MT-SD User Guide

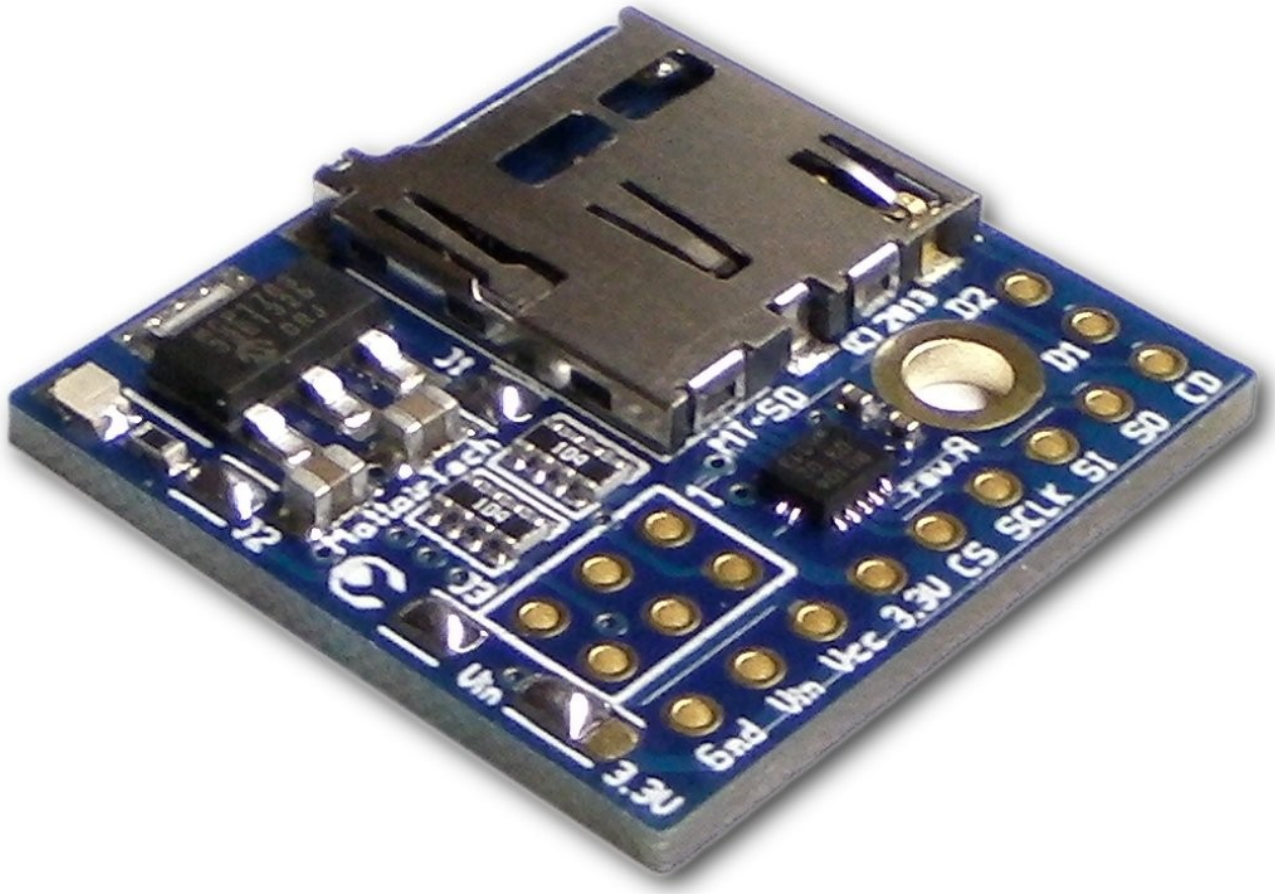
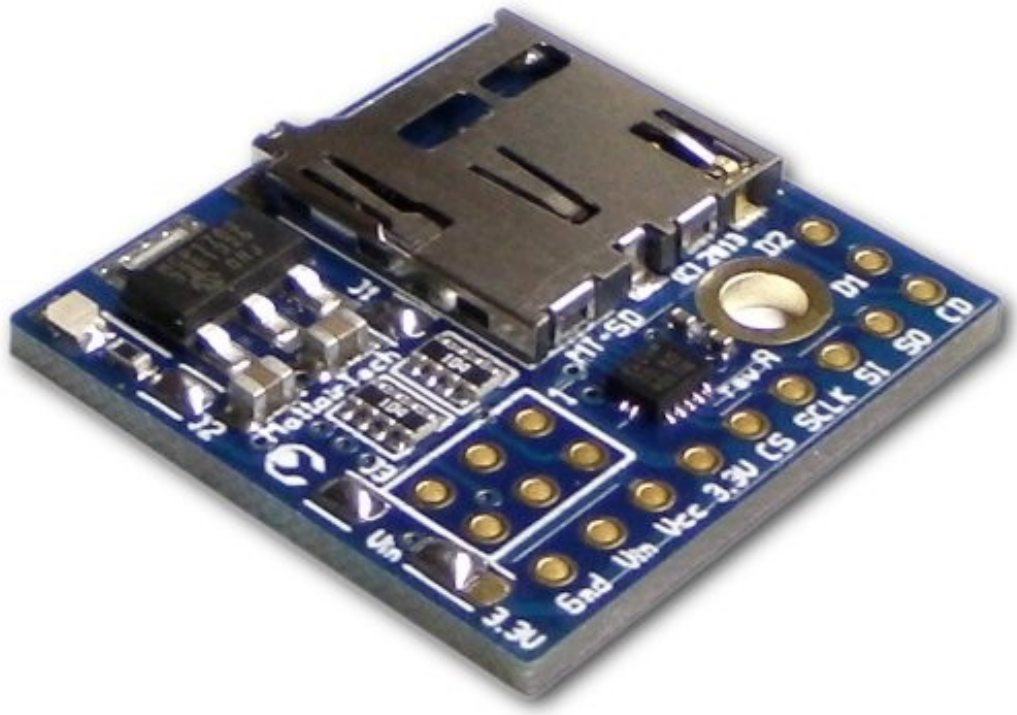


