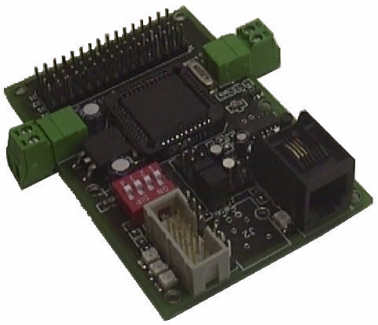
Universal Processor Board

MultiMotions specializes in the development of interactive and autonomous robot- and animatronics applications.

The past years MultiMotions developed an number of experimental robots:

1. A six legged autonomous ant-like robot of about 30 cm in length.
2. A biped robot to experiment with static walking and that can balance o none leg. More advanced two legged robots were developed by the Delft Bio Robotics lab, in which the UPB is used. See www.wbmt.tudelft.nl/mms/dbl
3. A four-legged robot dog with a number of sensors that can walk autonomously on a table-top, that reacts to sound and movement and is able to avoid obstacles.
4. An animatronics robot that follows bypassing people wit it's eyes and uses simple speech recognition to react to visitors.
5. An intelligent autopilot for a robotic sailboat used in trans-Atlantic solo racing. See www.robosail.com for details.
6. Electronics for interactive art and company presentations.



The experience gained in these projects is used in a universal processor board (UPB) that may be used for a variety of applications. The board has the following parts and interfaces:

1. Two RS232 interfaces
2. A USB interface (planned)
3. A onboard ICD (In circuit debugger/programmer) interface
4. A inter-processor bus SPI or I^2C interface.
5. Three switchable indicator leds (red, yellow, green)
6. An optional 4 position configuration switch
7. A on-board 5V 1A regulator, accepting 6 - 12V as input.
8. Eight 10 bits A/D inputs with 3 pin connections for standard 5v sensors like IR or PID sensors or potmeters. Power pins are part of the board. Reference voltage other than 5v may be used optionally. May also be used as digital I/O.
9. Eight standard RC servo connectors with standard on-board 3 pin connectors. May be supplied with other voltage than 5v. The A/D may also be used as servo pins. The RC outputs may also be used as digital I/O or as 8 bit parallel port. Separate RW and CS signals are available for this.
10. A total of 13 general purpose digital I/O pins are available. Some of them have multiple functions: 2 Timer/counters and/or 2 PWM outputs for motor control or signal timing

The UPB bus has a total of 29 I/O pins of which several have alternate functions like the RS232 connections and the PWM timers/counters. These alternate functions depend on the type of processor used and are listed in the table underneath:

