chip45.com – Infosheet

Savvy128 V1.2

ATmega128 Controller Board with MMC/SD-Card.

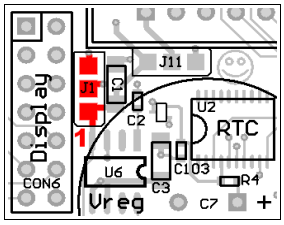
Savvy128 is the microcontroller motherboard for the SavvyBOX application development plattform. It provides the Atmel AVR ATmega128 microcontroller, onboard 3.3V voltage regulator, standard RS232 (RS485 optional) serial port with DB9 connector, USB2.0 full speed UART converter, MMC/SD-card header, realtime clock chip with optional GoldCap, push buttons, two-color LED, onboard status LED, infrared detector, expansion headers with all ATmega128 signals and a special header for SavvyDISP, which optionally provides an LC-display, four push-buttons and an LED.

***Please Note** – The new Savvy128 V1.2 version has been slightly redesigned. It now features voltage level shifters between the SD-card and the processor. This allows to supply the CPU at 5V (and use crystal frequencies up to 16MHz) whilst the SD-card is still powered from the onboard 3.3V regulator – or power everything from the onboard regulator like with the old V1.0.*

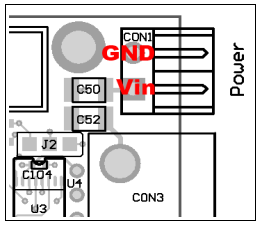
***Important notice:** The orientation of jumper J1 has been rotated 180° compared to the V1.0 board!!! See section "power suppy" for details.*

Scope of Delivery – Savvy128 comes as a high quality SMT board with all SMT components assembled and all non-SMT components added as a Components Kit, hence the customer can add components and functionality as required by the application. Optionally available is an RS485 kit with MAX485 driver and socket, as well as a GoldCap 1F capacitor, when backing up the realtime clock is necessary. An SD-card is also available as accessory at www.chip45.com.

Power Supply – Savvy128 provides an external power connector CON1 (see picture right) and a matching screw type cable connector in the components kit. There exist three configurations for supplying the board externally or from the local voltage regulator or from USB.



J1 location



power connector

a) The onboard voltage regulator can be bypassed by setting jumper J1 to position 1-2, which are the lower two red pads in the left picture on the right. Now the external supply voltage is directly connected to the onboard components, hence it must not exceed 5V±10%. All onboard components are now powered from the external voltage – except the sd-card, which is always powered from the onboard 3.3V regulator.

b) By setting jumper J1 to position 2-3 (the upper two pads in the left picture), the onboard voltage is supplied by the onboard 3.3V regulator from the external supply voltage and drives all onboard components. The external supply voltage must by at least 3.7V, to ensure proper regulation of the 3.3V. Since minimum and maximum input voltage depend on current consumption, you should check the voltage regulator datasheet for calculating the exact minimum and maximum voltage levels for your power requirement. The following table shows example configurations.

c) It is also possible to power the board from USB bus power. In that case jumper J1 needs to be set to external power supply (position 2-3) and jumper J3 has to be set according to chapter „USB 2.0 Port".

Jumper J1	Comment	Input Voltage Vin	Onboard VCC	Maximum Current Imax
1-2	The 3.3V regulator is bypassed. Only SD card is supplied 3.3V.	+5V±10% +3.3V±10%	+5V±10% +3.3V±10%	n/a n/a
2-3	All components are supplied from the regulator with 3.3V.	+4V +6V +10V +12V	+3.3V +3.3V +3.3V +3.3V	156mA 104mA 63mA 52mA

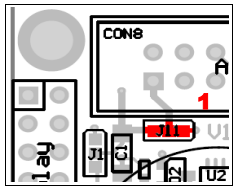
(Maximum current values are given at 25°C/77°F, for higher temperature see datasheet. Please note: These example values are due to maximum power dissipation of the voltage regulator and are not the real power consumption of the onboard components!)

J1 jumper settings and characteristics

Pin 1 of expansion connector CON8 can be connected either to the external input voltage Vin or to the output of the voltage regulator VCC. See table and picture on the right for setting and location of J11. Pad 1 is the right red pad in the picture.