Table of Contents

Overview

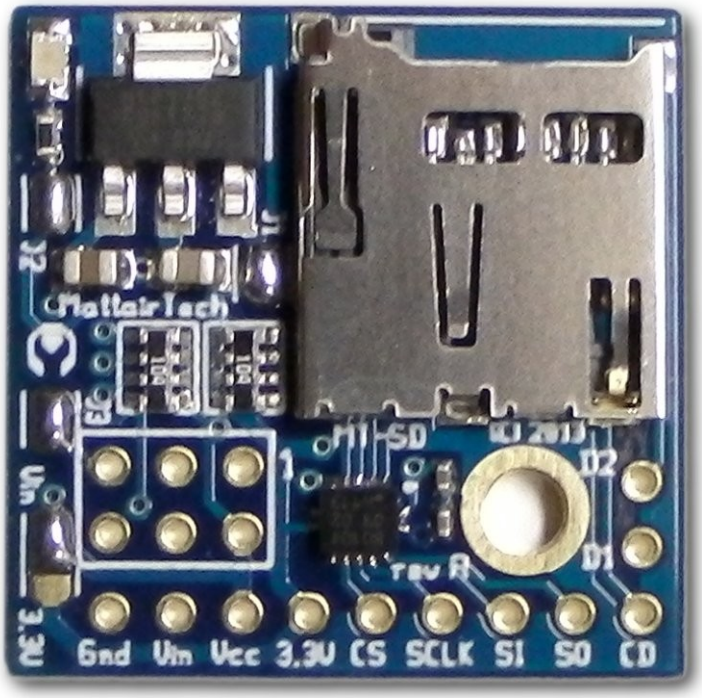


Introduction

The MT-SD is a MicroSD card slot with an onboard 3.3V LDO regulator and a level translator to convert between 3.3V and the microcontroller Vcc rail (3.3V to 5.5V), all mounted on a 26mm (1") square PCB with flexible configuration and connection options. The card slot has a push-push spring mechanism to secure the card in place. The board can be connected using the 9 pin single inline header with 100 mil pin spacing (typically using 6 or 7 pins). A SPI header is available which can be used to mount to the ISP/SPI or PDI/SPI connectors of many MattairTech boards, or to mount to the ISP-only connectors found on most AVR development and Arduino boards (must route CS separately). The regulator input can be up to 16V. It can output up to 250mA which can be used by external devices using the 3.3V pin. Both the regulator and the level translator have very low quiescent current consumption (2uA and 3.5uA, respectively). Eight pullup resistors ensure that all lines are pulled high when not driven by the MCU or MicroSD card. A green LED indicates 3.3V power. It can be disconnected to save power. The PCB is high-quality with ENIG (gold-plated) finish, blue soldermask, and white screenprinting showing the pinout. There is one 3mm mounting hole (~5mm pad). The PCB itself measures 26mm x 26mm x 1.6mm (1" x 1" x 0.062").

