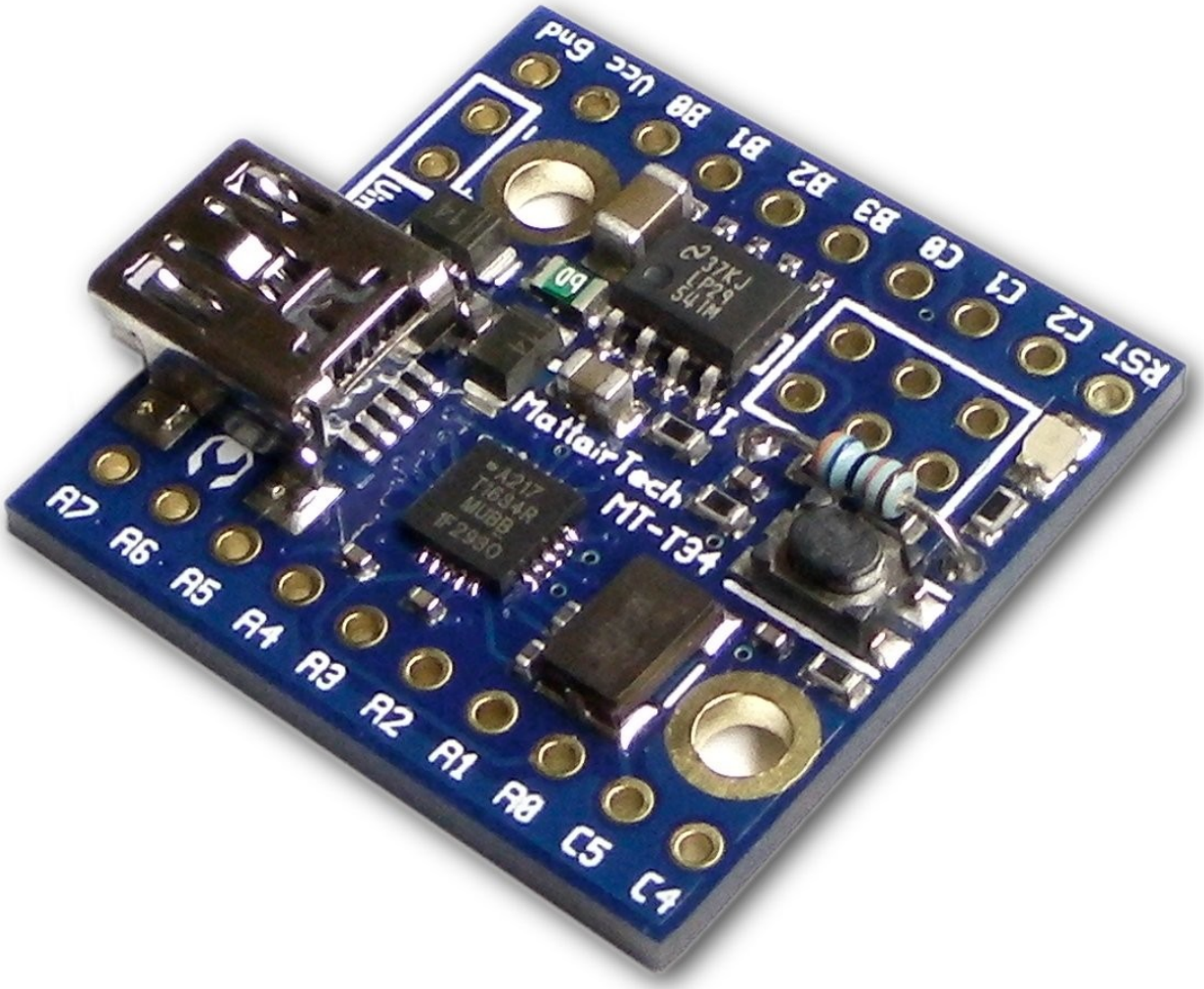
MattairTech



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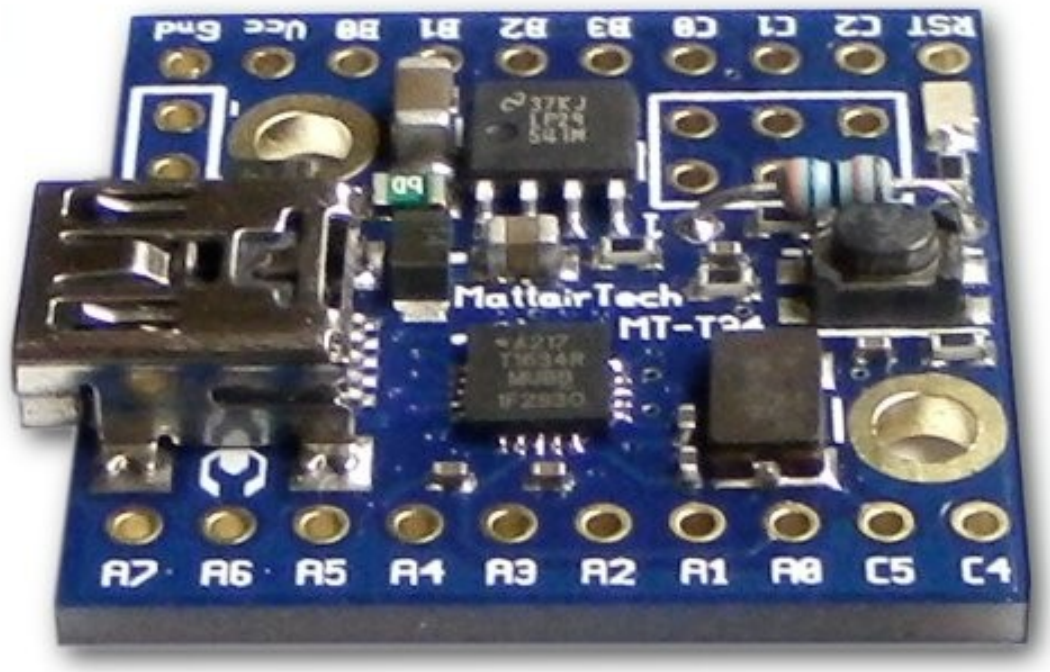
Overview



Introduction

The MT-T34 is a development board for the 20-pin Atmel AVR Tiny ATtiny1634 microcontroller. The ATtiny1634 contains 16KB FLASH, 1KB SRAM, and 256B EEPROM. Up to 18 pins are available for I/O. Power is supplied from the mini USB connector or from the Vin pin at up to 15V (up to 30V transients). Two schottky diodes facilitate simple switching between the two power sources, as well as reverse-polarity protection. Variable voltage regulation from 1.8V to 5V (1.8V to 3.8V from USB) is provided by the onboard 250mA, low quiescent current LDO regulator. A solder jumper selects between 5V or 3.3V, or a PTH resistor can be replaced for any voltage between 1.8V and 5V. Overcurrent protection is provided by a 300mA PTC resettable fuse. Also mounted is a mini USB connector, a green LED, a 12MHz or 11.0592MHz crystal, and a button that can be configured for reset or general purpose use (pin A2). The board has 20 main dual inline header pins with 100 mil pin spacing and 800 mil row spacing which supports mounting on a breadboard or perfboard. The ISP/SPI header can be used with an external programmer/debugger or be reconfigured for use as a SPI master or slave. A two-pin header (100 mil) is used for Vin. Board configuration is flexible with 10 solder jumpers. There are two 2.5mm mounting holes. The PCB measures approximately 1.0” x 1.0” x 0.062” (26mm x 26mm x 1.6mm).

