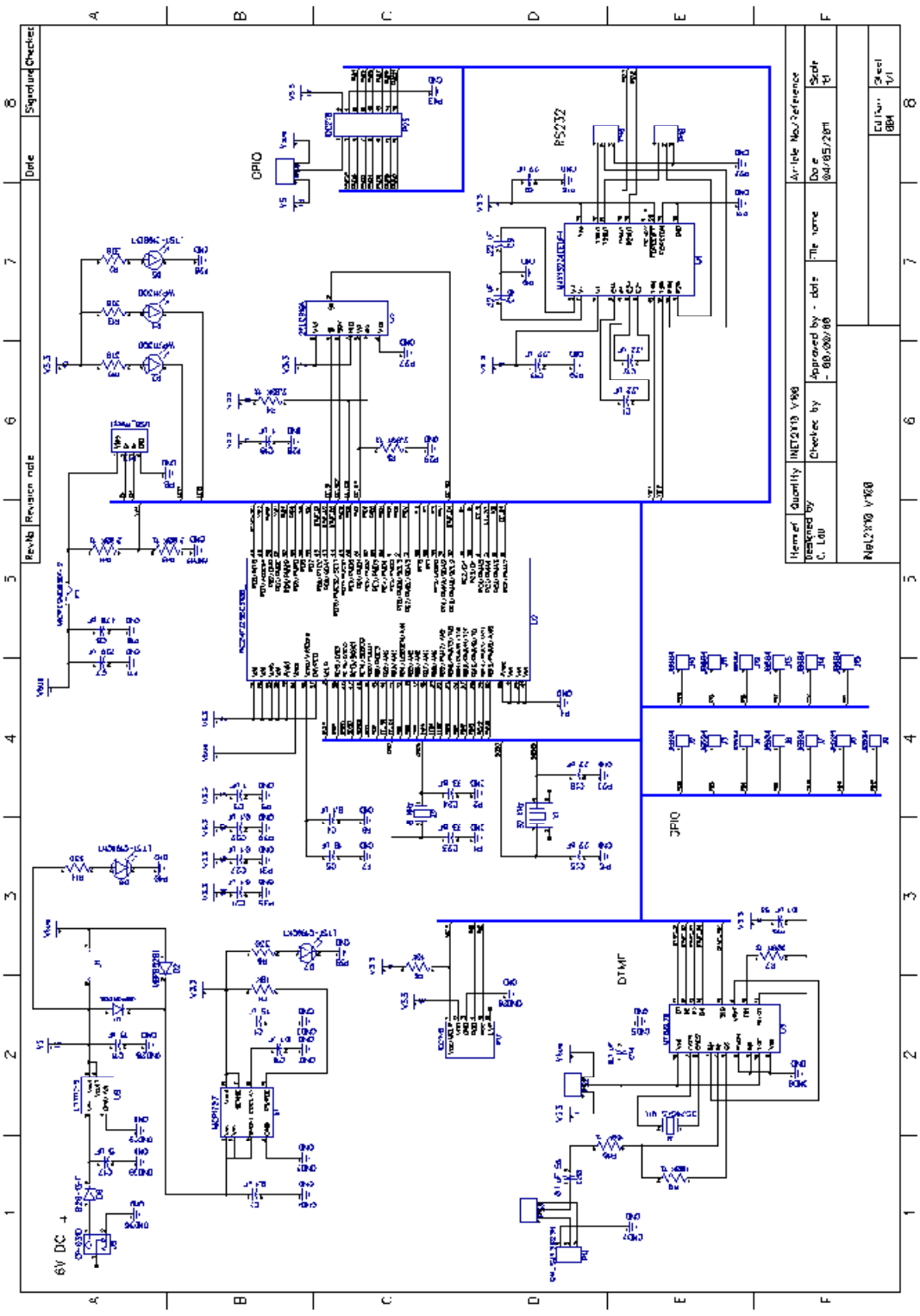


Top Assembly, Mounting Holes, 0.125” dia. (x4), PacTec™ Mounting Holes, 0.185” dia. (x2)



Bottom Assembly

Schematic Diagram



A larger version is available for download from the Tri-L web site.

Parts List

Item	PCB Reference	Type	Value
1	A1	HC49/US	3.579545 MHz
2	A2	HC49/US	8 MHz
3	C1, C15, C17	CAP	15 uF
4	C10, C11, C12, C13, C8, C9	CAP	.22 uF
5	C14, C16, C2, C21, C22, C27, C4	CAP	0.1 uF
6	C18, C3	CAP	1 uF
7	C19, C20	CAP	0.1 uF 5%
8	C23, C24	CAP	33 pF
9	C25, C26	CAP	22 pF
10	C5	CAP	10 uF
11	C6	CAP	470 pF
12	C7	CAP	220 uF
13	D1, D2	DIODE	MBR0520L
14	D3, D4	LED	WP7113GD
15	D5, D7, D8	LED	LTST-C190CKT
16	D6	DIODE	B120-13-F
17	F1	FUSE	MICROSMD050f-2
18	J5	PWR JACK	CP-031D
19	P13	USB Connector	AU-Y1006-2-R
20	P14	Mini phone jack	CUI_SJ1-3523N
21	P16, P18, P32, P34, P38	IDC1X3	IDC1x3
22	P17	ICSP Header	IDC1x6
23	P25	IDC2X8	IDC2X8
24	R1, R8	RES	10K
25	R10, R9	RES	100K 1%
26	R11, R12, R3, R4	RES	2.00K 1%
27	R13, R14, R19, R2, R6	RES	330
28	R7	RES	300K 1%
29	U1	REG	MCP1727, 3.3V
30	U2	microcontroller	PIC24FJ256GB106
31	U3	DTMF Decoder	MT88L70
32	U4	RS232 Transceiver	MAX13234EEUP+
33	U5	Serial EEPROM	25LC010A
34	U9	REG	LT1117-5, 5.0 V
35	X1	XTAL	32 KHz

Specifications

Size:	Board	2.14”W X 3.535”L X .4”H
Power:	Requirement	6V – 9V DC, approximately 70 mA
	Plug Type	1.3mm I.D. x 3.5mm O.D. x 9.5mm Female
USB:		Type A, USB 2.0
		1 Amp over current protection
DTMF:	Connector	3.50mm Headphone, mini plug

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Warranty

This Warranty shall be in lieu of any other warranty, express or implied. Implied warranties of merchantability and fitness for a particular purpose are limited in duration to 60 days from the date of purchase. The sole damages to which a purchaser or user of the iNet2X10 component may seek or recover from the manufacture, is the purchase price paid by the purchaser or user of the iNet2X10 component for the product. This Warranty shall NOT apply and is terminated when any product contained in this document or any part thereof has been subjected to accident, alteration, abuse, and misuse, or where incompatible parts are used.

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Any representations or promises inconsistent with or in addition to this Warranty are unauthorized and shall not be binding on iNet2X10's manufacturer.