MT-SD Features

- **MicroSD card slot with push-in/push-out spring action**
- **Onboard 3.3V, 250mA LDO regulator**
  - Up to 16V input on Vin pin
  - extremely low quiescent current (2.0uA typical)
  - low dropout (525mV typical @ 250mA, 725mV max. @ 250mA)
  - Over-current and over-temperature protection
  - Can use 3.3V output for external devices
  - Can disconnect regulator and supply your own 3.3V
- **Vcc (MCU) to 3.3V (SD card) level translator onboard**
  - Vcc (MCU IO voltage) can be from 3.3V to 5.5V
- **100Kohm pullup resistors**
  - All SPI pins (CS, SCLK, SI, and SO) have pullups on both sides of the translator
- **Green power LED (can be disconnected)**
- All MicroSD pins routed to headers, including card detect, and D1 & D2 (4-bit SD mode)
- Can be mounted on an ISP header (AVR based boards)*
  - With MT-DB-xx boards, all connections can be routed through ISP or PDI header
  - With Arduino or other boards, all but CS are routed through the ISP header
- Solder jumpers for flexible configuration
- High-quality PCB with gold-plated finish
- One 3mm mounting hole (~5mm pad)
- Measures 26mm x 26mm (1" x 1") and 1.6mm (0.062") thick.



MT-SD Hardware

Main Header Pins

Pin	*Description*
Gnd	Ground
Vin	Vin is connected to the regulator input. It supports from 4V to 16V. If light loads are expected (only the MicroSD card), the input voltage can be as low as 3.6V. Normally, the required power connections are Vin, Vcc, and Gnd. If both Vin and Vcc are greater than 4V(3.6V) and less than 5.5V (the limit on Vcc), Vin can be soldered to Vcc with J4. Then, only two power connectors are required. This would be convenient when Vcc is 5V. See Vcc pin below. See Installation section for details.
Vcc	Vcc must be the same voltage as the MCU IO voltage. It can range from 3.3V to 5.5V. It connects to the level translator VccB pin. So, the voltage you used for logic high on the interface between the MT-SD and your microcontroller is the voltage that should be applied to this pin. Normally, the required power connections are Vin, Vcc, and Gnd. See Vin pin above. See Installation section for details.
3.3V	**Optional connection.** By default, this is the 3.3V output from the regulator, which can be used to power external circuitry, including the microcontroller board Vcc (see Installation section). Alternatively, this pin can be used as a 3.3V input. See Installation section for details.
CS	CS chip select input in SPI mode (CD/DAT3 in SD 4-bit mode).
SCLK	SCLK clock input in SPI mode (CLK in SD 4-bit mode).
SI	DI data input in SPI mode (CMD in SD 4-bit mode).
SO	DO data output in SPI mode (DAT0 in SD 4-bit mode).
CD	Card Detect. Connected to ground when card is inserted, open otherwise.
D1	Unused in SPI mode (DAT1 in SD 4-bit mode).
D2	Unused in SPI mode (DAT2 in SD 4-bit mode).

ISP Header Pins

Pin	*Description*
1 / SO	This pin is closest to the MicroSD card slot and is labeled 1. It is connected to the SO main header pin. See above for details.
2 / Vcc	Connected to Vcc main header pin. See above for details.
3 / SCLK	Connected to SCLK main header pin. See above for details.
4 / SI	Connected to SI main header pin. See above for details.
5 / CS or reset	See explanation for solder jumper J3 in the table below.
6 / Gnd	Ground