Board Features

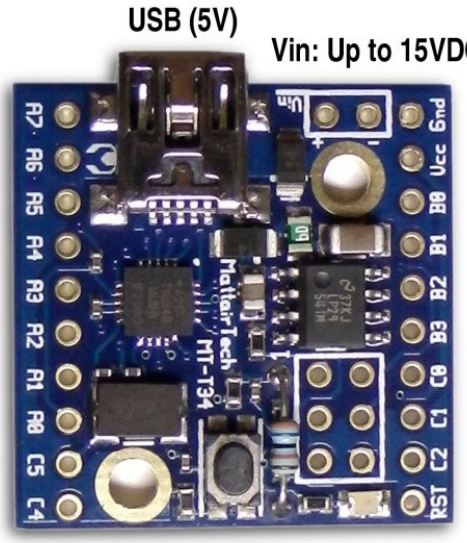
- **Atmel AVR Tiny 1634 20-pin microcontroller**
  - ATTiny1634R variant installed (+/-2% accuracy internal oscillator)
  - 16KB FLASH, 1KB SRAM, 256B EEPROM
- **Onboard 1.8V – 5V (1.8V - 3.8V from USB) Adjustable 250mA LDO regulator**
  - Up to 15V DC input on Vin pin
  - Output adjustable from 1.8V to 5V
    - Set to 5V by default (using two 0.1%, 25ppm SMT resistors)
    - Solder jumper enables a third resistor (1%, 50ppm) for 3.3V output
    - Third resistor is PTH, so it can be replaced to set voltage from 1.8V to 5V
  - low quiescent current (110uA typical)
  - low dropout (60mV typical @ 1mA, 310mV typical @ 100mA)
  - Current and thermal limiting
- **Simple power source switching**
  - 2 schottky diodes (USB Vbus and Vin)
  - Low voltage drop (300mV @ 50mA, 400mV @ 500mA), low-leakage
  - Reverse-polarity protection
  - Vin can be routed through a resistor divider (not included) to pin B0 (ADC5)
- **PTC resettable fuse (300mA)**
- **ISP/SPI header (ISP by default)**
  - As an ISP header, it is used to program the AVR with an external programmer
  - debugWire support on reset line
  - Header can be converted to SPI (master or slave) with 3 solder jumpers
  - Can mount the MT-SD MicroSD card slot directly to this header
- **12MHz or 11.0592MHz crystal options**
- **Green Status LED (can be disconnected with solder jumper)**
- **Reset/User button (set to reset by default)**
  - Solder jumper routes button to either reset or pin A2
  - Solder jumper connects 100nF capacitor for debouncing
- **Mini USB connector**
  - Provides 5V (VBus) to regulator input (regulator output should be set to <3.8V)
  - Optionally supports low-speed software USB (ie: V-USB)
    - Four 0603 SMT resistors required (PCB bottom, not included)
- **10 solder jumpers for configuration flexibility**
- Solder jumper to enable 100nF capacitor on Aref pin
- All PORT pins routed to headers
- 2 main headers are on 0.1” spacing (breadboard/perfboard mounting)
- **Two 2.5mm mounting holes (~4.5mm pad)**
- High-quality PCB with gold-plated finish
- Measures approx. 1.0” x 1.0” (26mm x 26mm) and 0.062” (1.6mm) thick