Jumper J11	Voltage at CON8 / Pin1
1-2	local VCC
2-3	external Vin

J11 jumper settings



J11 location

System Reset – A proper reset signal is generated onboard by R1, D1 and C6. The internal brown out reset detection of the ATmega128 controller is disabled by default, since it's dependent on the supply voltage.

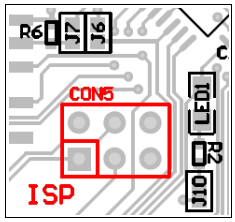
System Clock – By default the ATmega128 on Savvy128 runs with the internal RC-oscillator set to 8MHz. The frequency of the RC-oscillator can be tuned to 1MHz, 2MHz, 4MHz and 8MHz by changing fuse bits CKSL3..0 with an ISP oder JTAG adapter. See ATmega128 data sheet on page 39 for details.

Location of X1

Additionally to the internal RC-oscillator an external quartz crystal X1 in HC49 package can be assembled beside the ATmega128. See picture on the right for location of X1. The maximum crystal frequency depends on the supply voltage of the ATmega128 (e.g. 0-8MHz @ VCC=2.7-5.5V, 0-16MHz @ VCC=4.5-5.5V), the minimum frequency for a higher frequency crystal is about 400kHz, alternatively a watch crystal with 32768Hz can be connected as X1. In any case, the fusebits CKSEL3..0 and CKOPT need to be set according to the desired oscillator option. See datasheet chapter „System Clock and Clock Options".

Memories – The ATmega128 provides 128kbytes of onchip, non-volatile Flash memory for program code storage, 4kbytes of onchip application SRAM and additional 4kbytes of onchip non-volatile EEPROM memory.

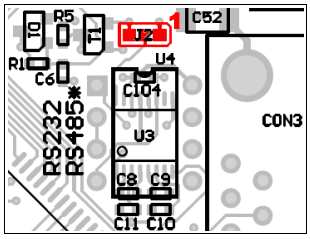
In-System Programming (ISP) – CON5 is the standard 6-pin Atmel AVR ISP connector and can be used with most ISP adapters (e.g. stk200/300 compatible adapters like CrispAVR-200 by chip45.com or Atmel's stk500) and software (e.g. uisp, avrdude, PonyProg, etc.). Keep in mind, that the ATmega128 shares the ISP signals PDI/PDO with UART0, hence serial communication might be blocked as long as the ISP adapter is connected.



ISP connector

Be careful when changing fusebits! By selecting an improper combination of fuse bits, it is possible to enter states, where no further ISP programming is possible (e.g. disabling ISP by SPIEN, selecting clock crystal with no crystal assembled or selecting external clock signal with no signal present).

Serial RS232/RS485 Port - RS232 level signals are provided by the onboard MAX3221 (U3) RS232 transceiver, connected to UART0 of the ATmega128. U3 can be enabled/disabled by jumper J2 (see picture right for location), which should be set to 1-2 (enabled) or 2-3 (disabled) position before operation. The RS232 signals are available at a standard DB9 male connector CON3.



J2 and RS232 port

DB9 male	RS232 signal	RS485 signal
1	-	-
2	RXD	-
3	TXD	A
4	-	-
5	GND	GND
6	-	-
7	-	-
8	-	B
9	-	-

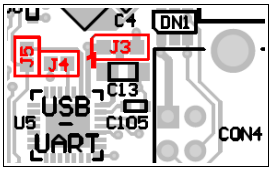
RS232 connector pinout

Optionally a common RS485 transceiver (e.g. MAX485) can be assembled as standard DIL8 device on footprint U4, right above the MAX3221. Be sure to disable the MAX3221 with jumper J2 before assembling the RS485 chip!

The table on the right shows the pinout of the DB9 male connector in both RS232 and RS485 mode. The direction pin DE/RE of the half duplex RS485 transceiver is connected to Pin 4 (signal PE2) of the ATmega128, which can switch between send mode (PE2 = high) and receive mode (PE2 = low).

During ISP programming of the ATmega128 the /RESET signal is asserted and disables the RS232 driver MAX3221 through transistor T1. This avoids the RXD signal of the MAX3221 driving against the ISP signal PDI from the ISP adapter.