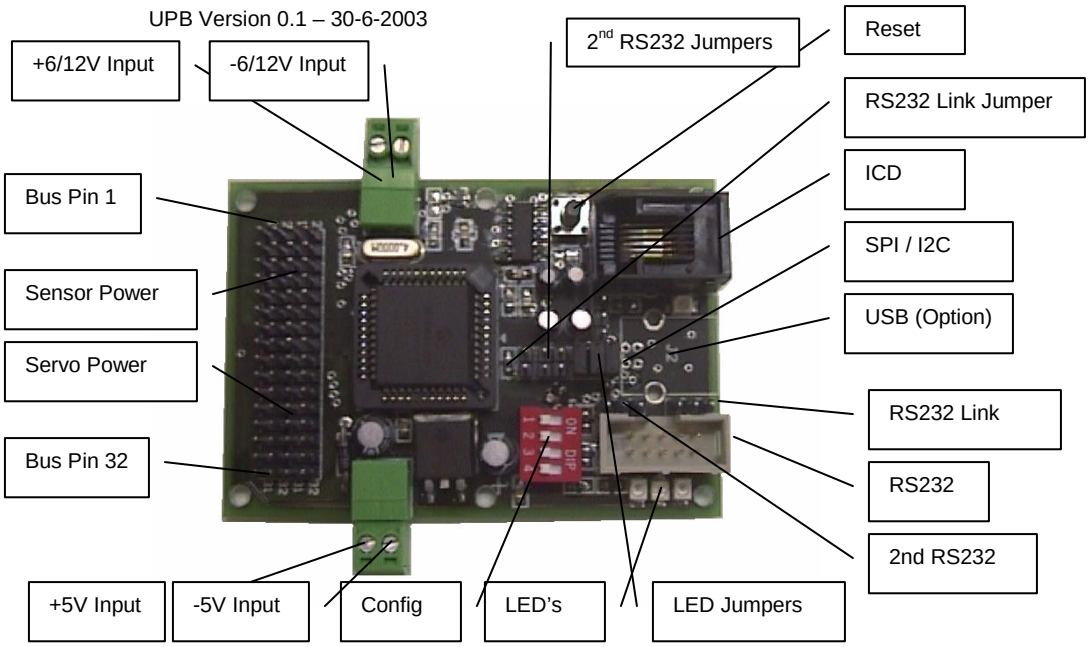
Bus Pen	Bus ID	Proc Pen	Alt functie	Alt Functie	Alt Functie	Opm
1	Vcc					+5v Reg
3		RA4	T0CKI – Timer 0			
5	LD3	RB3		Led Grn		
7	LD2	RB2		Led Yel		
9	LD1	RB1		Led Red		
11	Int	RB0	Int			
13	SW0	RB4		Switch 0		RB6 – SW2
15	SW1	RB5		Switch 1		RB7 – SW3
17	TIM1	RC0	T1OSO/T1CKI	Timer1 I/O		
19	PWM2	RC1	T1OSI/CCP2	Timer1 I / Capt2 / PWM2		
21	PWM1	RC2	CCP1	Capt1 / PWM1		
23	SPIC	RC3	SCK/SCL	SPI / I2C Clk	Usb Clk	
25	SPII	RC4	SDI/SDA	SPI / I2C Data	D- Usb	
27	SPIO	RC5	SD0	SPI Data out	D+ Usb	
29	nc					
31	Vss					Ground
2	AD0	RA0				
4	AD1	RA1				
6	AD2	RA2	Vref-			
8	AD3	RA3	Vref +			
10	AD4	RA5	SS	Slave Select		
12	AD5	RE0		PSP RD		
14	AD6	RE1		PSP WR		
16	AD7	RE2		PSP CS		
18	RD0	RD0		PSP0		
20	RD1	RD1		PSP1		
22	RD2	RD2		PSP2		
24	RD3	RD3		PSP3		
26	RD4	RD4		PSP4		
28	RD5	RD5		PSP5		
30	RD6	RD6		PSP6		
32	RD7	RD7		PSP7		

The board can host a number of existing and planned processors:

1. Pic processors from the 16F87X series (4-20 Mhz) (2K to 8K)
2. Processors from the 16C745/765 (USB interface) (4-20 Mhz) (2K to 8K)
3. Processors from the 18F4X5 series (Hi performance + USB (planned)) (8-48 Mhz) (16K to 32K)
4. Processors from the 18F458 series (CAN interface planned) (8-48 Mhz) (16K tot 32K)
5. Processors from the 18F452 series

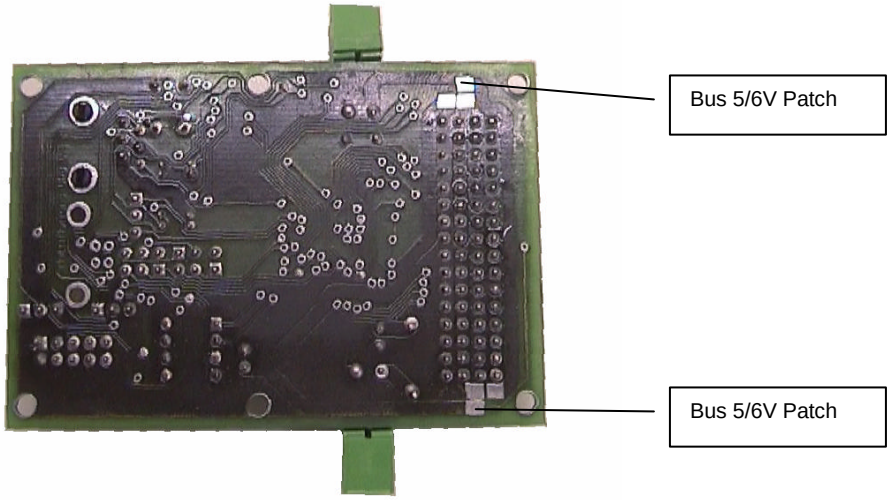
For these processors there is a choice from Flash and OTP versions.

