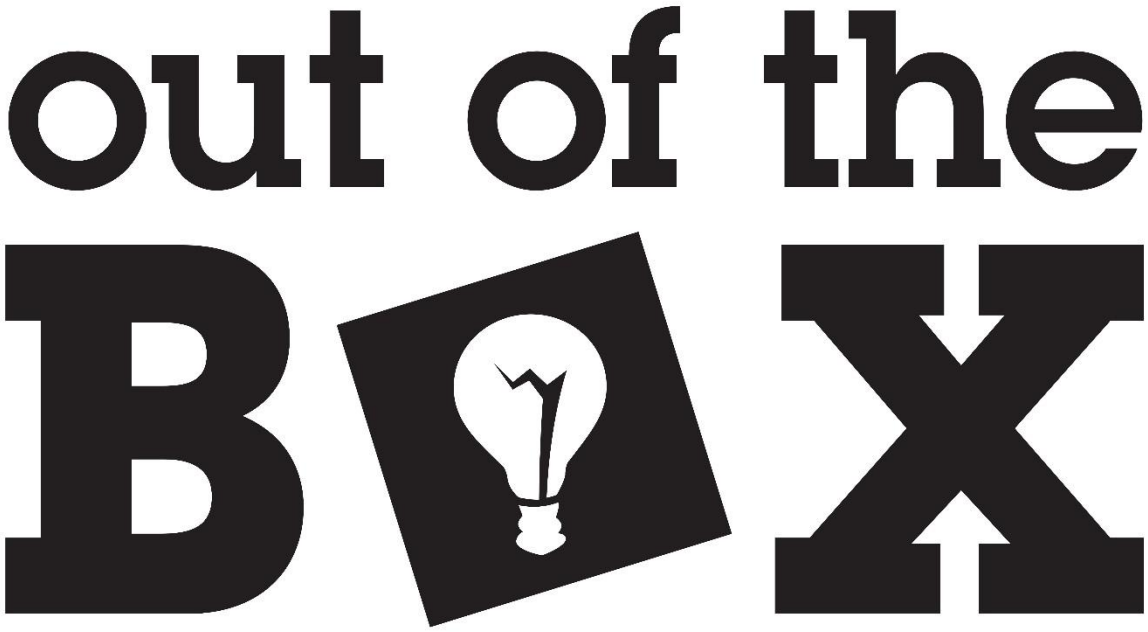

µPAD 2.X Manual

Last Revised 4/29/2019

out of the BOX
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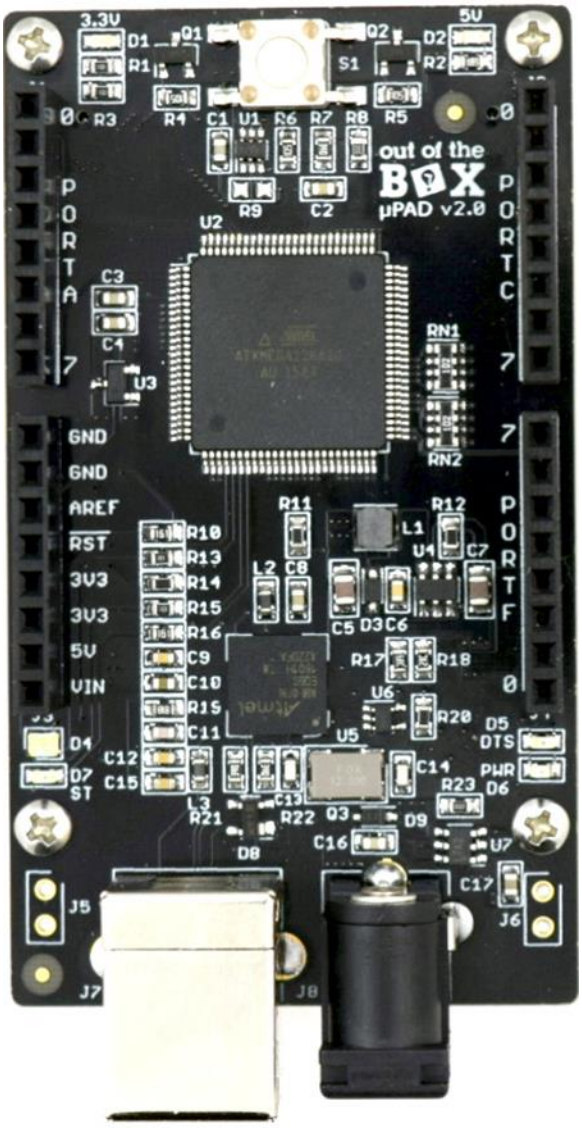
3.3V
5V
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PORTA
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Warning: READ BEFORE PROCEDING

It is possible to damage your µPAD irreparably with poor software. PORTB pins 0 and 1 are reserved for the analog reference and a GND reference respectively. **Setting the direction register for PORTB pins 0 or 1 risks destroying the module**. Always use care when using PORTB of the µPAD's Xmega.