ATtiny1634 Features

- **High Performance, Low Power AVR® 8-bit Microcontroller**
- **Advanced RISC Architecture**
  - 125 Powerful Instructions – Most Single Clock Cycle Execution
  - 32 x 8 General Purpose Working Registers
  - Fully Static Operation
- **High Endurance, Non-volatile Memory Segments**
  - 16K Bytes of In-System, Self-Programmable Flash Program Memory
    - Endurance: 10,000 Write/Erase Cycles
  - 256 Bytes of In-System Programmable EEPROM
    - Endurance: 100,000 Write/Erase Cycles
  - 1K Byte of Internal SRAM
  - Data retention: 20 years at 85C / 100 years at 25C
  - Programming Lock for Self-Programming Flash & EEPROM Data Security
- **Peripheral Features**
  - Dedicated Hardware and QTouch® Library Support for Capacitive Touch Sensing
  - One 8-bit and One 16-bit Timer/Counter with Two PWM Channels, Each
  - 12-channel, 10-bit ADC
  - Programmable Ultra Low Power Watchdog Timer
  - On-chip Analog Comparator
  - Two Full Duplex USARTs with Start Frame Detection
  - Universal Serial Interface (two-wire or three-wire(SPI), master or slave)
  - Slave I^2C Serial Interface
- **Special Microcontroller Features**
  - debugWIRE On-chip Debug System
  - In-System Programmable via SPI Port
  - Internal and External Interrupt Sources
    - Pin Change Interrupt on 18 Pins
  - Low Power Idle, ADC Noise Reduction, Standby and Power-down Modes
  - Enhanced Power-on Reset Circuit
  - Programmable Brown-out Detection Circuit with Supply Voltage Sampling
  - Calibrated 8MHz Oscillator with Temperature Calibration Option
  - Calibrated 32kHz Ultra Low Power Oscillator
  - On-chip Temperature Sensor
- **I/O and Packages**
  - 18 Programmable I/O Lines
  - 20-pad QFN/MLF, and 20-pin SOIC
- **Operating Voltage:**
  - 1.8 – 5.5V
- **Speed Grade:**
  - 0 – 2MHz @ 1.8 – 5.5V
  - 0 – 8MHz @ 2.7 – 5.5V
  - 0 – 12MHz @ 4.5 – 5.5V
- **Temperature Range: -40C to +85C**
- **Low Power Consumption**
  - Active Mode: 0.2mA at 1.8V and 1MHz
  - Idle Mode: 30µA at 1.8V and 1MHz
  - Power-Down Mode (WDT Enabled): 1µA at 1.8V
  - Power-Down Mode (WDT Disabled): 100nA at 1.8V

MT-T34 Hardware

Top View / Pinout



*** Note that when USB is supplying regulator input, output should be set to <3.8V to maintain regulation.**

Header Pins (power)

Pin	*Description*
Vin +	Vin is the external power / battery input pin. Up to 15V can be connected. It is routed through a schottky diode, which provides simple switching between power sources (Vin and USB Vbus) and reverse-polarity protection. It is further routed through a 300mA trip (100mA hold) PTC fuse to a 4.7uF, 50V X7R ceramic capacitor on the regulator input. Vin voltage can optionally be measured on pin B0 by installing two 0603 SMT resistors (R1 and R2 on bottom of PCB). Note that the regulator can support up to 30V. The PTC fuse can have up to 15V across its terminals. Thus, Vin can support transient voltages up to 15V higher or lower than the nominal (ie: 30V transient from a nominal 15V input).
Vin -	Ground
Vcc	This pin is connected to the regulator output. It is also connected to the Vcc pin of the AVR, the PDI/SPI header Vcc pin, the regulator feedback network, and the reset pullup. There is a 10uF X7R ceramic capacitor on this line. Vcc can be adjusted from 1.8V to 5V (5V by default).
Gnd	Ground

Header Pins (signal)