Solder Jumpers

Pin	*Description*
J1: Regulator Output Disconnect	Remove solder to disconnect 3.3V regulator output from output capacitor and 3.3V rail. This is useful when supplying 3.3V externally on the 3.3V pin. When configured this way, Vin should be disconnected and the center pad of J4 should be soldered to 3.3V. See Installation section for details.
J2: LED Disconnect	Unsolder this to disconnect the LED, which will save around 6mA.
J3: SPI Header CS	The CS line is always routed to the CS pin on the main header. Solder J3 to also route the CS line to the SPI header pin 5. Do this only with compatible MattairTech boards (ie: MT-DB-xx). These boards have an ISP or PDI programming header that can be converted to route SPI signals and chip select instead. On other boards with an ISP header, the SPI signal pins are compatible, however, the CS pin is instead connected to microcontroller reset. Use of the SPI header may still be convenient, but the CS signal must be routed separately from the main header and J3 must be unsoldered.
J4: Power Configuration	This is the 3-pad solder jumper labeled Vin on the left and 3.3V on the right. The center pin is connected to Vcc, which is the voltage used by the microcontroller side of the level translator. Normally, the required power connections are Vin, Vcc, and Gnd. If both Vin and Vcc are greater than 4V (3.6V under light loads) and less than 5.5V (the limit on Vcc), Vin can be soldered to Vcc with J4 (solder blob on Vin side). Then, only two power connectors are required. This would be convenient when Vcc is 5V. If, however, Vcc is 3.3V, connect Vcc to 3.3V with J4 (solder blob on 3.3V side) and disconnect J1. See pins table. See Installation section for details.

Onboard 3.3V, 250mA LDO Regulator

- Microchip MCP1703-3302E
- 250mA, 3.3V output
- Up to 16V input
- extremely low quiescent current (2.0uA typical)
- low dropout (525mV typical @ 250mA, 725mV max. @ 250mA)
- No minimum load
- 0.4% output tolerance typical
- Over-current and over-temperature protection
- -40C-125C operating temperature
- Consult datasheet for more information

Level Translator

- NXP NTB0104BQ,115 level translator
- auto-direction sensing
- 3.3V on VccA, 3.3V-5.5V on VccB
- 3.5uA typical supply current
- All outputs high-impedance when either Vcc or 3.3V are not present
- 2mA+ drive required by inputs
- Up to 70pF capacitive loads (one-shot driver)
- -40C-125C operating temperature
- Consult datasheet for more information

Pullup Resistors

- 100Kohm pullup resistors (8 total) for SI, SO, SCLK, and CS (both sides of translator)
- Should not use additional pull resistors (any additional pullup MUST be at least 100Kohm)

Card Detect

The CD pin can be used to detect the presence of a MicroSD card. When the slot is empty, CS is not connected. When a MicroSD card is inserted, CS will be connected to ground.

4-bit mode

Two additional pins, D1 (DAT1) and D2 (DAT2), are used for 4-bit SD mode. Some microcontrollers support this mode in hardware.

Mounting Hole

There is one grounded mounting hole. It has a hole diameter of 3mm and the pad is 4.8mm. It is located behind the MicroSD card slot.

Installation / Configuration

Installation Using the Main Header

Most boards should be installed using the main header. Connect two to four power pins (Vin, Vcc, 3.3V, and Gnd), and the four SPI signal pins (SI, SO, SCLK, and CS). Normally, the required power connections are Vin, Vcc, and Gnd. Vin is connected to the 3.3V regulator input. It supports from 4V (3.6V under light loads) to 16V. Vcc is the MCU IO voltage, which is needed by the level translator and can range from 3.3V to 5.5V. If both Vin and Vcc are greater than 4V(3.6V) and less than 5.5V (the limit on Vcc), Vin can be soldered to Vcc with J4. Then, only two power connectors are required. If Vcc is 3V-3.6V, instead solder J4 to connect Vcc to 3.3V and disconnect J1. If the MicroSD card supports operation down to 2.7V, then the 3.3V rail can also be as low as 2.7V. Again, only two power connectors are required in this case.