Overview

The µPAD module (pronounced "Micro PAD") is ideal for education, prototyping, and system integration. The µPAD contains everything needed to develop an embedded system quickly and easily. The board contains a built-in debugger, supports various powering methods, PC communication, and supports two kinds of mezzanine connections. The first mezzanine connection is referred to as the backpack connectors. These connections are likened to that of Arduino shields, which are ideal for prototyping. The other mezzanine connection is known as the Base Connector. This has more signals and utilizes a fine pitch fine pitch connector. The Base Connector makes the µPAD ideally suited as a drop-in embedded system solution.

Why Xmega

The Xmega line of microcontrollers are arguably the best suited platform for learning on the market. The modular design of the Xmega microcontrollers promotes portability of code and the use of higher-level languages such as C++. The vast and modern peripheral set, including such features as DMA and the Event system, make the Xmega a very powerful yet simple microcontroller. It is this simplicity combined with capability that make the Xmega such an ideal teaching tool.

Microcontroller Features

- 128KBytes of in-system self-programable flash
- 8Kbytes boot section
- 2KBytes EEPROM
- 8K – internal SRAM
- External bus interface supporting up to 1Mbytes SRAM
- 4-channel DMA controller
- 8-channel event system
- 8 16-bit timer/counters
- 4 timer/counters with 4 output compare or input capture channels
- 4 timer/counters with 2 output compare or input capture channels
- High resolution extension on all timer/counters
- Advanced waveform extension (AWeX) on all timer/counters.
- 8 USARTs and IrDA support for one USART
- 4 two-wire interfaces with dual address match (I2C and SMBus compatible)
- 4 serial peripheral interfaces (SPIs)
- AES and DES crypto engine
- CRC-16 (CRC-CCITT) and CRC-32 (IEEE® 802.3) generator
- 16-bit real time counter (RTC) with separate oscillator
- 2x 16-channel 12-bit, 2MSPS Analog to Digital Converters
- 2x 2-channel 12-bit, 1MSPS Digital to Analog Converters
- 4 Analog Comparators (ACs) with window compare function, and current sources.
- External interrupts on all general-purpose I/O pins
- Programmable watchdog timer with separate on-chip ultra-low power oscillator.
- QTouch® library Support
- Capacitive touch buttons, sliders and wheels
- Special microcontroller features
- Power-on reset and programmable brown-out detection
- Internal and external clock options with PLL and prescaler
- Programmable multilevel interrupt controller
- 5 sleep modes
- PDI (program and Debug interface)
- Operating frequency of 0-32MHz

Board Features

In addition to the features of the Xmega, the µPAD has several board specific features such as a built-in debugger, a USB serial port, automatic power source switching, various indicators, several power supplies, and two sets of Mezzanine connections.

Built-in Debugger

The µPAD 2.0 module contains the Microchip EDBG (embedded debugger). With this device, the Xmega microcontroller can be fully debugged and programmed without any external tools.

USB Serial Port

Another nice feature of the EDBG is that it features a USB serial port rated for up to 2Mbps. This USB device as well as the debugger are a few of the many composite USB devices created by the EDBG. This means that debugging and USB communication is not only over a single USB cord, but both functions can be utilized at the same time!

Automatic Power Source Switching

The µPAD was designed to be powered by USB or through an external source. However, this external source may be fed through any of three connections.

1) The Barrel Jack
2) The VIN backpack signal
3) The VIN base signal

The µPAD uses an ideal diode smart power switch to switch between USB or external power on the fly.

Supply Rails

The µPAD has a primary system voltage of 3.3V used by the Xmega and EDBG etc. However, the µPAD features a 5.0V supply and a 2.5V precision analog reference as well. These supplies are exposed by the µPAD Backpack Headers, and all but the 2.5V reference are exposed on the Base Connector.

Indicators

The µPAD has several indicators for debugging and development.

Power Indicators

There are 5.0V and 3.3V LEDs tied directly to the respective power rails. If either of these indicators do not light (when enabled) There is an issue with an external circuit connected to the module, that should be immediately addressed.
Power indicators are enabled by default, but can be turned off by pulling PORTR pin 0 LOW.

Status LED

This is a general-purpose debugging LED connected to PORTD pin 7

RGB Indicator

The µPAD features a super bright tri-color (Red Green Blue) LED indicator. RGB LEDs are special because they contain three discrete LEDs each of which a primary color of visible light.