Pin	*Description*
A7	ADC4, RXD0, PCINT7, PA7 (standard sink)*
A6	ADC3, OC1B, PCINT6, PA6 (high sink)*
A5	ADC2, OC0B, PCINT5, PA5 (high sink)*
A4	ADC1, T0, PCINT4, PA4 (standard sink)*
A3	ADC0, T1, SNS (capacitive touch), PCINT3, PA3 (standard sink)*
A2 / **BTN**	Button, AIN1, PCINT2, PA2 (standard sink)* This pin can be connected to the button using J4. Additionally, the button can be debounced by soldering J3. See J3 and J4 below.
A1 / **LED**	LED, AIN0, PCINT1, PA1 (standard sink)* This pin can be connected to the green LED through a 330ohm resistor by soldering J5. Drive pin A1 high to turn on the LED. This pin can source up to 10mA @ 5V (5mA @ 3V). Disconnect J5 to disable the LED.
A0 / **REF**	AREF, PCINT0, PA0 (standard sink)* When using as AREF, solder J9 to connect a 100nF capacitor to this line.
C5 / **X1**	XTAL1, CLKI, PCINT17, PC5 (standard sink)* This pin is always connected to one terminal of the crystal and to a 22pF capacitor. It can be used as an external clock input or for GPIO as well.
C4 / **X2**	XTAL2, PCINT16, PC4 (standard sink)* This pin is always connected to one terminal of the crystal and to a 22pF capacitor. It can be used for GPIO as well.
B0 / **EV**	EV (External Voltage), ADC5, TXD0, PCINT8, PB0 (standard sink)* This pin can be used for voltage measurement of Vin. To do this, install appropriate value resistors on the 0603 SMT pads marked R1 and R2 (bottom of the PCB). This will create a voltage divider. The divided voltage will appear on this pin for measurement using ADC5. See schematic.
B1 / **DI**	DI (SPI/ISP Data In), ADC6, SDA, RXD1, PCINT9, PB1 (standard sink)* This pin is routed to the ISP/SPI header using J7 or J8 (see below).
B2 / **DO**	DO (SPI/ISP Data Out), ADC7, TXD1, PCINT10, PB2 (standard sink)* This pin is routed to the ISP/SPI header using J7 or J8 (see below).
B3 / **LV**	LV (Low Voltage error), ADC8, OC1A, PCINT11, PB3 (high sink)* This pin can be connected via J6 to the Low Voltage error output of the regulator, which will drive low if the output falls out of regulation by more than 5%. Enable the internal pullup resistor on this pin to use this output.