USB 2.0 Port – Savvy128 provides a USB 2.0 full speed to UART interface based on the CP2102 chip by Silicon Laboratories (www.silabs.com). The USB chip is connected to UART1 of ATmega128 (signals RXD1/TXD1) and converts USB bus data format to UART format at a baudrate of up to 921600 baud. The USB port is externally available at the standard USB-B connector CON4.



USB jumpers

Before you can use the USB port, power needs to be applied to the USB chip via jumper J3. There exist three configurations for Savvy128, which are listed in the table on the right. It is important, that when powering either just the USB chip from USB bus power or powering the whole board from USB bus power, the external Vin voltage must be in the range of 4.0V to 5.25V, due to the USB chip electrical characteristics. Jumper J1 (see chapter Power Supply above) must be set to using the onboard voltage regulator.

Jumper J3	USB Power Configuration
1-2	USB chip is powered from USB bus
2-3	USB chip is powered from Vin (4.0V ≤ Vin ≤ 5.25V)
1-2-3	whole board is powered from USB bus (4.0V ≤ Vin ≤ 5.25V)

USB jumper/power configuration

A royality-free virtual COM port driver for Windows, MacOSX and Linux is available for download at www.chip45.com. Please install the USB driver prior to connecting the module to the PC.

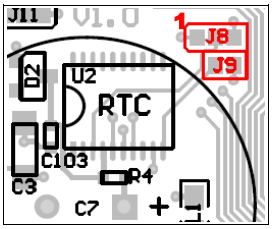
The CP2102 offers an integrated EEPROM for storing USB parameters like VID, PID, product string and serial number, hence providing the possibility to individualize a product based on Savvy128, by customizing these parameters. Silabs offers a free Windows tool, as well as another tool for generating a customized Windows USB driver. By providing such a driver to your customers, your product will be recognized immediately when connected to a PC and will be registered in Windows control panel with it's unique product name. Later your product will be assigned the same COM port number each time it is conneced to the PC, which simplifies access to your product from PC applications.

The tools and the corresponding application notes (AN144 and AN220) by Silabs are also available at http://www.chip45.com.

Realtime Clock – Savvy128 provides a realtime clock chip RTC-8564JE, which is connected via I²C bus (SDA/SCL) to the ATmega128 controller (pins PD0/PD1). The RTC-8564 provides one configurable clock output, which can be connected to ATmega128 Timer2 input (pin PD7) by setting jumper J8 to position 1-2, whilst position 2-3 disables the clock output. J8 should be set to either position before operation to ensure a well-defined state of the clock output enable pin of the RTC. The configurable interrupt output of the RTC can be connected to INT7 of the ATmega128 (pin PE7) by closing jumper J9. Please see the RTC-8564 datasheet (available for download at www.chip45.com) for further details on the clock chip.

Jumper J8	clock output
1-2	clock output enabled
2-3	clock output disabled
Jumper J9	interrupt to INT7
closed	interrupt enabled
open	RTC interrupt not used

RTC jumper settings



RTC jumper location

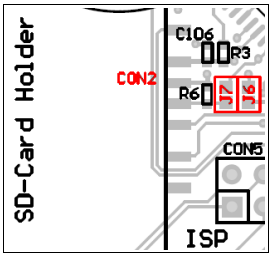
If a battery or capacitor backup of the RTC is desired, it is possible to assemble a standard 1F GoldCap right above the RTC chip, see large circle C7 in the picture above. A suitable GoldCap is available as accessory at www.chip45.com. Simple charging of the capacitor is done by diode D4 and resistor R4, which limits charging current to 10mA. It is also possible to connect a battery to the pads of C7 instead of the GoldCap. In that case another diode has to be put in series to the batterie, to avoid current flowing into the battery, while the board is powered!

With the standard 1F GoldCap capacitor a backup time of about 140 days at 5V power supply and about 100 days at 3.3V power supply can be expected.

MMC/SD-Card Interface – Savvy128 provides a spring-eject socket for MMC/SD-cards. The card is connected internally to the SPI interface of the ATmega128 controller (pins PB0..3, PB0 is chip select output), hence MMC/SD-cards are used in SPI mode. Two jumpers J6 and J7 allow to also route the card's card detect signal and write protect signal to the ATmega128 controller. See table for details.

