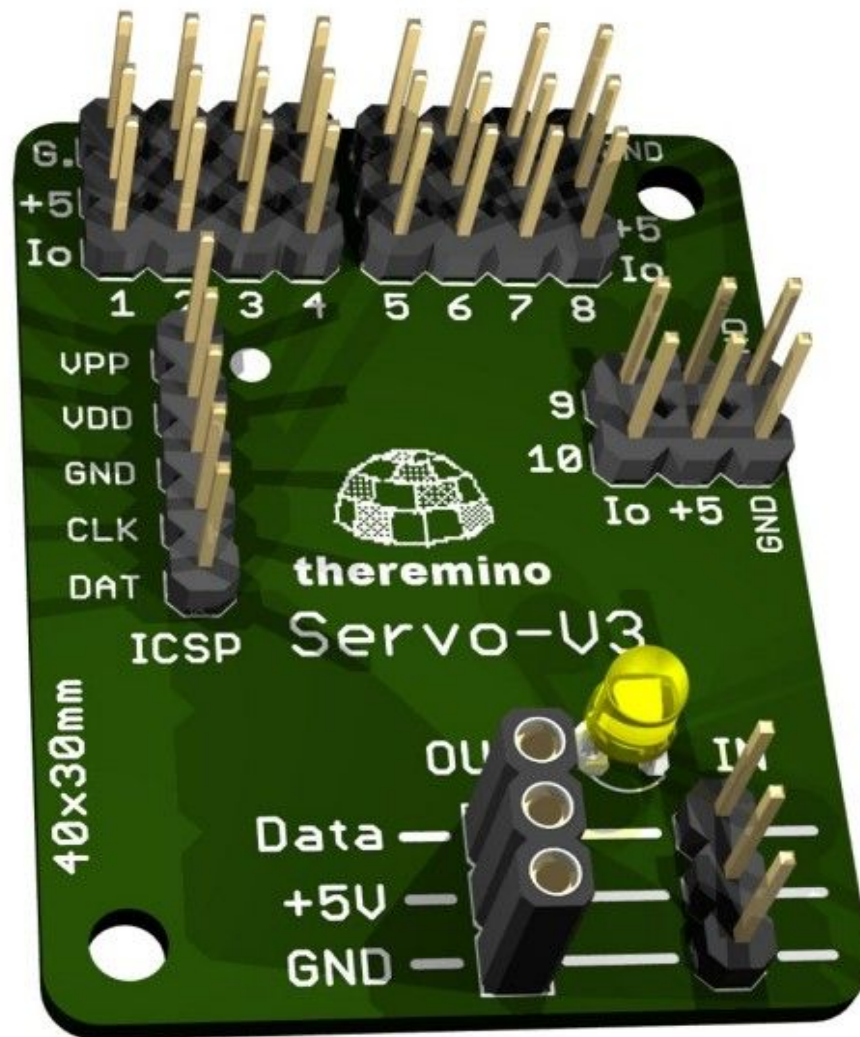


**theremino**  
•the•real•modular•in-out•

System *theremino*

# Slave Servo

## The slave "Servo"



This "Slave" provides ten "Pin" of generic Input-Output, very comfortable for fast connections with the standard leads Brown / Red / Yellow

# Configure the slave "Servo"

Each of the ten pins of InOut can be configured independently as:

- Not used
- Digital output
- Output PWM
- Output for servo-commands
- Digital input
- Input ADC for potentiometers and transducers
- Input for capacitive buttons
- Input for resistive transducers
- Count input, frequency and period
- Input for special transducers



## Valid configurations

- Up to 10 digital outputs
- Up to 10 PWM outputs for digital to analog conversion (**Note 1**)
- Up to 10 outputs SERVO for servo-commands (**Note 1**)
- Up to 10 inputs for digital signals DIGIN (**Note 2**)
- Up to 8 ADC inputs for analog signals (pins 1, 2, 3, 4, 5, 6, 7, 8) (**Note 1**)
- Up to 8 CAP inputs for capacitive keys (pin: 1, 2, 3, 4, 5, 6, 7, 8) (**Note 1**)
- Up to 8 inputs RES for resistive transducers (pin: 1, 2, 3, 4, 5, 6, 7, 8) (**Note 1**)
- Up to 10 inputs COUNTER measures for counting and frequency (**Note 2**)
- A FAST\_COUNTER pin for fast counting and frequency (pin: 8) (**Note 2**)
- A PERIOD pin for the measure of the period of a signal and frequency (pin: 9) (**Note 2**)
- A USOUND\_SENSOR pin for SRF05 ultrasonic sensors or other similar sensors (pin: 9)