C0 / **D-**	D- (USB), ADC9, OC0A, XCK0, PCINT12, PC0 (high sink)* This pin can be connected to the USB D- pin for use with low-speed software USB. Appropriate resistors must be installed to R3, R4, R5, and R6 (0603 SMT pads on bottom of PCB). See schematic. V-USB should be able to be ported to the Tiny1634. You will need to use the 12MHz crystal and operate at 3.3V (note that it will be overclocked). This has not been

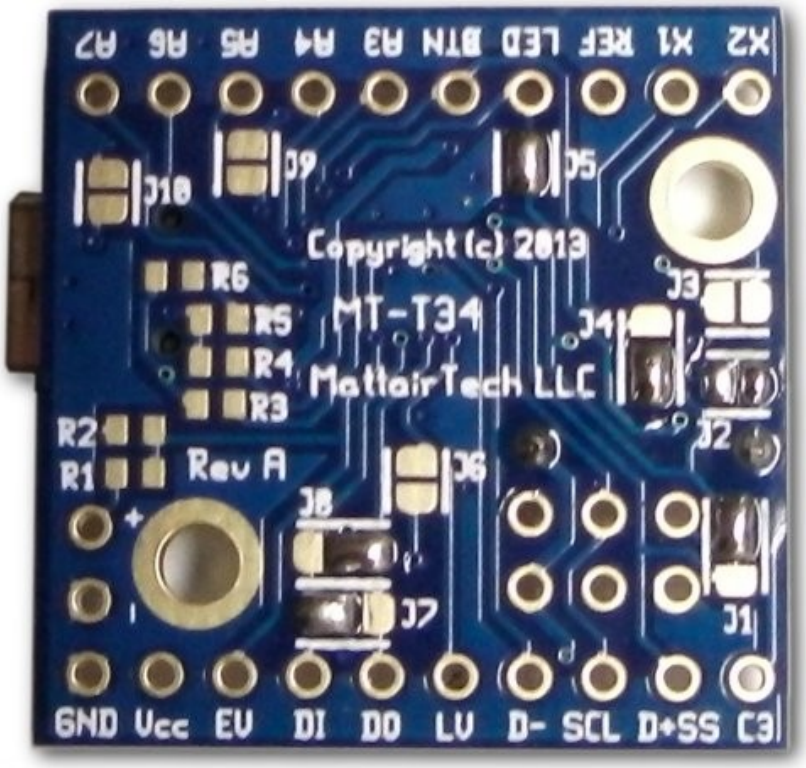
	tested. See V-USB documentation for resistor values and documentation.
C1 / SCL	SCL (SPI/ISP Clock), ADC10, ICP1, USCK, XCK1, PCINT13, PC1 (standard sink)* This pin is connected to the ISP/SPI header as well. See schematic.
C2 / D+SS	SS (SPI/ISP CS/SS), D+ (USB), ADC11, CLKO, INT0, PCINT14, PC2 (standard sink)* This pin can be connected via J1 to the ISP/SPI header for use as a CS or SS signal. See J1 below. This pin can also be connected to the USB D+ pin for use with low-speed software USB. See C0/D- above for details.
RST / C3	RESET, dW (debugWIRE), PCINT15, PC3 (low drive)* This pin connects to the reset pin of the Tiny, and can optionally connect to the reset button through J4, and to the PDI/SPI header through J1. See J1 and J4 below. A 10K pullup resistor is connected to this pin. This pin can be used for GPIO if the reset function is disabled by fuse setting.
ISP/SPI Header	This header can be connected to an external ISP programmer/debugger (debugWire supported). Alternatively, this header can be used for SPI communications (master or slave). To convert the header to SPI mode, switch solder jumpers J1, J7 and J8 to their alternate positions. This will switch the positions of USI pins DI and DO (B1 and B2) and connect C2 for use as CS (or SS if in slave mode). Note that when using the header for ISP debugging, the button debouncing capacitor must be disconnected (jumper J3) if the button is configured for reset. See schematic for pinout.