Color	Board Pin	PWM
Red	PORTD 4	TCD0: CCA (with remap to higher nibble)
Green	PORTD 5	TCD0: CCB (with remap to higher nibble)
Blue	PORTD 6	TCD0: CCC (with remap to higher nibble)

Real Time Clock Oscillator

The µPAD has an external 32.768 kHz Real Time Clock (RTC) oscillator. This frequency is significant due to the relationship of $32768 = 2^{15}$. This means that a 15-bit counter fed a clock of this frequency will overflow precisely in 1 second intervals.

Mezzanine Connectors

The µPAD has two types of mezzanine connectors. There are the 4 backpack connectors on the top of the board and the single base connector on the bottom of the board. The backpack connectors are for interfacing smaller generally less complex accessory boards, while the base connector contains the external bus interface connection and is generally used for more involved accessory boards.

Backpack Connectors

The backpack connectors consist of 4 8-pin .1" female headers. The backpack signals are shown in the following tables.

Table 1: PORTA Backpack Header

J1 Pin	Signal Name
1	PORTA 0
2	PORTA 1
3	PORTA 2
4	PORTA 3
5	PORTA 4
6	PORTA 5
7	PORTA 6
8	PORTA 7

Table 2: PORTC Backpack Header

J2 Pin	Signal Name
1	PORTC 0
2	PORTC 1
3	PORTC 2
4	PORTC 3
5	PORTC 4
6	PORTC 5
7	PORTC 6
8	PORTC 7

Table 3: Power and Control Backpack Header

J3 Pin	Signal Name
1	VIN
2	5V
3	3.3V
4	3.3V
5	RST
6	2.5V
7	GND
8	GND

Table 4: PORTF Backpack Header

J4 Pin	Signal Name
1	PORTF 0
2	PORTF 1
3	PORTF 2
4	PORTF 3
5	PORTF 4
6	PORTF 5
7	PORTF 6
8	PORTF 7

Base Connector

The base connector is a 2x50-pin 0.05" female header. The base signals are shown in the following table.

Table 5: Base Connector

J101 Pin	Signal Name
1	PORTF 7
2	PORTF 6
3	PORTF 5
4	PORTF 4
5	PORTF 3
6	PORTF 2
7	PORTF 1
8	PORTF 0
9	PORTE 0
10	PORTE 1
11	PORTE 2
12	PORTE 3
13	PORTE 4
14	PORTE 5
15	PORTE 6
16	PORTE 7
17	PORTB 2
18	PORTB 3
19	PORTB 4
20	PORTB 5
21	PORTB 6
22	PORTB 7
23	VIN
24	GND
25	GND

26	PORTK 7
27	PORTK 6
28	PORTK 5
29	PORTK 4
30	PORTK 3
31	PORTK 2
32	PORTK 1
33	PORTK 0
34	PORTJ 7
35	PORTJ 6
36	PORTJ 5
37	PORTJ 4
38	PORTJ 3
39	PORTJ 2
40	PORTJ 1
41	PORTJ 0
42	PORTH 7
43	PORTH 6
44	PORTH 5
45	PORTH 4
46	PORTH 2
47	PORTH 1
48	PORTH 0
49	5V
50	3.3V

Electrical Characteristics

Table 6: Absolute Maximum Ratings

Item	Min	Nom	Max	Unit
VIN			12.0[1]	V

1) Though the µPAD itself is rated for 12V accessory boards connected may or may not be. Always ensure the VIN voltage applied is within range for external power for the backpack or base boards connected to the µPAD

Table 7: General Characteristics

Item	Min	Nom	Max	Unit
3.3V Tolerance		3.3		V
5.0V Tolerance	4.85	5.0	5.15	V
2.5V Ref Tolerance	2.49	2.50	2.51	V
VIN Range	4.5	5.0	12	V
2.5V Rail current		15[1]		mA
3.3V Rail current		1.00		mA
5.0V Rail Current			275	mA
µPAD Idle Current		~125		mA
RTC Oscillator Frequency	-30		30	ppm

1) It is not recommended to power external circuits using the 2.5V reference.

Powering the µPAD

The µPAD is designed to be powered via USB and external sources (VIN on Backpack Header, Barrel Jack, and Base Connector). The µPAD is designed to automatically select the external power source when it is available.

External Power Considerations

Since the µPAD has three external power inputs, the barrel jack, Backpack and Base Connections, take care to ensure no more than one source is connected at a time. If a custom Base or Backpack is used a low forward voltage diode in line with VIN is advised. This will ensure only one source will drive VIN.