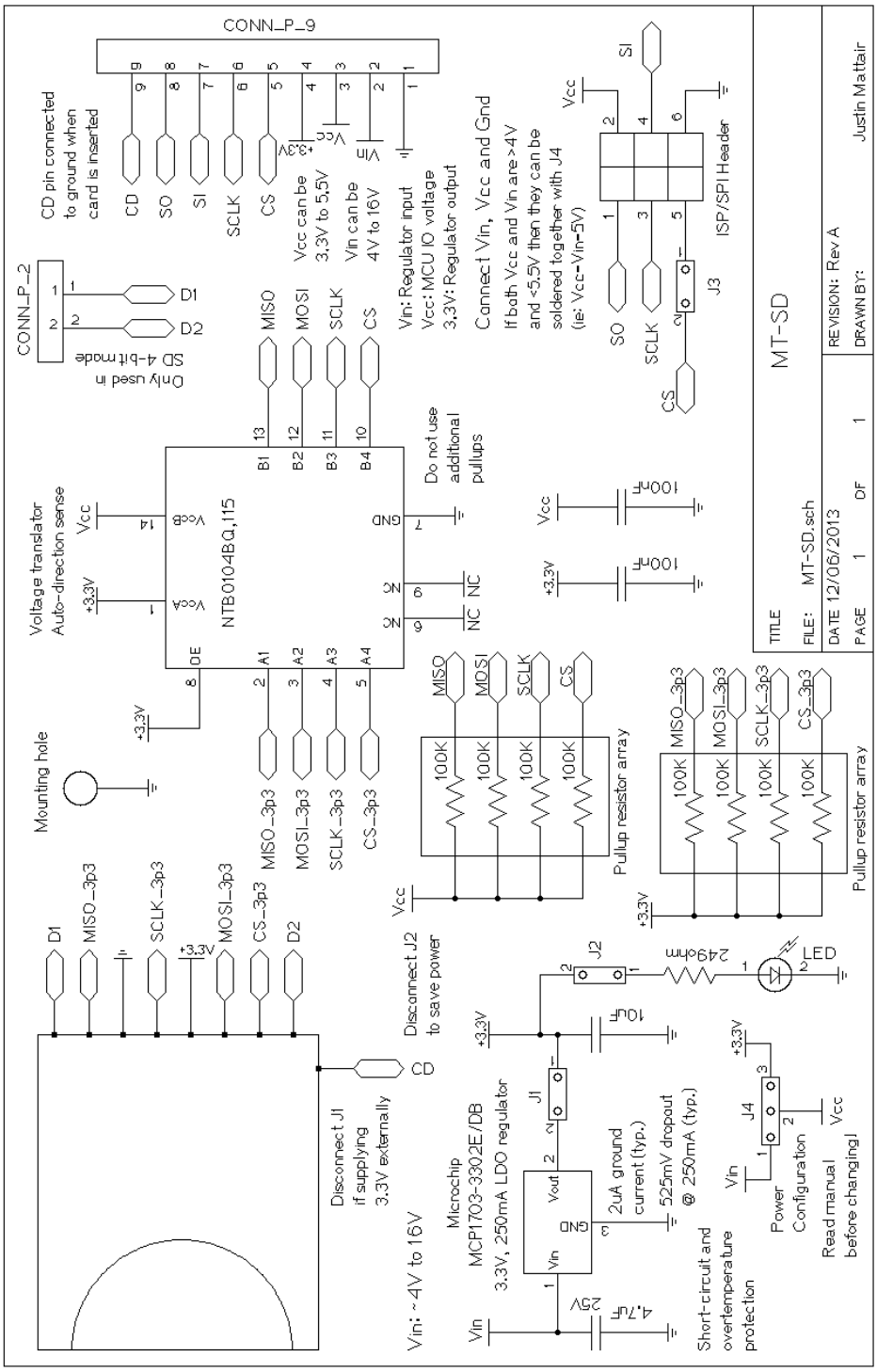
Additionally, the MT-SD can be mounted directly (not using wires) to the main header of some MattairTech boards. This is because the pinout of a portion of the MT-DB-Ux (currently the MT-DB-U4 and MT-DB-U6, but not the MT-DB-Xx) main header matches the pinout of the MT-SD. When viewing the MT-DB-Ux board with the USB connector to the right, the portion of the main header that will be connected to the MT-SD starts at the upper right pin (ground). When connecting the MT-DB-Ux this way, leave J4 unconnected to either Vin or 3.3V. The MT-DB-Ux has a jumper (usually J1) that sets Vcc to either 5V or 3.3V. 5V is provided by USB Vbus or a regulator, and 3.3V can be supplied by the MT-SD 3.3V regulator. When using the MT-SD 3.3V as Vcc, the AVR internal 3.3V regulator should be disabled (however, everything should still work if it is not disabled).