** Standard sink pins: 10mA @ 5V (5mA @ 3V). High sink pins: 20mA @ 5V (10mA @ 3V).*

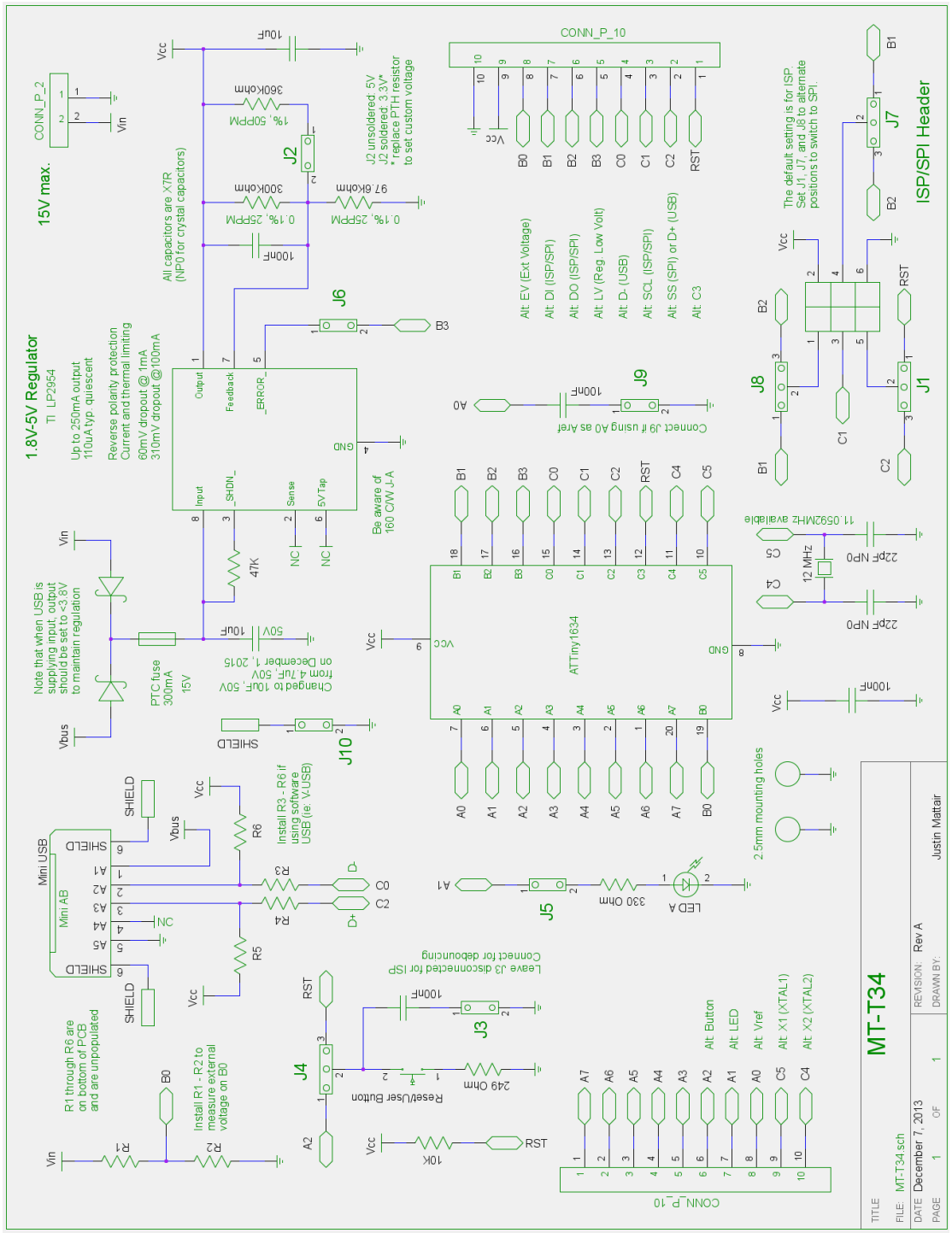
Solder Jumpers

Pin	*Description*
J1: ISP/SPI Selection	This jumper routes pin 5 of the ISP/SPI header to either reset (for ISP) or pin C2 (for SPI CS or SS). The default setting is reset (solder blob away from J1 printing). See ISP/SPI Header above.
J2: Regulator Voltage Selection	A voltage divider is used to set the output voltage of the regulator. Two SMT resistors are installed that set the voltage to 5V. A third PTH resistor is also installed. Soldering J2 will place this resistor in parallel with the top resistor of the SMT divider, bringing the output voltage down to 3.3V. The PTH resistor can be replaced as well, allowing any voltage between 1.8V and 5V (see regulator datasheet for details). Note that the PTH resistor is next to the button. If J2 is soldered, then pressing the button may result in contact with the resistor lead near the edge of the PCB, which will cause a glitch in the output voltage. A 100nF capacitor on the feedback line, as well as the 10uF output capacitor, help limit this glitch. However, it is best to avoid contact with this lead when J2 is soldered. **Note that when USB is supplying the regulator input, the output should be set to <3.8V to maintain regulation.**

J3: Button Debouncing Capacitor	Solder this jumper to enable the button debouncing capacitor. Leave disconnected if using debugWire on the ISP header.
J4: Button Function Selection	This jumper routes the button to either reset or to pin A2. The default setting is reset (solder blob away from J4 printing). See J3.
J5: LED	This jumper connects the LED to pin A1. See pin A1.
J6: Regulator Error Output	This connects the regulator Low Voltage error output to pin B3. See pin B3.
J7: ISP/SPI Selection	This jumper routes pin 4 of the ISP/SPI header to either DI (for ISP) or to DO (for SPI). See ISP/SPI Header in table above.
J8: ISP/SPI Selection	This jumper routes pin 1 of the ISP/SPI header to either DO (for ISP) or to DI (for SPI). See ISP/SPI Header in table above.
J9: Aref capacitor	Solder this jumper to enable a 100nF capacitor on pin A0. This is useful when using pin A0 as Aref.
J10: USB Shield Ground	Jumper J10 can be soldered to connect the USB shield to ground. The USB specification calls for the USB shield to be connected to ground on the host side only. However, some prefer to have it grounded. An 0603 component may be soldered here as well.