**(Note 1)** The Pin of type PWM, SERVO, ADC, CAP and RES can be configured to 8 or 16 bit

**(Note 2)** The Pin type DIG\_IN, COUNTER, PERIOD FAST\_COUNTER can be configured with or without a pullup

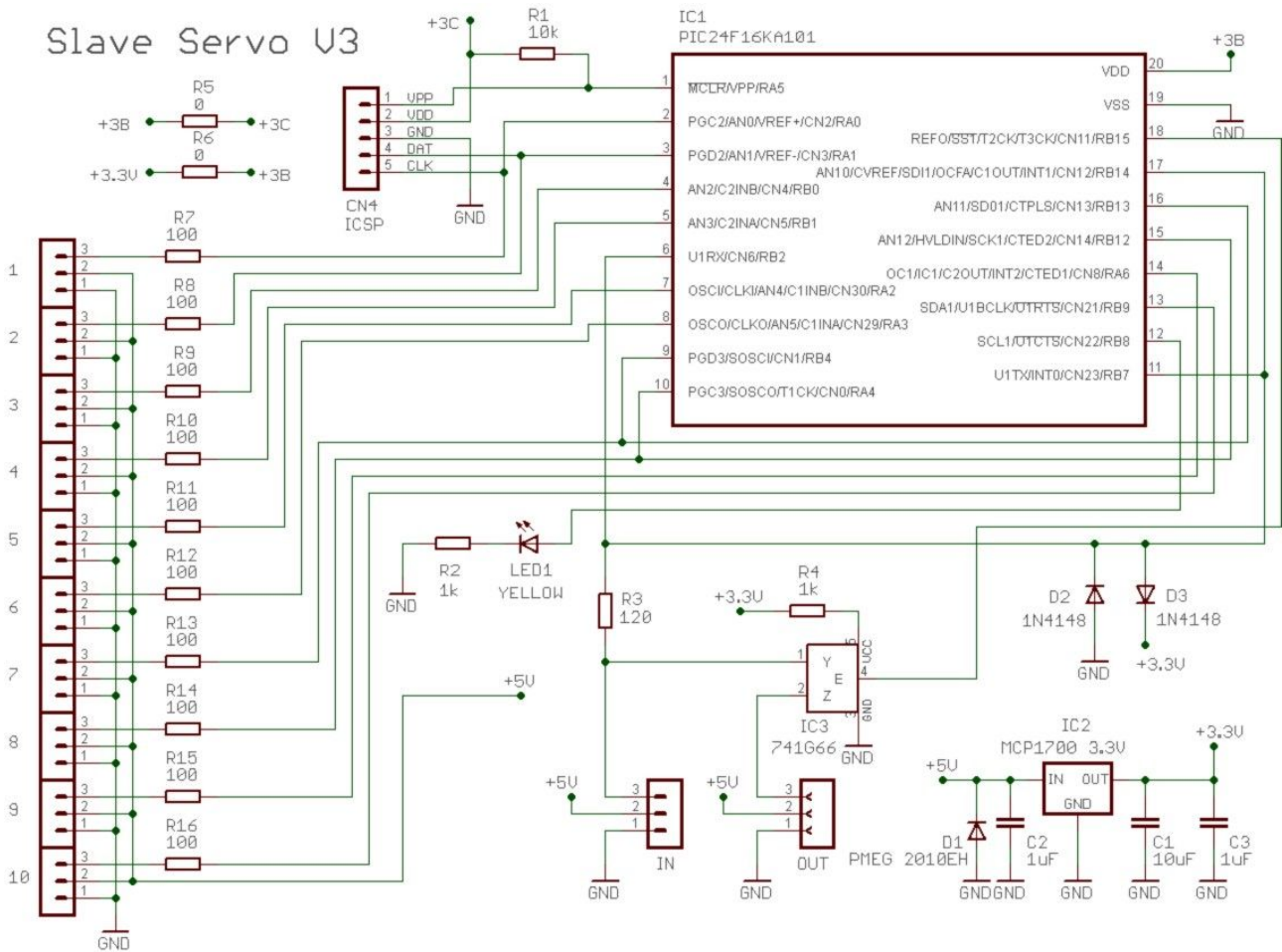
## Voltages and currents

The Pin of Input-Output work with analog signals from 0V at 3.3V. On the connectors it is available the voltage of 5V and a voltage from 3.3VOLT stabilized useful for some sensors. The maximum current for pins configured as output is + /-15mA. for those that are configured as input instead should limit the voltage from -0.3 V to +3.6 V and not exceed these thresholds with currents greater than + /-100uA (see [technical/pin-types](#) and [technical/tables-and-notes](#) for more information on currents and voltages)

## Connectors

From version 3 onwards screw connectors have been replaced with the connectors for the standard extensions male-female. These connectors are not as beautiful to look at but they are more convenient and reliable. (The screw connectors required a very small screwdriver, tighten them without too much force was needed to avoid damaging the screw, but if the strength was low by the time they loosened. With the new connectors instead the connections are faster and safer)

# Electric schematics



**The ten connectors Pin1 in Pin6**, with protection resistors R7 to R16, provide ten "PIN" InOut generic, configurable to connect all kinds of sensors and actuators with the standard: GND / +5 V / Signal

**The regulator IC2 and components of power circuits C1, C2 and C3** stabilize the very inaccurate and noisy 5Volt in the USB to 3.3 Volt well stabilized. The use of ceramic capacitors of high capacity allows to eliminate any trace of noise from the measurements with the ADCs.