Multiple boards may be connected either by using the SPI or I^2C interfaces or by daisy chaining RS232 interface. Up to 4 boards may use the common RS232 signal.



ICD	In Circuit Debugger. This facility allows the processor to be programmed and debugged in-circuit. For this an ICD or ICD-2 is required Check www.micochip.com. The connector directly plugs into the ICD and programming is done via the free MPLab development software. When used, the switches 3 en 4 must be in the OFF position and the second RS232 port must not be in use. The UPBtest software contains a bootloader function that allows programming without the use of an ICD.
Reset	The reset button is only operational when the ICD is not connected.
SPI/I2C	3 pin connector for SPI or I^2C facility of the chip. May be used to interconnect several UPB boards or other devices
USB	Optional USB connector. Requires a special version of the processor. When used takes the place of the SPI/I2C connection.
RS232	Three wire connector for RS232.
RS232 Link	Three-pin header to connect RS232 to other boards. With this connector up to 4 boards may share one RS232 connection. When used, the first board should set the RS232 Link jumper. All processors share the RS232 signal. Software must make sure that only one processor sends data at the same time.
RS232 Link Jumper	Jumper used to terminate the first board for the shared RS232 connection.
2nd RS232	Three wire connector for the second RS232 connection. Is connected to RB6,7. Since this is also used for the ICD, the 2nd RS232 cannot be used at the same time as the ICD.
2nd RS232 Jumpers	Must be set when the second RS232 is used.
LED's	3 LEDs that can be used freely. The standard UPBvm software uses the red led as a heartbeat indicator..
LED Jumpers	Must be set when using the LEDs. Every LED has its own jumper. When bits RB2,3,4 are to be used for other purposes, the corresponding jumpers must be removed.

Config Switch	4 switches that may be used freely. When not in use, they should be in the OFF position. In the ON position the inputs of RB4,5,6,7 are connected to ground. In the OFF position these inputs are not connected and may float. Therefore the corresponding inputs should use the internal weak pullups to prevent errors as a result of floating inputs. Remember that when setting the TRISB the outputs must be set high before setting the pin direction. Not doing so will not turn on the weak pull-ups.
5V Input	Main supply connector. There is a single diode to prevent problems with accidental reversal of polarity. The supply may range from 6V to 12V. The supply may sink max 1A. When using servos the second supply may have to be activated.
6/12V Input	This supply connector can be connected to the servo- and sensor pins using solder pads at the bottom of the board. The servo- and sensor supply pins may be connected directly to the 5v or to the extra supply. This is listed as 6v but may also be used at a higher voltage, depending on the used servos, sensors or piggy-back boards.
Bus	The bus consists of two parts, the sensor- and servo lines and the additional lines. The sensor lines are directly connected to the A/D inputs, the servo lines are connected to port D. Next to this row of pins are two more rows with which the I/O pins form a 3-pin connector that will allow standard 3-pin servo connectors to be used.
Sensor/Servo Power	The middle pin is always the power pin, the top row is ground. The supply for the sensors and servos can be connected to the 5v or extra power input using a solder pad. This is done especially with servos to prevent power spikes to enter the processor electronics. When using the sensor pins for servos as well a total of 16 servos may be controlled by the UPB.
Bus 5/6V Patch	To select how the sensors and servos are powered, solder pads are provided on the bottom layer to determine how the pins are connected. The default connection is 5v which puts all sensors and servos on the main supply line. When this is not desired the solder pads have to be used to change this.



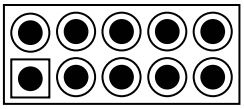
External connections and jumpers

In all jumpers and connectors pin 1 is indicated by a square solder pad, both in the documentation and on the board.