Installation Using the SPI Header

The MT-SD can be mounted directly to the 6-pin ISP/SPI or PDI/SPI header found on many MattairTech boards (ie: MT-DB-xx series). These headers are normally used for programming, but can be reconfigured to route SPI signals and chip select. On boards with ISP, only one solder jumper is required to be switched. On boards with PDI, conversion to SPI requires several jumpers. See the board documentation for details. Once the header is converted to SPI, solder J3 on the MT-SD to connect the CS line to the SPI header. If the MattairTech board has a 4V(3.6V) to 5.5V Vcc, solder J4 to connect Vcc to Vin. Otherwise, if Vcc is 3V-3.6V, solder J4 to connect Vcc to 3.3V and disconnect J1. Voltages above 5.5V are not supported when using only the SPI header.

Many AVR based boards, including Arduino boards, have an ISP header. The MT-SD can be mounted directly to this header as well. However, the CS line must be routed separately using the main header and ISP programming can only be performed with the MT-SD disconnected. When doing this, unsolder J3 on the MT-SD to disconnect the CS line from the SPI header, as this line is used as reset on the corresponding ISP header. Additionally, if the board has a 4V(3.6V) to 5.5V Vcc, solder J4 to connect Vcc to Vin. Otherwise, if Vcc is 3V-3.6V, solder J4 to connect Vcc to 3.3V and disconnect J1. Voltages above 5.5V are not supported when using only the SPI header.

Schematic


CONN_P_9
CD pin connected to ground when card is inserted
CD
SO
SI
SCLK
CS
Vcc can be 3.3V to 5.5V
Vin can be 4V to 16V
Vin: Regulator input
Vcc: MCU IO voltage
3.3V: Regulator output
Connect Vin, Vcc and Gnd
If both Vcc and Vin are >4V and <5.5V then they can be soldered together with J4 (ie: Vcc=Vin=5V)
ISP/SPI Header
J3
CONN_P_2
Only used in SD 4-bit mode
D1
D2
MISO
MOSI
SCLK
CS
Voltage translator
Auto-direction sense
NTB0104BQ,115
Do not use additional pullups
Mounting hole
MISO_3p3
MOSI_3p3
SCLK_3p3
CS_3p3
100K
Pullup resistor array
100nF
MT-SD
TITLE
FILE: MT-SD.sch
DATE 12/06/2013
PAGE 1 OF 1
REVISION: Rev A
DRAWN BY: Justin Mattair
Disconnect J2 to save power
J2
249ohm
LED
10uF
Disconnect J1 if supplying 3.3V externally
Vin: ~4V to 16V
Microchip
MCP1703-3302E/DB
3.3V, 250mA LDO regulator
J1
2uA ground current (typ.)
525mV dropout @ 250mA (typ.)
4.7uF
25V
Short-circuit and overtemperature protection
J4
Power Configuration
Read manual before changing!

Troubleshooting / FAQ

Nothing yet

Support Information

Please check the MattairTech website (http://www.MattairTech.com/) for documentation 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.

Justin Mattair
MattairTech LLC
PO Box 1079
Heppner, OR 97836 USA
541-626-1531
justin@mattair.net
http://www.mattairtech.com/

Legal

Copyright Notices

Software Warranty Disclaimer

Hardware Disclaimer

Trademarks

Appendix A: Precautions

CAUTION
Take care when setting jumper J4, as misconfiguration may lead to permanent damage to the MT-SD and/or your microcontroller board. Do not change power configuration while unit is powered.

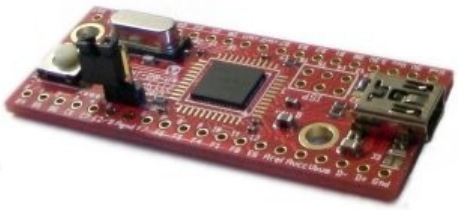
CAUTION
Do not exceed 16V on the Vin pin. Do not exceed 5.5V on Vcc. If Vin is connected to Vcc via J4, Vin and Vcc cannot exceed 5.5V.

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

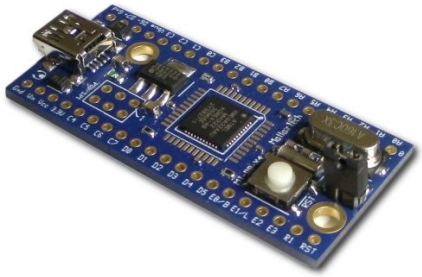
Appendix B: Other MattairTech Products

- **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-U4 USB AVR development board**
  - ATmega32U4 USB AVR
  - 32KB FLASH, 2.5KB SRAM, 1KB EEPROM
  - 16MHz crystal, LED, USB powered
  - boot jumper, Reset button, mounting holes
  - 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