**IN connector:** It connects to the master or to the slave of the previous chain and allows the bidirectional serial communication. The resistor R3 decreases the slew rate to prevent noise radiated radio frequency.

**OUT connector:** Returns the serial line for the slave following the chain. The switch bilateral IC3 enables or disables the following slaves, for the recognition and auto-configuration of the modules. The resistor R9 protects IC3 from reverse polarity, short circuit or between power and signal and caused by bad connection.

**The connector CN4 has two functions: AUX PINS P1 and P2:** Are the same pin 1 and 2 of the connectors of InOut main but, unlike normal PIN InOut, on this connector there is the +3.3 volt stabilized instead of +5 Volt, very useful for sensor type "Ratiometric", ie sensors whose output signal depends on the supply voltage. **ICSP:** This connection allows you to reprogram the module with a Master PicKit1 / 2 or 3, for firmware upgrades or to add new features.

**LED1** provides a visual indication of proper operation. The rate of change is twenty times the speed of flashing, if the led flashes fast all is OK.



# Connect the Slave modules

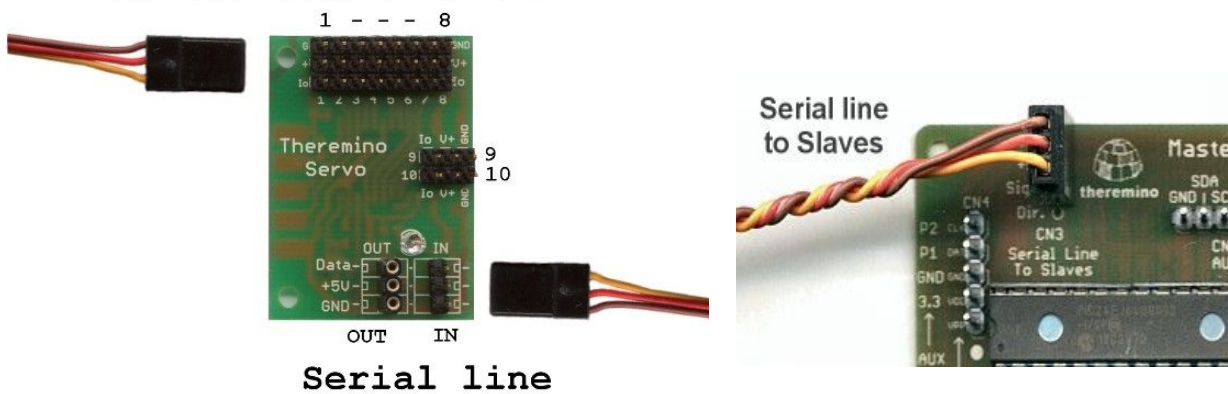
The cables to connect the serial line that goes to the slave are the same that are used to connect sensors and actuators to Pin Input / Output.



But you should not confuse the two lines, wiring errors do not cause damage, but if you do not make the right connections, these will not work.

Even if the connectors are the same, be careful! Connectors "Pin" are used for sensors and actuators while the connectors "Serial" are used to connect modules "Master" and "Slaves" to each other.

## In-Out Pins 1 to 10



The serial line from the Master must be connected to the "IN" of the first "Slave"

To add a second slave using the "OUT" connector of the first slave, and so on up to 200 slaves.



The slaves can be connected in any order but if you change them or their number the hardware configuration is misaligned from the HAL program

Thus, after composing the chain of Masters and Slaves, press the button "Recognize" and then eventually "Validate" to accept the new hardware configuration to Theremino\_HAL

# Connect capacitive buttons

It would be good to procure a certain number of standard extensions, cost little and can be cut in order to obtain females and males, with the wires connected, at a price so low that it is not worth of make them.



Otherwise, you must obtain soft silicone wire and solder to **female connectors turned**, with the round hole. The other models **with the square hole, make contact sometimes, and then give you nothing but trouble.** See the advice of this page: [www.theremino.com/technical/connection-cables](http://www.theremino.com/technical/connection-cables)



Some pieces of thread, alone or with squares of copper or aluminum tape attached, can act as capacitive keyboard.