SPI

Pin 1 – SCK/VUSB
Pin 2 – SDI/D-
Pin 3 - SDO/D+

RS232



Pin 1 – Connected with 2 + 7
Pin 2 – Connected with 1 + 7
Pin 3 – TXD
Pin 4 - Connected with 5
Pin 5 - Connected with 4
Pin 6 – RXD
Pin 7 – Connected with 1 + 2
Pin 8 – Not Connected
Pin 9 – Ground
Pin 10 – Not Connected

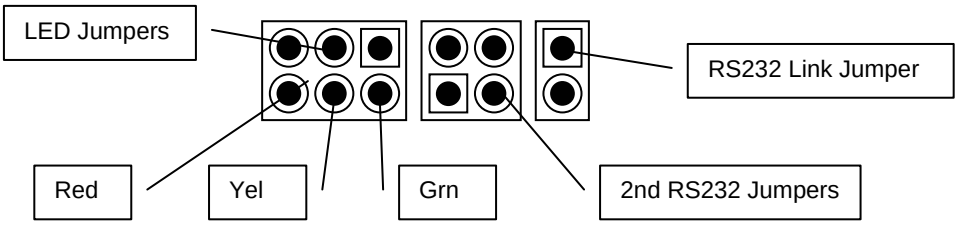
2e RS232

Pin 1 – TXD
Pin 2 - RXD
Pin 3 - Ground

RS232 Link

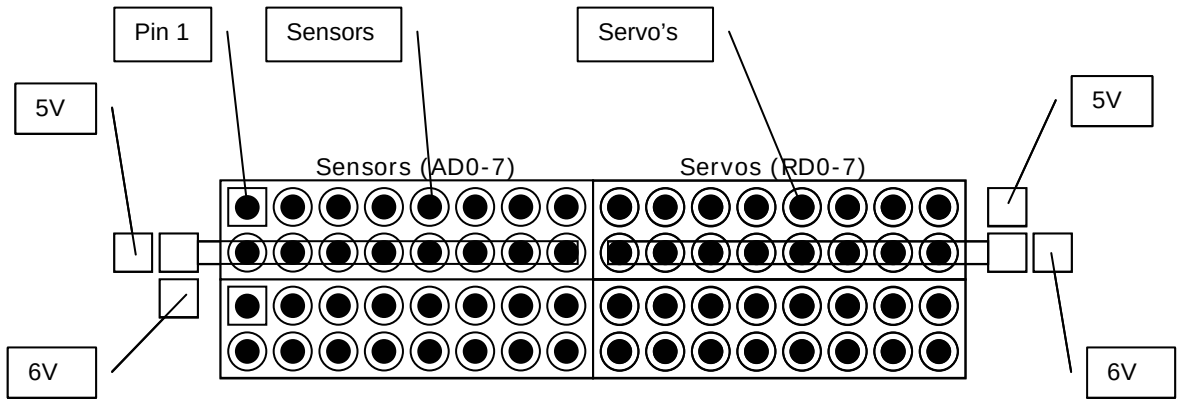
Pin 1 – TXD
Pin 2 – RXD
Pin 3 - Ground

Jumpers



The LED jumpers are placed for each of the 3 LEDs when they are used. If the second RS232 port is used, both jumpers for resp. TXD and RXD must be placed, connecting RB6,7 with the second RS232 port.
If the RS232 Link is used, one of the boards needs to set the RS232 Link Jumper. The other boards are connected using the RS232 Link connector.