Jumper J6	write protect WP
closed	WP connected to PB4
open	WP not used
Jumper J7	card detect CD
closed	CD connected to INT6
open	CD not used

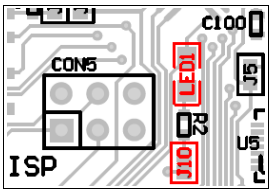
SD-card jumper settings



SD card and jumpers

On the new V1.2 Savvy128 board the SD-card is always supplied with 3.3V and level shifters are integrated to interface it to the processor.

Status LED – A preassembled small status LED is connected to the ATmega128 OC2/OC1B/PB7 pin. Configuration is low-active, hence the LED flashes, when the pin is set to low. The LED is available after closing jumper J10, see picture on the right for location. J10 is already closed by default, since it is used to indicate proper initialization of the preinstalled bootloader (see below).



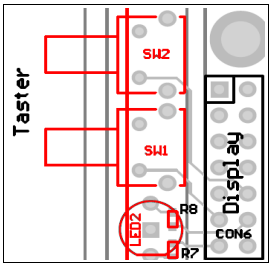
status LED

Push Buttons and LED – Two push buttons and one two-color LED is available as control elements on the front side/panel beside the MMC/SD-card slot. Both buttons and the duo-LED is included in the components kit. See table on the right for connection of the components to the ATmega128 controller and picture for components location.

The buttons and the duo-LED share pins with the SavvyDISP board, hence their usage with SavvyDISP is not possible / recommended!

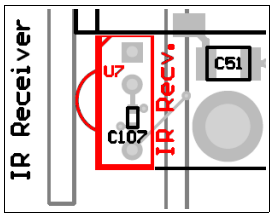
buttons	ATmega128 pin
SW1	PD4
SW2	PD5
LED	ATmega128 pin
green	PG3
red	PG4

button and LED signals



control elements

Infrared Detector – An infrared detector can be assembled optionally and provides the possibility to control Savvy128 based application by a standard TV or simular remote control. The default IR detector included in the components kit is a TSOP1736, which is optimized for 36kHz signals, other frequency types can be used alternatively. See the components datasheet for details. Location of the IR detector is shown in the picture on the right. The SavvyCASE front panel and optional SavvyDISP front panel provide a small hole in front of the detector's sensitive area. The output signal of the IR detector is connected to the ATmega128 INT5/PE5 pin.



IR detector

Expansion Connectors – Two 26 pin headers CON7 and CON8 provide most of the ATmega128 signals and can be used for expanding the board with customer specific addon cards. The pinout of the connectors is shown the following table. The connectors provide standard 2.54mm grid spacing.

SavvyDISP Connector – A special 14 pin connector CON6 is located beside the push buttons and LED and provides additional expansion possibilities with one 8 bit port and 4 single bit signals. This connector is primary intended for use with the SavvyDISP LC-display and key addon board, which perfectly matches to the connector and the guiding rails in the plastic enclosure SavvyCASE (see chapter below). Of course the connector CON6 can be used for other purposes, the pinout is shown in the picture on the right. CON6 is based on standard 2.54mm grid spacing.

Enclosure – The plastic enclosure Bopla Unimas-85 is compatible with Savvy128 and SavvyDISP and is available as SavvyCASE from chip45.com with fully machined front and rear panels for the onboard connectors and components. SavvyDISP comes with a new front panel, since it requires addition holes for LCD and buttons.


SavvyCASE

Development Tools – Savvy128 is based on the ATmega128 AVR microcontroller, which can be programmed either in assembler (e.g. the original AVR Studio by Atmel: http://www.atmel.com/avr) or with several high level languages, including C/C++, Pascal or Basic. There exist several commercial C/C++ compiler suites (e.g. IAR Embedded Workbench or CodeVisionAVR) as well as the WinAVR GNU C/C++ compiler and tools suite (see http://winavr.sourceforge.net for details, the bootloader and all examples by chip45.com were developed with WinAVR). A suitable and reasonably priced Basic compiler is BASCOM-AVR by http://www.mcselec.com. For a good Pascal environment please go to http://www.e-lab.de. Both the AVRco Pascal by E-Lab and the Bascom-AVR provide built-in support for MMC/SD-card.

Further Information – Application notes and datasheets of the onboard components as well as the schematics can be downloaded at http://www.chip45.com. The official Atmel AVR homepage is http://www.atmel.com/avr. A valuable source of information dedicated to AVR microcontrollers is http://www.avrfreaks.net.