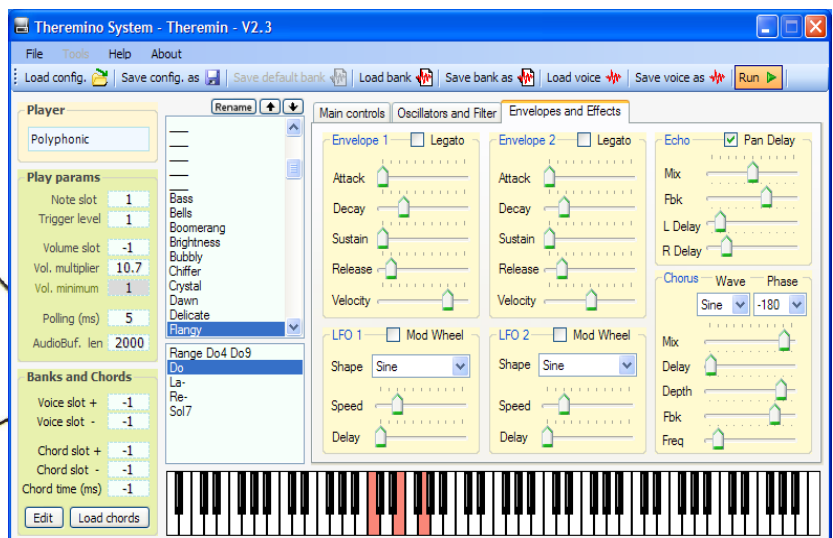
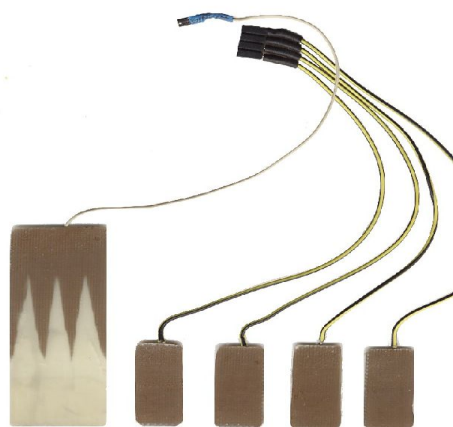
This is a video on the capacitive keys (comfortable, fast and bounce-free) [CapTouch\\_Sensors](#)

# Musical Keyboards



With the capacitive keys of the module "Servo" united to the Theremin (Synthesizer Polyphonic) and at the Sound Player (sampler) it is possible to build musical instruments never seen before.

More information in the instruction sheets Theremino Theremin application that you download from here: [www.theremino.com/downloads/multimedia](http://www.theremino.com/downloads/multimedia)



## Advice

Servo Pins can be configured to measure capacitance, resistance and voltage, but they are not designed to replace a tester. First of all, you could only measure very small capacitance, resistance up to 50K and then you should carry out laborious calibration, in order to have a reasonable accuracy.

The Input Pin are used for process control, to adjust positions and adjust a volume or scroll through a video. In these applications it is important to make absolute measurements but it is essential to do many tens of measurements per second.

For control applications, you do not need to know the exact value but, on the other hand, the value must be very stable, and have the least possible noise so you do not "shake" the object under control.

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This reasoning is, in general, valid for all variables of InOut system Theremino

The system Theremino works with very high resolution, up to one part in 65000, much higher than the resolution of a normal tester (1 part in 2000), also the values are very stable, low noise and sampling rates are higher by hundreds if not thousands of times compared to those of a tester.

On the other hand the accuracy of the measurements is poor. With the standard input-output Pins, the achievable accuracy is of the order of one percent, and it can be up to 0.1% or so, with a hardworking individual calibration.

## Scalability of the system

Although the system can withstand up to 200 Servo modules, there are limits to the speed of the serial line communication, limitations due to the demands of total reliability and limits the ability to manage systems of great complexity with a simple list of Pins.

We therefore recommend to restrict the systems to a few dozen modules, and then the Input Output to a few hundred. During the design of large systems consult us or experiment to see if the speeds obtainable are sufficient and whether the final system is sufficiently reliable, and manageable.

## Precautions to be taken

The system is a project Theremino "Freeware", "Open Source" and "Not for Profit" and its components are "mounting kit" and not "finished products".

Therefore **who is responsible for connecting the modules in a system, comply with the limits of the law** radio frequency emissions and obtain necessary certifications. To reduce noise limits of law might be necessary, depending on the case, use shielded cables and metal containers or other techniques.

Manufacturers and retailers from the system Theremino are not aware of the actual conditions of use of the modules and therefore can not respond to improper use, illegal or dangerous of them.

For more information, see this page: [www.theremino.com/contacts/copyrights](http://www.theremino.com/contacts/copyrights)