Schematic


MT-T34
1.8V-5V Regulator
TI LP2954
ISP/SPI Header
ATTiny1634
Justin Mattair
December 7, 2013
Rev A

Troubleshooting / FAQ

- Nothing yet

Support Information

Please check the MattairTech website (http://www.MattairTech.com/) for firmware and software updates. Email me if you have any feature requests, suggestions, or if you have found a bug. If you need support, please contact me (email is best). You can also find support information at the MattairTech website. A support forum is planned. Support for AVRs in general can be found at AVRfreaks (http://www.avrfreaks.net/). There, I monitor the forums section as the user physicist.

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Appendix A: Precautions

CAUTION
Do not change power configuration, or solder any jumper while unit is powered. Do not short Vin, Vcc, or ground to each other (ie: solder jumpers on bottom shorting on clipped lead).

CAUTION
The MT-T34 contains static sensitive components. Use the usual ESD procedures when handling.

CAUTION
Higher regulator input voltages mean larger voltage drops and thus higher thermal dissipation for a given amount of current. Be sure to limit current consumption to prevent excessive heat when using higher voltages and/or currents or operating at high ambient temperatures. **The regulator has a theta j-a of 160C/W.** The regulator will enter thermal shutdown if it gets too hot.

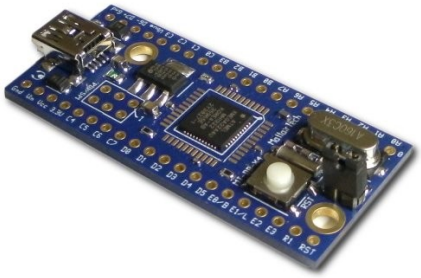
Appendix B: Other MattairTech Products

ZeptoProg II AVRISP mkII Programmer

- AVRISPmkII compatible AVR Programmer
- Supports all AVRs with ISP, PDI, or TPI
- Optional 5V output via headers to target board, with standard jumper and PTC fuse
- 4-channel Logic Analyzer
- Serial bridge / pattern generator / SPI interface
- GPIO / PWM / frequency input & output
- Atmel Studio / AVRDUDE support
- Target board voltage of 2V to 5.5V via level-shifted pins on two main headers

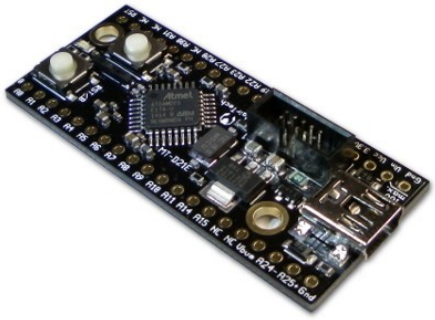
MT-DB-U6 USB AVR development board

- AT90USB646 / AT90USB1286 USB AVR
- 64KB/128KB FLASH, 4KB/8KB SRAM
- 5V, 500mA LDO regulator (3V-30V input)
- Auto power source selection IC (USB/External)
- 16MHz and 32.768KHz crystals
- Arduino compatible
- CDC or DFU bootloader



MT-DB-X4 USB AVR XMEGA board

- ATxmega128A4U USB XMEGA AVR
- 128KB FLASH, 8KB SRAM, 2KB EEPROM
- 3.3V LDO regulator (low quiescent current)
- 16MHz and 32.768KHz crystals
- LED, boot jumper, PDI header
- Reset button, mounting holes
- USB DFU bootloader preinstalled



MT-D21E USB ARM Cortex M0+ board

- ATSAMD21E17A or ATSAMD21E18A (32-pin)
- 128KB/256KB FLASH, 16KB/32KB SRAM
- Onboard 3.3V, 250mA LDO regulator (2uA quiescent)
- 16MHz and 32.768KHz crystals
- USB connector (power by USB or external up to 15V)
- Blue LED, 10-pin Cortex header, 2 buttons, I2C pullups
- USB Mass Storage Bootloader (no programmer required)