Bus



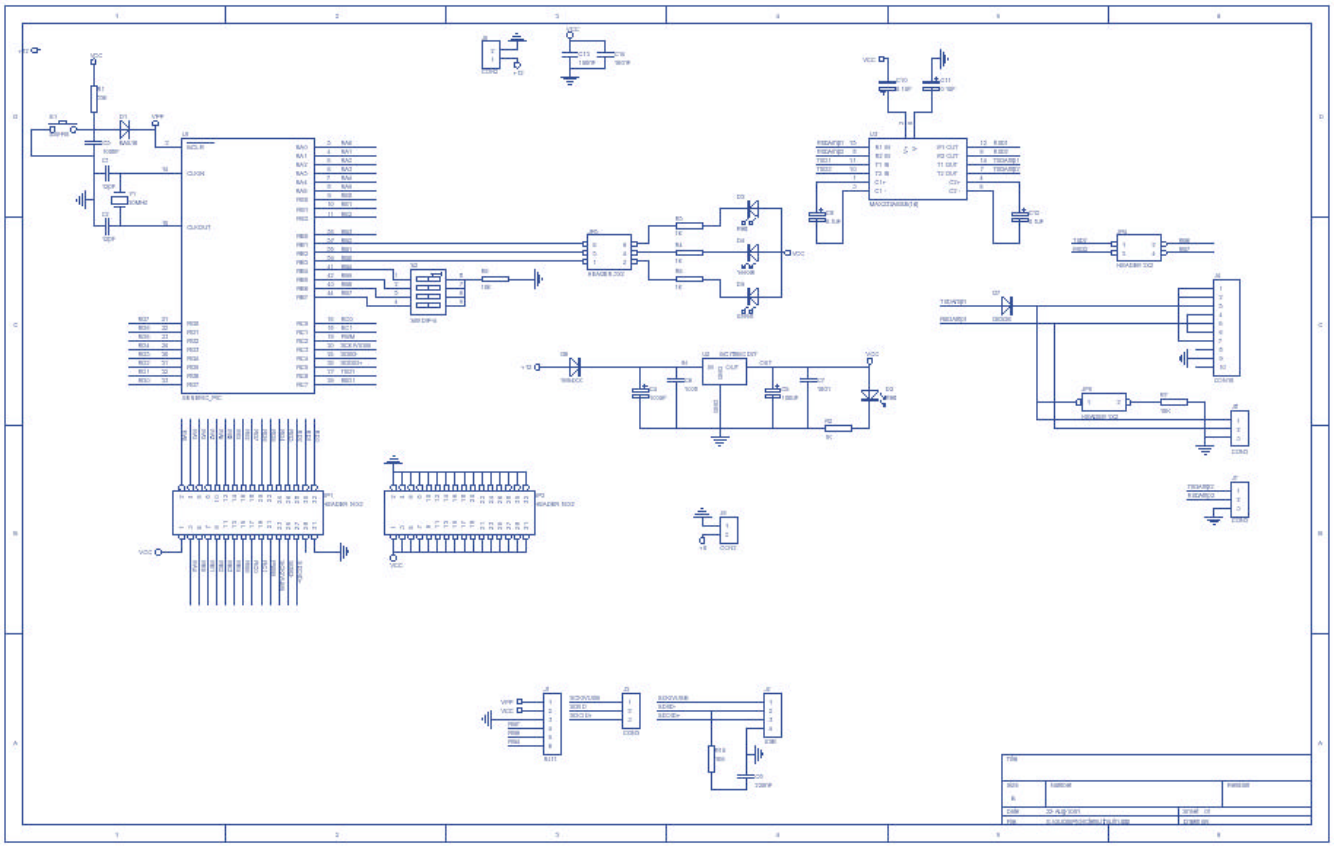
The upper rows of the bus form the power supply for the sensors and servos. The even row is the +5V of +6/12V row, the odd row is ground. The print has the 5V connected to the sensor and servo sections. When the power pins need to be connected to the 6/12V connector, a sharp knife needs to be used to cut the connection to the solder pads and a new connection

needs to be made with the 6/12V pad. Do NOT solder the pads without first cutting the connection between the 5v pads. The Servos and Sensors may be powered independently using these pads.

Test programs

A small test program is provided that controls the LEDs and the RS232 connection with settings of 9600,8,N,1. Using a terminal program this test may be executed. This program is provided with the board. Alternatively a standard UPBvm version may be loaded in the UPB that may be connected to the UPBtest program that allows offline programming of the board. Details of this are found in the UPBtest manual that may be downloaded along with the program from www.multimotions.com.

The small test program shows a repeating 0 in the screen of a standard terminal program. As soon as a character is sent, the red and yellow leds will light up. If the # character is sent the characters 1, 2 etc are shown every time a new # is entered. This allows quick testing of the board's LED's and the RS232 port.



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